

MECHANIC AGRICULTURAL MACHINERY

NSQF LEVEL - 4

2nd Year

TRADE THEORY

SECTOR: AUTOMOTIVE

(As per revised syllabus July 2022 - 1200Hrs)



Directorate General of Training

DIRECTORATE GENERAL OF TRAINING
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
GOVERNMENT OF INDIA



**NATIONAL INSTRUCTIONAL
MEDIA INSTITUTE, CHENNAI**

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Sector : Automotive
Duration : 2 Years
Trade : Mechanic Agricultural Machinery - 2nd year Trade Theory
- NSQF Level - 4 (Revised 2022)

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FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of Media Development Committee members of various stakeholders viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Mechanic Agricultural Machinery 2nd Year Trade Theory in Automotive Sector** under **Yearly Pattern**. The NSQF Level - 4 (Revised 2022) Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 4 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 4 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these Instructional Media Packages IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

The Director General, Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind

ATUL KUMAR TIWARI, I.A.S

Secretary

Ministry of Skill Development & Entrepreneurship,
Government of India.

January 2024

New Delhi - 110 001

PREFACE

The National Instructional Media Institute (NIMI) was established in 1986 at Chennai by then Directorate General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under Ministry of Skill Development and Entrepreneurship) Government of India, with technical assistance from the Govt. of the Federal Republic of Germany. The prime objective of this institute is to develop and provide instructional materials for various trades as per the prescribed syllabi under the Craftsman and Apprenticeship Training Schemes.

The instructional materials are created keeping in mind, the main objective of Vocational Training under NCVT/NAC in India, which is to help an individual to master skills to do a job. The instructional materials are generated in the form of Instructional Media Packages (IMPs). An IMP consists of Theory book, Practical book, Test and Assignment book, Instructor Guide, Audio Visual Aid (Wall charts and Transparencies) and other support materials.

The trade practical book consists of series of exercises to be completed by the trainees in the workshop. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered. The trade theory book provides related theoretical knowledge required to enable the trainee to do a job. The test and assignments will enable the instructor to give assignments for the evaluation of the performance of a trainee. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also help him to assess the trainee's understanding. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirements, day to day lessons and demonstrations.

In order to perform the skills in a productive manner instructional videos are embedded in QR code of the exercise in this instructional material so as to integrate the skill learning with the procedural practical steps given in the exercise. The instructional videos will improve the quality of standard on practical training and will motivate the trainees to focus and perform the skill seamlessly.

IMPs also deals with the complex skills required to be developed for effective team work. Necessary care has also been taken to include important skill areas of allied trades as prescribed in the syllabus.

The availability of a complete Instructional Media Package in an institute helps both the trainer and management to impart effective training.

The IMPs are the outcome of collective efforts of the staff members of NIMI and the members of the Media Development Committees specially drawn from Public and Private sector industries, various training institutes under the Directorate General of Training (DGT), Government and Private ITIs.

NIMI would like to take this opportunity to convey sincere thanks to the Directors of Employment & Training of various State Governments, Training Departments of Industries both in the Public and Private sectors, Officers of DGT and DGT field institutes, proof readers, individual media developers and coordinators, but for whose active support NIMI would not have been able to bring out this materials.

Chennai - 600 032

EXECUTIVE DIRECTOR

ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisations to bring out this Instructional Material **(Trade Theory)** for the trade of **Mechanic Agricultural Machinery 2nd Year NSQF Level - 4 (Revised 2022)** under **Automotive** Sector for ITIs.

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NIMI records its appreciation of the Data Entry, CAD, DTP Operators for their excellent and devoted services in the process of development of this Instructional Material.

NIMI also acknowledges with thanks, the invaluable efforts rendered by all other staff who have contributed for the development of this Instructional Material.

NIMI is grateful to all others who have directly or indirectly helped in developing this IMP.

INTRODUCTION

TRADE THEORY

The manual of trade theory consists of theoretical information for the Course of the **Mechanic Agricultural Machinery 2nd Year NSQF Level - 4 (Revised 2022) in Automotive**. The contents are sequenced according to the practical exercise contained in NSQF Level - 4 (Revised 2022) syllabus on Trade Theory attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This correlation is maintained to help the trainees to develop the perceptual capabilities for performing the skills.

The trade theory has to be taught and learnt along with the corresponding exercise contained in the manual on trade practical. The indications about the corresponding practical exercises are given in every sheet of this manual.

It will be preferable to teach/learn trade theory connected to each exercise at least one class before performing the related skills in the shop floor. The trade theory is to be treated as an integrated part of each exercise.

The material is not for the purpose of self-learning and should be considered as supplementary to class room instruction.

The manual is divided into Ten modules

Module 1	Tillage Equipments and their uses
Module 2	Agricultural implements and their uses
Module 3	Soil forming equipments and their uses
Module 4	Planters and fertilizer applicators
Module 5	Irrigation and drainage system
Module 6	Power tillers and their uses
Module 7	Farm Electrical motors, sprayers, dusters and their uses
Module 8	Reapers, Harvesters, threshers, diggers and their uses
Module 9	Winnower, cleaner, grader, huller, polisher, feed grinder cum mixer and their uses
Module 10	Farm equipment care and maintenance

TRADE PRACTICAL

The trade practical manual is intended to be used in practical workshop. It consists of a series of practical exercises to be completed by the trainees during the course. These exercises are designed to ensure that all the skills in compliance with NSQF Level - 4 (Revised 2022) syllabus are covered.

The skill training in the shop floor is planned through a series of practical exercises centered around some practical project. However, there are few instances where the individual exercise does not form a part of project.

While developing the practical manual, a sincere effort was made to prepare each exercise which will be easy to understand and carry out even by below average trainee. However the development team accept that there is a scope for further improvement. NIMI looks forward to the suggestions from the experienced training faculty for improving the manual.

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LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

S.No	Learning Outcome	Ref. Ex.No.
1	Test and rectify faults in functionality of major components and assemblies of Mould Board Plough, Disc Plough and troubleshoot of tillage and its implements. (NOS:AGR/N1119)	2.1.109 - 2.1.118
2	Check, test and troubleshoot faults in functionality of major components and assemblies of Chisel Plough and Rotavator. (NOS:AGR/N9430)	2.1.119 - 2.1.127
3	Troubleshoot & Test the functionality of major components and assemblies of disc harrows (Off set Type/Double action and single action) and Power harrows. (NOS:AGR/N1119)	2.2.128 - 2.2.136
4	Check and service proper functionality of major components and assemblies of cultivators and soil forming equipments. (NOS:AGR/N1119)	2.2.137 - 2.2.142
5	Identify and check functionality of major components and assemblies of Lazar leveller, trencher & post hole digger. (NOS:AGR/N9431)	2.3.143 - 2.3.148
6	Dismantle, assemble and troubleshoot seed drills. (NOS:AGR/N9432)	2.3.149 - 2.3.153
7	Test and verify functions of major components and assemblies of planters and fertilizer applicators. (NOS:AGR/N9433)	2.4.154 - 2.4.166
8	Identify and check functionality of major components and assemblies of volute type centrifugal pump and submersible pump. (NOS:AGR/N1114)	2.5.167 - 2.5.172
9	Service irrigation valves and hydrants. (NOS:AGR/N1006)	2.5.173 - 2.5.177
10	Service and Trouble shoot power tillers/power weeder. (NOS:AGR/N1111)	2.6.178 - 2.6.185
11	Identify and check functionality of grain handling seed treating and drying and troubleshoot major components and assemblies of AC motors. (NOS:AGR/N9434)	2.6.186 - 2.6.187
12	Identify and trouble shoot faults in major components and assemblies of sprayers & dusters. (NOS:AGR/N9435)	2.7.188 - 2.7.202
13	Detect and troubleshoot major components and assemblies of reaper, reaper winder, straw- reapers. (NOS:AGR/N9436)	2.8.203 - 2.8.209
14	Troubleshoot the faults in functionality of major components and assemblies of Thresher, Maize seller, Groundnut decorticator. (NOS:AGR/N9437)	2.8.210 - 2.8.217
15	Identify and check functionality of major components and assemblies of combine harvester- cutter bar assembly, feeder unit, threshing unit, separating unit. (NOS:AGR/N1105)	2.8.218 - 2.8.229
16	Test and troubleshoot functionality of major components and assemblies of mower, folder harvester, power chaff/silage cutter. (NOS:AGR/N9438)	2.8.230 - 2.8.235
17	Detect and rectify functionality of major components and assemblies of rotary harvester, hay bailer. (NOS:AGR/N9439)	2.8.236 - 2.8.241
18	Find and troubleshoot major components and assemblies of groundnut digger, potato / onion digger. (NOS:AGR/N9440)	2.8.242 - 2.8.247
19	Service and troubleshoot winnower, cleaner & grader. (NOS:AGR/N9441)	2.9.248 - 2.9.251
20	Maintain and service rice huller, polisher, feed grinder-cum-mixer, hammer mill. (NOS:AGR/N9442)	2.9.252 - 2.9.255
21	Detect and rectify functionality of grain handling seed treating and drying equipment. (NOS:AGR/N9443)	2.10.256 - 2.10.265

SYLLABUS			
Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
Professional Skill 43 Hrs; Professional Knowledge 08 Hrs	Test and rectify faults in functionality of major components and assemblies of Mould Board Plough, Disc Plough and troubleshoot of tillage and its implements. (NOS:AGR/N1119)	109. Use of PPE while dismantling and assembling of Mould Board plough. (08 hrs.) 110. Explain range of machinery used in the trade & their features. (6 hrs.) 111. Demonstrate precautions to be observed in handling farm machinery. (6 hrs.) 112. Dismantle Mould Board plough. Check, repair & replace their Component. (4 hrs.) 113. Assemble MB plough, measure Horizontal & Vertical suction. (3 hrs.) 114. Dismantle disc plough, check, repair & replace their components. (3 hrs.) 115. Assemble disc plough, measure disc & tilt angle of disc plough. Workshop adjustments. (3 hrs.) 116. Perform Hitching of ploughs. Field operation & adjustments. (5 hrs.) 117. Identify Faults and apply remedies. (2 hrs.) 118. Perform care and maintenance. (3 hrs.)	Introduction to the trade curriculum. Importance of the trade in the advancement of Agriculture technology in the country. Types of tillage & their uses. Working principles of ploughs. Constructional details. Workshop adjustments. Method of hitching. Importance of weight transfer. Considerations while using mounted and semi mounted implements. Method of ploughing. Methods of field operation. Recommended speeds for operation under different field conditions. Daily and periodical maintenance (08 Hrs)
Professional Skill 25 Hrs; Professional Knowledge 8 Hrs	Check, test and troubleshoot faults in functionality of major components and assemblies of Chisel Plough and Rotavator. (NOS:AGR/N9430)	119. Service sub soiler and dismantle chisel plough. (1 hr.) 120. Check, repair & replace the component. (3 hrs.) 121. Assemble chisel plough. (1 hr.) 122. Hitch sub soiler/ chisel plough. (2 hrs.) 123. Dismantle Rotavator, check repair and replace its components. (5 hrs.) 124. Assemble Rotavator and conduct workshop adjustments. (5 hrs.) 125. Perform field operations & adjustments. (3 hrs.) 126. Find Faults and apply remedies. (3 hrs.) 127. Perform Care and maintenance. (2 hrs.)	Function & working of sub soiler/ chisel plough. Constructional details. Function & working of Rotavator. Workshop adjustments. Method of hitching. Importance of weight transfer. Method of ploughing. Method of Field operation. Recommended speeds for operation of rotavators. Daily and periodical maintenance (08 Hrs)

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
Professional Skill 25 Hrs; Professional Knowledge 10 Hrs	Troubleshoot & Test the functionality of major components and assemblies of disc harrows (Off set Type/ Double action and single action) and Power harrows. (NOS:AGR/N1119)	128. Dismantle & assemble disc harrows (Off set Type/ Double action). (5 hrs.) 129. Dismantle & assemble disc harrows (Single action). (4 hrs.) 130. Measure gang angle. (1 hr.) 131. Dismantle & assemble bar/ power harrows. (1 hr.) 132. Service spring/blade harrow. (2 hrs.) 133. Plan and prepare Hitching arrangements. (1 hr.) 134. Perform field operation & adjustments. (7 hrs.) 135. Detect Faults and apply Remedies. (2 hrs.) 136. Perform Care and maintenance. (2 hrs.)	Types of harrows & their uses. working principles & Constructional details. Setting and adjustments. Hitching and mode of operation. Difference between disc harrows & drag harrow. Difference between disc harrows & disc plough. Trouble shooting. Safety precautions. (10 Hrs)
Professional Skill 25 Hrs; Professional Knowledge 06 Hrs	Check and Service proper functionality of major components and assemblies of cultivators and soil forming equipments. (NOS:AGR/N1119)	137. Dismantle the cultivator (Spring /Rigid) and check, repair & replace the components. (6 hrs.) 138. Assemble the cultivator. (1 hr.) 139. Illustrate setting of cultivators with the help of floor diagram. (3 hrs.) 140. Demonstrate Workshop adjustments, and perform field operation & adjustments. (6 hrs.) 141. Trace Faults and implement Remedies. (6 hrs.) 142. Perform Care and maintenance. (3 hrs.)	Types of cultivator. Working Principles & their constructional details, adjustments. Common types of shovels & seeps. Adjustments, mode of operation. Trouble shooting. Care & Maintenance. (06 Hrs)
Professional Skill 20 Hrs; Professional Knowledge 08 Hrs	Identify and check functionality of major components and assemblies of Lazar leveler, trencher & post hole digger. (NOS:AGR/N9431)	143. Dismantle and assemble levelers, scrapers/ blade terracer, ditchers and bund formers/ dozer/ dumper. (4 hrs.) 144. Service Lazar leveler, post hole digger. (4 hrs.) 145. Dismantle, check, repair & replace the components of Lazar leveler, trencher & post hole digger. (4 hrs.) 146. Assemble Lazar leveler, trencher & post hole digger. (3 hrs.) 147. Arrange and perform Workshop adjustments. (2 hrs.) 148. Set, adjust and troubleshoot field operation. (3 hrs.)	Soil forming equipment & their types. Constructional details of levelers, scrapers/ blade terracer, ditchers and bund formers. Constructional details of Lazar leveler, trencher & dozer/dumper and post hole digger. Prime mover & driving practice. Adjustments, mode of operation. Method of Field operation. Recommended speeds for operation. Daily and periodical maintenance, Care & Maintenance. (08 Hrs)

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
Professional Skill 44 Hrs; Professional Knowledge 09 Hrs	Dismantle, assemble and troubleshoot seed drills. (NOS:AGR/N9432)	149. Dismantle & assemble seed drills. (5 hrs.) 150. Calibrate seed & fertilizer rates. (5 hrs.) 151. Perform Workshop adjustments of special drills such as zero till, strip drill/rotto drill & Happy seeder. (15 hrs.) 152. Conduct Field operation & adjustments of special drills such as zero till, strip drill/rotto drill & Happy seeder. (15 hrs.) 153. Trace Faults and apply remedies. (4 hrs.)	Types of seed drills & their uses. Constructional details of seed cum fertilizer drill. Seed & fertilizer metering devices. Constructional details of special drills such as zero till, strip drill/rotto drill & Happy seeder. Types of furrow openers, methods of transmission of power. Calibration & workshop adjustments. Field calibration and mode of operation. Guide chart for mixing fertilizers. Recommended speeds for operation. Care & maintenance. (09 Hrs)
Professional Skill 85 Hrs; Professional Knowledge 22 Hrs	Test and verify functions of major components and assemblies of planters and fertilizer applicators. (NOS:AGR/N9433)	154. Dismantle & assemble of planters, calibrate seed & fertilizer rates. (08 hrs.) 155. Conduct Workshop adjustments and set planter with different seed plates & adjusts for planting. (10 hrs.) 156. Repair furrow openers. (5 hrs.) 157. Servicing of veg. transplanter. (5 hrs.) 158. Use veg. transplanter and adjustments. (5 hrs.) 159. Service paddy transplanter and raise type of MAT type nursery for paddy. (5 hrs.) 160. Use paddy transplanter. Raise bed and adjustments. (4 hrs.) 161. Use cage-wheels and paddy 162. Puddles. (4 hrs.) 163. Dismantle and assemble fertilizer applicators. (12 hrs.) 164. Perform minor repairs of fertilizer applicator; calibrate fertilizer applicator. (6 hrs.) 165. Perform field operation & adjustments of fertilizer applicators and troubleshoot the problems. (15 hrs.) 166. Follow precautions to be observed in handling fertilizer. (6 hrs.)	Types of planters. Constructional details of Maize, Cotton, G/ nut & potato planters. Constructional details of paddy transplanter, Sugarcane & paddy transplanter. Common metering devices. Types of furrow openers. Power transmission. Function of row marker. Field operation of paddy transplanter. Field operation of veg. transplanter. Use of cage wheels and puddles. (11 Hrs) Types of fertilizer applicators. Constructional details of fertilizer applicators Types of furrow openers, Methods of transmission of power. Calibration & workshop adjustments. Field operation & adjustments of fertilizer applicators. Recommended speeds for operation Care & maintenance. (11 Hrs)
Professional Skill 50 Hrs; Professional Knowledge 16 Hrs	Identify and check functionality of major components and assemblies of volute type centrifugal pump and submersible pump. (NOS:AGR/N1114)	167. Visit to a tube well boring sites for study of boring and its operation. (8 hrs.) 168. Dismantle and assemble a volute type centrifugal pump. (4 hrs.)	Source of water. Study common irrigation and drainage systems. Types of irrigation systems. Types of pumps. Working principles & constructional details of centrifugal pumps. (08 Hrs)

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
		169. Prepare foundations and install a pumping set. (8 hrs.) 170. Check Adjustments and operation of a pumping set. (5 hrs.) 171. Service a submersible pump. (10 hrs.) 172. Measure discharge of water and install HDPE, QRC, PVC & dipper pipe line. (15 hrs.)	Types of centrifugal pumps constructional details & principle of operation of a submersible pump. Description of tools and equipment required for boring a tube well. Use a compressor for revitalizing the tube well to improve its discharge. (08 Hrs)
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Service irrigation valves and hydrants. (NOS:AGR/N1006)	173.Repair and adjust irrigation valves and hydrants. (5 hrs.) 174.Install sprinkler and fogger. (5 hrs.) 175.Install pop-up and drippers. (3 hrs.) 176.Install drippers on level/ hilly ground. (3 hrs.) 177. Field operation & adjustment (angular/ full circle). Faults and remedies. Troubles and remedies. (9 hrs.)	Pump selection, common prime movers, and coupling devices. Different types of irrigation pipes. Working principles of valves and hydrants. Working principles of Popup/sprinkler & mister /fogger. Working principles of drippers. Methods of field operation & adjustment. Daily and periodical maintenance. Precautions to be observed. Care & Maintenance. (09 Hrs)
Professional Skill 25 Hrs; Professional Knowledge 10 Hrs	Service and Trouble shoot power tillers/ power weeder. (NOS:AGR/N1111)	178.Service Power tiller/power weeder. (4 hrs.) 179.Perform field operation with different attachments with Common adjustments. (4 hrs.) 180. Dismantle and assemble a cultivator and performer pairing and maintenance. (4 hrs.) 181. Adjust the cultivator with the help of floor diagram. (2 hrs.) 182. Set shovels and sweeps. (1 hr.) 183. Perform field operation of cultivator with shovels and sweeps. (4 hrs.) 184. Troubleshoot faults and apply remedies. (3 hrs.) 185. Plan and prepare care and maintenance work. (3 hrs.)	Types of power tillers, their uses, constructional details. Method of power transmission for different field operation with different attachments. Common types of weeds and their control. Methods of weed control. Constructional detail of power weeder. Premergence and post emergence applications. Recommended weedicides for different crops. Equipments used for their applications. Trouble shooting and remedies. Daily and periodical maintenance. Precautions in handling weedicides. (10 Hrs)
Professional Skill 11 Hrs; Professional Knowledge 07 Hrs	Identify and check functionality of grain handling seed treating and drying and troubleshoot major components and assemblies of AC motors. (NOS:AGR/N9434)	186. Familiarize to the trade curriculum. (6 hrs.) 187. Explain importance of the trade in the advancement of Electrical technology in the country. (5 hrs.)	Introduction to the trade curriculum. Importance of safety precaution to be observed in the section. Range of machinery used in the trade & their features. Precautions to be observed in handling farm machinery. (7 Hrs)

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
Professional Skill 40 Hrs; Professional Knowledge 12 Hrs	Identify and troubleshoot faults in major components and assemblies of sprayers & dusters. (NOS:AGR/N9435)	188. Dismantle and assemble AC motors and identify their parts. (3 hrs.) 189. Demonstrate motor starting devices and its periodical maintenance. (3 hrs.) 190. Detect faults and apply remedies. (3 hrs.) 191. Dismantle and assemble common sprayers. (3 hrs.) 192. Calibrate sprayers and carryout field adjustments & operation of sprayers. (3 hrs.) 193. Dismantle and assemble common dusters. (3 hrs.) 194. Service fogging machine and Calibrate common dusters. (3 hrs.) 195. Carryout field adjustments & operation of duster. (3 hrs.) 196. Service high clearance/ cotton sprayers. (3 hrs.) 197. Service Aero blast sprayers. 198. Calibrate & adjust high clearance/ cotton sprayers & Aero blast sprayers. (3 hrs.) 199. Carryout repairs and maintenance work. (3 hrs.) 200. Perform field operation & adjustments. (3 hrs.) 201. Troubleshoot faults and apply remedies. (3 hrs.) 202. Apply precaution measure while handling insecticides and pesticides. (1 hrs.)	Types of electrical motors used on the farm, their constructional details, selection, operation, care and maintenance. Different types of starters. Fuses and their capacities. Installation of motors. Safety precautions Types of sprayers & dusters. Working principles. Calibrations of sprayers & dusters. Method of operation. Common prime movers. Workshop adjustments. Constructional details, working principles & calibration of high clearance sprayers/ cotton & Aero blast sprayers. Methods of operation. Field operation. Common accidents and their prevention. Care and maintenance. (12 Hrs)
Professional Skill 30 Hrs; Professional Knowledge 07 Hrs	Detect and troubleshoot major components and assemblies of reaper, reaper winder, straw-reapers. (NOS:AGR/N9436)	203. Dismantle and assemble a reaper. (4 hrs.) 204. Carryout Workshop adjustments. (3 hrs.) 205. Dismantle and assemble reaper winder and demonstrate workshop adjustments. (6 hrs.) 206. Dismantle and assemble straw-reapers and carry out their workshop adjustments. (3 hrs.) 207. Carryout hitching and fitting with prime mover. (4 hrs.)	Reapers & their types Functions, working principles, constructional details. Field adjustments & operation Care and maintenance. Trouble shooting. Precautions in working & transporting. (07 Hrs)

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
		208. Perform field operation & adjustment of reapers/ reaper winder/ straw - reapers. (8 hrs.) 209. Trace faults and ensure correct functioning. (2 hrs.)	
Professional Skill 25 Hrs; Professional Knowledge 08 Hrs	Troubleshoot the faults in functionality of major components and assemblies of Thresher, Maize seller, Groundnut decorticator. (NOS:AGR/N9437)	210. Dismantle and assemble thresher. (4 hrs.) 211. Carryout workshop adjustments. Fit with prime mover. (3 hrs.) 212. Select tools and use for adjusting and operating in field. (2 hrs.) 213. Dismantle and assemble Maize seller. (4 hrs.) 214. Dismantle and assemble ground nut decorticator; fit with prime mover. (4 hrs.) 215. Measure important speeds affecting the performance. (1 hr.) 216. Detect fault and apply remedies. (2 hrs.) 217. Demonstrate precautionary measures for safe operation. (5 hrs.)	Types of threshers, maize Sheller and ground nut decorticators. Working principles, constructional details. Adjustments and operations. Prime mover and driving systems. Troubleshooting and remedies. Transmission of power belts and pulleys. Safety precautions. (08 Hrs)
Professional Skill 65 Hrs; Professional Knowledge 25 Hrs	Identify and check functionality of major components and assemblies of combine harvester- cutter bar assembly, feeder unit, threshing unit, separating unit. (NOS:AGR/N1105)	218. Perform on different components systems of combine harvester. (5 hrs.) 219. Describe drive mechanism and controls of combine harvester. (5 hrs.) 220. Drive combine harvester. (4 hrs.) 221. Dismantle cutter bar assembly. Dismantle feeder unit. (2 hrs.) 222. Dismantle threshing unit / separating unit. (2 hrs.) 223. Check, repair and replace the defective components. (6 hrs.) 224. Assemble the components of different systems of combine harvester. (9 hrs.) 225. Carryout workshop adjustments. (3 hrs.) 226. Transport practice of the combine. (9 hrs.) 227. Operate the combine in the field and adjust according to the field and crop conditions. (9 hrs.) 228. Carryout its servicing and maintenance work. (6 hrs.) 229. Compute grain losses. Storage during off season and perform care and maintenance work. (5 hrs.)	Purpose of a combine harvester. Advantages and limitations. Types of combine harvester. Special purpose combine harvesters. Working principles & constructional of different systems of combine harvester. Components of different systems of combine harvester. Flow path material of combine harvesters. Power transmission & drive systems. Workshop adjustments. Methods of field operation. Field adjustments according to crop & soil condition. Types of grain losses, their causes and remedies. Factors affecting the performance of a combine. Recommended speeds. Considerations while selecting a combine. Custom hiring of combine. Calculating of combine operation of combine harvesting. Safety precautions. (25 Hrs)

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
Professional Skill 75 Hrs; Professional Knowledge 15 Hrs	Test and troubleshoot functionality of major components and assemblies of mower, folder harvester, power chaff/silage cutter. (NOS:AGR/N9438)	230. Dismantle and assemble mower / fodder harvester. (12 hrs.) 231. Demonstrate dismantling and assembling of power chaff/ silage-cutter. (12 hrs.) 232. Perform Workshop adjustments. (14 hrs.) 233. Perform hitching and fitting with prime-mover. (13 hrs.) 234. Carryout field operation and adjustments. (12 hrs.) 235. Perform servicing and maintenance. (12 hrs.)	Need of green harvesting equipment. Working principles, constructional details of mover. Functions, working principles, constructional details of folder harvester. Functions, working principles, constructional details of power chaff/ silage- cutter. workshop and field adjustments. Methods of field operation. care and maintenance. Trouble shooting. Precautions in working & transporting. (15 Hrs)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Detect and rectify functionality of major components and assemblies of rotary harvester, hay bailer. (NOS:AGR/N9439)	236. Dismantle and assemble rotary harvester/ hay bailer. (2 hrs.) 237. Carryout Workshop adjustments. (3 hrs.) 238. Perform Hitching and fitting with prime- mover. (3 hrs.) 239. Perform field operation and adjustments. (8 hrs.) 240. Use Safety precautions while servicing and maintenance. (2 hrs.) 241. Troubleshoot Faults and apply remedies for proper functioning. (7 hrs.)	Function and working of rotary harvester. Function and working of hay-bailer. Workshop adjustments. Method of field operation. Method of transportation. Common accidents and their prevention. Trouble shooting. Care and maintenance. (07 Hrs)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Find and troubleshoot faults in major components and assemblies of groundnut digger, potato / onion digger(NOS:AGR/N9440)	242. Dismantle groundnut digger / potato / onion digger. (08 hrs.) 243. Check, repair and replace the defective components. (08 hrs.) 244. Assemble groundnut digger potato /onion digger. (07 hrs.) 245. Carryout Workshop adjustments. Attachment of diggers with prime- movers. (07 hrs.) 246. Perform field operation and adjustments, servicing and maintenance work. (13 hrs.) 247. Identify and troubleshoot faults following safety precautions and apply remedies for proper functioning. (07 hrs.)	Need & importance of root harvesting machine. Types & working of diggers. Components of diggers. Prime mover attachments and driving system. Transporting the root harvesting machinery. Settings & Adjustments. Troubles & Maintenance. Safety precautions. (14 Hrs)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Service and troubleshoot winnower, cleaner & grader. (NOS:AGR/N9441)	248 Service and adjust the winnower, cleaner & graders. (10 hrs.) 249. Fit with prime mover attachment. (10 hrs.)	Important of winnowing. Types of winnower and its parts. Importance of cleaning & grading. Types of cleaner/ grader.

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
		250. Operate winnower, cleaner and grader. (20 hrs.) 251. Trace Common troubles and its causes. (10 hrs.)	Methods of cleaning/grading. Prime mover attachments and driving system. Settings and Adjustments. Troubles & maintenance. Safety precautions. (14 Hrs)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Maintain and service rice huller, polisher, feed grinder-cum- mixer, hammer mill. (NOS:AGR/N9442)	252. Service and adjust the huller, polisher, the feed grinder-cum-mixer. (15 hrs.) 253. Service and adjust the hammer mill and fit with prime mover. (10 hrs.) 254. Operate rice huller, polisher, hammer mill. (15 hrs.) 255. Trace Common troubles and its causes. (10 hrs.)	Importance of rice huller and polisher, feed grinder- cum-mixer, hammer mill, oil extractor and sugarcane crusher. Constructional details, materials used. Principles of operation. Common faults and remedies. Care & maintenance. Safety precautions. (14 Hrs)
Professional Skill 52 Hrs; Professional Knowledge 15 Hrs	Detect and rectify functionality of grain handling seed treating and drying equipment. (NOS:AGR/N9443)	256. Visit to a grain drying and storing plant and study different aspects of the construction, adjustments, controls. (9 hrs.) 257. Operate grain handling seed treating and drying equipment. (12 hrs.) 258. Explain silo structure. (5 hrs.)	Working of fans and blowers. Purpose of grain auger, bucket elevator etc., Constructional details and working of a grain drier. Grain storage structure i.e. concrete and sheet metal bins (sylo structure). Methods and instruments used for measuring moisture contents of grains. Equipment and methods used for treating and fumigating seeds and grains. (07 Hrs)
		259. Prepare Log books. (1 hrs.) 260. Maintain necessary records i.e. Log books of tractors, combines etc. (6 hrs.) 261. Plan and prepare service schedules, off season storage of farm equipment. (6 hrs.)	Operation of transporting and handling equipment i.e. Tractor, tractor trailer, power tiller & combine harvester. (04 Hrs)
		262. Visit to a Government Farms, Haryallee and Co-operative Societies. (2 hrs.) 263. Describe farm records, accounts and log books. (6 hrs.) 264. Plan and prepare service schedule of farm machinery, off season storing of farm equipment. (3 hrs.) 265. Plan and prepare layout and list of equipment of a typical farm workshop. (2 hrs.)	Procedure and principle for efficient management and organization of a farm. Discussion on different farm shop layout. (04 Hrs)

Trade Curriculum, importance of the trade and advancement of agriculture technology in India

Objectives: At the end of this lesson you shall be able to

- state the trade curriculum
 - state the importance of the trade
 - describe the advancement of agriculture technology in our country.
-

Introduction to the Trade curriculum

The second year of Mechanic Agricultural Machinery trade curriculum is briefing about the following events.

- Working principles, types, constructional details, calibration & workshop adjustments, Methods of field operation, Method of hitching and Maintenance of ploughs, Rotavator, harrows, cultivator, Soil forming equipment, seed drills, furrow openers, planters, fertilizer applicators, and power tillers.
- Importance of irrigation systems.
- Working principles, types, and constructional details of, centrifugal pumps, submersible pump, Popup/sprinkler & mister/fogger.
- Examines and drives Agricultural implements on field to diagnose troubles and defects.
- Repair or replaces defective parts, reassembles them with prescribed settings, clearances, timings and adjustments by further tooling as necessary and ensures accuracy of fit.
- Repair other agricultural machinery for ploughing leveling, harvesting etc.
- Prepare the log books.
- Plan and prepare the service schedule of agriculture equipments and machineries.
- Grain harvesting, threshing, cleaning, grading, drying and storage.
- Visit to a Government farms and co-operative society.

Importance of the trade: Agricultural machines are professional farming technicians that deal with the maintenance and repair of cultivation machines. They help to the farmers to keep high productivity of agricultural product. There are many carriers in agriculture involve basic agricultural mechanic skill.

Agricultural equipment technicians work with farm machinery. They assemble, adjust, operate, maintain, machine test and even help design it, he can repair and maintain including automatic, animal, feeding systems, milking machine systems and tilling, planting, harvesting, irrigation drying and other handling equipments used in agricultural field.

Employment opportunities in the trade of Mechanical Agricultural Machinery.

On successful completion of the trade can either get employed, or became a self-employed Entrepreneur in anyone of the following fields.

a Wage Employment

- 1 Agricultural Machinery Mechanic.
- 2 Tractor Service Mechanic.
- 3 Auto Fitter in Tractor Manufacturing Concern in Assembly Shop or Test Shop.
- 4 Mechanic in Agricultural machinery Manufacturers.
- 5 Dealer service mechanic.
- 6 Driver/Tractor Operator.
- 7 Spare Parts Sales Assistant/Manufacturer's Representative.
- 8 Laboratory Assistant.

Self-Employment

- Agricultural Machinery Mechanic
- Tractor Service Mechanic
- Tractor Operator
- Spare Parts Salesman
- Spare Parts Dealer

Modern technology in agriculture: Agriculture in India is largely dependent on nature, but climate and global warming issues make farming unpredictable. The need of the hour is to educate farmers in the use of modern technology and innovative approaches to increase productivity and raise profitability.

Technology has a major role in farming and agriculture practice and with the advent of digital technology, the scope has widened, innovation in agriculture is leading and evolution in agricultural practices, thereby reducing losses and increasing efficiency. This is positively impacting farmers use of digital and analytic tools and equipments improving crop yields and helping to increase the income of the farmers. New age technologies focus on robotics precision agriculture artificial intelligence, block chain technology and more the government has undertaken several focused development programmer scheme, reforms and political towards chancing the income of farmers. For providing modern technology

support to the income support to the farming community and other stake holders. ICAR has created the countrywide network of 722 Krishi Vigyan Kendras.

India has a long way to go in adoption of modern farming practices through technology. The advanced technology can help save foreign exchange of our country, increase productivity and lead to an improvement in the overall standard of farmers.

Advanced of Agricultural Machinery

Agricultural machinery is the milestones of human development. It has been man's quest to ease the physical labour that has been the root of several inventions. This holds true for agricultural machinery as well.

There was a time when farming was carried on with bare hands, with a stick or a stone thrown in once in a while. No wonder man, resourceful as he is, developed knives, scythes and wooden ploughs to ease his job. These were the tools of the trade for thousands of years to come.

The Industrial Revolution brought in radical changes in the way agriculture was practiced, and agricultural machinery took a new form altogether. There were machines to do the harvesting and thrashing. These machines were originally powered by the efforts of horses and other domestic animals, till steam power came along.

The coming of the steam-propelled, and later on gasoline and diesel, agricultural machinery, like the tractor and the combined harvester and thrasher, brought in prosperity in agriculture.

The advances in agricultural machinery continue with the "Information Age" tools. These days there are machines that come fitted with computer monitoring systems, GPS locators and self-guiding programs that enable the device to be more precise, sparing and accurate with the use of seed, fertilizer and fuel.

The new-age applications of genetic engineering and nanotechnology with their emphasis on sub-microscopic devices and biological procedures impart the agricultural apparatus with unusual powers.

Farm machinery comes in various shapes and sizes and is designed to perform the entire range of farm activities. The tractor is the most popular kind, tillage and irrigation machinery following closely behind. You also have the seeder that is used to distribute seeds uniformly in long rows and also helicopters for aerial spraying of pesticides.

Agricultural machines are the best alternative to compensate deficit of farm labours, especially in times of harvest and in places where manual labor is scarce.

Farm equipment is especially helpful when you want to reap the benefits of large-scale production.

Agricultural machinery has improved by leaps and bounds to provide food to the ever-growing hungry world population.

Type of tillage equipment and their uses

Objectives: At the end of this lesson you shall be able to

- state the type of implements
 - state the importance of tillage operation
 - state the working principle of tillage plough.
-

State the importance of tillage operation

The tillage operations defined as mechanical manipulation of soil are performed to achieve the desired seedbed to provide optimum environment for seed germination and plant growth. Seedbed preparation for sowing/planting of different type of crops is done through primary and secondary tillage operations.

Types of tillage and their uses

Tillage are grouped according to the equipment used as follows

- Primary tillage
- Secondary tillage

Primary tillage

Primary tillage refers to deep ploughing which is done to achieve a desired granular soil structure for a seedbed and to allow rapid infiltration and good retention of moisture, to provide adequate air exchange capacity within the soil and to minimize resistance to root penetration and shoot growth. Mould board plough, disc plough, soil stirring plough, ridger plough is used to break soil and invert furrow slice to control weeds.

Secondary tillage

Secondary tillage refers to shallow cultivation which is done to produce a granular soil structure in the final seedbed by breaking the clods left by primary tillage implements. Cultivators and disc harrows are used for breaking the clods. Power driven implements like rotavator disintegrate the clods over a wide range of soil moisture and provide uniform and fine size clods or aggregates in seedbed.

Mould board plough

Objectives: At the end of this lesson you shall be able to

- state the uses of mould board plough
 - state the constructional details and components of mould board plough
 - state the procedure for field adjustment of mould board plough
 - state the field operation of mould board plough
 - state the maintenance of mould board plough.
-

Uses of mould board plough

Ploughs are used for primary tillage operations.

The mould board plough loose the furrow slice, inverts the furrow slice with more or less pulverisation

It cuts trash and buries it completely.

Working principle of plough: Plough is working the discs roll forward under the action of counter force from earth and open the soil with its cutting edge. The soil block gradually becomes loose and broken in the moving process along the concave side of the discs and its turned furrow finally.

A plough is a large farming tool with sharp blades which is pulled across the soil to turn it over, usually before seeds are planted.

Method of ploughing: There are three types of ploughing method is used by farmers. They are as follows.

- Continuous ploughing method.
- Round and round ploughing.
- One way ploughing.

Method of hitches the mounted implements:

Generally two types of hitch linkages are used on tractor rear mounted three point parallel type link hitches for front mounted three point parallel type link hitches for front mounted cultivators are not common in India. Single axis hitches are replaced by three point hitches. Any of these types can be operated with hitch members acting as free link in vertical plane or retrained links.

Load transfer systems for pull implements: Load transfer with pull type implements as a means of increasing tractive ability of larger tractors in important load transfer tends to reduce the depth of same type of implements. Maximum acceptable amount of implement vertical load reduction is influenced by soil conditions, implement mass and type, tractor front and stability and steering is response.

It is also used for turning green manure crop for decaying under the soil, which adds humus to the soil.

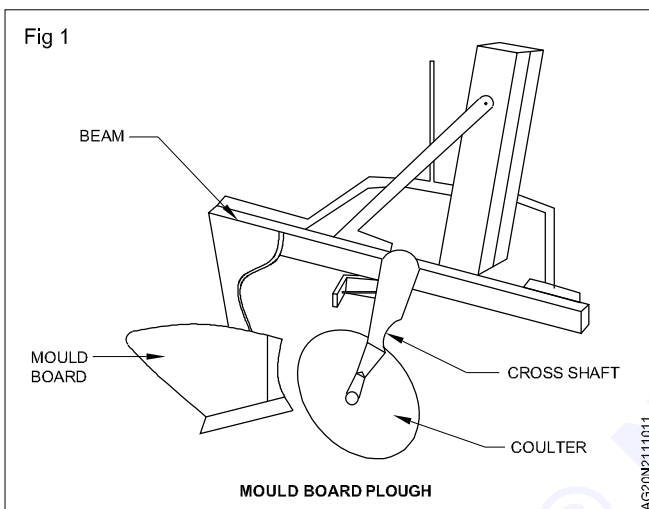
Constructional details and components of mould board plough

The main parts of mould board plough are given in (Fig 1)

- Plough bottom
- (Plough bottom includes landside, mould board and share)
- Plough accessories

The plough accessories include

- Adjusting coulter, jointer
- Plough frame and beam
- Gauge wheel
- Lifting mechanism
- Plough hitch
- Leveling and depth adjusting mechanism
- Furrow opener



Plough bottom

Plough bottom is the basic unit of plough. The three main parts are landside, mould board and share which are rigidly attached to the frog.

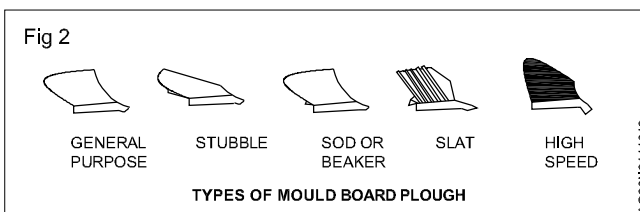
The plough bottom is a three sided edge with the landside and horizontal plane of the share's cutting edge as flat sides and top of the share and mould board together acting as a curved side. The primary functions of the plough bottoms are to invert the furrow slice to cover thrashes. The size of plough bottom is the width of furrow it is designed to cut.

Land side: It is a long flat metal piece, which absorbs the side forces when the furrow is turned. It slides along the face of the furrow wall. It also helps to steady the plough while it is being operated. The material used in making land side is cast iron, solid steel and soft centre steel. A small metal piece is fitted at the rear of the land side, is known as heel.

Mould board: The mould board is bolted to the side of the frog just above the share. It turns the furrow slice on its edge. It may be made up of solid steel, soft centre steel or chilled cast iron. Solid steel and soft centre steel are the best under most conditions owing to the facts that this material scours better. Solid steel is better where scouring is not a problem. Chilled cast iron is better for sandy, gravely soils.

The cutting edge of mould board is known as shin. Detachable shins are used for stony and gravel soils where wear is excessive.

On some mould board an extension is provided to turn the soil over more gradually and completely. Mould boards can be classified as shown in Fig 2.



General purpose (Fig 2): Works well in ordinary conditions. Suitable for clay and stiff sod soil, old ground.

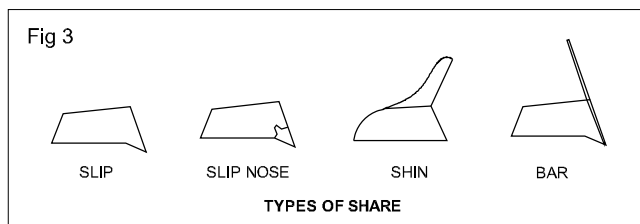
Black land: Scours more easily in black lands than general purpose. It has a relatively small mould board area. Also suitable for "Gumbo soils".

Sod or breaker (Fig 2): A sod bottom has a long, low mould board with a gradual twist (spiral) that completely inverts the furrow slice with a minimum of break - up, thus covering vegetative matter thoroughly.

High speed mould board (Fig 2): They are specially designed generally purpose bottoms for ploughing efficiency at high speed.

Share: Share is the business end of the plough bottom, it cuts the underside of the furrow slice away from the land. It is bolted to frog. The main parts of a share are point of share (which enters first into the soil and also supports plough bottom). Throat or cutting edge of share (which cuts the furrow slice) from soil body. Wing of share (which is the out-side corner of cutting edge) and gunnels of share (which supports the plough bottom against furrow wall). (Fig 3)

Types of share (Fig 3)



Material for share

Cast iron: Cast iron shares are used in cheap ploughs as they are easily broken.

Chilled Cast iron: It does not wear rapidly. It is especially adapted to sandy and strong soils but works well in clay or loam soil.

Soft Centre Steel: It is used on steel ploughs that do not scour well. A plough scours well when the soil is not sticky for the surface, takes good finish and consequently will scour where other metals do not.

Solid steel: It is used where scouring is not a problem. This share is tough and resistant to shock but not resistant to abrasive material. It is also called crucible steel. It is fairly high carbon steel, which is forged into shape.

Frog: Frog is that part of plough which joints the mould board, landside and share together. The materials used in making frog are mild steel and cast iron.

Plough accessories (Fig 1)

All the parts other than the plough bottom can be considered as accessories. Included in the list are as follows.

- 1 **Frame and beam:** The plough beams usually provide the main part of the frame or tractor plough. Extra frames are provided to support the wheel axles and lift mechanism. Most plough beams are curved upward and forward and then downward to the hitch point for proper alignment.
- 2 **Cross shaft:** The steel shaft fitted at the front at right angles to the beam is known as cross alignment.
- 3 **Coulter:** Coulter serves to
 - a Reduced draft of plough.
 - b Avoid the share.
 - c Cut the trash over the surface off the field for better coverage by the furrow slice.
 - d Clean the furrow wall and width slightly.

Mostly used coulters are :

- a Rolling coulters (disc type)
- b Sliding coulters (knife type)

Jointer is a miniature plough attached with coulter. It shapes like the plough bottom. It prevents weed to stick with share and also reduces draft by cutting to player of hard soil.

4 Lifting Mechanism

5 Plough hitch

6 Leveling and depth adjusting mechanism

7 Farrow opener

Wheel: These are attached at the end of beam to control depth of ploughing. Some ploughs have and adjustment for lead of furrow wheel away from the furrow wall to adjust pressure against the land side.

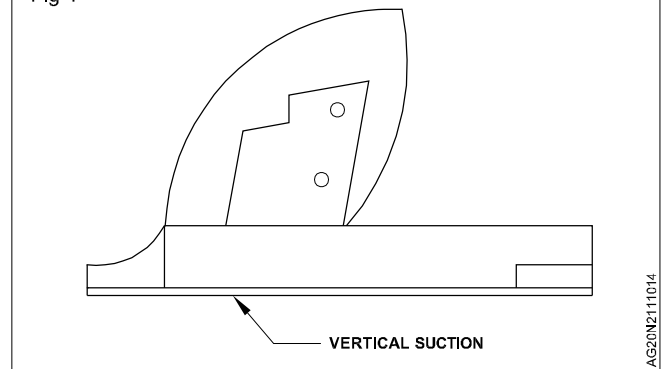
Field adjustment of mould board plough

These are two main factors which influence the ploughing in soil.

I Vertical or down suction

This is the bend down ward of the point of share to make the plough penetrate the soil to the proper depth when the plough is pulled forward. The amount of suction shall vary from $1/8$ to $3/16$ inch depending on the style of plough and the soil it will make to work in. This suction can be measured by placing a straight edge on the bottom of the plough extending from the heel of the bottom of land side to the point of share, then measuring vertically and the greatest clearance from the straight edge to the plough bottom (Fig 4).

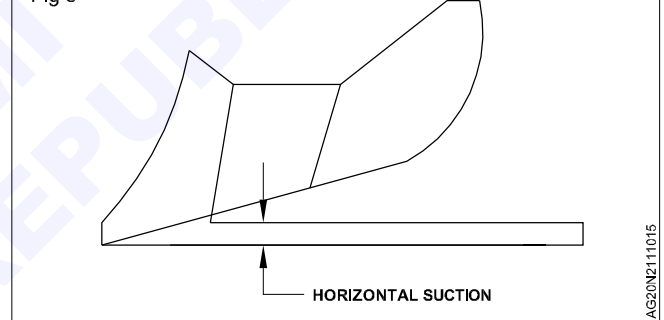
Fig 4



ii Horizontal or land suction

Horizontal suction is the amount the point of share is bend offline with the landside. The object of the suction is to make the plough take the proper amount of furrow width. Horizontal suction is measured by playing a straightedge on the side of the plough extending from the heel of the landside to the point of share, then measuring horizontally the greatest distance from the straight edge to the plough bottom. The amount is usually about $3/16$ inch (Fig 5).

Fig 5

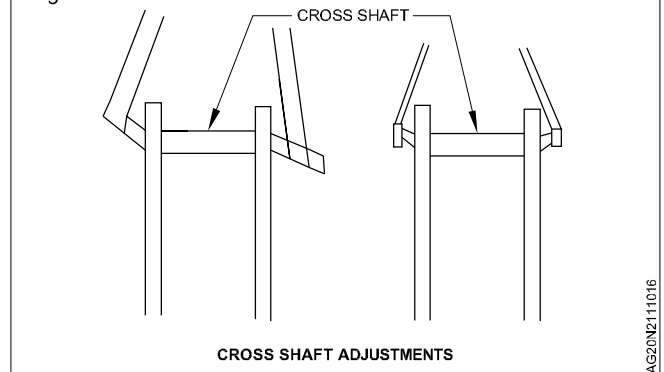


Plough setting - step by step sequence

i Cross shaft

Have the centre of the cross shaft directly beneath the top link attachment point on the plough. The cranked end of the cross shaft should be vertical at this stage. Giving variations in the cranked ends the width of cut can be vertical at this stage. Giving variations in the cranked ends the width of cut can be changed slightly (Fig 6).

Fig 6

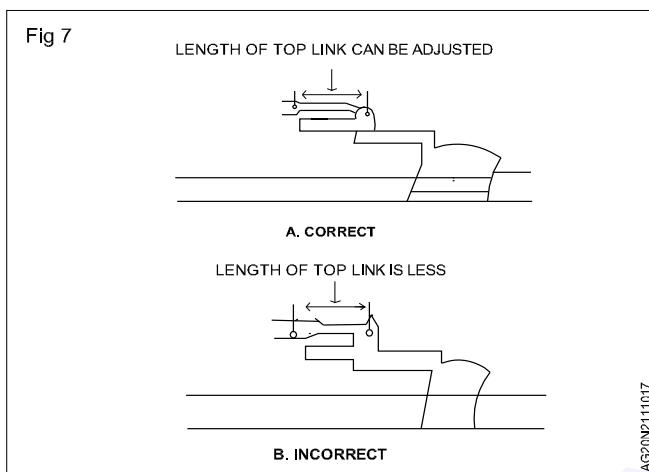


ii Top link setting

Set the top link to its standard length. By shortening or lengthening the length of the top link the pitch of the plough can be adjusted if the front plough bottom goes deeper than the rear, the top link should be lengthened. Whereas shorten the top link if the rear bottom penetrates more than the front one. Fix the length of the top link when each and every bottom reaches up to uniform depth (Fig 7).

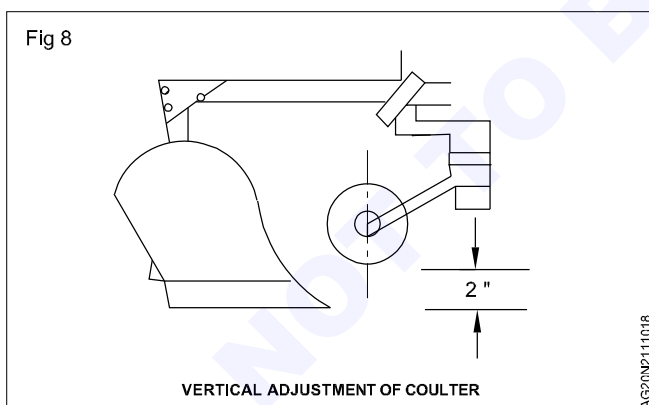
iii Lower link setting

Use leveling lever to get plough frame parallel to ground. This must be judged from the tractor seat during work. While marking the headlines, the operator should make the use of this leveling lever.

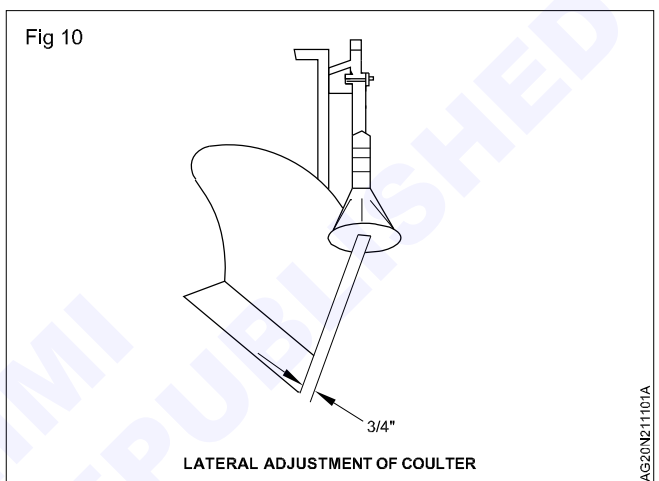
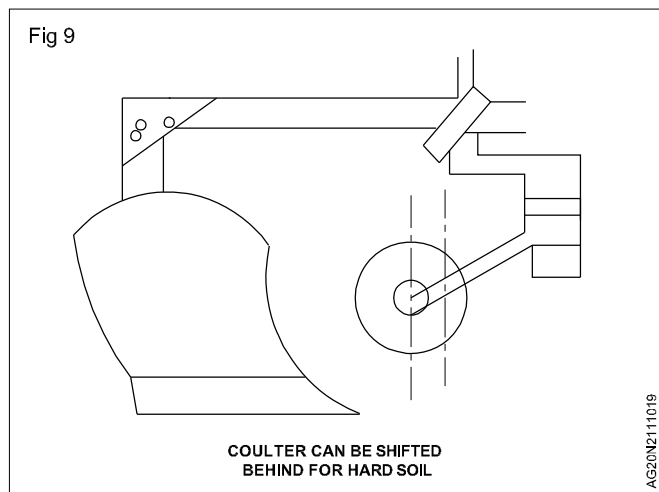


iv Coulter (Fig 8, 9, 10)

Coulter settings are most important. It is almost impossible and certainly tedious to give correct coulter settings for all ploughs in all conditions because it does not have any certain procedure even though vertical and lateral adjustments are carried out on a plough.



In general the coulter should be set about half the depth of ploughing. The best rule is to put the plough toe work and set the rear coulter first to give a clean cut furrow wall and match there maiming coulters to it. Have coulters really sharp and just deep enough to do the work. If set too deep, a disc coulter will act as a wheel and carry part of the plough weight. This must be avoided.



v Jointer

After adjusting the coulter, adjust the jointer blade to run on an average of 2" deep. Adjust the jointer point close to the coulter blade and see that the coulter turns freely and does not touch the jointer points.

Set the jointer deep enough so that the whole surface of its miniature mould board will be scoured by the turning soil. If the soil over flows this miniature moulds board, the jointer is too deep.

Set the jointer points slightly to the land side of the plough point, usually about 1/2".

Regulate the pitch or angle at which the jointer meets the soil so that the jointer mould board will scour well.

vi Depth of work

Set the plough to work at the depth desired. Do not go too deep for type of width of mould board.

vii Tractor and plough alignment

The aim here is to achieve the most favorable position of tractor and plough in order to reduce side draft to the minimum.

viii Final top link setting

Adjust the length of the top link to get all bases working at equal depth. Always remember to have correct tyre pressure to suit conditions. Whenever additional weight for traction is necessary, add weights to the plough before adding to the tractor.

ix Adjusting land-side clearance

Set the furrow wheel to prevent the landside from pressing against the furrow wall. When the rear furrow wheel properly angled into the corner of furrow, a little space approximately is maintained between the landside and furrow wall.

x Adjustment of furrow wheel and heel clearance

Set the furrow wheel to run straight in the corner and deep enough so that the land side heel is off the bottom of the furrow. The heel of the rear plough bottom (with long landside and heel casting) should run lightly on bottom of furrow and should not carry the full downward.

Mixed method: This is combination of both gathering and "casting application for larger fields". The whole field is divided into number of strips approximately of 20m, 30m and 40m for 2, 3 and 4 bottom plough respectively. This gives saving in fuel and time.

Mould board plough- Maintenance

Checking beams: Most of the less obvious plough setting difficulties is caused by plough being out of alignment. Plough consists of a number of beams, which together

with brackets and braces form the frame of plough. No plough will do satisfactory work unless the beams and frame are true and each plough body is in the same position relative to the other and to the beams.

All the ploughs should, therefore, be checked periodically on a smooth level floor to make sure they have not been damaged by obstructions.

Bar point/share: Such of bar points or share can be checked with a straight edge.

Cross shaft: Check the position of the cross shaft and ensure that it is put back with the crank downwards on the right hand side of the plough when viewed from the rear.

Coulters: Dismantle all coulters and clean. Coulter edges must be kept sharp by grinding.

Wearing parts: All wearing parts like coulter, bar points, shares mould board and land sides must be periodically checked and renewed when necessary.

Storage: During the off-season plough must be cleaned and stored under cover. All soil engaging parts must be coated with antirust compound.

Disc board plough

Objectives: At the end of this lesson you shall be able to

- state the working principle of disc plough
- state the constructional details of disc plough
- state the field adjustment of disc plough
- state the field operation of disc plough
- state the maintenance of disc plough.

Working principle of disc plough

The disc plough is an implement where the cutting and inversion of soil is performed by means of disc. This was introduced to reduce friction by making rolling bottom instead of a bottom that would slide along. Unlike mould board plough, disc plough creates no suction but depends on weights and disc angle for penetration.

Disc plough-Uses

It is suitable for dry, hard ground that cannot be penetrated with an mould board plough

Rough, stony and rooty ground where the disc will ride over the roots

Sticky, waxy ground soils where the mould board does not scour

Soils where deep ploughing for reclamation work is required

It is often used after harvesting grain crops where the ground is hard.

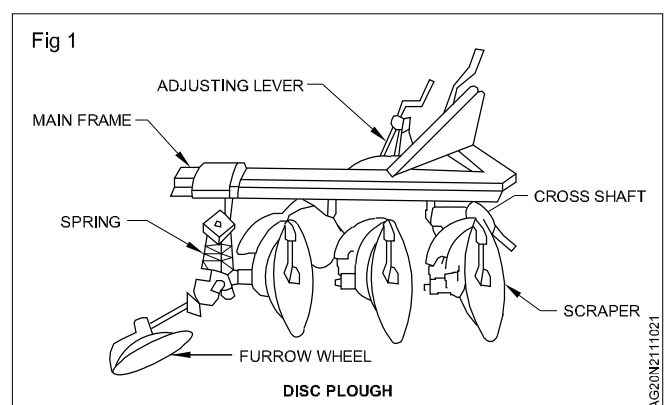
1 Concave discs

The size of the disc (1) is given in terms of diameter and thickness. Discs are mostly made up high carbon steel. Where ploughing conditions are particularly rough, alloy steel may be used.

2 Furrow wheel

The purpose furrow wheel is to stabilize the rear of the plough and to hold it in a position to control the width of cut by the front disc.

Disc plough-Constructional details (Fig 1)



Tractor mounted disc plough has 1 to 7 discs and weight 150 - 540 kg per disc. It is attached to the three point linkage and can be lifted or lowered by the hydraulic system.

3 Disc scraper

Each disc is equipped with scraper which gives a good turning effect to the furrow slice for better covering of

the thrash much better. It helps to clean the disc to get a better pulverisation.

There are three types of scraper

- 1 Mould board
- 2 Hoe
- 3 Disc

The M.B. type turns the soil and thrashes best. It cleans the disc to some extent. The hoe scraper cleans best and is very good in sticky soils. The disc scraper is used in non - scouring soils such as black land.

4 Standard

The standard connects the disc bearing to the plough beam. However, in some design there are no standards the beam is bent down for disc attachments. Some standard are movable where they join the beam can be shifted at that point for spacing and angling the discs. Other standards have pivoted bearing bracket at their lower end. Standard are usually of high carbon steel.

5 Cross shaft

The steel shaft fitted to the plough at the front at right angles to the beam is known as cross shaft. Both ends of the shaft have cranks opposed to each other. The width of cut of the plough can be changed by rotating the cross shaft as its clamps.

6 Bearings

Roller bearings (6) are usually mounted in pairs. Taper roller bearing absorbs thrust in all direction and can be readily adjusted.

7 Mainframe

Provide support to discs, furrow wheel etc.,

8 Springs

By adjusting spring pressure, it controls the vertical movement of furrow wheel from the ground.

Disc plough-Adjustments

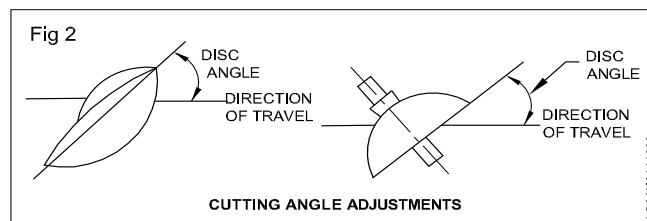
In order to get better results, the followings adjustments are necessary.

1 Cutting angle adjustments

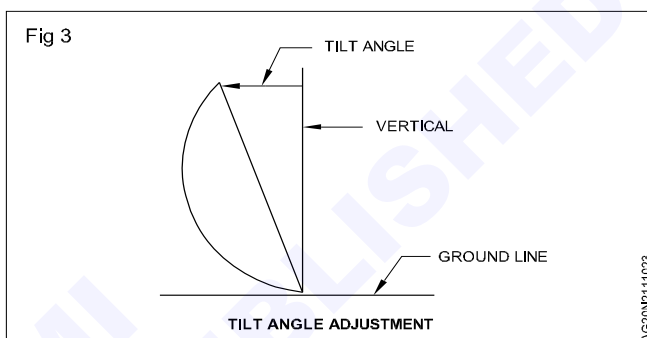
Discs would not cut if they are rolled straight ahead. They must be set at an angle. Provision is made in the plough standard for adjustment of the horizontal disc angle and vertical tilt angle to obtain disc operations in different soil conditions.

Disc angle is the angle which the plane of cutting edge makes with the line of travel. It is normally.

42° - 47°. Reducing the angle increases disc rotation with respect to ground speed and reduce the tendency of the plough to overcut. Increasing the disc angle improves disc penetration (Fig 2).



Tilt angle is the angle which the plane of cutting edge makes with the vertical line. It ranges from 15° - 25° increasing the tilt angle improves disc penetration in heavy, sticky soils. Decreasing the tilt angle improves disc penetration in loose and brittle soils. Setting disc in the steeper position puts soil pressure on the disc resulting in faster disc rotation, greater soil pulverisation and better covering coverage of thrash (Fig 3).



Effect of changing the cutting angle. The cutting angle depends upon the concavity. If the backside of the disc rubs the furrow wall because of small angle, the draft will increase. The draft decreases and penetration increases up till 45° after that, draft will again increase especially in heavy soils.

2 Width of cut adjustment

Every disc plough has a particular width of cut ranging from 18 - 25 cm, which depends on the diameter of the blade. However to suit various draft and penetration requirement the width of cut for the front disc can be adjusted to a few centimeters by rotation of the cross shaft and lateral positioning of the furrow wheel. In some ploughs (for e.g. plough of TAFE company) the cross shaft has an index line which can be lined up with either of the three markings (1, 2, 3) on the right hand cross shaft carrier. This gives 11 3/4", 11" and 10 1/4" width of cut/ disc respectively. This adjustment is done in conjunction with the lateral setting of the furrow wheel axle.

In addition to rotation of the cross shaft, the plough can be shifted to the right or left on the cross shaft. If this places the plough far from the center such that the steering is effected, the tractor wheel tread must be adjusted such as to get the disc plough as close to the tractor centre as possible.

3 Leveling the plough

Most mounted ploughs are designed for the frame to run parallel to the ground, both fore-and-aft and laterally. The fore - and - aft level of the plough is controlled by the tractor to plink. If there a bend of the plough beam is higher than the front end of the beam,

lengthen the top link and vice versa. Lateral leveling is controlled by adjusting the length of tractor right lower link. These adjustments must be made with plough in operating position.

4 Tightening bearings

Bearings must be kept tight. Tighten castle nuts until each disc binds, then return back the nut off one-sixteenth to one-eighth of a turn and pin the nut there.

5 Scraper adjustment

Scraper a reset low enough to catch and turn the furrow slice before it falls away from the disc. They are set about 1/8th inch away from the centre of the disc and about 1/4" away from the centre of the outer edge of the disc. More clearance at the outer edge prevents the material from wedging between the scraper and the disc. For deeper ploughing, the scraper has to be set a little higher, however it should be noted that all scrapers should be placed at the same height. For sticky soils, set them closer to the disc. Scrapers can be adjusted in four ways.

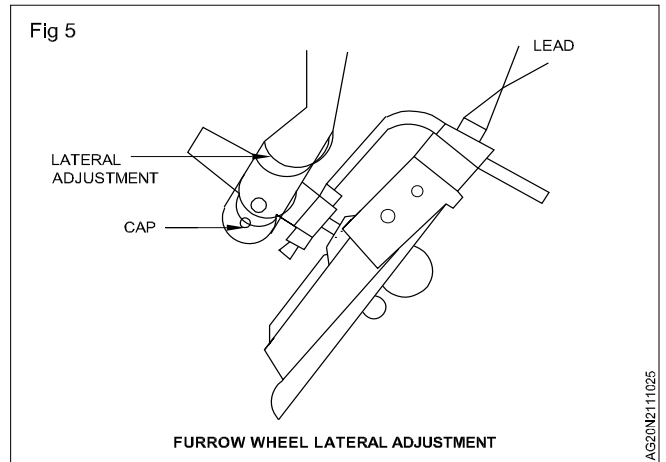
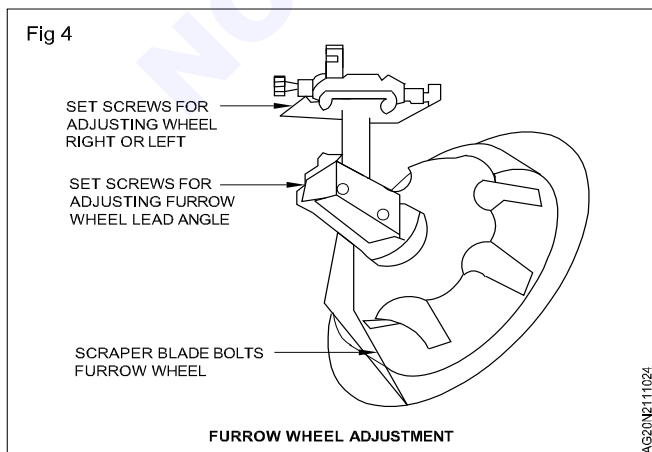
- The shank can be raised or lowered in the eye.
- The clamp can be moved to regulate the position of the scraper on the face of the disc.
- The angle between the face of the disc and the scraper blades can be adjusted by mean soft he slotted hole in the scraper arm.

6 Furrow wheel adjustment

The furrow wheel has following three adjustments.

- a Furrow wheel spring tension adjustments:** There is an adjusting screw with a lock nut. The screw when tightened over the spring cap compresses the spring and when slackened releases the pressure. Screwing down the adjusting screw puts more pressure on the furrow wheel and allows the blade to bite into the soil more firmly and vice versa.

By adjusting the spring pressure it either permits or restricts the amount of upward travel of the furrow wheel from the ground. This determines the amount of the plough weight that is carried on the furrow wheel. In wet or loose soil the spring pressure is increased in the furrow wheel to carry more weight, to prevent side movement of the ploughs. In hard soil, the pressure on the spring may be decreased to transfer weight to the plough disc to increase penetration (Fig 4, 5).



- b Furrow wheel lateral adjustment:** The furrow can be adjusted laterally to increase or decrease the of cut of the front disc. In general moving the wheel left will decrease the cut of the front disc and the set and vice-verse.

- c Furrow wheel lead angle adjustment:** If the has a tendency to swing towards the un ploughing increasing the lead angle but if the plough swings the ploughed land decrease the lead angle.

Field operation of disc plough

Tractor drawn disc ploughs may have from one to seven disc blades which have the same tilt and disk angles as the animal drawn plough. The diameter of the disc blades varies between 60 to 80cm and the radius of curvature between 45 and 63 cm.

The perfectly round concave steel discs sharpened on the edges are bolted to the cast iron supports which are individually suspended from the main frame. Taper roller bearings or thrust type ball bearings are used on the ploughs. Similar to the trailed type mould board ploughs, these ploughs are also provided with a front furrow wheel, a rear furrow wheel and a land wheel. There are also depth adjusting levers, drag links and scrapers on the plough.

When the plough is pulled forward, the individual disc rotates on its own axis. The furrow slice rides along the curvature and is pulverized to some extent before being thrown on the other side into the previous furrow. The scraper of the disc also helps in getting more pulverization and better scouring of the furrow slice. In order to cut a deeper furrow slice, the tilt angle of the disc is reduced; that is, the disc is set in a more vertical position.

The other method of increasing the penetration is by adding weights to the plough frame. If the soil condition is favorable, the tilt angle should be increased to achieve better turning of the furrow slice. If the soil condition is not favorable, increasing the disc angle improves the penetration but the width of cut is reduced.

Disc plough-Maintenance

Lubricate the bearings for free rotation of disc. Keep disc bearings clean and properly adjusted frequently. Check plough adjustments if the steering is hard. Check the cutting angle and scraper adjustment frequently. Sharpen discs if the blades are dull. Sharpening may not be necessary if the angle of cut is correct. Constantly check for loose nuts and bolts, if found loose tighten the bolt and nut.

Sub Soiler

Objectives: At the end of this lesson you shall be able to

- state the working principle of sub soiler and its uses
- state the constructional detail of sub soiler
- state the field operation of sub soiler
- state the maintenance of sub soiler.

Working principle of sub soiler

- The sub soiler implements used to break up impermeable layers and hard pan caused due to constant use of tillage implements.
- It helps in breaking up hard pan, allows deeper cultivation to stimulate root growth, improve the infiltration and drainage.

Sub soiler

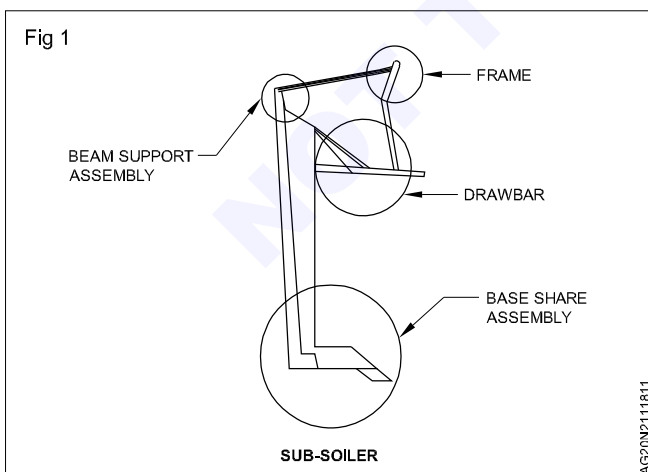
Uses

- 1 Sub soiler is used to break the lower impermeable hard pan.
- 2 Successful sub soiling loosens and breaks compact soil layers by creating many cracks and fissures thus allowing roots to develop more freely and water to move down more rapidly.
- 3 This inexpensive implement provides a simple and economical way to obtain good crop yield and profits.

Constructional details

There are two types of sub soilers one is single standard and another is more than one standard. One standard sub soiler is generally used for the deeper depth but to or more standard sub soilers can be used for shallower operations. Sub soil ploughs are available in both trailing and mounted units.

Main parts of the sub soiler (Fig 1)



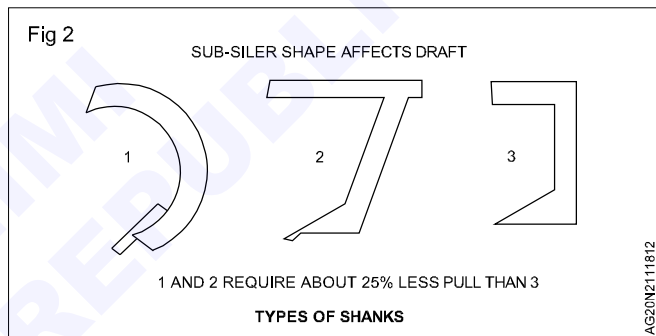
1 Shank or standard

2 Beam or tool bar

3 Tooth or share

4 Frame

Shank or standard: Shank or standard is the main part of the unit. It is vertical or curved towards the front. The shank may have several holes drilled in its sides which are used to hold wings and sweeps for other purposes (Fig 2).



Beam or toolbar: The top of the standard is fastened to a straight flat iron which acts as a beam. The joint is made with gusset plates and bolts or rivets. Other standards are fastened to a tool bar located behind the tractor rear wheels. The tool bar can be raised or lowered from the tractor.

Tooth or share: Tooth or share is fitted at the foot of shank. Most sub soiler have steel point that is reversible when worn.

Some sub soilers are equipped with wheels and axles. Usually one wheel powers the axle so that it can act as a crank to raise the soil - working unit. This is done by a clutch unit as on some ploughs, or by a ratchet and pinion mechanism.

Field operation of sub soiler

The subsoiler is usually centered directly behind the tractor or so that there is no side draft. Field should be sub soiled at right angles to the intended direction of ploughing. Then you sub soil the field about every 4 feet for rain age and for breaking-up the hard pan, reduce the spacing to 2 feet in the worst cases. Sub soiling depth is changed by raising or lowering the standard with in the beam angles and some sub soilers the suction can be varied by tilling

the standard and tooth. The tooth creates some suction, which pulls the unit the upward pulling force of the tractor balances the machine's weight and suction. Tractor wheels can beat any track setting although it is useful to set front wheels as a guide for spacing. In flat tyre store commended pressure. Weight added on front and rear wheels to increase pulling power and to avoid excessive slippage according to recommendations.

Subsoiler - Maintenance

Parts must be cleaned before the implement is used and after the implement is used. Remove any paint at the top link connection and ends of draw bar. Check for loose, broke nor missing bolts, nuts and parts. Check for badly worn or broken points. No lubrication is necessary for the applied parts of the sub soiler. Oil is applied to the moving parts of the sub soiler

Chisel plough

Objectives: At the end of this lesson you shall be able to

- state the working of chisel plough
- state the uses and components of chisel plough
- state the constructional details of chisel plough.

Working of chisel plough

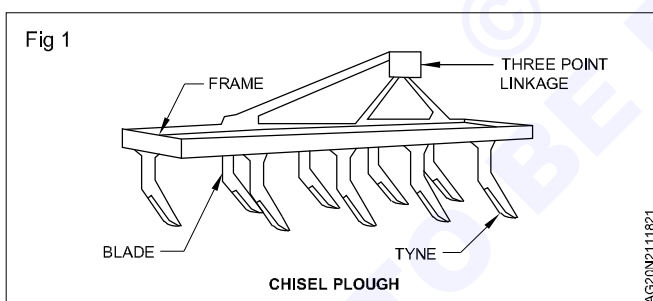
It will breaks up the soil without inverting it, but which is not as efficient for weed control as a conventional plough. Chisel ploughs are becoming increasingly popular because of their high work rate and simple construction, but the power required is higher than that for mould board ploughing under identical conditions.

Chisel plough - Uses

It is a pointed curved bar type implement useful for breaking hard layer of soil below the normal ploughing depth to facilitate infiltration of rainwater.

Components of chisel plough

The different components of chisel plough are given in (Fig 1).



Frame

The frame is the main body on which gangs are attached through bearing standard. Arrangement to angle the gang and the draw bar a real so connected to the main frame.

Blade

Blades or knives enter in to the soil to cut it. Under normal conditions these blades are self - sharpening and they are arranged in a scroll or spiral pattern on the rotor so that not more than one blade strikes the soil surface at a time.

Tyne

The tyne is made of mild steel flat having carbon content ranging from 0.15 to 0.25%. A flat of usually 40 x 6 mm size is used for tyne.

Three point linkage

It is used for hitching the implement to the tractor. The depth control is done on three point linkage.

Chisel plough (Fig 1)

Constructional details

The chisel type plough is a tool with a rigid curved or straight shank with relatively narrow shovel points. It may be termed a heavy - duty deep cultivator. The soil is stirred more or less in place. The standard or shank is constructed of nickel - alloy heat - treated spring steel that is given a long, gradual curve flat wise to permit a slight spring action. The standards are arranged on heavy frames in two or three staggered row stop permit trash to pass between them without choking. Most chisel plough are provided with coil cushion springs in conjunction with the clamps. This permits the ground tool to swing back and up and to un hook the point. The furrows may be as close as 12 inches or as wide apart as 2 to 3 feet. The depth o fploughing may be as shallow as desired or as deep as 18 inches or more.

Some types of chisel ploughs are available in sizes ranging from 5 to 45 foot widths. On some of the larger ploughs the outer sections can be folded upon the center section. This aids in transporting the tool. Pneumatic tired wheels control the depth or serve for transportation. Hydraulic lifts are provided for all sizes of ploughs.

As the soil is broken by stirring, it is not inverted and pulverized to the extent that moldboard and disk ploughs crush the soil. Therefore, the chisel plough is often used to loosen hard, dry soils before the regular plough is used. The chiseling and stirring operation does not throw enough soil to cover trash completely. Hence, the chisel type plough is used for stubble mulch or subsurface tillage practices. This type of plough is also useful in breaking up hard layers of soil just below the regular ploughing depth. This layer of soil is called by several names, such as hard pan and plough sloe. Special plough shovels, sweep and knife assemblies and seeding attachments make it possible to do many jobs with chisel type plough.

Rotavator

Objectives: At the end of this lesson you shall be able to

- state the uses of rotavator
- state the constructional detail of rotavator
- state the adjustments of rotavator
- state the operation of rotavator.

Rotavator

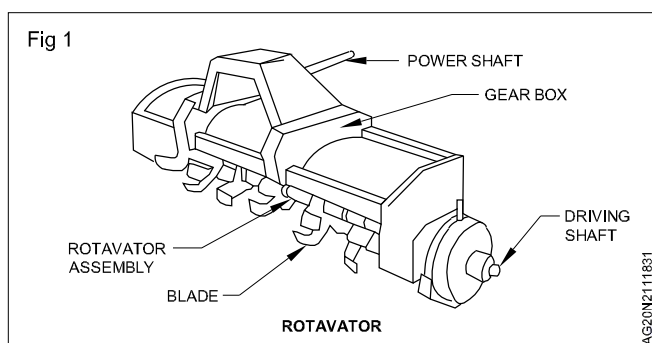
Uses

It is suitable for preparing seed bed in a single pass both in dry and wetland conditions.

It is also suitable for incorporating straw and green manure in the field.

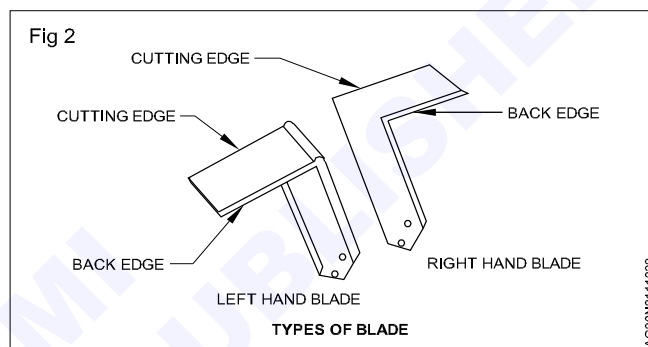
Rotavator - Constructional details

It consists of propeller shaft, slip clutch, gear box, side drive, blade and size of cut or bit (Fig 1).

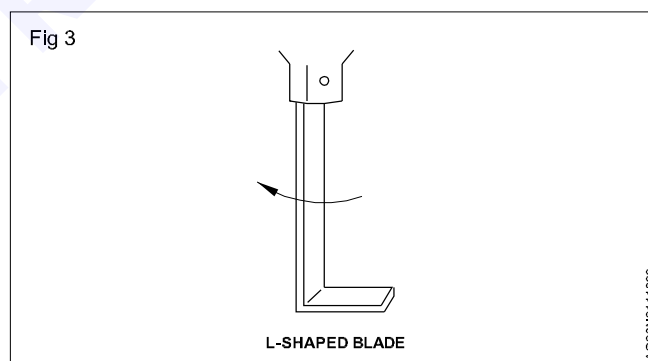


- 1 Propeller shaft:** This shaft receives the drive from the tractor PTO and transfers it to the slip clutch unit of the rotavator.
- 2 Slip clutch:** A slip clutch is usually provided in the tiller drive train. It protects the tiller transmission against excessive strains encountered while working. The clutch disengages automatically as soon as the safety setting is exceeded. In some rotavator instead of slip or safety clutch, a shear bolt is provided.
- 3 Gear box:** Also known as the primary reduction unit, the gear box is used for reducing the speed received from the tractor PTO to a desired rotor speed according to field conditions. Some models have a single rotor speed for a particular PTO rpm, whereas in some model stiller rotation speed can be adjusted without altering the tractor PTO speed. This can be done by changing the gear pair provided in the tiller box.
- 4 Side drive:** Also known as the secondary reduction units, generally consists of chain and sprocket assembly. There are two sprockets where the upper sprocket receives the drive from the gear box and lower sprocket transfer sit to the rotor shaft. A check chain adjuster is provided for chain tension adjustment. Some rotavator may instead have a 3 spur gear assembly for transmitting the drive from the gearbox to the rotor assembly.

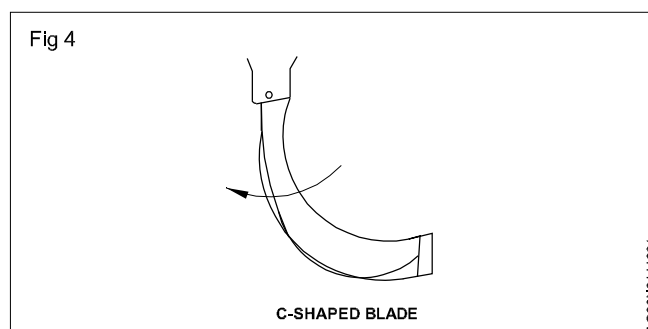
- 5 Blade:** Blades or knives enters in to the soil to cut it. Normally, 2 or 3 pair so fright and or left-hand blades are used on each flange. Under normal conditions these blades are self - sharpening and they are arranged in a scroll or spiral pattern on the rotor so that not more than one blade strikes the soil surface at a time. Failure of which may cause uneven work and excessive vibration. There are about 24 to 36 blades bolted to the flanges on the rotor shaft. Different types of blades are used for different field conditions (Fig 2)



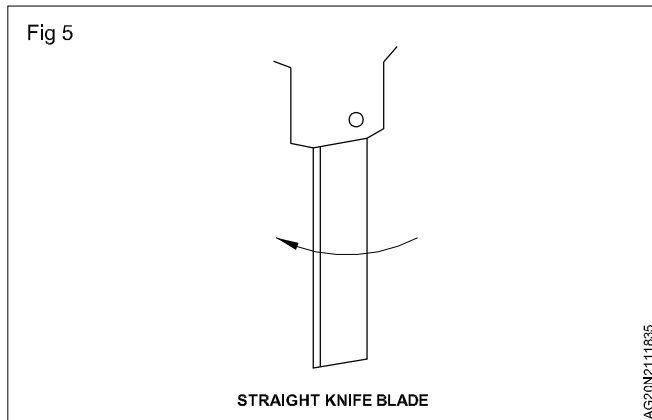
- i L - shaped blade:** Most common as the shape is superior to other sin heavy thrash. They are better to kill weed sand generally cause less oil pulverization (Fig 3)



- ii C - shaped blade:** Penetrating hard ground is easier with these blades. They are more curved than L-shaped blades and are recommended for heavy, wet soils because they have fewer tendencies to clog (Fig 4).



- iii **Long shank blade:** They have longer shank than the L - shaped blade can be used for deeper cultivation.
- iv **Speed blade:** Especially suitable for penetrating hard ground and for mixing heavy thrash. Have fewer tendencies to clog in wet condition.
- v **Straight knife blade:** These simply slice through the soil compaction and improve moisture penetration. Primary application is for lawns, parks and golf courses (Fig 5).



Some machines designed primarily for secondary tillage and cultivation have thin, flat, straight blades with narrow, rectangular edges that strikes the soil to break clods and tear out weeds.

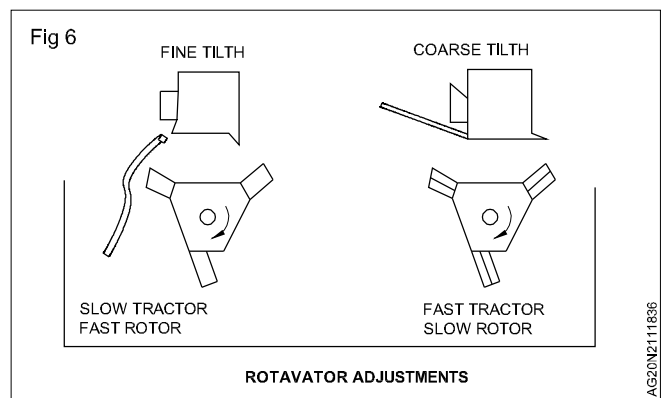
Rotavator - Adjustment

For leveling the machine fore and after adjust the top link. Lift the rotavator a little above the ground and adjust the side to side level such that all the blades shave the same clearance. For desired working depth, adjust the gauge shoes, skid or wheels.

For desired tilth change the rotor speed. Raise or lower the shield for coarse, medium or desired tilth. Change the number of blades according to field conditions. Check the slip clutch from time to time and adjust the compression of the spring according to the operator's manual.

For fine tilth, lower the soil shield select a fast rotor speed or a slow tractor speed or both.

For coarse tilth, raise the soil shield. Select a slow rotor speed or a fast tractor speed or both (Fig 6)



Rotavator operation

Rotary tiller applies tractor engine power directly to the soil through the PTO without wheel slippage of excessive tractor weight. With good tillage management and proper operation, they can provide a valuable tillage alternative to ploughing and harrowing.

Two or three pairs of blades are used on each flange, which in turn are clamped to the rotor shaft and may be shifted or removed for varying tillage patterns. As the rotor shaft revolves each blade cuts a slice from the untilled soil. The cross sectional area of the slice depends upon the depth of the tillage and the amount of forward tillage per cut.

Rotavator

Daily maintenance

Lubricate the entire machine and grease all greasing points before and after use. Check the level of oil in the gearbox and if needed top up as the gears need lubrication or else the teeth wear of gear will be more. Inspect rotor for loose, bent or broken blades. The wear on the outer surface of blades is inspected as it affects cutting rate. Check the machine for loose bolts and worn or broken parts. The rotor bearings are checked for twine, wire or thrash wrapped will run the release bearing.

Periodic maintenance

Check the condition of blades, straighten and replace bent or damaged ones. Check lubricant level in the gear box drain, flush and refill them. Remove the chain case, check the chain and sprocket for wear, tightness and lubricate them and lubricate all shaft bearings also. Check all bolts and set screws for tightness. Be sure all cotter pins are spread. Check rotor and proper scroll pattern of blades.

Harrows and their uses

Objectives: At the end of this lesson you shall be able to

- state the comparing and contrasting a drag harrow vs disc harrow
- state the difference between disc harrow and disc plough
- state the safety precaution of harrowing.

Comparing and contrasting a drag harrow vs disc harrow

Harrows are used to breakup or spread soil. Harrow is used for gardening and landscaping to cultivating large crop fields consequently.

The drag harrow is known as blanket harrow and chain harrow it is made of a light chain mesh with small spikes or teeth. A disc harrow breaks up large clumps of dirt to ready a field for planting. It is composed of metal disc on heavy metal frame with different types of disc for different soil conditions.

Disc Harrow	Drag harrow
Breaking up large clumps of soil Uprooting weeds Chopping up old crops and stumps Turning and mixing soil Leveling large swaths and uneven grounds It is ideal for the toughest jobs	Lightly leveling surface soil Breaking up small dirt clumps to create a finer surface Covering newly planted seeds Spreading fertilizer Leveling and smoothing sports fields It is ideal for aerating or lightly spreading soil

Difference between disc harrows and disc plough

Disc Harrow	Disc plough
It is secondary tillage implements with a group of disc size 40cm to 60cm. It is used for after primary or disc plough Disc are uniformly spaced along a common axle. No disc angle and tilt angle but gang angle Even topography after ploughing with disc harrow result is tilted soil without any large clods.	It is a primary tillage implement with an individual disc size of 60cm to 90cm Disc angle and tilt angle are subjected to change in disc plough Field after plowing with disc plough result in large soil clouds and uneven topography

Safety Precaution of harrowing

- Do not stick your hands in moving parts of harrow.
- Hitching the harrow unit with tractor properly.
- Wear seat belt.
- Follow the recommended speed and do not run over anyone.
- Keep all nut bolts tight and keep the equipment and attachment in good operating condition.
- Keep the children and pets away from the working area.
- Always use the personal protective equipment, while operating harrow in the field operation.
- Keep in mind that the operator or user responsible for accidents or hazards occurring to other people, their property, and themselves.
- Never leave the harrow unattended, if you leave the area shut off the tow vehicle and remove the key.
- Only use the manufacturers recommended replacement parts while repair the harrow.

Harrow trouble shooting: Learning how to troubleshoot a disc harrow, here is a quick guide to troubleshooting disc harrow problem.

Trouble	Cause	Remedies
Harrows dig too deep	- Improper disc adjustment	- Adjust properly
A harrow leaves break in soil	- Going too fast with tractor	- Maintain the recommended speed
Uneven rows	- Bend cross bar/bent disc	- Replace
Disc harrow bearing noise	- Bearing dry grease	- Lubricate it
Disc mounting loose	- Nut bolt thread w/o	- Replace nut bolt
Improper disc angle	- Improper disc angle adjustment	- Adjust 40° to 45°
Improper tilt angle	- Improper setting	- Adjust 15° to 25°

Harrows, disc harrow and their uses

Objectives: At the end of this less on you shall be able to

- state the importance of harrow
- state the different type of harrows
- state the components and constructional details of disc harrow
- state the field adjustment of disc harrow
- state the field operation of disc harrow
- state the maintenance disc harrow
- state the working of other six different type harrows.

Importance of harrows

Harrow is one of the tillage tools, which are used to prepare the land by breaking clods, cutting weeds. Pulversing the soil, converting seeds, and smoothing the surface.

This tool is mainly used for seed bed preparation just before planting.

Type of harrows

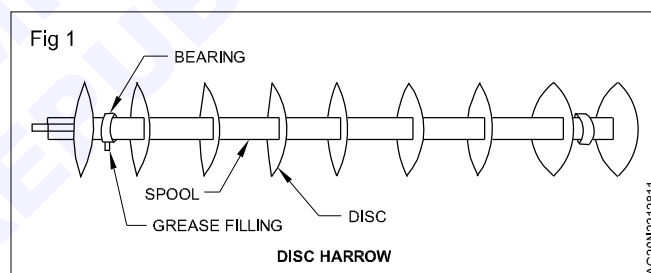
- 1 Disc harrows
- 2 Drag harrows
 - Single bed harrows
 - Spring bed harrows
- 3 Blade harrows
- 4 Gun taka harrows
- 5 Acme harrow (knife harrow)

Uses

Harrows are used for primary tillage and light duty harrows are used for secondary tillage - seedbed preparation, summer fallowing, chemical in corporation, weed control, to spread seed and fertilizer to disk after ploughing, to pulverize lumps and to control weeds.

Components and constructional details of disc harrow

The components are indicated in the Fig 1



Disc blades

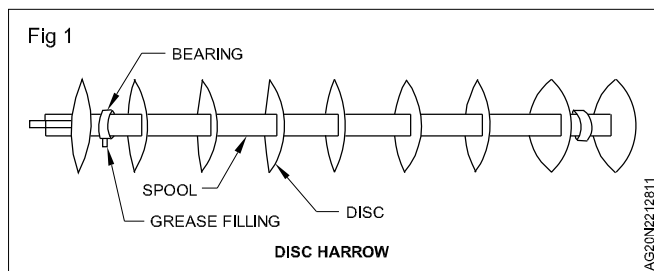
The blades of the harrow are concave in shape and have a sharp edge. The diameter and thickness varies depending upon the harrow type, size and weight. However in general a thickness of 3mm to 9mm and a diameter of 40 cm to 60 cm are common. Blades with not checked general so available for the areas where heavy crop residue or grass is to be cut and pulverized. The blade spacing varies between 18 cm 36cm depending upon the nature of work. For fine finish or the spacing is less. As pool made of cast iron with machined end is used for spacing.

Gang

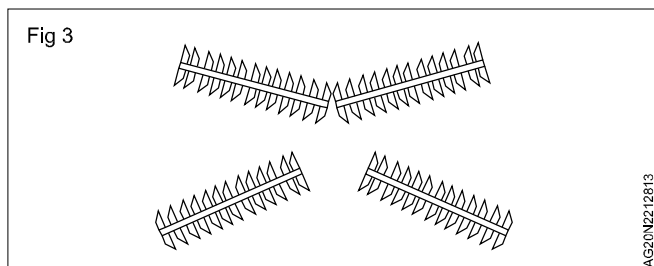
A group of more than two discs are fitted on a shaft with spacers in between them is called a gang. The shaft can be square or round and is normally known as arbor bolt, one end of the shaft has threads and the other end a large washer. The discs mounted on the shaft are tightened with the help of washers and nuts, making the gang a composite unit in which the disc, shafts pool rotate together.

Arrangement of gangs

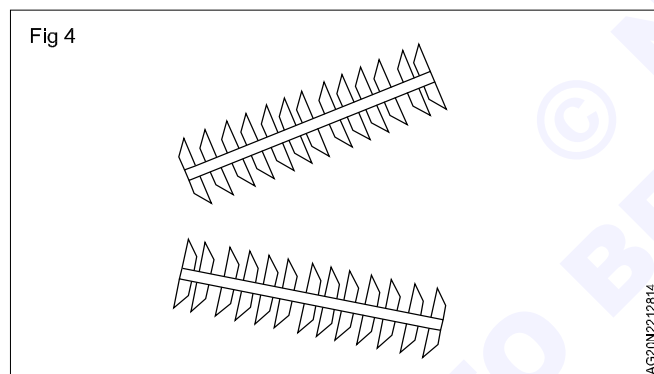
- Single action:** Two gangs are placed end to end, which throw soil in opposite directions (Fig 2).



ii. Double action (or) tandem: In this type two gangs are placed one behind the other. The front gang throwing soil to the right and the rear gang pulls the soil back to the centre. Double action harrows are also known as tandem harrow (Fig 3)



iii Offset: An off-set disc harrow has two gang of discs. The concave disc on front gang moves the soil to the right hand side and there are to the left hand. The land is tilled twice and the fields are nearly leveled after harrowing. The angle of the gang is variable and can be adjusted to suit particularly tilling requirements and soil conditions (Fig 4).



Bearings

The gang is mounted on the frame through bearings housing which carry bearings. These bearings can be either friction type, which remains filled with grease, or antifriction type. All the bearings are subjected O axial thrust caused due to tangling of the shaft. This effect is countered by the edge of the spool, which runs in the ring groove of the bearing housing.

Mainframe/spool

The frame is the main body on which gangs are attached through bearing standard. Arrangement to angling the gang and the drawbar are also connected to the main frame.

Disc harrow-Adjustment

a Disc gang angle O' cuffing angle adjustment

Generally the gang cutting angle varies from degrees from the line perpendicular to the line of single or double

action harrow but may be used between the two gangs, in some offset. Increasing disc gang angle improve penetration, while working in a previously worked field minimum gang must be used. The angle can be increased for penetration in dry soil while it should be reduced plugging in wet soil. Thrash cutting and coverage be increased with the increase in the gang an accordingly the draft also increases proportional the front and there are gang angles can be change the help of an angle selector, by sliding the gang the desired position, by loosening the clamp by tightening when the desired angle has been obtained.

Generally the rear gang angle is kept a little more than the front gang. While clamping the disc gangs to the frame make-sure there are disc tracks centrally between the marks made by the front discs.

Tightening when the desired angle has been obtained. Generally the rear gang angle is kept a little more than the front gang. While clamping the disc gangs to the frame make use the rear disc tracks centrally between the marks made by the front discs.

b Disc harrow leveling: To eliminate uneven penetration and side draft the fore and aft leveling is to be done by means of top link. While the tractor pulls to the right, the rear gang should be lowered a little. When the tractor pulls to the left, the rear gang should be raised. The implement may be leveled side to side by turning the implement leveling lever clockwise or anticlockwise.

c Soil leveling: Disc harrow should leave the soil smooth and free of ridge and valley. If a ridge is left in the centre of at an dem harrow, increase the front gang angle and reduce the rear gang angle.

If a valley or low spot is left in the centre reduce the front gang angle and increase the mar gang angle. Re-level the harrow and increase the speed of travel.

Ridges at the outer ends can be leveled by moving rear gang to pull in more soil or by reducing operating speed. Reducing front gang angle also reduces the amount of soil thrown out.

Furrow filler blades may be added to the outer ends of rear gang to till and level the furrow left by outer blade when operating in loose soil.

d Offsetting the harrow: The offset harrow can be used directly behind the tractor or can be offset to the right or to the left while working in the orchards etc. To offset, loose nor if necessary remove the clamp bolts and move the harrow along with the attaching channel to the right or left. When the determined amount of offset is obtained, clamp the harrow frame to the attaching channel assembly. The front gang can be offset to the right or left, to a maximum of two feet in relation to the hitch frame. The rear gang may also be moved to the hitch frame. The rear gang may also be moved to the right or left to a maximum of two feet with respect to the front gang, thus giving a maximum of four feet (1.2 m).

- e **Scraper adjustment:** For conical type blade the gap between scrapers should be $\frac{1}{8}$ " at the inner point and $\frac{1}{4}$ " at the outer point. For spherical blade, the gap should be $\frac{1}{2}$ ". The scrapers can be adjusted by loosening the bolts at the scraper's clamp.
- f **Depth control:** The depth at which the implement is required to work is controlled hydraulically by raising or lowering the control lever on the tractor.
- g **Disc harrow penetration:** Factors affecting disc harrow penetration are
 - i Angle of gang
 - ii The weight of the harrow
 - iii Blade diameter Small blades penetrate better, larger blades work deeper in soft soil.
 - iv Blade sharpness
 - v The angle of hitch

Disc harrow-field operation

- 1 Before starting the operation determine the soil and thrash conditions of the field and make the preliminary adjustments accordingly. Final adjustments will be made in the field.
- 2 Divide the field into land of approximately 25m width (harrowing in the field is usually done in lands and breaks, to avoid awkward turns in the headland). If necessary, disc the boundary of the field to demarcate the area to be diced. Start the operation in the centre of the first land. Make adjustment, if necessary, in depth and level settings. After the first pass take a left hand turn and start along one side of the field leaving as trip of land equal to the head land in width. Continue the operation on the right side of the first pass. Successive passes in the same manner carry the work further across the field each time, until the uncultivated strip left in the first land disappears. At this point another strip is set off in the second land
- 3 While using a trailed type disc harrow, care should be taken to turn the harrow only in the left direction.
- 4 After finishing operation in all lands, make three passes in the head land.
- 5 It has been observed than in certain soil conditions, the soil tends to stick to the discs, the proper adjustment of the scrapers and the gang angle not with-standing. This problem is minimized if the discs are having clean and finished surface to begin with. Hence under sticky soil conditions, it is good practice to operate the disc harrow in a sandy soil first to give the discs the necessary, polish after removing any mud sticking to them.
- 6 If second disking is necessary, working at right angles or diagonally to the first pass improves results.

Disc Harrow - Maintenance

Lubricate the bearings and moving parts. Do not over grease as this may accumulate dirt. Check nuts and bolts for tightness. Repair or replace damaged or missing parts.

Sharpen or replace worn, racked or broken blades. After use, thoroughly clean all thrash, soil and dirty grease from the harrow. Before storing clean dirty blades and coat with heavy grease or antirust compound.

Working of other six different type harrows

1 Drag Harrow

- Drag harrow used to cut branches from the trees for use in leveling the soil in earlier days.
- Presently farmers drags long bamboo pieces with long nails to break the soil crush an stir the surface.

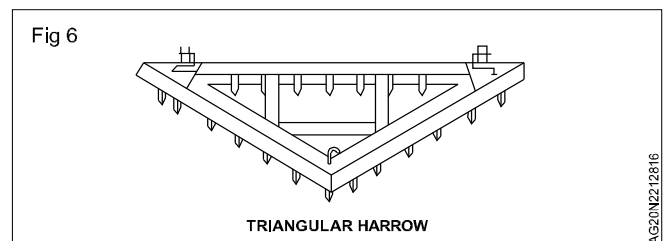
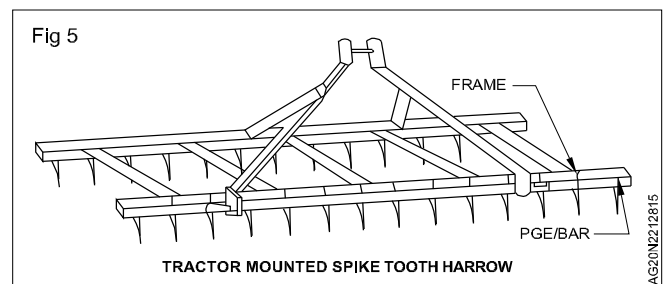
There are two principle of kinds of drag hammers namely

1 Spike tooth harrow

2 Spring type harrow

2 Spike tooth harrow

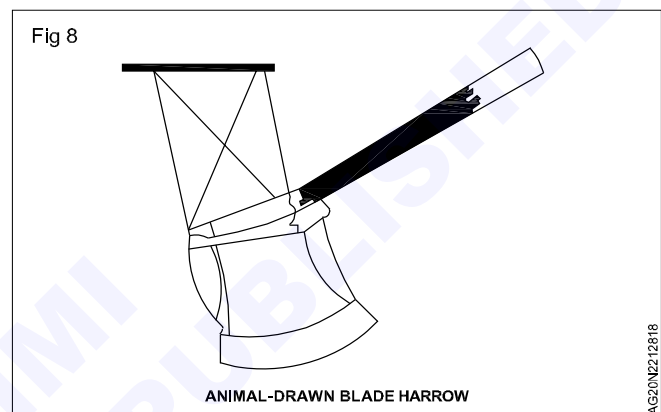
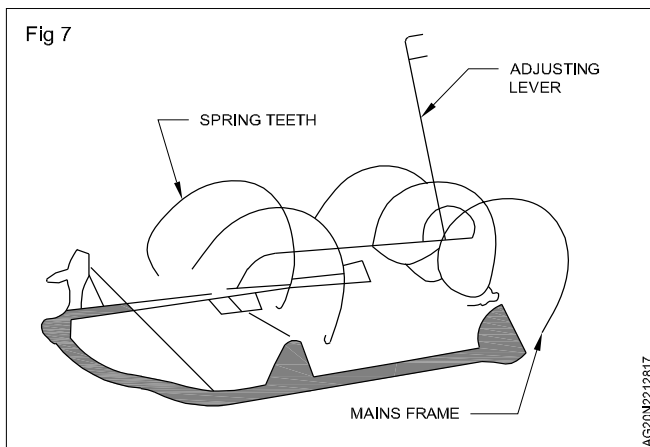
It is a harrow with peg shaped teeth of diamond cross-section attached to either rectangular Fig 5 or a triangular frame (Fig 6). The triangular frame is made of wood and is pulled by a pair of animals. The rectangular type spike tooth harrow frame is made of steel and is pulled by tractor. The spike tooth harrow is also known as peg-tooth harrow, bar harrow, drag harrow, section harrow or smoothing harrow. Its main use is to smooth and level the soil directly after ploughing. It is used to break clods, stir the soil, uproot the weeds, level the ground, break the soil crust and cover the seed. It can be used to cultivate corn and cotton and other row crops in early stages of growth. It is of two type rigid and flexible type. Animal - drawn spike tooth harrows are usually of rigid type. The teeth of spike tooth harrows are made of hardened steel. The teeth may be square, triangular or circular in section. It can stir the soil up to the depth of 5 cm.



- 3 **Spring tooth harrow:** It is a harrow with tough flexible teeth, suitable to work in hard and stony soils. It is fitted with springs, having loops of elliptical shape (Fig 7). It gives springing action in working conditions. It pulverizes soil and helps in killing weeds. It can also be used to loosen previously ploughed soil ahead of

grain drill. In this machine, teeth penetrate deeper than spike-tooth harrow and tears out the roots and bring them to surface. This harrow consists of teeth, tooth bars, clamps, frame, clevis, lever and links. The teeth consists of wide, flat, curved, oil - tempered bars of spring steel, one end of which is fastened rigidly to a bar; the other end is pointed to give good penetration. Adjusting angle of teeth by means of levers controls the depth to which teeth will penetrate the soil. The teeth are available with points of various widths and shapes with detachable points for different types of work. Trailing type spring tooth harrows are available in sizes ranging from 2.4 to 11.0 m. The draught of spring-tooth harrow varies from 100 - 200 kg/m width, depending upon the type of work and soil conditions.

- 4 **Blade harrow:** This is also known as bakhar (Fig 8). It consists of one or more blades attached to beam or frame and used for shallow working in the soil with minimum soil inversion. It is used to prepare seedbed mostly in clay soils. The blade is made of steel and its width varies from 40 to 100 cm. The body of the beam is made of wood.
- 5 **Guntaka harrow:** It is an improved type of blade harrow. The functions of Guntaka are same as that of Bakhar
- 6 **Acme harrow (knife harrow):** It is a special type of harrow having curved knives. Front part of knife compacts soil and crushes the clods. It is good for mulching also. The knife is made of high carbon steel. Putting additional weight on the frame may increase depth of penetration.



Cultivator and their types

Objectives: At the end of this lesson you shall be able to

- state the uses of cultivators
- state the different types of cultivators
- state the constructional details of cultivator
- state the maintenance of cultivators.

Cultivator

It is an implement consisting of a number of tynes attached to a frame which is used for tilling the soil between standing row crops.

Uses

To control weeds so that they do not compete with crops for water and nutrients.

To achieve rapid infiltration of rainfall and adequate aeration.

Breaking the clods.

Creating a mulch on the surface of the field, to conserve the moisture.

Sometimes used for sowing operation when provided with sowing attachments.

Inter culturing, especially when the plants are germinated. The row to row distance may be varied according to the requirement.

To prevent surface evaporation loss.

Types of cultivators

Cultivators are classified according to use of source of power

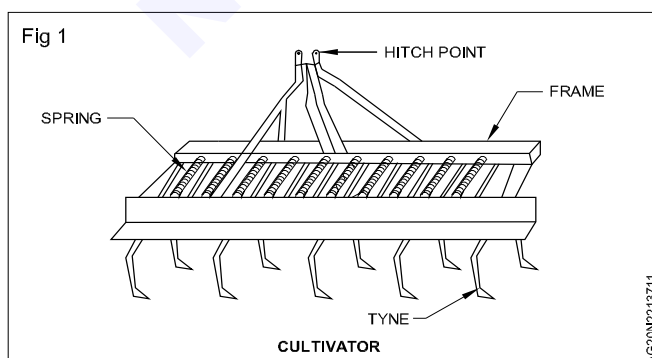
- 1 Hand operated cultivators
- 2 Power driven cultivators

According to the type of working parts they are classified as

- 1 Shovel cultivators
- 2 Disk cultivators
- 3 Surface cultivators

Components and constructional details of a cultivator

The different parts of the cultivator are given in (Fig 1)



Frame

Frame is made of steel flat usually of size 40 x 10 mm. There is vertical hitch or clevis arrangement with the help of which animals of varying sizes can be hitched to the cultivator.

Hitch point

Connected with three point linkage of tractor.

Tyne

The tyne is made of mild steel flat having carbon content ranging from 0.15 to 0.25%. A flat of usually 40 x 6 mm size is used for tynes.

Shovel

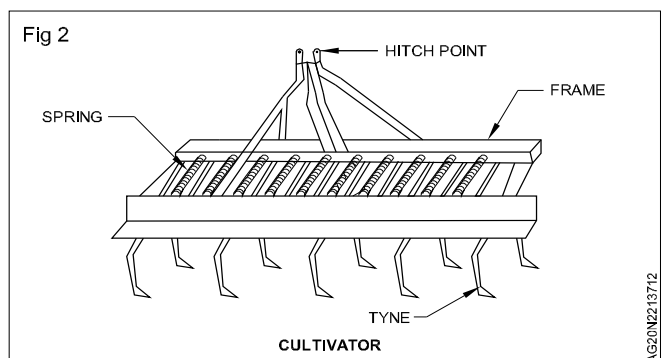
Shovel is usually of reversible type. The width of the shovel varies between 50 and 75 mm and is made of steel having carbon content ranging from 0.5 and 0.6%. The thickness of the shovel ranges between 3.15 to 4.50 mm. The cutting angle varies in the range of 15° to 20°. The shovels are fixed to the tynes with suitable bolts.

Spring

The springs operate, when the points strike roots or large stones by allowing the tyne stored over the obstruction, thus preventing damage. On passing over the obstruction, the tynes are automatically reset and work continues interruption.

Cultivator with spring loaded tynes

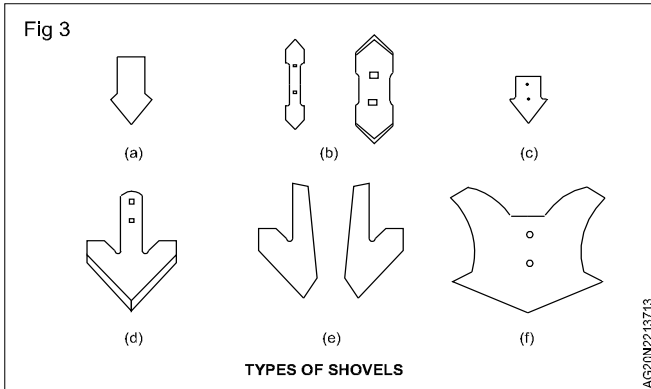
A tyne hinge to the frame and loaded with a spring so that it swings back when an obstacle is encountered is called spring loaded tyne (Fig 2)



Each of the tyne of this type of cultivator is provided with two heavy coil springs, pre tensioned to ensure minimum movement except when an obstacle is encountered.

The tynes are made of high carbon steel and are held in proper alignment on the main frame members. A pair of gauge wheels is provided on the cultivator for controlling the depth of operations. The cultivator may be fitted with 7, 9, 11, 13 tynes or more depending upon the requirements.

For actual cutting the soil, different types of shovels and sweeps are used. A few important shovel and sweeps are (Fig 3)



- a Single points shovel
- b Double points shovel
- c Spearheads shovel
- d Sweep
- e Half sweep
- f Furrower

Care and maintenance of cultivator

Check shovel point and sharpen or renew. Adjust shovels for uniform depth of penetration. Check for general condition

Trouble shooting of cultivator

Problems	Remedies
1 Rotary hoe jammed	Check replace
2 Rotary hoe accessories damaged	Replace
3 Flex tine bent	Replace
4 Spike tooth harrow damaged	Replace
5 Cultivator spring tension weak	Replace the spring
6 Cultivator frame cracked	Repair / replace
7 Cultivator hitch point hole in oversize	Repair
8 Hitch point support beam bent	Repair / straighten
9 Cultivator sweeps, knives and wings damaged	Replace
10 Residue cutting coulter damaged	Replace
11 Depth band defective	Replace
12 Tynes mounting bolt damaged	Replace
13 Tynes sturdy clamps damaged	Replace

for frame. Oil and adjust tension of spring trips. Replace badly worn wheel bearings. Remove end play from wheels with the take-up washers provided. Adjust wheels to toe-in slightly. Lubricate wheel bearings.

Cultivators adjustments

- Cultivator shank adjustments can be varied due to amount of desired soil throw and harness of the soil type.
- Attach sweep with tighten nuts securely
- Adjust the angle of the sweep to control the amount of soil throw.
- To have more angle turn the adjustment bolt counter clockwise.
- To have in more of a flat position turn the adjustment bolt clockwise.

Cultivators operation

- Before starting work with a cultivator, it is necessary to set all the working section correctly.
- Read the user manual to find out about the cultivator setting advantages and difficulties with cultivators.
- Adjust the track cultivator to fulfill the required task.
- Hitch the cultivator with prime mover
- Lift the cultivator while travel on the road or hard ground
- Don't sharp turn the prime mover while operate the cultivator in the field.
- Adjust the cultivator depth of penetration.

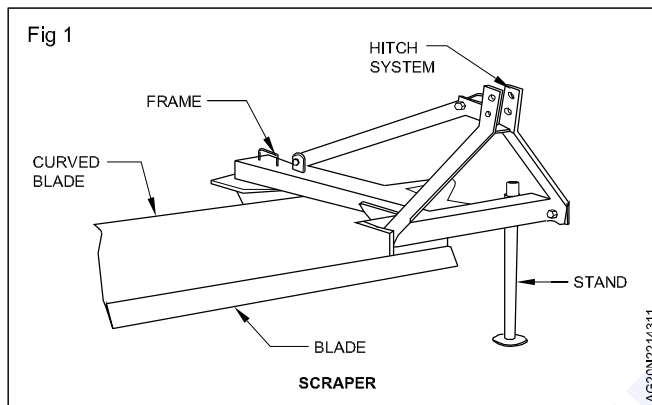
Soil forming equipment and their types

Objectives: At the end of this lesson you shall be able to

- describe the components and uses of scraper
- describe the components and uses of digger and dumper
- state the components and uses of terracer, laser and leveller.

Scraper

The hydraulic scraper is towed behind the tractor. The scraper consists of cutting blade, hitch system, curved blade and detachable blade (Fig 1).



The stand is used when the scraper is un mounted from tractor.

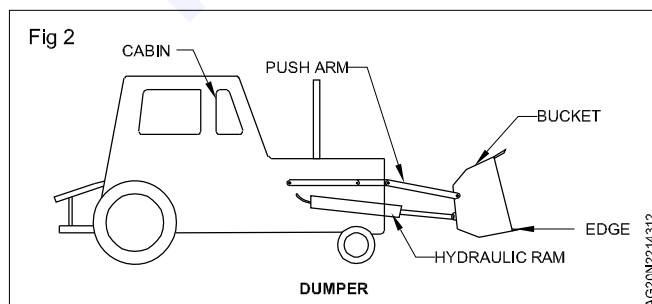
Uses

It is used for collecting the soil from one place and unloading at the other. It is used for rough leveling, cutting of high spots and filling of depressions.

Dumper

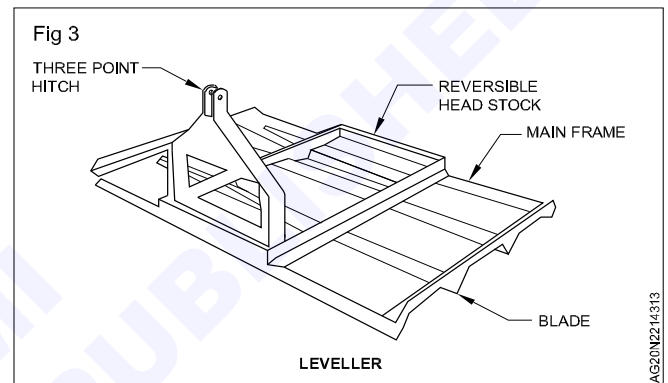
A dumper is a vehicle designed for carrying bulk material, often on building sites (Fig 2). Dumpers are distinguished from dump trucks by configuration. Dumper is usually an open 4-wheeled vehicle with

the load skip in front of the driver, while a dump truck has its cab in front of the load. The skip can tip to dump the load this is where the name “dumper” comes from. They are normally diesel powered. A towing eye is fitted for secondary use as a site tractor. Dumpers with rubber tracks are used in special circumstances and are popular in some countries.



Leveller

It is a tractor-mounted implement controlled by tractor hydraulics and three-point linkage. It consists of hitch system, replaceable cutting blade with sharp edge, and a curved plate with side wings, which form a bucket. (Fig 3)



Hitch system

The hitch system is the attachment of leveller to the tractor's three point linkage.

Blade

The blade is made from medium carbon steel or low alloy steel, hardened and tempered to suitable hardness. During operation, the blade digs into the soil and extra soil is collected in the bucket, which is released in the depressions of the field.

Curved plate

The angle and pitch of leveller is adjustable. The leveller can also angled left or right, or reversed for back filling.

Uses

It is suitable for land preparation such as scraping, grading, leveling and back filling operations. It is also used for irrigation, terrace work and general cleaning of field.

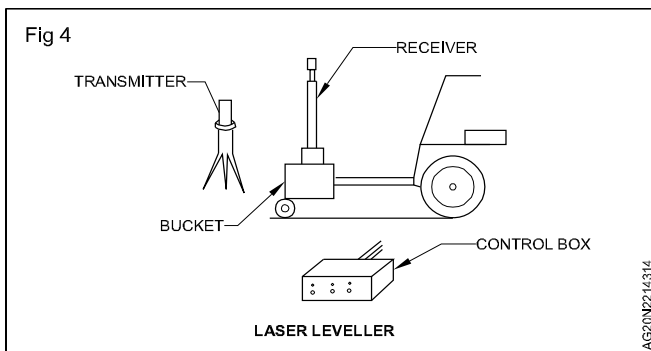
Laser leveller (Fig 4)

Laser leveling results in a much more level field.

Uses

- More level and smooth soil surface.
- More uniform distribution of water in the field.
- More uniform germination and growth of crops.
- Decreases the time to complete tasks of irrigation.
- Reduces the amount of water required for land preparations.

The laser-controlled system requires a laser transmitter, a laser receiver, an electrical control panel and a twin solenoid hydraulic control valve (Fig 4).



Hole - digger

A post hole digger is a tool designed to quickly and efficiently dig holes that are small to moderately sized for various landscaping, farming, orchard plantation and other practical applications. Post hole diggers are useful for digging multiple holes such as for fence posts for transplanting.

A manually driven post hole digger has two handles that each resemble the handle of a shovel at the end of each handle is a curved, blade - like head. A manually driven post hole digger is designed for various landscaping and home uses.

A hydraulic post hole digger (Fig 5) is designed for larger applications. Though some are free standing, there are a variety of post hole diggers and augers designed for attaching to equipment. A three-point post hole digger is an example of a hydraulically driven post hole digger or auger that attaches to a tractor.

Uses

Uses for digging holes for fence post, erection of lamp post, planting small trees and saplings, soil sampling and construction work.

Scraper

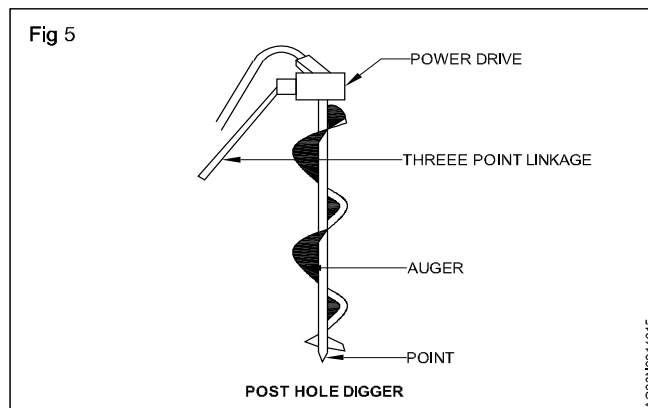
Objective: At the end of this lesson you shall be able to

- describe the construction of scraper.

Scraper (Fig 1)

This invention relates to earth working equipment and more particularly to tractor drawn scrapers of the class having a load carrying bowl with a cutting edge for directing earth into the bowl. The invention provides a multiply jointed apron assembly which may be manipulated through a variety of movements to provide for self loading, to facilitate ejection, and for other purposes.

A conventional earth moving scraper depends upon the forward motion of the vehicle to force earth from the cutting blade up into the load carrying bowl. As the contents of a partially filled bowl offers substantial resistance to the entrance of additional material it has usually been necessary

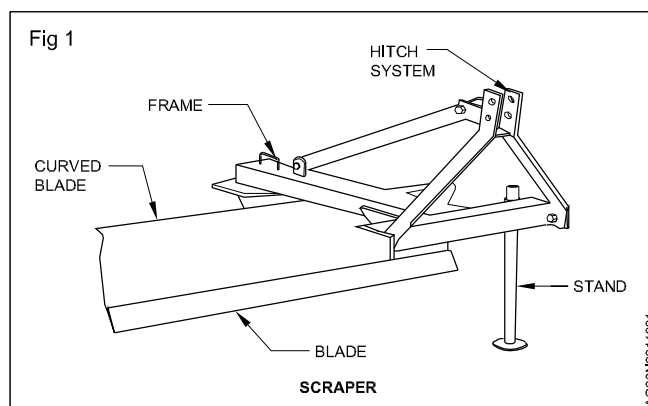
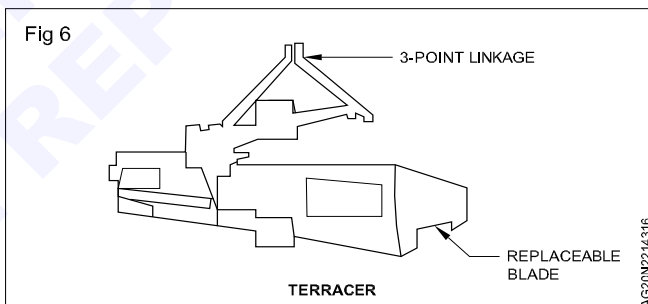


Terracer

It is attached to the tractor with the 3 - point linkage system and is hydraulically controlled (Fig 6). It consists of a replaceable blade attached to a curved steel body, a side wing and an indexing arrangement for tilting and angling of the blade. The cutting blade is made of medium carbon or alloy steel and the cutting edge is hardened and sharpened. The blade with body is also called a mould board. The mould board can be angled left or right by lifting the spring loaded latch pin and by turning the mould board. To tilt the blade for ditching or terracing the blade is tilted to the desired angle by moving the index pin.

Uses

The terracer blade is used for grading, leveling of fields, filling of depressions and smoothing of field for irrigation.



to make use of a pusher tractor, in addition to the tractor which draws the scraper, in order to completely fill the bowl so that the full load carrying capacity of the scraper is utilized. As this practice is costly and inefficient a variety of self loading scrapers have been developed.

The most commonly used form of self loading scraper is provided with a chain and flight elevator structure at the forward face of the bowl and above the cutting edge. The elevator functions to continually carry earth away from the immediate region of the cutting edge and thus lessens the resistance to entrance of additional soil into the bowl. Under many conditions, the elevator enables complete filling of the bowl without employing supplementary motive power.

However elevator equipped self loading scrapers have been found to be subject to certain operating problems of their own. The elevator limits the size of the entrance opening into the bowl and thereby prevents the loading of boulders or other objects which are larger than some specific size. Further the elevator is particularly susceptible to jamming and damage from large boulders or other similar obstructions. Certain types of soil sand soil condition seriously interfere with elevator operation. Still another

problem is encountered in that there are conditions under which the elevator will not ensure full loading of the bowl and it becomes desirable to utilize a pusher tractor as with a conventional scraper. As the elevator partially obstructs the front of the scraper bowl, push loading is inefficient. Although multiple elevator speeds can be provided, the rate at which material is forced into the bowl by push loading is difficult to coordinate with that of the elevator.

To avoid some of these problems a second general class of self loading scraper has heretofore been proposed. Instead of an elevator, such scrapers have an apron mounted at the open front of the bowl in such a manner that it may be pivoted upward and downward and maybe reciprocated in a horizontal direction. The apron may thus be made to undergo a kind of raking or hoeing motion to pull material into the bowl from the region of the blade. Scrapers of this class are not extensively used in the industry at present. This results at least in part from operational limitations of the apron manipulating mechanism as heretofore designed. The mechanism has been cumbersome while providing for only a very restricted variety of motions thereby limiting its utility for facilitating loading and preventing its use for other scraper operations.

Dumper, digger and terracer

Objective: At the end of this lesson you shall be able to

- describe the construction of dumper, digger and terracer.

Dumper (Fig 1)

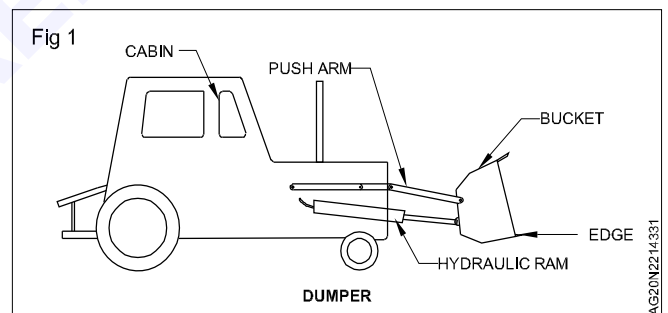
A dumper is a vehicle designed for carrying bulk material, often on building sites. Dumpers are distinguished from dump trucks by configuration a dumper is usually an open 4-wheeled vehicle with the load skip in front of the driver, while a dump truck has its cab in front of the load. The skip can tip to dump the load; this is where the name “dumper” comes from. They are normally diesel powered. A towing eye is fitted for secondary use as a site tractor.

Dumpers with rubber tracks are used in special circumstances and are popular in some countries.

Early dumpers had a payload of about a ton and were 2-wheel drive, driving on the front axle and steered at the back wheels. The single cylinder diesel engine was started by hand cranking. The steering wheel turned the back wheels, not front. Having neither electrics nor hydraulics there was not much to go wrong. The skip was secured by a catch by the driver's feet. When the catch is released, the skip tips under the weight of its contents at pivot below, and after being emptied is raised by hand.

Modern dumpers have payloads of up to 10 tonnes and usually steer by articulating at the middle of the chassis (pivot steering). They have multi-cylinder diesel engines, some turbocharged, electric start and hydraulics for tipping and steering and are more expensive to make and operate. Lifting skips are available for discharging above ground level. In the 1990s dumpers with swivel skips, which could

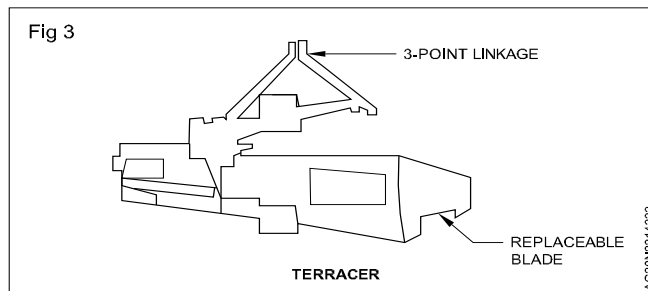
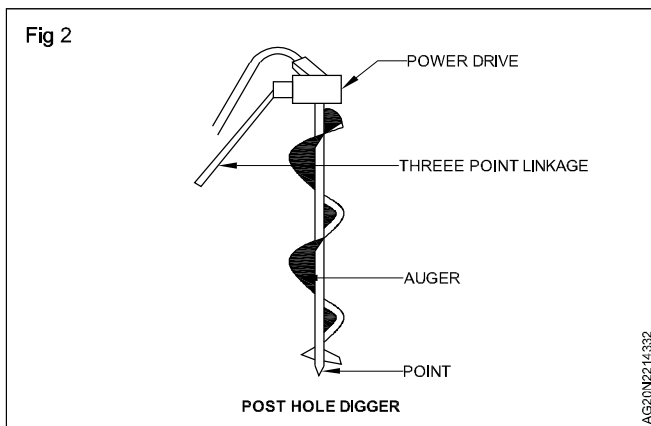
be rotated to tip sideways, became popular, especially for working in narrow sites such as road works.



Digger

A posthole digger is a tool designed to quickly and efficiently dig holes that are small to moderately sized for various landscaping, farming, orchard plantation and other practical applications. Post hole diggers are useful for digging multiple holes such as for fence posts for transplanting.

A hydraulic posthole digger (Fig 2) is designed for larger applications such as with farming. Though some are freestanding, there are a variety of posthole diggers and augers designed for attaching to equipment. A three-point post hole digger is an example of a hydraulically driven post hole digger or auger that attaches to a tractor.



Features

- 1 Easy attachment to the tractor via three point linkage
- 2 Sturdy all steel constructions
- 3 Strong and low cost implement
- 4 Ideal implement for land leveling, grading, scraping, back filling or ditching.
- 5 One man operation
- 6 Depth controlled by tractor hydraulics

Terracer (Fig 3)

Terracer blade is an ideal heavy duty implement with enough strength for scrapping, grading, leveling and back - filling. It is the most suitable implement for irrigation, terracer work and general cleaning up jobs.

Laser leveller and leveller

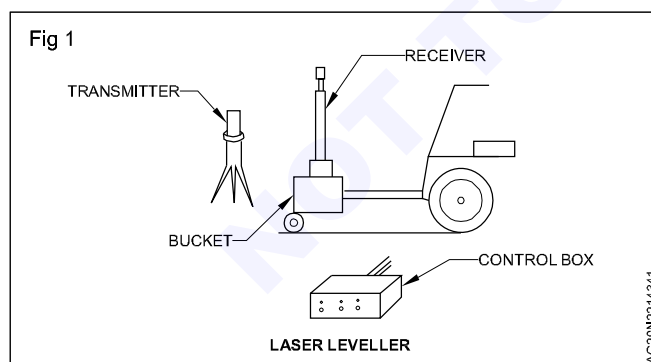
Objective : At the end of this lesson you shall be able to

- describe the construction of laser leveller and leveller.

Laser leveller

4 - wheel tractor using rear mounted tractor blades or drag buckets. 4 - wheel tractors are very effective for leveling both wet and dry fields. Wet fields are best leveled with a rear - mounted tractor blade. Dry fields are best leveled using hydraulically operated drag buckets. Tractor work rates are dependent on the tractor's capacity and the amount of soil to be moved. It takes approximately 8 hours to level 1 hectare with a rear mounted tractor blade. This reduces to about 4 hours when using a drag bucket.

4 - wheel tractor with a laser - controlled bucket. The use of laser - controlled equipment results in a much more level field - up to 50% better than leveling using other techniques (Fig 1).



The laser - controlled system requires a laser the hydraulic control valve, which will raise or lower the bucket. Some laser transmitters have the ability to operate over graded slopes ranging from 0.01% to 15% and apply dual controlled slope in the field. It has transmitter, a laser receiver, an electrical control panel and a twin solenoid hydraulic control valve. The laser transmitter transmits a

laser beam, which is intercepted by the laser receiver mounted on the leveling bucket. The control panel mounted on the tractor interprets the signal from the receiver and opens or closes.

4 - wheel tractor

A 4 - wheel tractor is required to drag the leveling bucket. The size of the tractor can vary from 30 - 500 hp depending on the time restraints and field sizes. In Asia tractors ranging in size from 30 - 100 hp have been successfully used with laser - controlled systems. It is preferable to have a 4 - wheel drive tractor than 2 - wheel drive and the higher the horsepower the faster will be the operation. Power shift transmissions in the tractor are preferred to manual shift transmissions.

Plough

The fields will require ploughing before and after land leveling. Depending on the amount of soil that must be cut it may also be necessary to plough during the leveling operation. Disc, moldboard or tine ploughs can be used.

Drag bucket

The levelling bucket can have either 3 - point linkage mounted or pulled by the tractor's drawbar. Pull type systems are preferred as it is easier to connect the tractor's hydraulic system to an external hydraulic ram than connect to the internal control system used by the 3 point - linkage system. Bucket dimensions and capacity will vary according to the available power source and field conditions. A 60 hp tractor will pull a 2m wide x 1m deep bucket in most soil types. The design specifications for the bucket should match the available power from the tractor.

Laser transmitter

The laser receiver is an omni - directional receiver that detects the position of the laser reference plane and transmits these signals to the control box. The receiver mounts on a manual or electric mast attached to the drag bucket.

Control panel

The control box accepts and processes signals from the machine mounted receiver. It displays these signals to indicate the drag bucket's position relative to the finished grade. When the control box is set to automatic, it provides electrical output for driving the hydraulic valve.

The control box mounts on the tractor within easy reach of the operator.

Hydraulic control system

The hydraulic system of the tractor is used to supply oil to raise and lower the leveling bucket. The oil supplied by the tractor's hydraulic pump is normally delivered at 2000 - 3000 psi pressure. As the hydraulic pump is a positive displacement pump and always pumping more oil than required, a pressure relief valve is needed in the system to return the excess oil to the tractor reservoir. If this relief valve is not large enough or malfunctions damage can be caused to the tractors hydraulic pump.

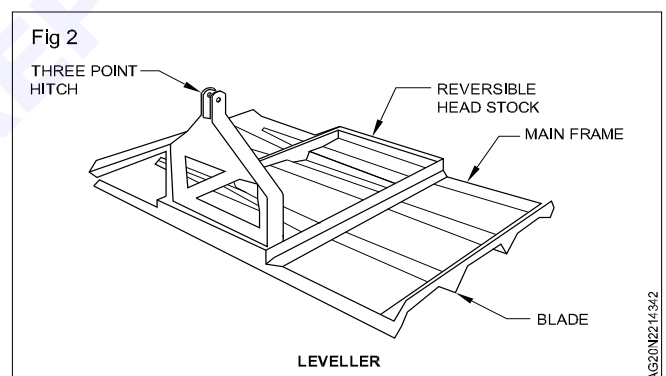
Wherever possible it is advisable to use the external remote hydraulic system of the tractor as this system has a built - in relief valve. Where the oil is delivered directly from the pump to the solenoid control valve, an in line relief valve must be fitted before the control valve. The solenoid control valve, when supplied by the laser manufacturers has a built - in relief valve. The solenoid control valve controls the flow of oil to the hydraulic ram which raises and lowers the bucket. The hydraulic ram can be connected as a single or double acting ram. When connected as a single acting ram only one oil line is connected to the ram. An air breather is placed in the other connection of the ram to avoid dust contamination on the non - working side of the ram. In this configuration the weight of the bucket is used for lowering. The desired rate at which the bucket raises and lowers will depend on the operating speed. The faster the ground speed the faster

the bucket will need to adjust. The rate at which the bucket will raise and lower is dependent on the amount of oil supplied to the delivery line. Where a remote relief valve is used before the control valve, the pressure setting on this valve will change the raise/lower speed. Laser manufacturer supplied control valves have pressure control adjustments on both the bypass relief valve and the raise and lower valves. When using a hydraulic ram, the ram should be positioned so that the ram body is connected in such a way as to push from the bucket frame rather than the depth control wheels.

Leveller

In irrigated areas land levelling is an essential operation for farming (Fig 2). Leveled fields receive uniform penetration of irrigation water with high efficiency. The possibility of water logging and soil erosion is reduced considerably. The entire leveled field becomes ready to receive timely agricultural operations like ploughing seeding and inter culturing. Smooth fields also facilitate the operation of field equipment and are very important for mechanical harvesters.

The leveller consist of frame, 3 - point linkage closed from sides to form a bucket. The scraping blade is made from medium carbon steel or low alloy steel, hardened and tempered to about 42 HRC. The blade is joined to the curved sheet with fasteners and it can be replaced after being worn out or becoming dull. The working depth of the implement is controlled by hydraulic system of the tractor.



Construction of bed former, bund maker and ditcher

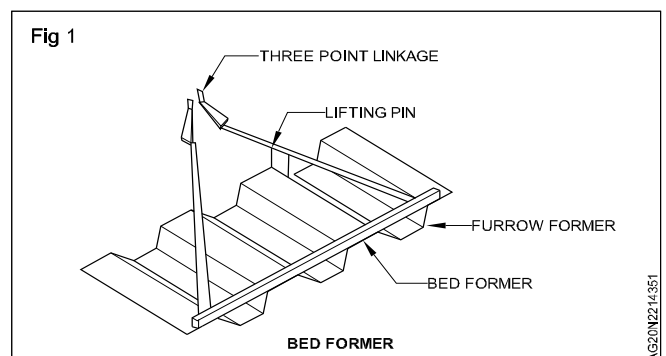
Objectives : At the end of this lesson you shall be able to

- state the construction of bed former
- state the construction of bund maker
- state the construction of ditcher.

Bed former

The tractor drawn bed - furrow former consists of mild steel angle iron frame, three point linkage, lifting pin, furrow former, bed former and stiffeners (Fig 1).

The bed and furrow formers are made of mild steel sheet and bent in required shape. The stiffeners are used to strengthen the formers. The implement is operated in the tilled soil.

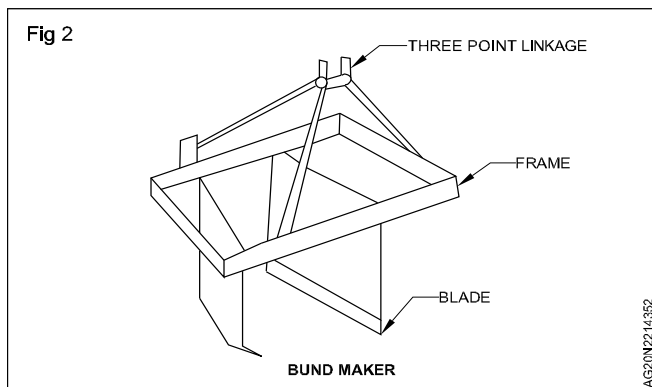


Uses

It is used for forming alternate beds and channels. The beds are suitable for planting crops like sorghum, maize, and cotton. This bed and furrow system is ideal for efficient irrigation management.

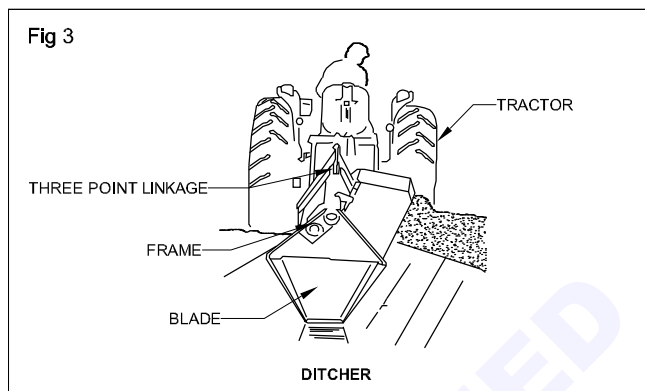
Bund maker

Consists of mild steel angle iron frame, hitch system, and two blades (wings) (Fig 2). It is used for making of bunds in the field.



Ditcher

The ditcher consists of frame, blades and three point linkage for connecting to the tractor. The blade is fitted on the frame. The frame is connected to three point linkage. The ditcher is mounted on the tractor by the three point linkage.



Adjustments, maintenance and storage of soil forming equipments

Objectives: At the end of this lesson you shall be able to

- state the adjustments of leveller
- state the adjustments of scraper
- state the adjustments of ridger
- state the adjustments of bed former
- state the adjustments of bund maker
- state the maintenance of leveller, scraper, ridger, laser leveller, bed former and bund former
- state the storage of leveller, scraper, ridger, laser leveller, bed former and bund former.

Adjustments for soil farming equipments

Leveller

Adjust the working depth of leveller using the hydraulic control lever of tractor. Repair the bend on blades by striking it using hammer till it become straight.

Scraper

Adjust the depth of scraper using the hydraulic system of tractor. Adjust the scraper angle by adjusting the left and right links of three point linkage, to get better penetration. Repair the blade if it is blended.

Ridger

Adjust the width of the ridges and the distance between them by shifting the tools on the toolbar in a lateral direction. Adjust the depth using hydraulic control of tractor. Adjust the tilt angle to determine the slope of the ridge shoulders. Add weight to ridger if desired depth is not obtained.

Bed former

Adjust the height by using the hydraulic system of tractor. Repair the blades when it is blunt or blended using hammer. Tighten all bolt and nuts using spanners.

Bund maker

Loosen the bolt on which the blades are fitted using spanners. Adjust the blade width manually. Tighten the bolt when correct position of blade is obtained. Adjust the angle of blade similar to width adjustment.

Maintenance

The maintenance of equipment is essential one. The bolt and nuts of all the equipments must be tightened before and after use. The mud sticks in the equipment and this should be cleaned with water. The lubrication to moving parts is important. The greasing points are greased using grease gun. The linkages are lubricated by oil. The blades of equipment should be checked for worn out and replaced if necessary.

Storage

The equipment must be cleaned and prevented from rust and dust while storing. Before storing, clean the equipments from mud using water. Then dry the equipment from water. Apply oil or paint the equipments.

Dry the equipment, if painted. The oil does not allow moisture on it. The paint also doesn't allow moisture and prevent rust. Finally store the equipments in a closed shed.

Checking and repairing of land shaping and development machinery

Objectives: At the end of this lesson you shall be able to

- state the check and repair of scraper
- state the check and repair of digger and dumper
- state the check and repair of terracer and laser leveller.

Scraper

The blade wears in scraper. The blade is to be checked for any wear or damage. Replace the blade if damaged and worn beyond limits.

Digger

Clean the mud from auger and check the blade. The auger may be damaged during digging. The stones in the soil damage the auger and auger point. Check the auger point for worn and sharpen it. Check the auger blade for bends and repair it.

Dumper

The buckets may be damaged by loading stones, so check the buckets for any damage and repair if necessary. Check

the hydraulic oil level and top up to correct level. Check for leaking of hydraulic oil and repair it by changing gaskets. Tighten the bolt and nuts using spanners.

Terracer

Clean the blade from mud and check for cracks. The blade is checked for any damage or bend. Repair, if there is bend, by striking with the hammer.

Laser leveller

Check the transmitter, whether it send signals. Check the receiver whether it receives the signal. Operate the controls in control box and check for its working. Check the attachment of laser leveller to tractor and tighten the bolt and nuts.

Workshop and field adjustment of land shaping and development machinery

Objectives: At the end of this lesson you shall be able to

- state the workshop and field adjustments of scraper and leveller
- describe the workshop and field adjustments of digger and dumper
- state the workshop and field adjustment of terracer and laser leveller.

Scraper

Adjust the depth of scraper using the hydraulic system of tractor. Adjust the scraper angle by adjusting the left and right links of three point linkage, to get better penetration. Repair the blade if it is blended.

Leveller

Adjust the working depth of leveller using the hydraulic system of tractor. Repair the bend on blades by striking it using hammer till it become straight.

Laser leveller

- 1 Open the tripod legs and adjust the individual positioning of the legs until the base plate is relatively level. Use the horizon as a visual guide to get the base plate level.
- 2 Attach the laser transmitter to the base plate.
- 3 If the laser is not self - leveling, adjust the individual screws on the base of the transmitter to get the bubble into the center of both circles. Most lasers will not rotate unless the transmitter is level.
- 4 Once the transmitter is level attach the receiver to the staff and activate the sound monitor.
- 5 The laser is now ready to commence recording heights.

Digger

The average operating range of the digger should be between 5" and 65" above ground level. It is recommended that the 3 - point hitch be adjusted toward the minimum required operating range, due to the fact that the greater the operating range, the less force there is available for raising the auger in difficult soil conditions . Any time an adjustment is made to the 3 - point hitch, reference should be made to the 3 - point hitch section of the tractor

operator's manual. After any adjustments, the digger should be carefully raised and lowered through its operating range and checked for interference. To change vertical limits of the digger (transport height and digging depth).

- 1 Attach front end of boom to a hole in the upper link bracket. Upper holes will lower the digger, lower holes will raise the digger.
- 2 Check tractor hydraulic system to be sure it is raising and lowering to its maximum and minimum recommended heights. Transport height and digging depth can be limited by adjusting lift control handle limit stops.
- 3 If the front end of the boom strikes some part of the tractor when digger is raised or lowered. a If at all possible, relocate or adjust the part of the tractor that is causing the interference.
- 4 If the tractor has difficulty raising the digger, decrease the lift range.
- 5 If the tractor hitch raises or lowers rapidly during hydraulic functions, refer to hydraulic adjustment section of the tractor manual.

Dumper

Adjust the bucket height by the hydraulic control lever. Adjust the push arm to rest the bucket in correct position. The adjustment is important for loading materials for dumping.

Terracer

Adjust the three point linkage to rest the blade in correct position. Tighten the bolts securely after adjusting. The terracer blade has to be replaced if there is more damage or wear.

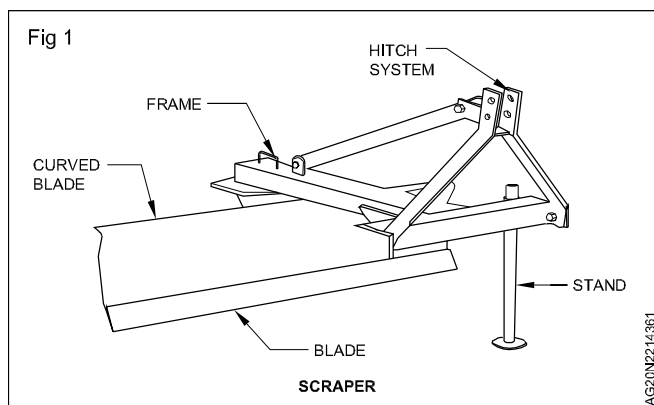
Field operation of land shaping and development machinery

Objectives: At the end of this lesson you shall be able to

- state the field operation of scraper and leveller
- state the field operation of digger and dumper
- describe the field operation of terracer laser leveller and leveller.

Scraper

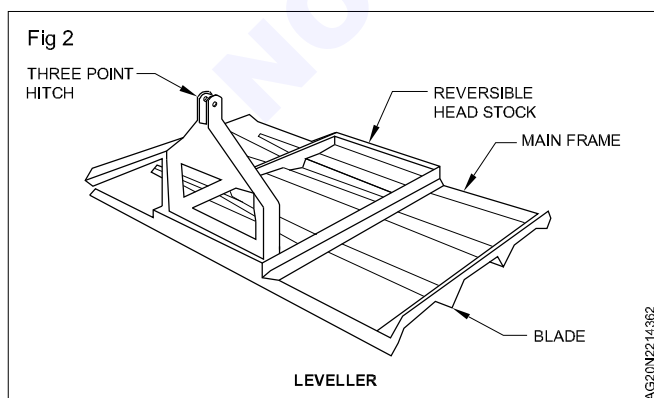
Mount the scraper on the tractor (Fig 1). Check the hydraulic control and operate the tractor. When running down grade, avoid over speeding the engine by keeping the scraper speed at, or below, the maximum speed for the transmission range engaged. As a general rule, downhill scraper speed should not exceed 5 mph more than that attained on level ground in the transmission ratio engaged.



Downhill speed can be slowed, if necessary, by lowering the scraper bowl until the cutting edge drags enough to slow the scraper to the required speed to permit proper downshifting or stopping.

Leveller

The scraper working is controlled by the hydraulic arrangement. The blade is made of alloy steel and has self-sharpening tungsten carbide cutting edge. For operation, the scraper is attached to the tractor, hydraulic system connected and apron is raised. With the forward movement of the tractor, the blade penetration to the soil and fill bucket bowl gets filled. The apron is closed after the bucket is filled and the scraper is moved to the point of unloading. For unloading, the bucket is tilted hydraulically (Fig 2).



Laser leveller

The laser transmitter transmits a laser beam, which is intercepted by the laser receiver mounted on the leveling bucket. The control panel mounted on the tractor interprets the signal from the receiver and opens or closes the hydraulic control valve, which will raise or lower the bucket. The tractor is driven by a person the control of leveller is fully automated by laser.

Some laser transmitters have the ability to operate over graded slopes ranging from 0.01% to 15% and apply dual controlled slope in the field.

Levelling the field

The laser-controlled bucket should be positioned at a point that represents the mean height of the field.

- The cutting blade should be set slightly above ground level (1 - 2 cm).
- The tractor should be driven in a circular direction from the high areas to the lower areas in the field.
- To maximize working efficiency, as soon as the bucket is near filled with soil the operator should turn and drive towards the lower area. Similarly as soon as the bucket is near empty the tractor should be turned and driven back to the higher areas.
- When the whole field has been covered in this circular manner, the tractor and bucket should then do a final leveling pass in long runs from the high end of the field to the lower end.
- The field should then be re-surveyed to make sure that the desired level of precision has been attained.
- In wet areas where there is poor traction or a chance of bogging the tractor, care needs to be taken to fill the wet areas from the effected edge in a circular motion.
- If the fields are ploughed in lands and leveling undertaken in the areas of soil settlement in the second year, the fields should not require further major leveling works for at least 8 years.
- Maintain or repair levellers.

Digger

With your digger correctly assembled and attached to the tractor, engage the tractor PTO at idling speed to give the digger a test run. Then disengage tractor PTO. Place the auger at a vertical position at the desired location of the first hole. Set tractor brake to hold the tractor at the correct position and to prevent damage to the digger. Make sure gloves are on; eye protection is in place, and that nobody is within twenty-five feet (25') of the operation. Engage

PTO with the engine at a little more than idle (this speed will depend on soil conditions and experience will help determine proper speed). Slowly lower digger to the ground. After the auger goes a foot or so into the ground, raise auger almost out of the hole, this allows the auger to clean itself of loose soil. Then drill deeper and raise the auger again. Repeat this procedure until the desired hole depth is reached. Do not raise digger too high with PTO running, as it will damage the PTO shaft. When desired hole depth is reached, disengage PTO and raise auger from the hole. For tractors that require PTO engagement to produce lifting power, allow auger to turn at idle while raising it from the hole.

If shear bolt breaks

- Shut - off tractor engine and allow PTO shaft to come to a complete stop.
- Remove broken shear bolt
- Install new shear bolt, then tighten the shear bolt nut securely.

If auger becomes lodged on an obstruction underground, shut - off PTO and tractor engine. Turn the auger several revolutions in reverse. Never attempt to use hydraulic lift of tractor to dislodge auger.

Dumper

Start the engine and drive dumper to the field. Lift the dump material using control lever. Move the dumper and dump the material in other place. Repeat this process until all the material is dumped in other place.

Terracer

The terracer is attached to the three point linkage of the tractor. Then check the working of hydraulic system by lifting the terracer and lowering the terracer using hydraulic control valve. Move the tractor to the field. Drive the tractor on field by lowering the terracer to desired depth. Repeat this operation for the entire field.

Care and maintenance of land shaping and development machinery

Objectives: At the end of this lesson you shall be able to

- **state the care and maintenance of digger**
 - **trouble shooting of laser leveller**
 - **describe the care and maintenance of terracer and scraper**
 - **state the storage of land shaping machinery.**
-

Digger

Always perform maintenance operations such as lubrication, adjustments or repairs on the post hole digger with the tractor engine off, the PTO drive disengaged and the auger point resting on the ground. Always use the correct shear bolt (grade 5). Never use or replace the shear bolt with one that is longer than the one specified in the manual (3/8" x 3").

Periodically inspect all moving parts for wear and replace when necessary with authorized service parts. Look for loose fasteners, worn or broken parts, and leaky or loose fittings. Serious injury may occur from not maintaining this machine in good working order.

Safety measures

- Guards and safety shields are for your protection. Do not operate equipment unless they are in place.
- Always operate tracer PTO (Power Take - Off) at recommended RPM (Revolutions Per Minute).
- Disengage tractor PTO and shift into neutral before attempting to start engine.
- Read and observe all safety decals on the tractor and digger.
- Never allow anyone within 25' of machine while it is in operation.
- Do not stop or start suddenly when going uphill or downhill. Avoid operation on steep slopes. Be alert for

holes in terrain and other hidden hazards. Always drive slowly over rough ground.

- Reduce speed on slopes and in sharp turns to prevent tipping or loss of control. Be careful when changing direction on slopes.
- Stop digger and tractor immediately upon striking an obstruction. Turn off engine, inspect digger, and repair any damage before resuming operation.
- Disengage power to digger and stop engine before is mounting from tractor, before making any repairs or adjustments, transporting, or unclogging digger.
- Take all possible precautions when leaving tractor unattended: Disengage PTO, lower digger, shift into neutral, set parking brake, stop engine and remove key from ignition.
- Front tractor weights or front tire ballast should be used to enhance front end stability on small tractors.
- Check to make sure PTO is properly connected and that the driveline is correct to prevent bottoming out pulling apart during the full lift range of the hitch.
- This implement is designed for a one - man operation. It is the responsibility of the tractor operator to see that no one is in the proximity of the implement when it is started. Do not operate the implement with another person within 25' of the implement, PTO drive.

Laser leveller

Trouble shooting

Problem	Cause/solution
Bucket will not raise or lower	1. Check the transmitter is working 2. Check hydraulic connections 3. Check electric connections on solenoid 4. Check pressure relief valve setting on control valve 5. Check for contamination in oil lines
Bucket doesn't respond in certain parts of field	1. Line of vision between transmitter and receiver blocked 2. Receiver the same height as tractor cabin 3. Laser beam above or below the receiver height
Bucket will only move in one direction	1. Check hydraulic connections 2. Check electric connections on solenoid 3. Check pressure relief valve setting on control valve 4. Check for contamination in oil lines
Bucket raises and falls automatically	1. Check line of vision 2. Check electronic connections on solenoid 3. Check oil level in tractor hydraulic system
Field uneven	1. Traveling too quickly 2. Raise and fall speed too slow
Field not level or slopes the wrong way	1. Check the levelness/calibration of the transmitter 2. Soil too compacted for bucket to cut
Soil not flowing out of the bucket	1. Soil too wet 2. Too much foreign matter in soil
Soil not flowing into the bucket	1. Too much crop/weed residue on surface 2. Soil too compacted or auger

Terracer

All the bolts and nuts are periodically checked for loose and tighten them frequently if it is needed. The shaft pins can be checked for excessive wear and replaced. The parts can be painted, if paints are scratched to prevent rust. Clean and store under cover in a clean place.

Scraper

The maintenance of equipment is essential one. The bolt and nuts of all the equipments must be tightened before and after use. The mud sticks in the equipment and this should be cleaned with water. The lubricated to moving

parts is important. The greasing points are greased using grease gun. The linkages are lubricated by oil. The blades of equipment should be checked for worn out and replaced if necessary.

Storage of land shaping machinery

The equipment must be cleaned and prevented from rust and dust while storing. Before storing, clean the equipments from mud using water. Then dry the equipment from water. Apply oil or paint the equipments. Dry the equipment, if painted. The oil does not allow moisture on it. The paint also doesn't allow moisture and prevent rust. Finally store the equipments in a closed shed.

Operations of leveller, scraper, ridger and laser leveller

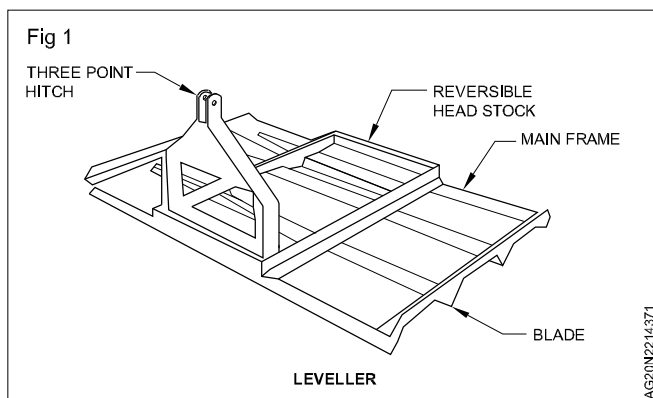
Objectives: At the end of this lesson you shall be able to

- describe the operations of leveller
- explain the operations of scraper
- state the operations of ridger
- describe the operations of laser leveller.

Leveller (Fig 1)

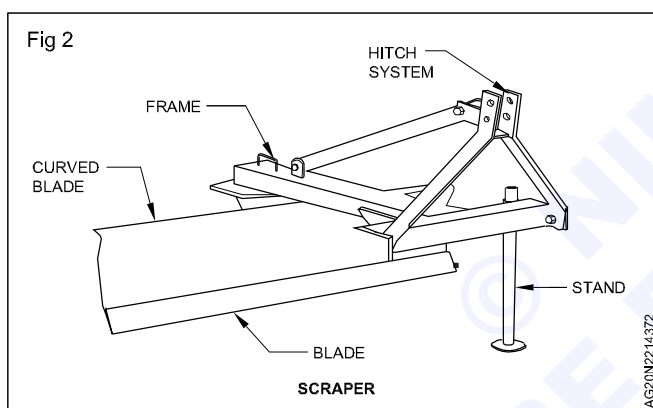
The leveller working is controlled by the hydraulic arrangement. The blade is made of alloy steel and has self-sharpening tungsten carbide cutting edge. For operation, the leveller is attached to the tractor, hydraulic system connected and apron is raised. With the forward movement

of the tractor, the blade penetration to the soil and fill bucket bowl gets filled. The apron is closed after the bucket is filled and the scraper is moved to the point of unloading. For unloading, the bucket is tilted hydraulically.



Scraper (Fig 2)

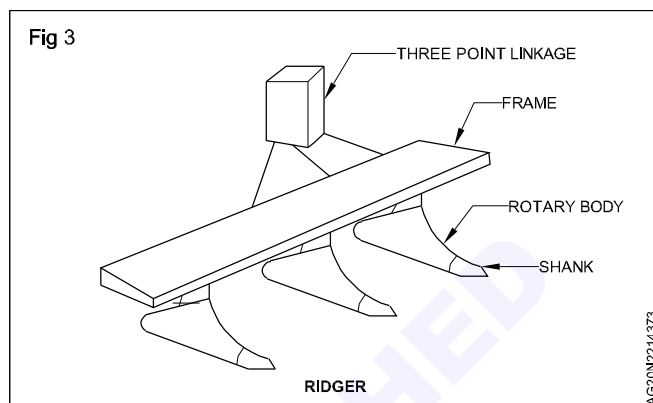
Mount the scraper on the tractor. Check the hydraulic control and operate the tractor. When running downgrade, avoid over speeding the engine by keeping the scraper speed at, or below, the maximum speed for the transmission range engaged. As a general rule, downhill scraper speed should not exceed 5 mph more than that attained on level ground in the transmission ratio engaged. Downhill speed can be slowed, if necessary, by lowering the scraper bowl until the cutting edge drags enough to slow the scraper to the required speed to permit proper downshifting or stopping.



Ridger (Fig 3)

The ridger body consists of two moldboards, share, point and tie bars to vary the wingspan of ridgers. The share point is made from medium carbon steel or low alloy steel, point is made from medium carbon steel or low alloy steel,

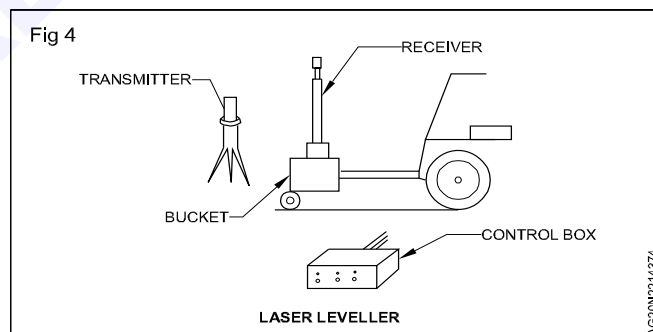
hardened and tempered. Upon wearing or becoming dull the share point can be replaced. The ridger is operated in tilled soil by a tractor, the share point penetrates in the soil, ridger body displaces the soil to both sides and a furrow is created. The soil mass between furrows forms a ridge. The depth of operation is controlled by hydraulic system of the tractor. Mount the ridger in tractor and operate the tractor.



The ridge is formed while driving the tractor. The depth can be adjusted by the hydraulic control valve.

Laser leveller (Fig 4)

The laser transmitter transmits a laser beam, which is intercepted by the laser receiver mounted on the leveling bucket. The control panel mounted on the tractor interprets the signal from the receiver and opens or closes the hydraulic control valve, which will raise or lower the bucket. The tractor is driven by a person the control of leveller is fully automated by laser.



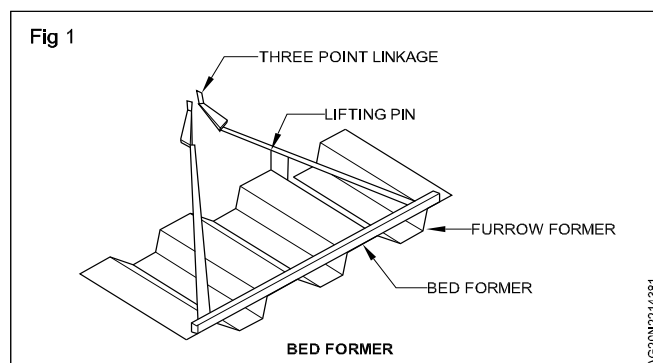
Operation of bed former and bund maker

Objectives: At the end of this lesson you shall be able to

- state the operations of bed former
- state the operations of bund maker.

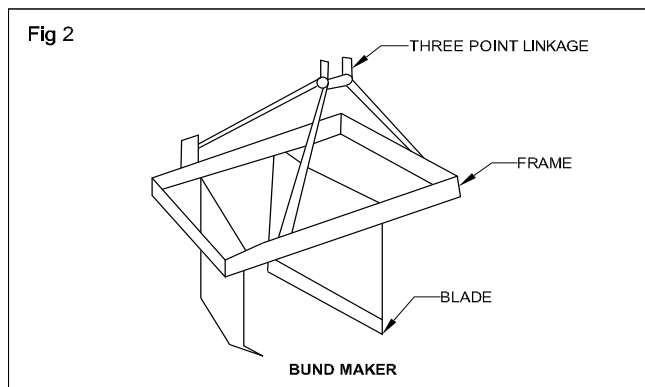
Bed former (Fig 1)

Mount the bed former in the tractor's three point linkage using spanners. Drive the tractor to the field. Use hydraulic lever to lower the bed former. Drive the tractor to form the bed. The number of beds and shape of beds depends upon the bed former used. Add weight to bed former if the bed is formed irregularly. The soil should be free from stones and roots for proper bed formation. Raise the bed former after operation using hydraulic lever.



Bund maker (Fig 2)

Mount the bund maker with the three point linkage of the tractor by using spanners. Check the tightening of bolt and nuts. Drive the tractor to the field. Lower the hydraulic lever and drive the tractor for bund formation. Adjust the depth using hydraulic control lever. Operate the tractor in field where the bund is to be made. The bund is formed and the soil is placed on the bund.



Operation of ditcher

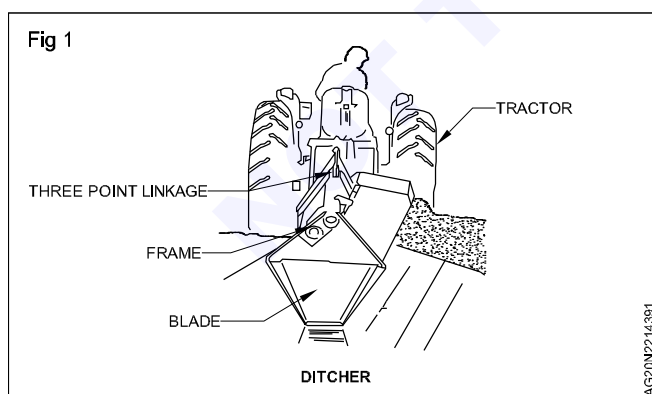
Objectives: At the end of this lesson you shall be able to

- describe the attachment of ditcher to tractor
- describe the operation of ditcher.

Attaching ditcher to the tractor

Remove the tow bar. Verify that the external chains of the tractor jack arm have been loosened. They must never be taut while the ditcher is in operating. Carefully check the decal on the ditcher to be sure that the speed of the PTO on the tractor matches that of the ditcher being used. Release the two sector - arms of the ditcher by pulling the pin from the coupling sector. Connect the tractor jack arms to the ditcher sector arms using the coupling draw bolts verify that the safety cotter pins in the coupling draw bolts are inserted properly. Raise the tractor jack arms so that the pins will fit into the lower first hole on the coupling sector, and then insert the safety cotter pins. Raise the tractor jack arms until the support feet are 4 - 5 inches off the ground. Remove the lock - pins, sliding the support feet down and reset them in transport position. Lower the jack arms connect the chain using the 3rd point fork of the tractor. Verify that the safety device is hooked up on the coupling.

Operation of ditcher (Fig 1)



Verify that the work area is not freely accessible to unauthorized personal, warn all working involved in other activities within the same area of the danger involved in the operation you are about to carry out, indicate the safety distance that must be observed at all times throughout the entire operation.

Have special personal on hand with red flags if the area is freely accessible to people because it is a public area or near roadway or houses. These workers must give timely warning to anyone approaching the area and keep them away. Otherwise they must sign the operator to warn him that work must stop until hazard is no longer present.

Before beginning to excavate a new ditch, it is advisable to stake some reference poles to help the operator move in the right direction. Regulate the adjustable guarding on the ditcher. Based on work required you can regulate the guarding so that the excavated dirt will be spread over a wide work radius or so that it will pile up along the ditch.

Turn off the engine and remove the ignition key before connecting the cardan shaft. Connect the cardan to the ditcher PTO first, and then to the PTO of the tractor. Make sure it is locked perfectly in place on the PTO shafts, and check to be sure that all the guarding on the cardan drive is in place and working properly. Lower the ditcher so it is resting on the ground make sure that the rotors are not touching the ground. Then move the tractor to dig a new ditch. After operation lift the ditcher using hydraulic control lever.

Adjustments, maintenance and storage of ditcher

Objectives: At the end of this lesson you shall be able to

- state the adjustments of ditcher
 - describe the maintenance of ditcher
 - describe the storage of ditcher
 - state the types of trenchers and uses.
-

Precautions

Start the tractor up with the gear and PTO disengaged.

Never approach the machine for any reason, even if it is jacked up and off the ground, unless the PTO has been end is connected the engine is off, the key removed from tractor.

Before starting work operations, verify that the guarding on the drive shaft and PTO of the tractor is in place and working efficiently.

Any damaged or missing components must be replaced and or installed correctly.

Before proceeding with any adjustments, inspections or maintenance work, disconnect the shaft from the PTO on tractor.

When the machine is put away after the work has been completed, block the rotors so that no one will be injured by trying to turn them.

Adjustments

Adjust one of the two lower lift arms up or down to level the powered ditcher from left to right and then adjust the length of the top center link to tilt the front of the ditcher down 2 to 5 degrees. Tighten all bolt and nuts using spanners before operation. Adjust the guards on machine so that no material falls on road. The depth can be adjusted by using hydraulic control lever.

Maintenance of ditcher

Check the oil level in the sight glass cap, every day before work operations. Check the rotor locknut to be sure it is tightened securely. Check the blades and teeth for wear.

Safety before start of the tractor

Objectives: At the end of this lesson you shall be able to

- practice the tractor for safety before start.
-

Step - by - step guide

Follow the step-by-step guide to tractor safety who uses a tractor, or tractor-operator .

Before starting

Check a tractor for the basic safety and safe stop, before start.

Safety checks

- 1 Wear suitable clothing and footwear
- 2 Read and understood the instruction manual

If they are overly worn, replace them immediately. Lubrication should be performed regularly to avoid serious damage to the transmission unit.

Change oil in the gear box unit and the transmission, after the first 30 hours of operation. Let all the oil out through the drain caps on the unit and transmission box. Pore about 1.5 liters of diesel oil through the inlet cap and allow the unit to run slowly for about 10 minutes open the drain cap again and drain out the diesel oil. Then pour new oil and close the cap after pouring. Use recommended oil mentioned in user manual.

Storage of ditcher

After operation the ditcher should be cleaned and prevented from rust formation during storage. Clean the ditcher from mud using water. Cover the PTO shaft with a layer of grease to prevent rust. Dry the equipment from water. Apply oil or paint to the ditcher. Dry the equipment, if painted. Cover the cleaned and lubricated machine completely. Store the ditcher in a shed.

Types of Trenchers

Trench digger, disc trenches, wheel trencher portable trencher, vernier trencher, chain saw machine trencher, stone cutting, block cutter, excavator.

Uses

Laying pipe and cable lines in frozen soil, harden soil, making tunnels, block cutter, excavator and etc.,

Need to carry out pre-start checks of the machinery

Do I know enough to work safely?

Safe stop

- 1 Make sure the handbrake is fully applied.
- 2 Make sure all controls and equipment are left safe.
- 3 Stop the engine.
- 4 Remove the key.
- 5 Use safe stop.

Before leaving your seat; or

When anyone else approaches; or

When anyone else is working on the machine

- 6 Take extra precautions when safe stop is not possible, when using slurry tankers or external controls.

Key points

- 1 Don't use a machine unless you are trained and know how to use it safely.
- 2 Don't use a machine unless it is properly maintained.

- 3 Keep away from moving machinery-remember that some machine components will continue to rotate or move even after the engine has stopped.
- 4 Wear footwear with a good grip and safety boots.
- 5 Wear clothes which will not snag on machinery – preferably overalls.
- 6 Keep long hair tied back.
- 7 Remove any jewellery which might snag.

Don't forget watches and rings

- 8 Find and read the operator's manual-keep it handy.

Safety, check and adjustments of the tractor in Position and Under Power

Objectives: At the end of this lesson you shall be able to

- practice the tractor for safety and adjustments in position and before driving
- check and adjust the brake and steering of the tractor Under Power.

Getting in and out

- 1 Use access steps and hand holds.

Don't jump from the cab.

- 2 Use the nearside cab doors whenever you can.
- 3 Keep floors, doors, pedals and your boots clean and mud - free.

Do not keep tools, drawbar pins or top links on the cab floor.

- 4 Follow safe stop, before leaving the seat.
- 5 Get out facing inwards so that you have a good grip.

Never get on or off a moving tractor.

Visibility and seat adjustment

- 1 Ensure the tractor is in safe stop, before carrying out adjustments.
- 2 Check the seat position that you can operate all controls comfortably.
- 3 Adjust the seat suspension to your weight.
- 4 Make sure mirrors are properly adjusted. When wearing a seat belt, double checks that you can still see clearly.
- 5 Make sure mirrors and windows are clean and give full visibility.

Seat belts

- 1 Wear a seat belt when driving on slopes, silage clamps, working on ditch sides and when on public roads.

A seat belt will prevent you being thrown out of the cab in an overturn or road accident, where you are most likely to be killed or injured.

Controls

- 1 Look in the operator's manual to find out what each control does.

- 2 Make sure that you know how the controls are operated.

Never use any control unless you are correctly seated in the cab.

- 3 Know where the controls should be before you start the tractor.

Don't forget that different tractors have different controls.

Never use a machine that you have not been taught how to use.

External controls

- 1 Look in the operator's manual to find out where to stand when using external controls.
- 2 Use external controls to hitch equipment in accordance with the operator's manual.

Do not place any part of your body in between the tractor and any mounted implement when operating these controls.

Check and adjustments Under Power

- 1 Make sure you understand the controls before you operate the tractor.
- 2 Check whether independent brakes are locked together. They should always be locked together for road and transport use.
- 3 Make sure no one else is near before you start the engine.
- 4 Check that no one is in danger before you move.
- 5 Check that the brakes and steering operate correctly.
- 6 Make sure you know what each control does.

Never drive a tractor or other machinery unless you have been trained to do so.

Hitching the machineries and implements to tractor

Objective: At the end of this lesson you shall be able to

- practice on hitching the machineries and implements to the tractor 3-point linkage.

Attaching implements to 3-point hitch

- 1 Check the implement to be hitched.
- 2 Move drawbar ahead or remove it, if necessary.
- 3 Check for any other potential interference.
- 4 Back tractor up to implement so hitch points align.
- 5 Place transmission in neutral, stop the engine and engage brakes before leaving the tractor seat.
- 6 Slip draft links over implement hitch pins, and retain with quick-lock pins.

Locking pins can be stored on draft links (through holes in sway chain ears) when not in use.

- 7 Remove center-link from transport hook, lift center link locking clip, and rotate tab to rear to center link clip.
- 8 Attach center link to implement top mast.
- 9 Adjust center link and lift links as necessary.
- 10 Use rockshaft position control lever, lower and raise implements slowly and check for any point of interference.

Avoid body injury or machine damage whenever an implement, implement quick coupler, or other attachment is connected to the tractor 3-point hitch and check full range of operation for interference, binding or PTO separation.

Driving the tractor

Objectives: At the end of this lesson you shall be able to

- check the tractor for brakes, steering and other controls before starting the engine
- check the different controls, fuel and warming up the engine
- drive tractor on road to apply brake and stopping the tractor and engine
- overturn the tractor and turn on slopes
- perform the turning of tractor with rear mounted equipment on slope
- drive the tractor with raised load on the front end.

Before starting the engine

- 1 Check fuel gauge to be sure tractor has plenty of fuel.
- 2 Place gear shift lever in "NEUTRAL" or PARK and range shift lever in "NEUTRAL" position.
- 3 Place rockshaft control levers in lower position.
- 4 Check indicator lights. Indicators should illuminate when key switch is turned to the 'ON' position.

Starting the Engine

- 1 Push hand throttle forward off idle position (approximately 1/3 of full throttle).

Engine may not start with throttle pulled completely down.

- 2 Depress clutch pedal and turnkey switch fully clockwise to engage starter.
- 3 Release key when engine starts.
- 4 Wait until starter and engine stop turning before trying again, if key is released before engine starts.

Check engine indicators and gauges.

Check oil pressure indicator.

- 1 Check whether oil pressure indicator will light if engine oil pressure is low.

Indicator should light when key is turned to engage starter and go out when engine starts.

Check charging system indicator

- 1 Check whether charging system indicator will light when alternator output is low.

Indicator should light when key is turned to engage starter, and go out when engine starts.

- 2 Stop engine and check for causes, if indicator stays lit for longer than five seconds in normal operation.
- 3 Check whether the fan belts are broken or loose.

Check coolant temperature gauge

- 1 Check whether needle on the temperature gauge rises as engine warms up.

If needle reaches red zone, stop engine and determine the causes.

- 2 Check coolant level in radiator when engine cools.
- 3 Check grille, radiator and radiator side screens for plugging.
- 4 Check fan belt tension.

Watch fuel level

- 1 Stop to refuel before gauge reaches empty mark.

Should tractor run out of fuel and not start in several tries, air must be bled from fuel system.

Changing engine speeds

- 1 Push hand throttle forward, to increase the speed.
- 2 Increase the engine speed temporarily above hand throttle setting, depress foot throttle.

Engine should have kept at idling for 30 sec before the rpm is increased, this should be strictly followed otherwise sudden acceleration may damage the turbocharger.

Warming up the engine.

Do not place tractor under full load until it is properly warmed up.

- 1 Keep the engine idle at about 1200 rpm for 1 to 2 minutes (2 to 4 minutes in cold washer).
- 2 Run engine at about 1900 rpm and under light load until engine reaches normal operation condition.

Driving on public roads

- 1 Apply brake pedals together using brake locking bar.

Avoid hard applications of brakes.

- 2 Reduce speed if towed load weight more than the tractor and is not equipped with brakes.
- 3 Use additional caution when transporting towed loads under adverse surface conditions and when turning or braking on inclines.
- 4 Be sure wheel tread is adjusted wide to provide maximum stability.
- 5 Check local laws and regulations for lighting requirements.
- 6 Be sure turn signal lights and tail lights are clean and visible.
- 7 Turn light switch to position.
- 8 Turn light switch to dim lights position always when meeting another vehicle.

Never use flood lamps or any other lights which could blind or confuse other drivers.

- 9 Use turn signal when turning. Be sure to return lever to center position after turning.
- 10 Drive slowly enough to maintain safe control at all times.
- 11 Shift to gear low enough to control speed without using brakes, before descending a hill.
- 12 Slow down for rough ground, and sharp turns, especially when transporting heavy, rear mounted equipment.

Operating transmission

- 1 Use range and speed shift levers in different combinations.
- 2 Keep range shift in neutral for the engine to be started.

Shift transmission

- 1 Depress clutch pedal and stop tractor before shifting either range shift lever or gear shift lever.
- 2 Release clutch pedal to take up load smoothly.
- 3 Use a higher gear and lower engine speed, for light load operation.

Using brakes

- 1 Use individual brakes to assist in making sharp turns.
- 2 Disengage brake pedal locking bar and depress only one brake pedal.
- 3 Reduce speed towed load is not equipped with brakes and weighs more than the tractor.
- 4 Avoid hard braking applications.
- 5 Use additional caution when transporting towed loads under adverse conditions, when turning or stopping on inclines.

Stopping tractor

- 1 Stop the tractor and place gear shift lever in park position.
- 2 Apply brakes.
- 3 Lower all equipment to ground using rockshaft control levers.
- 4 Pull hand throttle down to slow idle position.
- 5 Allow engine to idle for one to two minutes.
- 6 Turnkey switch to off position.

Stopping the engine

- 1 Pull hand throttle down to slow idle position.
- 2 Allow engine to idle for one to two minutes.
- 3 Put gear shift lever in 'PARK' position.
- 4 Turnkey switch to the "OFF" position.

Prevent unexpected movement of rockshaft by placing draft sensing lever in the forward or OFF position before attaching implement to hitch.

Overturning

- 1 Know and recognize the dangers of slopes.

A tractor can overturn anywhere - on silage clamps, near field drains and even on the flat. Most overturns happen on slopes.

- 2 Do not drive on slopes until you are properly trained.

Accidents happen because drivers misjudge slopes ignore changing ground conditions and forget the effect of loads on stability.

Key points

- 1 Remember, overturning can happen on flat ground as well as on slopes.

- 2 Remember, although a tractor can be driven up a slope with a hard surface, it cannot necessarily come down the same slope safely.
- 3 Couple and use trailer and trailed equipment brakes.
- 4 Use seat belts if they are fitted, if they are not, get them fitted. You are at risk even if you have a cab.
- 5 Make sure a safety cab is fitted - or a roll frame on older tractors (in which case a seat belt must be fitted and used.)

If in doubt, walk the ground before driving over it to check for hollows, hidden logs, tree stumps, rock outcrops, rabbit holes etc.

- 6 Get yourself trained in slope safety.

A safe working system

- 1 **Always plan work in advances so that the work methods are safe at all stages.**
- 2 **Drive slowly where the ground surface is not easily seen, e.g in long grass bracken etc.**
- 3 **Ensure you use a large enough tractor for the machine or trailer you are using, taking account of the weight of the machine, trailer and any load.**

Driving across and turning on slopes.

- 1 Descend straight down the gentlest possible gradient of a slope, rather than driving diagonally across it.
- 2 Avoid working across slopes if your tractor has large diameter, tubeless, low-ground pressure tyres.
- 3 Avoid turning down a slope - this is especially hazardous.
- 4 Plan work across slopes so that turns are made uphill rather than downhill.

- 5 Use the widest practicable wheel track setting to reduce the likelihood of the tractor overturning.

Turning with rear-mounted equipment on a slope

- 1 Add enough front ballast to counterbalance rear-mounted equipment, particularly when working on slopes. But remember, using such ballast by reduce safety when travelling downhill.
- 2 Remember when using rear-mounted fertilizer spreaders or sprays, the tractor rear-wheel grip reduces as the load is discharged.
- 3 Remember the steady weight reduction reduces traction and increases the possibility of sliding, especially when coming down the slopes.
- 4 Keep mounted equipment as low as possible.

The higher the mounted equipment is on the tractor rear linkage, the less stable the tractor becomes.

- 5 Select the correct gear for the ground condition and turn slowly, so that the tractor is under complete control during the manoeuvre.
- 6 Do not turn downhill on a slope.
- 7 Use a three-point turn on sharp corners.
- 8 Take extra care with offset-mounted machines. Turn slowly with the offset load on the upslope.

Tractor with raised load on the front end

- 1 Ensure enough ballast weight is fitted to the rear.
- 2 Make sure the loader is not overloaded (consult the manufacturer's handbook).

Whenever possible lower the loader for travel.

- 3 Do not drive at speed, make abrupt turns, or suddenly stop with the loader raised.
- 4 Plan fore-end loader work to minimize travel with the loader raised.

Safety for other people

Objectives: At the end of this lesson you shall be able to

- **check for nearby people and objects for safe driving.**

If you are an operator

- 1 Check for bystanders before starting tractors or machines.
- 2 Check where assistants are working and make sure you can see them.
- 3 Agree a way to work safely and make sure everyone follows it.
- 4 Communicate clearly and make sure instructions can be heard and understood.
- 5 Carry someone else, if a proper passenger seat is fitted.
- 6 Use the horn to warn assistants that you are going to start.

If you are helping a tractor operator.

- 1 Agree a way to work safely and follow it.

If you are using hand signals, agree their meaning beforehand.

- 2 Make sure the tractor operator can see you.

Never stand in the line of travel of a tractor or machine.

- 3 Find out the safe places to work or stand when near machines.
- 4 Listen to and follow instructions.
- 5 Do not operate any external controls unless you have been instructed to do so.

If children could be present

- 1 Don't allow them to ride on a tractor – member it is illegal to have a child under 13 years old as a passenger.
- 2 Keep them away from working tractors.
- 3 Engage safe stop.
- 4 Be aware of places where children may be.

If you see any children, stop work and make sure they move to a safe place.

PTO shafts

- 1 Follow safe stop whenever possible - it makes sure nothing will move.
- 2 Take extra care when using a PTO driven machine.
- 3 Ensure guards are in place - check they are properly chained, lubricated and free from defects.
- 4 Report any faults immediately.

Do not use a machine with a damaged PTO shaft guard.

- 5 Ensure the tractor is chocked or that there is a mechanical connection between the tractor and a stationary PTO - driven machine to ensure the tractor or machine does not move, causing the PTO shaft to separate.

Trailers

- 1 Use tractors and trailers without an adequate braking system which led to loss of control, jackknifing and tractor-overturning incidents.
- 2 Stop the tractors and trailers used on or off the road safely within a reasonable distance under all conditions.

Inadequate trailer brakes can lead to accidents

When maneuvering on slopes or slippery surfaces, as the tractor may be pushed sideways and slide out of control.

If trailer brakes are inadequate the tractor braking system can be subjected to excessive wear.

- 3 Safe towing requires the use of a large enough tractor and selecting the most suitable gear to stop the combination within a safe distance.
- 4 Make sure you buy trailers that have a suitable braking system to match your tractor and ask the supplier for brake efficiency information.
- 5 Fail safe trailer braking provides emergency brakes if the tractor stalls.

Seed drill and their types

Objectives: At the end of this lesson you shall be able to

- describe the types of seed drill and their uses
- describe the components and uses of zero till drill and strip till drill.

Seed drill

Seed drill is used for sowing seeds of small sizes viz. wheat, gram, etc. and must be capable of placing the seed at a depth where optimum soil temperature and moisture are available for germination. A good seed drill must be able to ensure metering of correct and uniform amount of seed rate at a precise depth without causing any damage to it. Now a days the seed drill have additional feature of fertilizer attachment also which ensures placement of fertilizer at a proper place along with seed.

Functions of seed drills

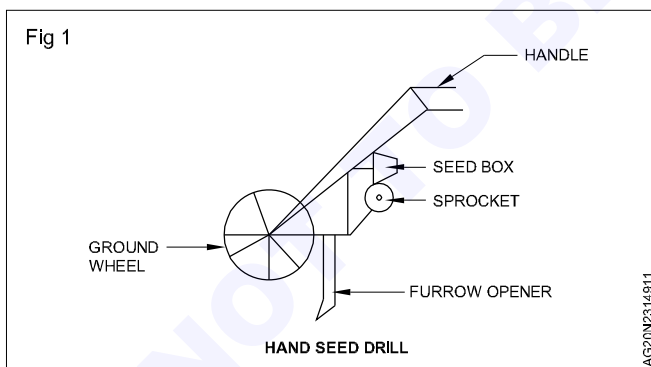
- It opens furrows to a uniform depth.
- It drops seeds uniformly without injury.
- It covers the seeds and compacts the soil around them.

Various types of seed drill

Five types of seed drill are described below.

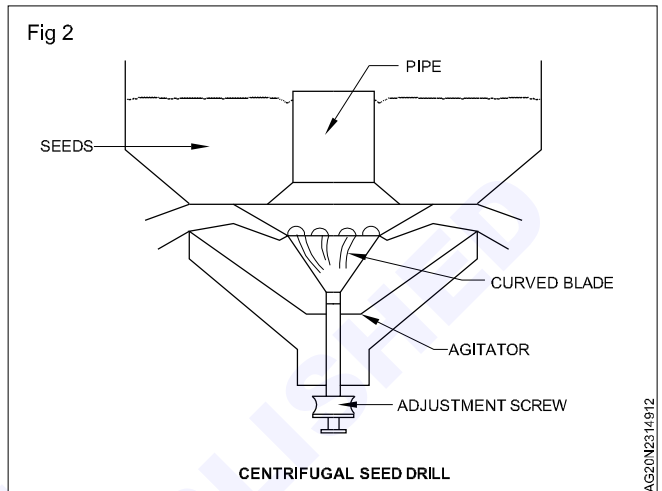
1 Hand seed drill

It is a manually operated implement, consists of a seed box, ground wheel, furrow opener, chain and sprocket. Seed box stores the seeds. Furrow opener is used to open the soil. Ground wheel transmits power to seed metering mechanism connected to seed box (Fig 1).



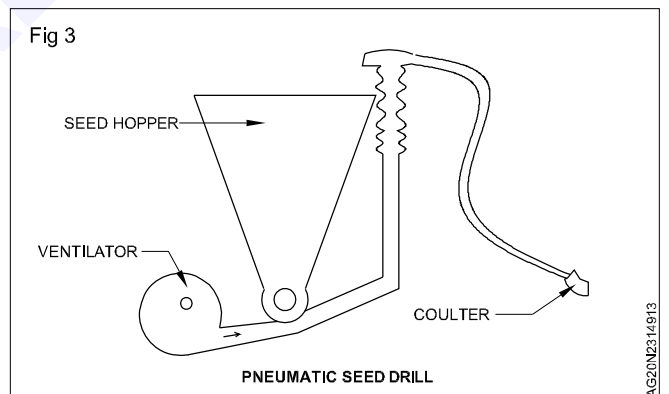
2 Centrifugal seed drill

Seeds placed in a cylindrical hopper pass through a series of openings into a funnel - shaped iron shield. In this, funnel is a rotating cone with welded curved vanes on the inside. Seeds enter through an adjusted opening in the bottom of the rotating funnel; centrifugal force causes the seeds to rise and to be ejected into the seed tubes, which can be opened or closed as desired. The drilling rate is little affected by ground surface, slope or forward speed (Fig 2).



3 Pneumatic seed drill

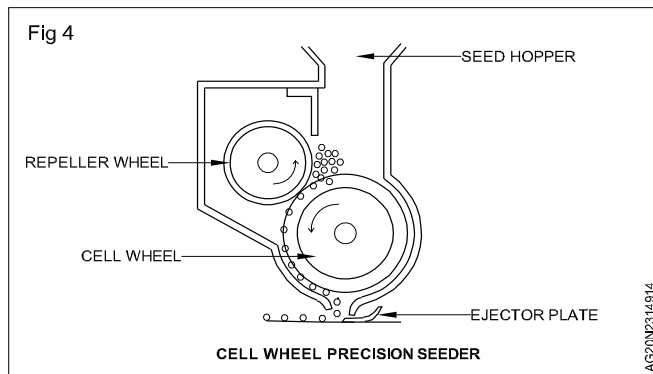
An air - stream produced by a fan to convey the seeds to a distribution head. At this head, a number of delivery tubes are fixed which direct the seeds to the furrow - openers a variant of this system is used as granulate distributor (Fig 3).



4 Cell wheel precision seeder

The types exist with vertical and slanting discs. Vertical cell wheels have one or more rows of holes at the Circumference. The cell wheels turn in the same direction as the wheels of the drill and repeller wheel removes the superfluous seeds at the bottom of the sowing mechanism where the seeds must fall down, an ejector plate empties the cells (Fig 4).

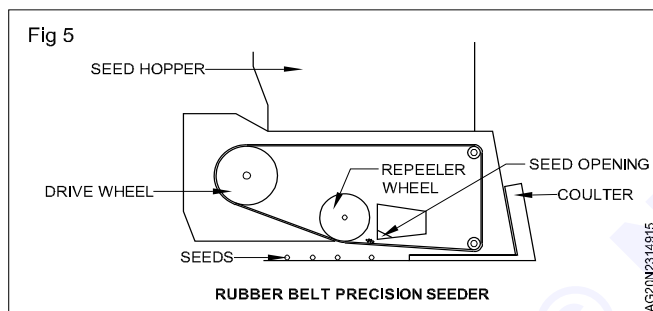
Both types of precision drills can adopt by using different belts or cell wheels and by the modification of the velocity of the belt or cell wheel the seed spacing wheel by a gearbox. The drills require round, calibrated or pelleted seeds.



For accurate drilling it is very important to choose the right belt or cell wheel with holes with a diameter matching that of the seeds. It is essential that every hole is filled with only one seed.

5 Rubber belt precision seeder

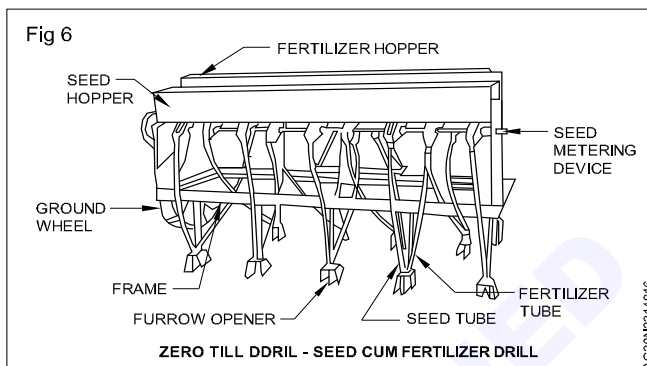
It traveling opposite the driving direction where the seed is leaving the band is transporting the seeds from the hopper to the delivery opening. A repeller wheel turns opposite to the direction of the belt and removes the superfluous seeds (Fig 5).



Zero till drill seed cum fertilizer drill (Fig 6)

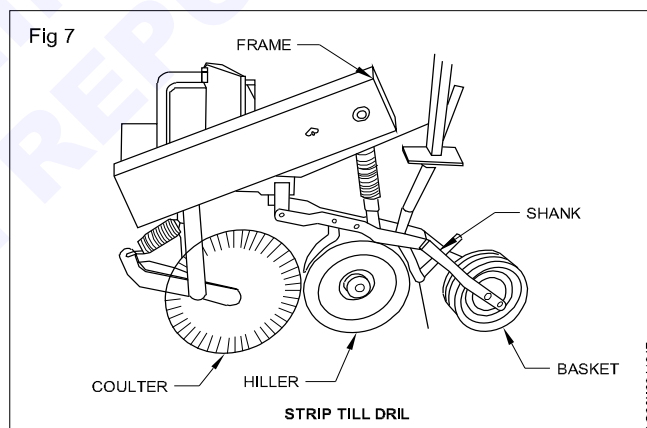
The seed cum fertilizer drill machine consists of seed box, fertilizer box, seed metering mechanism, fertilizer metering mechanism seed tubes, furrow openers, seed rate adjusting lever and transport cum power transmitting wheel. The fluted rollers are driven by a shaft. Fluted rollers, which are mounted at the bottom of the seed box, receive the seeds into longitudinal grooves of fluted roller and

expel them in the seed tube attached to the furrow openers. By shifting the rollers sideways, the length of the grooves exposed to the seed, can be increased or decreased and hence the amount of seed sown is changed. The seed cum fertilizer drill is popular in northern region of the country. Seed cum fertilizer drills are used for sowing of wheat and other cereal crops in already prepared field (Fig 6)



Strip till drill

It consists of coulter, tiller basket, shank and frame. Strip tillage refers to a system where strips 5 to 20 cm in width are prepared to receive the seed whilst the soil along the intervening bands is not disturbed and remains covered with residues. The system causes more soil disturbance and provides less cover along the rows than zero tillage (Fig 7).



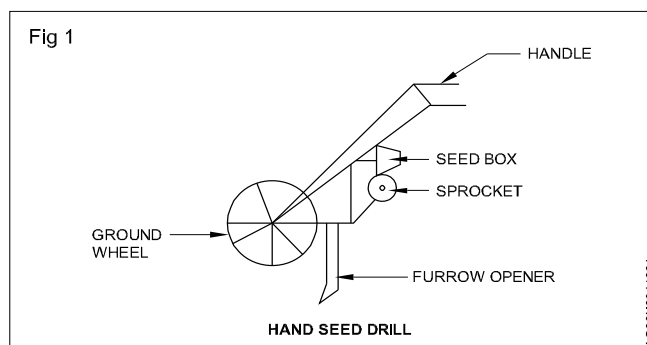
Construction details of seed cum fertilizer drill

Objectives: At the end of this lesson you shall be able to

- describe the construction details of hand seed drill
- explain the construction details of cell wheel precision seeder
- describe the construction details of rubber belt precision seeder.

Hand seed drill

It is a manually operated implement, consists of a seed box, ground wheel, furrow opener, chain and sprocket. Seed box stores the seeds. Furrow opener is used to open the soil. Ground wheel transmits power to seed metering mechanism connected to seed box (Fig 1).



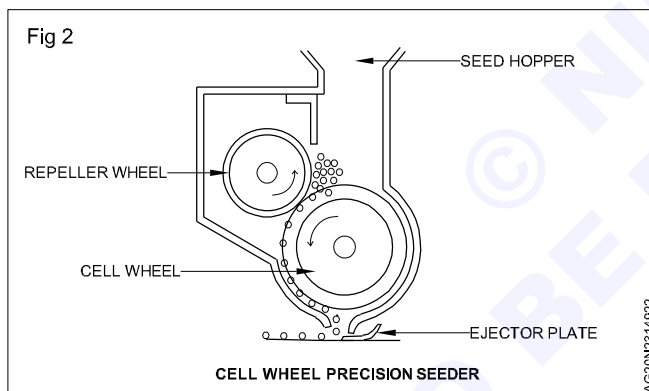
The machine consists of a seed box attached to the mainframe of a hand wheel hoe. A fluted roller assembly is provided at the bottom of the seed box. Fluted roller is rotated with the help of chain and sprockets from the ground wheel. The seed rate can be adjusted with the help of a lever provided on the seed box. The fluted roller used for sowing rapeseed and mustard has 8 flutes. Earth flute is 3 mm wide and 2 mm deep. The diameter of the fluted is 3 mm wide and 2 mm deep. The diameter of the fluted roller is 50 mm and its length, 32 mm. For operation, the machine is pulled by rope attached to the hook of machine by one man and other person steers the machine by holding it by the handle.

Uses

Manual hand seed drills are used for sowing rapeseed and mustard. By changing the fluted roller position, other crops like wheat, moog etc. can also be shown, it is also suitable for inter-row sowing.

Cell wheel precision seeder

The types exist with vertical and slanting discs. Vertical cell wheels have one or more rows of holes at the circumference. The coil wheels turn in the same direction as the wheels of the drill and repeller wheel removes the superfluous seeds at the bottom of the sowing mechanism, where the seeds must fall down, in ejector plate empties the cells (Fig 2).



The cell wheel rotates underneath the hopper one seed drops into each hole. To prevent other seeds drops into each hole. To prevent other seeds not completely in the hole from leaving the chamber, a repeller wheel rotates against the cell wheel. The seed is carried by the belt or wheel to a point where it can drop out into the slot in the soil made by the coulter.

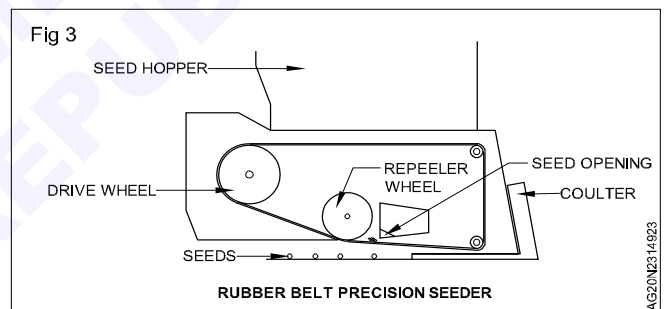
Correctly graded seed must be used in a precision seeder so that there is room for only one seed in each hole and seeds do not project above the hole resulting in damage.

Drive to the mechanism is either by v belt from the land wheel of each unit or by gears and shafts from a master land wheel. Like random seeder, high speed of operation can cause seeds to be missed and the recommended speed is 2 miles per hour.

Seed spacing and the type of seed sown is altered by changing the seed cell wheel for one that has differently spaced holes or different sized holes for other seeds.

Rubber belt precision seeder

It travelling opposite the driving direction where the seed is leaving the band is transporting the seeds from the hopper to the delivery opening. A repeller wheel turns opposite to the direction of the belt and removes the superfluous seeds (Fig 3).



The operation of rubber belt precision seeder is similar to cell wheel precision seeder. The main difference between them is the wheels are connected through a belt in rubber belt precision seeder, where as in cell wheel precision seeder they are connected directly.

Types of seed metering devices and furrow openers

Objectives: At the end of this lesson you shall be able to

- state the types and uses of seed metering devices
- state the types and uses of furrow openers
- seed and fertilizer metering mechanism.

Seed & fertilizer metering devices

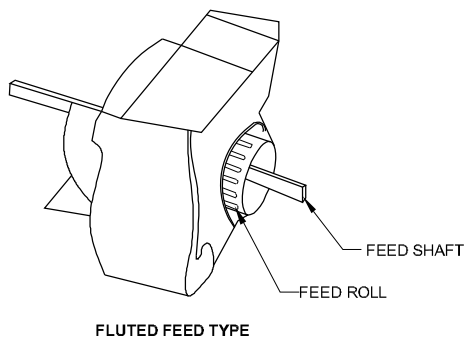
These metering mechanisms are placed in the bottom of the seed and fertilizer boxes to meter the desired quantity of seeds and fertilizers. The different types of metering devices, which are in use for seed cum fertilizer drill, are as under. Three types are given below.

1 Fluted roller

Fluted roller or fluted wheel is the most common metering device. It is made of aluminum or plastic coated body containing a roller, which contains 8 - 12

longitudinal grooves on its outer periphery. The roller along with its body is mounted on a square shaft. These grooves receive the seeds from the seed box and deliver it into seed tube through seed holes. The sideways movement of fluted roller on its shaft can regulate the quantity of the seeds. The side way movement of the rollers grooves exposed to the seed inside the body, which results in regulation of seed rate to be delivered. For different sizes of seeds, an adjustable spring loaded baffle plate is provided (Fig 1).

Fig 1

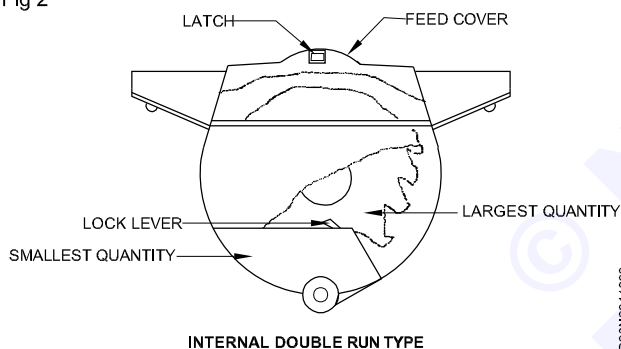


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2 Internal double run mechanism

In this type of metering mechanism, a double feed wheel is used. One face of the wheel has large openings for large size of seeds, whereas the other face has a smaller opening for small size of seeds. When one side is being used, the seed is prevented from flowing through the other side by using a special cover or gate that can be easily installed from the inside of the seed box. Changing the speed of the internal seed wheel by selecting the suitable gear ratio for driven and drive gear can regulate the seed rate (Fig 2).

Fig 2

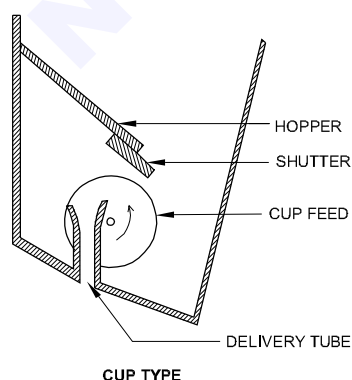


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3 Cup type

In this type of metering mechanism, a revolving disc containing fingers or cups on its periphery, which picks up the seeds and delivers them to the seed tube. These are used in drills for crops where seeds are easily damaged due to rough mechanical handling. The size of spoon depends on the seed size and the seedling rate depends on the number of cups and its rotating speed (Fig 3).

Fig 3



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Types of furrow openers

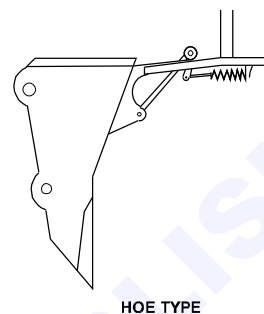
Furrow opening unit

It is used to open a furrow in the soil at uniform depth. The different types of furrow openers in use are as follows.

Hoe type

It is fitted with single point or reversible type shovels followed by single or double delivery boots, attached to it. It is suitable for light medium soil, free of excessive trash. This type of opener has a good penetration and when its shanks are equipped with automatic tripping mechanism (spring loaded) then it is very much suitable for stony and root infesting soil (Fig 4)

Fig 4

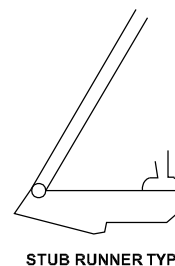


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Stub runner type

The sword shaped furrow opener with sharp edge cuts the soil in a neat furrow with minimum disturbance up to shallow or medium depth. It is used in corn drills in rough and trashy ground (Fig 5).

Fig 5

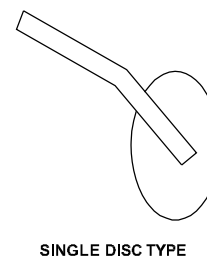


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Single disc opener

A slightly curved disc, set to run at a slight where between penetrations is needed and seedbed contains the thrashes and for better penetration, more suitable for shallow and medium seeding (Fig 6).

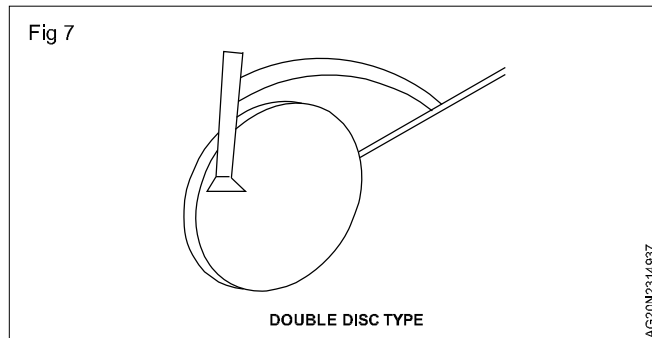
Fig 6



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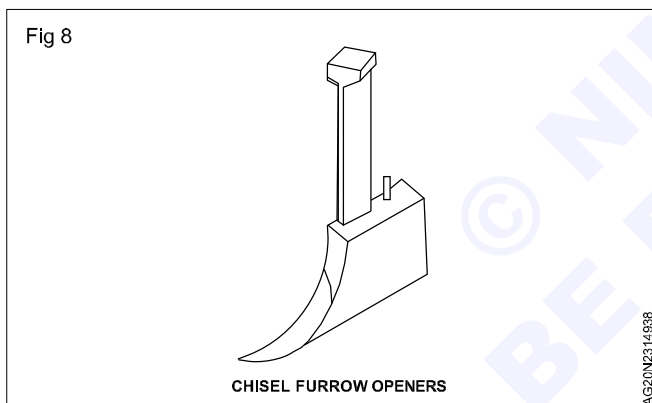
Double disc opener

In this type of furrow opener two discs facing each other at a slight angle from a cutting edge where it penetrates into the soil. The discs rotate as they are moved forward leaving a small centre ridge which causes seed to be deposited into row at about 25mm apart. These openers are especially suitable for deep sowing at relatively higher speeds. It is an ideal furrow opener for sowing small seeds in trashy seed bed (Fig 7).



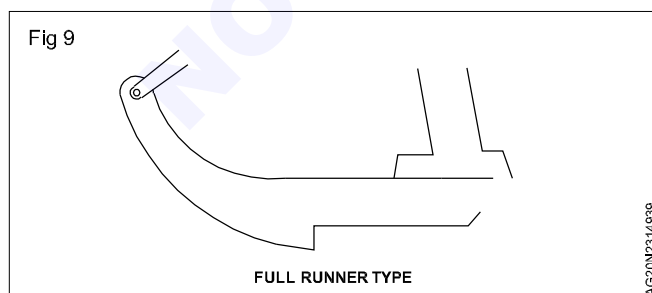
Chisel furrow openers

It is an opener made of a body with bar shape and has a sharp point projecting over the shoe. This type of furrow opener is especially suited for very hard and cloddy soils (Fig 8).



Full runner type

It is used for medium depth and seed beds free from trashes. It consists of a covered runner with sharp edge (Fig 9). Due to its length, it compacts the bottom of the furrow they are commonly used for maize, cotton and vegetable planters.

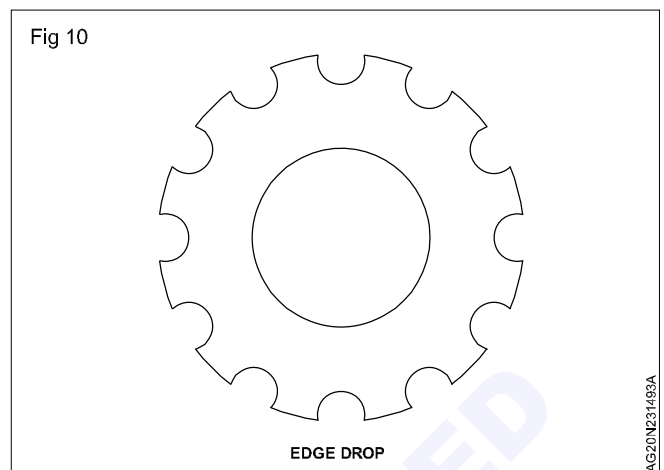


Horizontal plates

They horizontal seed plates have got suitable notches or holes called "cell". Depending upon the type of notches on the plates it is of three types edge drop flat drop hill drop.

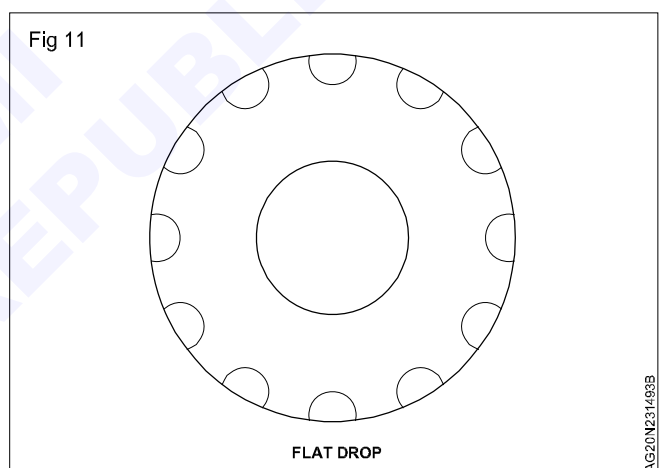
Edge drop

The carries the seed on edge in the cell of the plate (Fig 10).



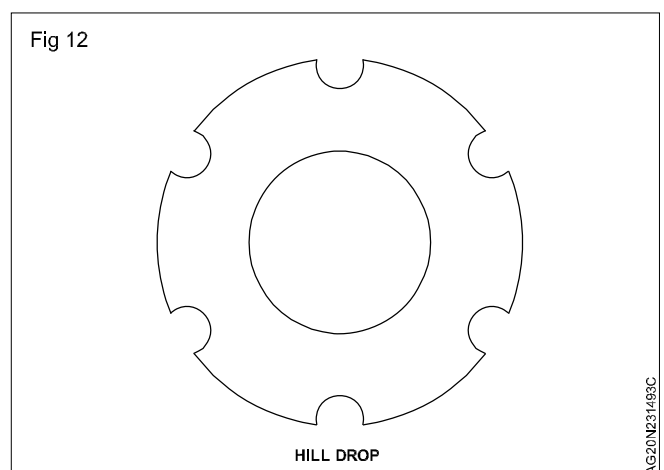
Flat drop

The flat drop carries the seed on a flat in the cell of the plate. Only one seed is allowed in the cell at each time (Fig 11).



Hill drop

In hill drop, the cells round the edge of the plate are large enough to admit several seeds at a time (Fig 12)



Power transmission

Planters are classified as tractor operated animal drawn or manually operated according to type of power unit. In tractor operated machines, power to drive metering devices is transmitted from rear drive wheels, transport - cum - depth control wheels or PTO in case of pneumatic planters. In animal drawn planters power is transmitted by means of the transport wheel, transport - cum - depth gauge wheel, press wheel etc. These drive wheels, which are in use, are of normally three types plain wheel, lugged wheel and pegged wheel.

The power from wheel may be transmitted by means of gears, chains and sprockets or V - belts. The belt drive is cheapest. Roller - chain drive is preferred because they are readily available and have no slip. But under dusty conditions V - belt drive is preferred over chain drive. A combination of chain and gear drive is used in tractor mounted machines.

Gear drive

Cast iron or plastic gears are extensively used to transmit power on the planters. However cast iron gears have a rough finish and are not accurate to use. Recent advancement in plastic industry has helped to produce good quality plastic gears which function well enough.

Belt drives

Power transmission also uses belt drive, mostly V - belts. It has an advantage of being low cost, having low noise, shock absorbing and requires no lubrication.

Chain drives

The chain and sprocket drives are used to transmit power from the ground wheel to metering device. A counter shaft drive is provided so that power from one shaft can be transmitted to different metering units.

Calibration and adjustments of seed drill

Objectives: At the end of this lesson you shall be able to

- state the calibration of seed drills
- describe the adjustments of seed drills.

Calibration of seed drills

Before taking a seed drill or planter into the field it is very essential to calibrate its metering mechanism to obtain the required seed rate per hectare or per acre of the crops to be planted. The following steps are followed in calibrating the seed drill. Jack up the seed drill and mark a reference point on the ground wheel. Measure the diameter of ground wheel. Let us say it is 'D' meter. Measure the working width of the drill or planter let us say it is 'W' meter

$W = n \times d$ Where,

n = number of tynes

d = distance between two tynes (m)

Workout the circumference of ground wheel ($\pi \times D$)

We assume that the planter or drill has to be used in a field having length x breadth as 100 x 100 square meter.

Workout the revolution of the ground wheel required to travel a distance of 100 m

$$= \frac{100}{\pi \times D} = X$$

Now give the 'X' revolution to the wheel and collect the seeds from all the furrow openers separately. Weigh all the collected seed separately. It should be noted that there should not be large variation in the weight of the seed collected from the different furrow openers. Let's say the total weight of the seeds collected from all furrow openers is 'P' kg.

Workout the total number of revolutions required to cover one hectare of field.

$$= \frac{100 \times 100}{\pi \times D \times W} = Y$$

Workout the total amount of seed for 'Y' revolutions for 'X' revolutions 'P' kg. of seed are collected

$$\text{Therefore, for } Y \text{ rev} = \frac{P}{X \times Y} = G \text{ (kg)}$$

Thus by substituting the value of 'P' and 'X' revolution and we can obtain the quantity of seed to be used in the field. Thus the process is repeated by suitably adjusting the lever on the indexing device till we get the seed rate, recommended for a particular crop under planting or sowing.

Adjustments seed drill

Adjust the lever on indexing device to obtain desired seed rate. Change the seed metering devices according to land and seed used. Lift the equipment and rotate the drive wheel to ensure that seeds are falling freely from the metering device. Check the penetration indexing mechanism for placement of seed position.

The metering unit in the hopper should always be covered with seed. The delivery rate of the seed is influenced by the forward speed, in such cases speed has to be limited to 7 km. h-1. To prevent displacement of the seed in the furrow the coverers and rear wheel should not press too hard. The sowing depth should be adapted to the seed size and soil conditions. Do not reverse during operation to prevent the furrow opener being filled with soil.

Operation of seed drill

Objective: At the end of this lesson you shall be able to

- describe the operation of seed drill.
-

Operation of seed drill

In order to have a good quality work the seed and the fertilizer should be placed at uniform depth and uniform quantity in all the furrow openers without causing any damage to the seeds, in such a manner that the fertilizer should not come in direct contact with the seed. No furrow opener should be left opened and soil cover should be compacted firmly to promote easy germination. This can be obtained by carrying out the following operation procedure.

- Employ the standard hitching procedure for mounted implements. Reverse the tractor to seed cum fertilizer drill. Attach the left link, then the right link by adjusting the length of the right left arm, the top link and stabilizer chain after centering the equipment.
- After the equipment is hitched to the tractor make the preliminary adjustment and carry out the daily maintenance.
- Now fill the seed and fertilizer boxes $\frac{3}{4}$ th of its capacity, also assure that seed and fertilizer are free from clods etc.
- Lift the equipment and rotate the drive wheel to ensure that seed and fertilizer are falling freely from the metering device, seed tube into the furrow opener
- Take the equipment to the field; select the point from where the operation is to be started. As the tractor enters the field, lower the equipment using the position control levers.

- Check that the drive wheel is touching the ground fully, if not, lengthen the top link. Then continue driving the tractor for about 10 meters distance and stop again. Check to see the drop of seed and fertilizers. Also check the penetration of furrow openers. If the desired depth is not obtained adjust the position control lever, till the desired depth of planting is obtained. Continue the above sequence of operation at the other end of the field to assure best efficiency or output from the equipment.
- Once the check and adjustments have been made, divide the field into lands of approximately 25 - meter width and mark the land at both the ends along with the field. The headland should be 1.5 times of the total length of tractor with equipment attachments from the outer end of field for mounted type drills. Now start the operation along one side of the first land leaving a strip of land equal to the headland. Make the adjustment in the depth if necessary and level the settings. At the end of the first pass take a left - hand turn in the headland at a distance slightly greater than the most convenient turning circle of the tractor. After the second pass again take a left hand turn and continue the operation on the left side of the first pass. Continue in the same manner and finish the operation on the whole land.

Maintenance and storage of seed drill

Objectives: At the end of this lesson you shall be able to

- describe the maintenance of seed drill
 - describe the storage of seed drill
 - troubleshoot and take remedial action.
-

Maintenance of speed drill

The following care should be taken for smooth and efficient functioning of seed - cum - fertilizer drill.

- Check the suitability of metering systems in respect to the seed and fertilizers to be used.
- Ensure the calibration of metering system to obtain the desired seed rate of the crop to be taken under cultivation.
- Ensure the placement of seeds at proper depth.
- Ensure the coverage of seeds and compaction of soil cover.
- Check the performance of the attachment.

Maintenance schedule

Daily

- Clean the furrow openers, covering device and seed tube.
- Apply grease to all existing grease points.
- Check that all the nuts and bolts are properly lightened.
- Remove the remaining fertilizer and clean the fertilizer system.
- Ensure the replacement of the parts, if any broken.

Periodically

- At the end of the season check the entire machine and make a list of broken and worn out parts and ensure its repairs or replacement.

- Thoroughly clean the seed and fertilizer hoppers and then apply a coating of heavy oil on moving parts.
- Clean the furrow openers, tubes and the metering system.
- Fertilizer system should be thoroughly cleaned by flushing with water, dried properly and an oil coating should be applied inside and outside of the fertilizer attachment.
- Roller chains should be removed, tagged and stored in a can of light oil.
- Detachable link chain should be coated with oil.
- If the seed drills have pneumatic wheel then the drill planter unit should be jacked up for its storage in a clean dry place, provided with proper sheds.

Storage of seed drill

Clean each part of the machine, reapply grease to the seed - metering clutch, and coat each rotary blade with old engine oil or paint, before storing the seed drill for long time. Store the seed drill in a dry, well - ventilated room. Keep the approximate tools with the machine during storage to ensure that they will be available when needed again.

Precautions

- Operator must ensure the leveling of the seed drill cum fertilizer with respect to the ground.
- The seed drill should always be operated at optimum speed in order to ensure uniform metering of seeds and fertilizer.

- After entering in to the field the operator must select suitable method of operation keeping in view the topography of the field.
- Before the operator starts the operation metering mechanism lever should be locked properly at calibrated scale.
- Before starting the operation, the operator should check the slippage/skidding of the ground wheel. He should ensure that it should not be more than that desired level which has been already taken into the consideration at the time of calibration.
- Depth of sowing should be kept uniform throughout the operation by locking the position control lever.
- Operator should ensure the proper and smooth working of agitator.
- Adjustment of marker should be kept uniform throughout the operation. It should be checked and readjusted if required after every turn.
- Check that all working parts have been protected properly by providing the guards or cover.
- Grain and fertilizers tanks should be checked at regular interval so that they should not become empty during sowing.
- When the tractor is in operation, the operator should not allow any person to sit on the tractor or to stand on the drill.
- No adjustment either on tractor or on drill should be made during operation.
- Operation should be done by the skilled operator only.

Trouble Shooting

Problem	Cause	Remedy
Press wheel is not rotating and causing hilling	The scraper angle is not sharp enough, or the clearance between the press wheel and angle iron. Press wheel bearings are locked. The scraper angle irons are in constant contact with the anti - skid tooth. Soil moisture is too high.	Adjust the scraper angle iron for sharp rotating and enough, or adjust the clearance between the press wheel and angle iron. Release the press wheel bearing lock / replace the bearing Release the constant contact with the anti-skid with the tooth. Let allow the soil to dry.
Seed is not dropping	The seed box is empty. from furrow opener The furrow opener or seed tube is blocked by soil/mud. The clutch is disengaged.	Fill the seed in seed box Clean the furrow opener and seed tube Engage the clutch properly.
Transmission is not engaging properly	Press wheel is not rotating and causing hilling. Seed is not dropping from furrow opener. Transmission is not engaging properly.	Replace the positioning spring with a new one. Repair the head or replace the opener. Repair the channel or replace handle.

Problem	Cause	Remedy
Furrow opener not penetrating the ground	Hard ground Worn out furrow opener	Use pressure spring attachment to increase pressure on runners. Replace or repair the furrow opener.
Soil loose around seed	Cloddy soil condition In sufficient press wheel pressure	Use press wheels or rubber tyres Increase pressure on press wheel
In accurate seed drop	Poorly graded seed Wrong seed plates	Use graded seeds Use recommended seed plates
Furrow openers plugging	Soil too moist Seed drill not running in level	Let allow the soil to dry Adjust the height of hitch

Happy seeder

Objectives: At the end of this lesson you shall be able to

- describe a happy seeder
- understand the components of happy seeder
- know the maintenance of happy seeder
- trouble shooting of happy seeder.

General

Agriculture is the main occupation in India. Wheat and paddy are main cereal crops of Punjab and appx. 28.45 lakh hectares area under the wheat paddy rotation. About 85% wheat and 91% paddy is harvested with combines. After wheat harvested with combines, the 80% bhusa is made from the wheat straw with straw reapers. Total profitable utilization of paddy straw for different purposes like production of electricity, in card board industries, mushroom cultivation, packaging, bedding for animals and as fodder for animals constitutes 5% of that produced annually. To solve the problem of sowing of wheat without burning is possible by using happy seeder machine.



Description of Happy seeder

Happy seeder, combined the stubble mulching and seed drilling functions into the one machine. This machine is capable of direct drilling of wheat into heavy paddy residue load (7-9 t/ha straw). Happy seeder consists of a rotor for managing the paddy residues and a zero till drill for sowing of wheat. Flail type (Gamma) blades are mounted on the straw management rotor which cuts the standing stubbles /loose straw coming in the front of the sowing tine and clean each line twice in one rotation of rotor for proper placement of seed in soil. The rotor blades/flails push the residues as surface mulch between the seeded rows. This PTO driven machine can be operated by 45 hp tractor and cover 0.25 to 0.3 ha/h. Wheat yield in case of happy seeder was nearly 10% more than conventional sowing practice. Weed matter was nearly 50% lesser on happy seeder trial compared to conventionally sown plots. Mulched crops residue improved the soil hearth and added organic matter to the soil. Soil temperature regime is conducive for adoption of long duration wheat varieties due to increased window period. Substantial water saving has also been recorded due to avoidance of first irrigation and mulching. This machine can also be used for sowing subsequent moong crop in wheat residue.

Components of Happy seeder (Fig 1 & Fig 2)

- The frame (17) of this machine is made of mild steel. All the parts of machine are attached to it. It works as a body in the machine.
- Furrow openers or slits (9) are attached to the lower portion of tynes which are used to drill the soil and place the seed and fertilizer at desired place. Fig 3 shows major parts of furrow opener/slits.
- The flails (18) are wings made of mild steel and attached to a shaft, called flail shaft. Flail blades are placed on the rotor and arranged in such a way that flails blades are in exactly ahead of machine furrow openers. When

the flail shaft rotates, the flails also rotate and clean the residue left in front of tynes to facilitate drilling of seed and fertilizers in the seed rows (see Fig 4). Each furrow opener has two set of flail blades which clean the furrow opener twice in one rotation of machine rotor. The accumulation of residues over machine tynes is dependent on clearance between rotating flail blades and machine tines.

- The seed and fertilizer box (1) set is trapezoidal shaped seed and fertilizer boxes, made of mild steel sheet (2 mm thick), are mounted side by side on the frame, fertilizer box in front and seed box in the rear.

Fig 3

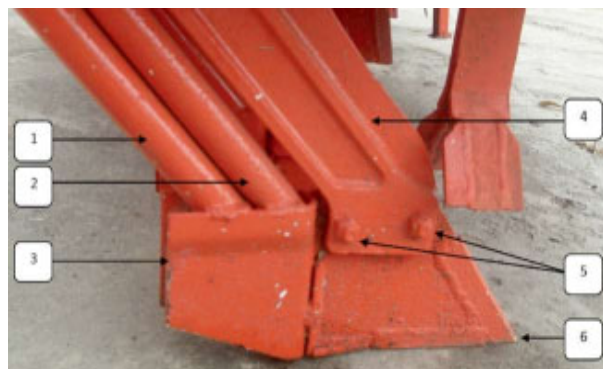
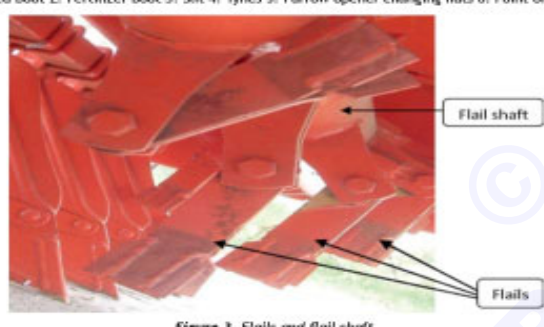


Fig 4



- The key elements of the seed metering system (5) are, seed box and fluted rollers.
- Seed box (1) is used to store the seed in the machine.
- Fluted rollers are attached to the shaft. As the shaft rotates, the fluted roller also rotates and seed delivered to the seed delivery pipe through the flow control tongue.
- The fertilizer metering system (6) controls the rate of fertilizer application in the field for a specific crop. (also see Fig 5)
- Drive wheel (7) is mounted on the side of the frame and placed either on front or back. The function of drive wheel is to provide drive to the seed and fertilizer metering systems.
- Two Depth control wheels are attached back side bar of the frame. The diameter of wheels is about 30-35 cm. it is made of mild steel. The function of these wheels is to regulate insertion of the furrow openers into the soil to place the seed at desired depth in all the rows and across the field. (also see Fig 6)

Fig 5

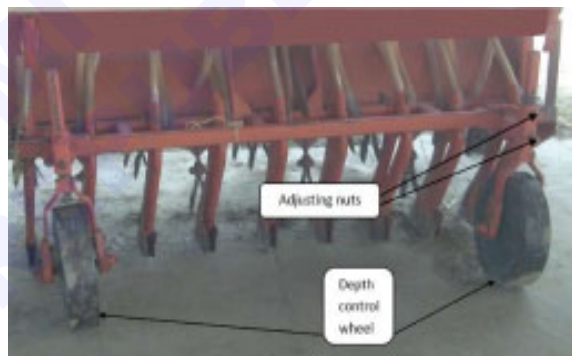


Figure 12. Fertilizer metering system

Figure 12. Fertilizer metering system



Fig 6



- There are two power transmission unit (19) in happy seeder
- a) PTO Shaft
- b) Drive Wheel

For proper sowing of wheat with the happy seeder machine, some points to be kept in the mind:

- Do not sow with HS where paddy residues are infested with pests (e.g. stem borer).
- Spread combine harvested rice straw evenly onto the field before sowing of wheat for optimum germination and crop establishment. A straw management system (SMS) attached on the rear of combine harvester has been developed by PAU, which is able to uniformly spread the loose straw and chaff coming from straw walkers and sieves without affecting the machine performance. It is a low cost and a very simple arrangement which requires very low energy and power. The use of the SMS attached with the combine harvester will enable harvesting of rice and sowing of wheat using HS on the same day/time in the residual soil moisture.

- Harvesting of rice crop with combine should be done at greater height (60:40 ratio) so that proportion of loose straw is smaller than the standing stubbles.
- The field may preferably be laser leveled prior to rice transplanting for achieving better results with Happy seeder.
- Rodent burrows in the fields as well as on bunds at the time of wheat sowing should be treated with 2% zinc phosphide or 0.005 % bromadiolone. About 10 g of the poison bait in paper boats should be inserted about 6 inches deep inside each live burrow. Second poison baiting should be done with any of the above two poisons in the month of February before milky grain stage. Place about 10g of poison bait on each piece of paper at 100 bait points/ha in 10 x 10 m grids.
- Moisture content of soil at the time of wheat sowing should be more compared to that for conventional wheat sowing. Soil moisture content is very critical for machine operation as excess soil moisture can cause uprooting of anchored straw which chokes the tyne and machine does not work satisfactorily. On the other hand low soil moisture affects the wheat germination.
- One acre field may be divided into four sub plots after wheat sowing for better irrigation water application.
- Treat the seed with chloropyrophos (4 ml/kg of seed) for protection against termite attack. Treat the seed with Rexil (1.0g/kg of seed) for protecting wheat against karnal bunt.
- Apply recommended seed rate and the depth of sowing should not exceed 5 - 6 cm.
- Apply light irrigation after sowing to avoid flooding, that which cause yellowing of wheat plants.

Maintenance and operational care of Happy Seeder

- Preferably use double clutch tractor for sowing operation with happy seeder.
- Tractor should be adjusted around 1500-1700 rpm before running the machine for sowing operation.
- Calibrate the machine before operation in the field for exact seed and fertilizer is dropped without any damage.
- Grease all bearing, points, chain and sprockets. Oil and gear box should be checked after a specified interval as suggested by the manufacturer.
- Lift the happy seeder while turning on headlands to avoid hindrance problem and bending of tines.
- Proper cleaning of the machine parts should be done after use, i.e seed box and fertilizer box etc. should be cleaned.
- Store in cool and dry place in off season when machine was not in use.

Sowing of wheat with happy seeder in paddy harvested field

Tractor Operated Multi Crop Planter: Two types of planting devices i.e vertical spoon type and other inclined plates are available to sow different types of bold seeds. Planting plates for different crops (Groundnut, Maize, gram, peas, soya beans etc.) can be changed easily. The machine worked well in maintaining seed rate and plant spacing for different crops.

Causes and remedies of happy seeder

Problem	Causes	Remedy
Clogging of residues in particular tyne	1. It may be due to improper alignment of tyne behind the flails. 2. Broken/worn out flail blades 3. Excess clearance between tyne and flail blades	1. Contact the machinery supplier to rectify this fault. 2. Replace the flail blades. 3. Contact the machinery supplier to rectify this fault
Straw clogging/ dragging while operation of machine for planting	1. Residues are too wet due to overnight dew and high surface soil moisture 2. Tractor engine RPM less than 1500 - 1700 3. Happy seeder flails are hitting the soil 4. High soil moisture content 5. PTO is not engaged before moving the machine in field 6. Worn out machine flails 7. Depth of seeding is more 8. Uneven residue load 9. Use of single clutch tractor	1. The field should be sun dried and after that sow wheat with happy seeder. 2. Increase the engine RPM by adjusting throttle accordingly. 3. Increase the length of top link accordingly and ensure that flails don't touch the soil while rotating. 4. Better to operate the Happy Seeder in relatively less soil moisture. 5. Engage the PTO gear, set the tractor engine RPM at 1500 to 1700 move the tractor in 2nd low gear. 6. Flail blades should be reversed/ changed after planting of 100 acres of crop in rice residues. It could be little more for other crop residues. 7. Adjust the depth of seeding with depth control wheels. 8. Ensure that residues are spread uniformly and there is no piling of residues. 9. It is always advised to use double clutch tractor for Happy Seeder.
Excessive vibrations in the machine	It may be due to broken or unbalanced flail blades	Replace the faulty flail blade.
Seed/fertilizer is not delivered in slit/furrow opener	1. The seed/fertilizer box is empty. 2. The furrow opener or seed tube is blocked due to wet soil or bending of fertilizer/seed delivery pipes. 3. The drive wheel does not touch the ground. 4. Broken chain/sprocket 5. Fertilizer fluted roller is blocked.	1. Refill the seed/fertilizer box 2. Clean mud out of the opener and/or seed tubes. Unbent the delivery pipes or replace if required 3. Lower down the hitch to get the drive wheel in contact with the soil. 4. Change the broken part 5. Clean the fluted rollers

Planters and transplanter types

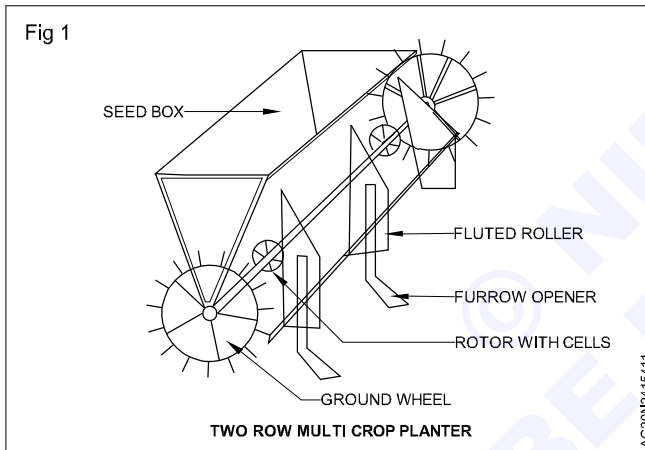
Objectives: At the end of this lesson you shall be able to

- state the components and uses of different type planters
- describe the components and uses of transplanters.

Different types of planters

Two row multi crop planter (Fig 1)

The planter consists of tubular steel section frame on which other components are mounted. The seed box is of mild steel and the metering mechanism uses aluminum fluted rollers for the fertilizer and a rotor with cells on the periphery for the seeds. The furrow openers are of shoe type and are made of medium carbon steel hardened and tempered for opening the furrow. The ground wheel provides the power needed for operating the seed metering mechanism and a pair of idler wheels on either side help in proper adjustment of depth of seed placement (Fig 1).

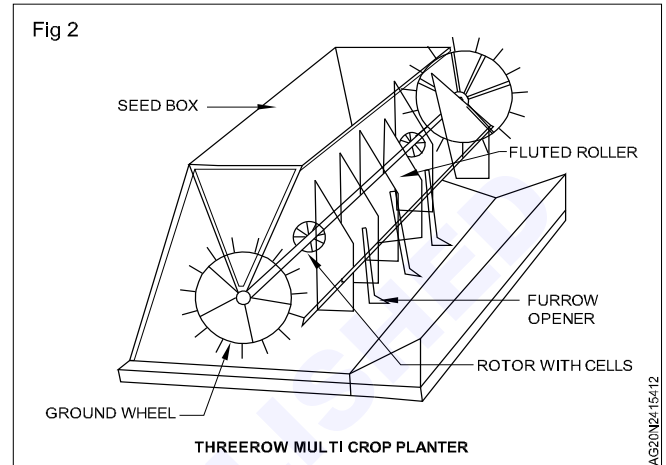


Three row multi crop planter (Fig 2)

The planter consists of a frame with tool bar, modular seed boxes; furrow openers and ground wheel. It has three independent seed boxes with inclined plate type seed metering mechanism. Ground wheel and power transmission system are fixed on the main frame. An optional fertilizer box with fluted roller type metering system can also be mounted on the main frame. Power from ground wheel is transmitted to the counter drive shaft through a set of chain and sprockets. Another set of sprockets on the counter shaft transmits the power to main drive shaft. Main drive shaft drives the individual drive shafts of modular seed boxes through sets of chain and sprockets and these shafts in turn rotate the inclined seed metering plates through a set of bevel gears (Fig 2).

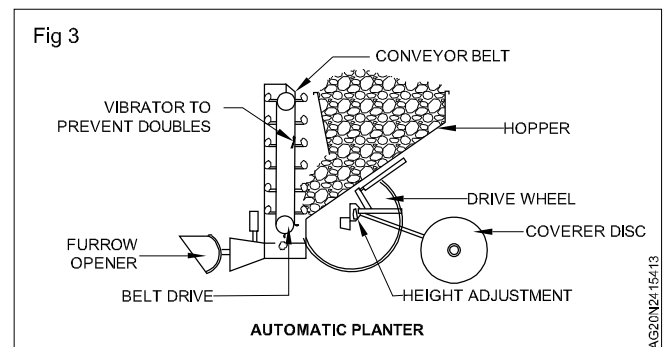
Potato planter (Automatic) (Fig 3)

Potato planter have two types of potato dropping mechanisms namely automatic and semi-automatic.

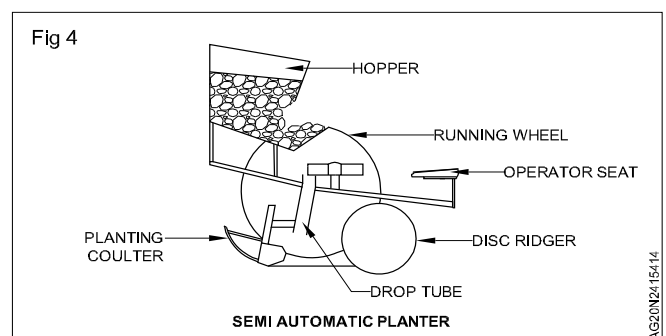


Automatic

The automatic potato planter consists of a picker wheel to which are attached from there to twelve picker arms. The picker wheel revolving on the main axle causes the picker arms and picker head to pass through the picking chamber containing the seed. Each picker head is equipped with two sharp picking points which pick out a single seed piece, carry it over to the front, and as the arm starts downward in its rotation, release the seed or force it off the points, dropping it into the seed spout, which guides it into the furrow made by the furrow opener (Fig 3).



Semiautomatic (Fig 4)



The seed drops from an elevator wheel through a feed spout into the pockets of a revolving horizontal feed ring, which carries the seed around to the opening over the seed spout through which it falls into the furrow. Should the elevator fail to place a seed piece in each pocket of the feed ring, it is the duty of the man on the planter to fill the pocket. Spacing of seed is done by changing the feed rings. Feeds may have ten, twelve, fifteen, or eighteen pockets (Fig 4).

Groundnut planter machines

A peanut planter is a professional machine that works especially for planting groundnuts. This type of machine is used for fertilization, seeding and soil coverings. The peanut planting machine can complete operations such as ditching, ridging, seeding, and soil covering. The peanut planting machine can complete operations such as ditching, ridging, seeding, fertilization, spraying buried drip irrigation pipe and soil covering at one time.

Peanut planter machine also used peanut planter's ridge width, ridge height, seeding depth, seed number, row spacing, ridge distance, film width, and hanging position are all adjustable. This type of machine improves work efficiency by more than 20 times and ensures consistent seeding row spacing, plant spacing and depth.

First the fertilizer in the fertilizer box enters the fertilizing shovel through the outer while groove fertilizer applicator and the shovel digs the soil layer while applying the fertilizer to the soil.

When the planter completes the fertilization process, the seeds in the seed metering device enter the ditch under the drive of the gear. So the seeds in the sowing box enter the planter and the ditch discharging device sows the peanut seeds evenly in the two or three row ditches, while disc-changing the soil and ditching to complete the sowing process.

Ground nut digger

Working principle

It will work in three stage operation:

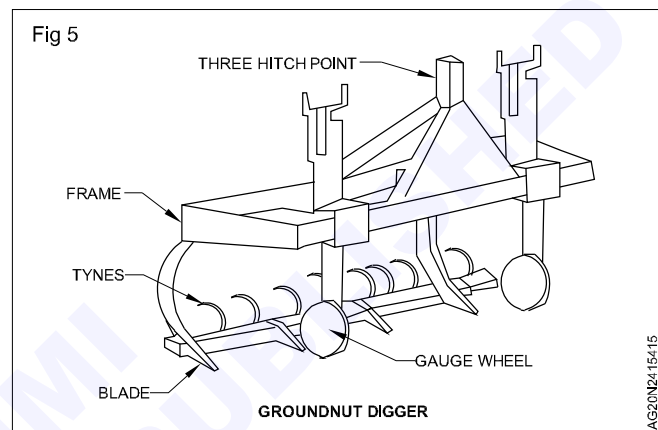
- 1 The tap root is cut, and the soil loosened around the groundnuts
- 2 The vines and nuts are lifted from the soil, passed over a shaker or shake off loose soil, and collected in windrows.
- 3 The windrows of groundnuts and vines are picked up and passed through a picker or thresher to separate the nuts from the vines.

Construction details

It is a tractor-mounted unit consisting of V-shaped blade and depth wheels mounted on mid steel frame made of angle iron or channel section. The blade is made from medium carbon steel or low alloy steel, hardened and tempered to suitable hardness. The blade is mounted with fasteners and can be replaced upon wearing or becoming dull. Depending on depth of pod zone, the depth of operation is adjusted by lowering or raising of gauge wheels. The

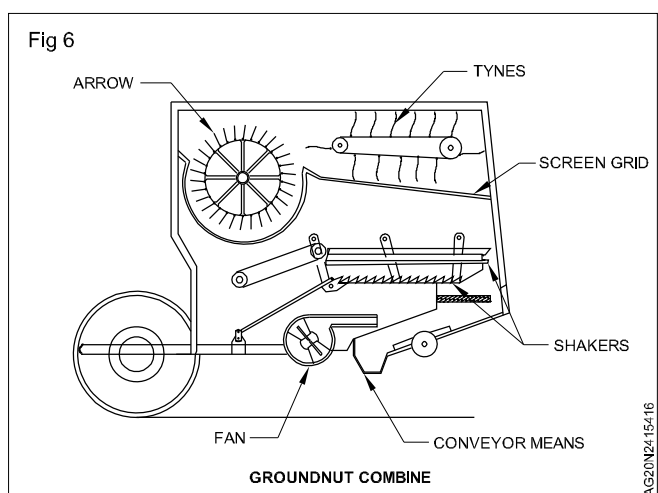
groundnut pools with vines are left on the ground and their separation from soil mass and picking is carried out manually subsequent to digging operation (Fig 5).

The initial functions performed by the groundnut digger are the same as the bulk potato harvester. A volume of soil, containing the groundnuts with the attached above ground portions, is engaged by a series of disk counters that are strategically positioned. The final pair of opposing coulters is designed to provide an elevation and inversion of the groundnut plant while depositing the plant mass on windrowing and soil separating finger-like elements at the rear end of the machine. In the machine, the PTO is used to vibrationally excite the separating elements to increase their separation effectiveness and assist in moving the plant material toward the central window position.



Groundnut combine

When the groundnut moisture has been sufficiently lowered, a groundnut combine, similar in function to a grain combine, is used to move through the field and thresh (separate) the groundnut from the plant stem material. In the case, the green groundnut combine must also possess the function of a root crop harvester in addition to the threshing and separation functions of grain combine. This detailed view shows how the dug plants with attached groundnuts are introduced at the arrow into the concave separation cylinder assembly that rotates about an axis. The tooth/line arrangements of this threshing device are designed to remove the green groundnut containing pods from the plant peg material while minimizing damage to the pods.



The entire mass of threshed material is moved across a stationary screen grid by the positive action of lines. Further separation is achieved with shakers, similar to straw walkers in grain combines, and a fan. Finally the cleaned pods are collected in conveyor means where they are elevated to the storage and transport element of machine.

Onion Digger

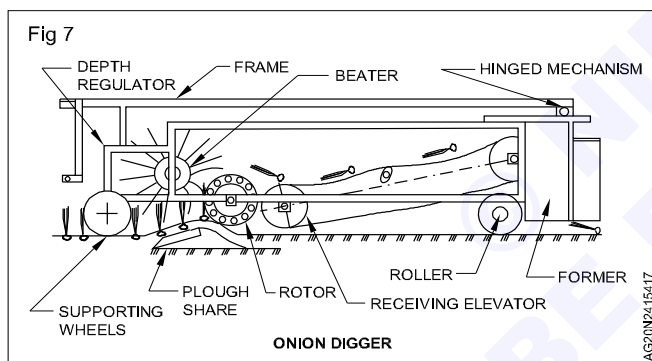
Working principle

The onions, which are grown in rows, are lifted by lifting wheels, picked up by an elevator or chain, and then several rows are put together in windrows on the ground for drying. After drying they are collected with a converted onion harvester, the lifting shares of which have been removed, or with a special pick-up-device.

Construction details

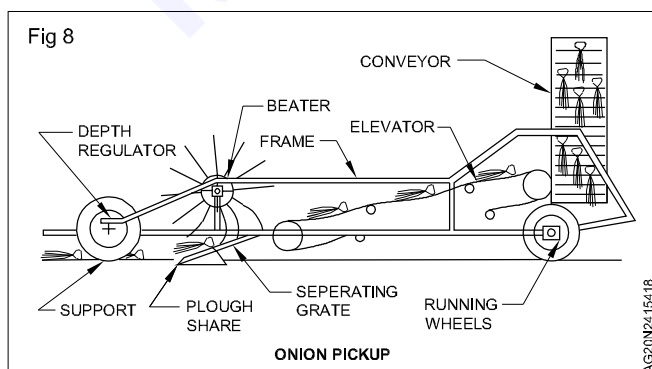
Onions are harvested in two stages. In the first stage the onions are lifted, and put into windrows for drying. Then they are picked up and transported to the store. Onions are generally harvested with a special onion harvester (Fig 7).

The onions, which are grown in rows, are lifted by lifting wheels, picked up by an elevator or chain, and then several rows are put together in windrows on the ground for drying.



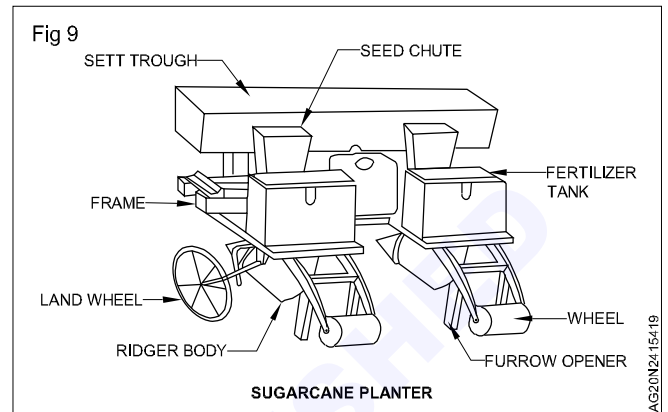
Onion pickup

After drying they are collected with a converted onion harvester, the lifting shares of which have been removed, or with a special pick-up device (Fig 8). Drying is necessary, as the surplus water, especially in the tops, has to be removed, otherwise rot or discoloration may set in during storage. If they have to be brought in too early, well with a shredder. With this crop too, damage is a decisive factor in the final assessment of the quality and its prevention merits the greatest attention.



Sugarcane planter (Fig 9)

It is a tractor - mounted implement and consists of sett trough, fertilizer tank, insecticide tank, ridge body for furrow opening, cultivator with shovel for sett covering, and ground and compaction wheels. The ridge body is made of two mould boards with share in the front. The share is made of medium carbon or alloy steel, hardened and tempered to suitable hardness (Fig 9).



Sugarcane cutter planter (Fig 10)

Machine consists of cane container, gearbox with cutter, fertilizer feeder unit with seat, leveler shovel, furrow and wheel for the operation, two laborers sitting on the machine feed complete sugarcane one by one into the sett cutting unit by picking from the seed hopper. The furrow - opening unit has two ridger mounted on the frame for opening the furrow. The machine has two sett cutting units one for each row. Each sett - cutting unit consists of rotating blades, which cut the cane into desired size before dropping into furrow. Chemical application is through nozzles (Fig 10).

Cotton planter (Fig 11)

Cotton planters are available with runner - knife seed furrow openers for planting land prepared flat. Hydraulic power lifts are used to raise and lower the equipment. Fertilizer attachments used with this type of planter. The cotton planter is equipped with middle breaker bottoms, hoppers, furrow openers and covering devices (Fig 11). The seeds can be planted in the furrow behind the bottom.

Transplanter

Paddy transplanter

Manual transplanter

The transplanter consists of two wooden floats, a mainframe that supports the seedling tray, mat pusher, tray movement mechanism and picker bar assembly and handle. The machine is manually operated and pulled through the field by operator. The tray movement mechanism is provided with the help of a chain and freewheel. Provision for changing planting depth and number of plants/hill are also made. Mat pusher helps to slide the seedling mat downwards during each stroke (Fig 12).

Fig 10

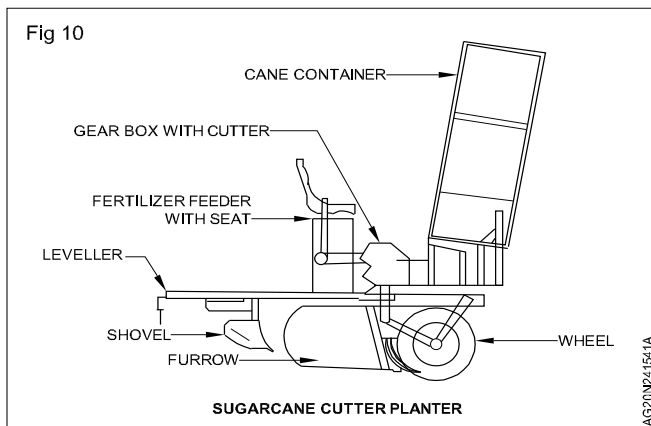
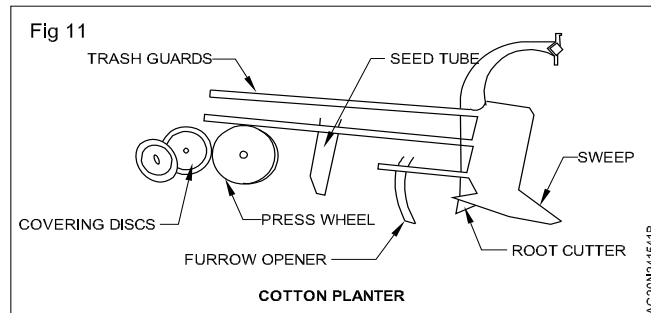


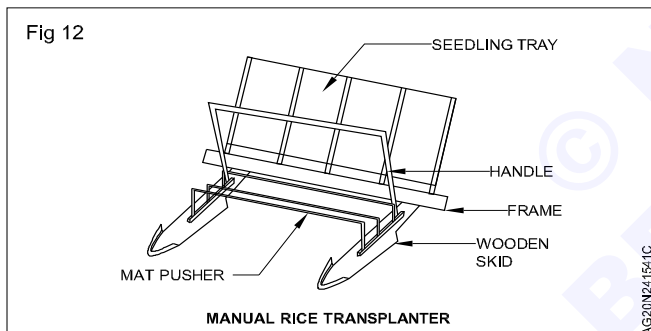
Fig 11



Power tiller mounted rice transplanter (Fig 13)

The transplanter consists of power tiller, cage wheel, engine, supporting hitch, tray, picker, float and four bar mechanism. The power tiller operated implement is

Fig 12



suitable for row transplanting of root washed type seedlings in puddled field. Power tiller operated transplanter has 8 rows with row spacing of 20 cms and hill to hill distance of 20 cms. It is operated by a power tiller of 8 hp. The depth of planting varies from 3 - 5 cm

Vegetable transplanter (Fig 14)

Transplanter consists of a toolbar with one or more transplanting units. A platform is assembled to stock the plants. Each unit is made up of a frame, furrow opener, transplanting unit, press wheel, coverer and a sheet. (Fig 14).

The furrow opener makes the furrow in which the plants are placed directly or by means of the transplanting mechanism. The inclined press wheels firm the soil around the roots to obtain a good contact and prevent wilting. The seedlings are put between the discs with the roots sticking out. At their lowest point the discs open again and the plant is placed in the furrow.

When placing the plant in the finger one has to press the finger a little bit by which it closes. The fingers open again in their lowest position and the plant is then put into the furrow.

Maize (Corn) planter: Maize planters available are either bullock operated or tractor operated. Bullock operated planters are usually single, 2 or 3 row planters, whereas tractor - operated planters are 4 to 6 row planters or even more.

Trailing and tractor - mounted maize planters can be classified according to the manner in which seeds are dropped: drill or hill - drop. Lister planters are the drill planters designed to plant maize seeds in listed furrows.

Drill planters are used for maize because, when maize is harvested with mechanical corn picker, it gives more even flow of corn through the picker mechanism. Four types of seed plates are used for planting maize, viz edge - drop, flat - drop, flat - drop round - hole and full - hill plate.

Planters are usually adjustable for row spacing as well as plant spacing. Precise planting rate is possible in maize because of size and nature of seed. Accurate single seed selection of graded seeds with properly fitted seed plates is possible. Maize is sown on both flat land and ridges.

It can be checked - rowed also for cross cultivation. This practice facilitates weed control, especially in very wet years. Mostly it is a horizontal or inclined plate type of planters and single seed selection can also be made. Planting rates depend on the number of cells per plate and the drive rates. Check row planters traditionally drop two, three or four seeds per hill. At higher speeds, scattering of seed is pre - dominant due to bouncing.

The accuracy of a planter depends upon the uniformity of kernels, shape of hopper bottom, speed of plate, shape and size of cell and fullness of hopper. A cone - shaped hopper bottom causes the seed to gravitate into the cells. The yield cut off pawl acting under spring pressure pushes the extra seed back as the cell passes under the plate cover. The height of the planter box from the ground level should not be more than 45 - 60 cm.

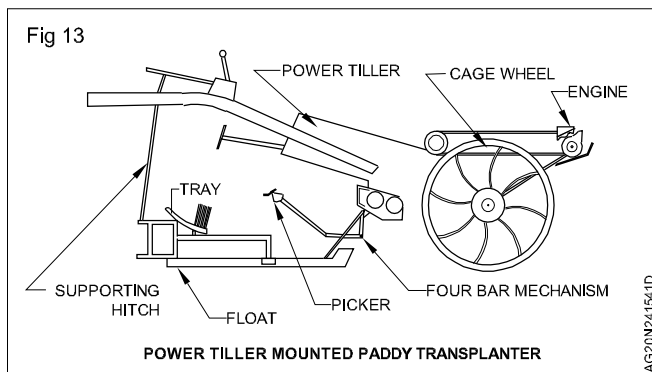
Maize is a traditional kharif season crop. However, it can be grown successfully in rabi season also by adopting suitable variety as well as agronomic practices. Planting of maize in rabi season is recommended on the southern side of east - west ridge to harvest maximum sunshine (Khera et al. 1982).

Planting of maize on ridges made either manually or by tractor operated ridger requires about 100 - 125 man hr/ha. A planting attachment to a 3 - bottom tractor mounted ridger can reduce labour requirement substantially. A ridge planter for winter maize consists of a 3 - bottom tractor mounted ridger, planting mechanism, furrow openers and spring loaded ground wheel.

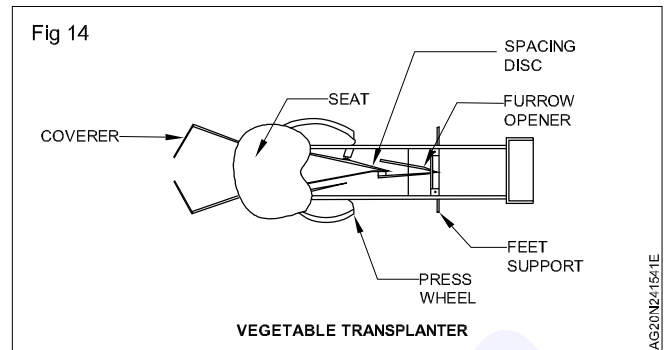
The distance between ridger bottoms can be adjusted as per requirement. Planting mechanism is of inclined plate type and has two units. Planting mechanism gets drive from spring loaded ground wheel, which moves in furrow. The machine has two furrow openers of reversible shovel type. These furrow openers are mounted on a frame, which

could be moved horizontally by an arrangement consisting of a set of levers and handle.

This handle can be operated by tractor operator while sitting on the tractor at the end of each turn so as to place furrow opener on the southern side of east - west



ridges. The furrow openers make furrows of 3 - 4 cm depth on the southern side of ridge and seeds are dropped in the furrows through transparent seed tubes. The machine maintains seed to seed spacing of 20 cm but can be adjusted as per need. It can cover about 1.5 ha/day.



Calibration and adjustments of planters, transplanter and row marker

Objectives: At the end of this lesson you shall be able to

- state the calibration and adjustment of planters
- state the calibration and adjustments of transplanters
- state the adjustments of row maker.

Calibration of planters

Planters should be carefully calibrated before sowing starts and this should be done every season because seed size varies and machinery wear can alter rates. Machinery manufacturers supply tables which give some indication of rate and these are a reasonable starting point. Actual calibration is not difficult once you have selected the rate required. This will be dependent on the required established plant population.

The simplest method of calibration is as follows

- Place some of the seed to be sown in the planter box
- Unhook the seeding tubes and tie bags over the outlets in order to collect any seed which would normally go down the tube.
- With the sowing mechanism engaged drive the planter over a measured distance (D meters), minimum distance 100 metres.
- Remove the bags of seed and weigh them on accurate scales (W kg).
- Measure the width of the planter in meters (P metres).

The formula for sowing rate is

$$\text{kg seed per ha} = \frac{D \times W}{P}$$

Adjustments of planter

The planter should be in leveled position. Improperly leveled planter can inhibit the action of the row units parallel bar linkage. Row unit down force should be adjusted when adding or removing row unit attachment, if there is a significant change in soil condition or if the row units are bouncing when planting.

Too little down force can result in row unit bounce and subsequently, shallow seed placement. To change the

row width, first locate the center of the planter. Check whether any gear or chain is to be removed before moving the furrow opener. The hitch should be adjusted on the tractor as low as possible especially in hard soil. If possible, tractor rear wheel must be set in a way that planter ground wheel must run on tractor tracks. Never run the planter opener in the tractor wheel marks. Long residue can wrap around the row cleaners. In this case a lead coulter may be needed to cut the residue, before it can be moved out of the way by the row cleaners. Release the row closing wheel down force and use a chain or strap to restrain the closing wheels so they don't touch the ground. Then the plant is long enough so that the planter gets up to speed.

Calibration of transplanter

Adjust spacing in the row by changing the number of fingers on the disc or the sprockets of the spacing disc and gear wheels. Keep the frame horizontal during transplanting. Keep operators in their own position because the depth of planting also depends on their weight.

Adjustments of transplanter

The machine has provision for adjustments of number of seedlings per hill, depth transplanting and hill - to - hill distance. The depth of transplanting is maintained constant, automatically during transplanting. The hill space or plant to plant spacing can be adjusted and varies from 11 to 17 cm.

Employee the standard hitching procedure for mounted implements. Make the preliminary adjustment viz., check the worn out parts and lubricate them thoroughly with oil, adjust the depth of the furrow opener. Lift the equipment and rotate the drive wheel to ensure that the seeds are

falling freely from the metering device. Check the drive wheel is touching the ground fully. Check the penetration of the furrow opener. Start the operation. The furrow opener makes the furrow in which the plants are placed directly or by means of the transplanting mechanism. The inclined press wheels firm the soil around the roots to obtain a good contact and prevent wilting. Adjust the spacing in the row by changing the number of fingers on the disc or the sprockets of the spacing disc and gear wheels. Keep the frame horizontal during transplanting. Keep the operators in their own position because the depth of planting also depends on their weight.

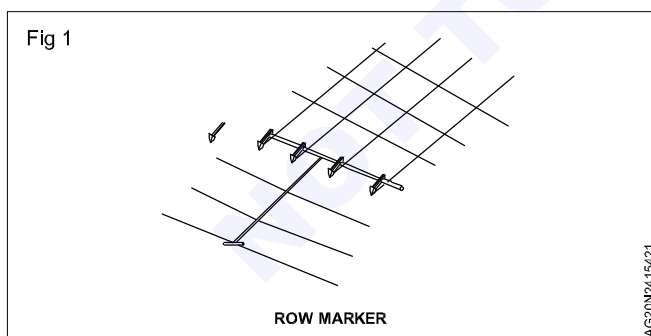
Gap of the seedling feeder in the front of the seed box. Holding position of the seedlings with claw, not to damage or bend seedlings. Number of the seedlings which are pulled out in one operation. At the normal condition, 3 - 4 seedlings should be pulled out and planted. Several sizes of claw are arranged and can be chosen according to the size of seedlings. Holding pressure of the claw, no to crush the seedlings.

Shifting speed of the seeding box to right and left, to supply moderate amount of the seedlings. Depth of planting that is adjusted by means of up and down the levelling plate and sledge.

The distance of the planting rows, under normal condition it is adjustable from 30 cm distance.

- Row marker
- Marking roller

Rows are drawn in one direction and then perpendicularly to the first ones (Fig 1). For providing correct spacing between rows after turnings, markers are used. While the planter is in operating position, lower one marker on the ground and set the markers outer part in such a way that in 2 row planter the mark should be 1.5 times the row width from the last row planted. With a 4 - row planter this should be 2.5 times and for a 6 - row planter it should be 3.5 times the row width from the last row planted. The center of the power unit must pass over the mark on each direction of travel to get equal spacing.



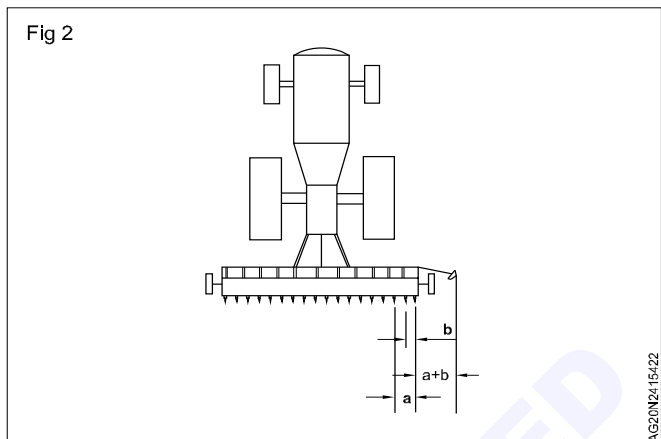
Good adjustment of the marker is essential for the subsequent cultivation of row crop (Fig 2)

The marker marks the line, which is followed by the front wheel of the tractor on the return run.

Drill which is hitched centrally behind the tractor, the following rule can be used.

The distance between the right front wheel of the tractor and right outside furrow opener+

One row width should equal the distance between the right outside furrow opener and the right marker.



Row spacing for different crops

Crops	Spacing
Rice	20 x 10 cm
Wheat	For normal sown crop: 20 to 22.5 cm between the rows For delayed sowing: 15 to 18 cm.
Maize	60 x 20 cm. For maximum yield - (60 x 15 cm)
Barly	Irrigated crops: 23 cm row spacing Rain fed crops: 23 - 25 cm row spacing
Oats	20 to 23 cm for fodder 23 to 25 cm for grain
Rye	Depth 2.5 cm. 20 to 25 cm row spacing
Sorghum	Sole sorghum: 45 x 15 or 45 x 10 cm (1,80,000 plants/ha) Intercropping and paired row system: 60//30 x 15 cm.
Bajra	45 x 15 cm
Red gram	Long and medium duration varieties: 75 x 30 cm Short duration: 45 x 30 cm Rain fed: 90 x 30 cm
Bengal gram	Kabuli type 45 x 10 cm and desi type 30 x 10 cm
Green gram	30 x 10 cm
Black gram	30 x 10 cm
Horse gram	30 x 10 cm
Cow pea	30 x 15 cm or 45 x 15 cm
Garden lab lab	90 x 90 cm (climber) 45 x 15 cm 45 x 30 cm

Field lab lab	90 x 30 cm and mixed crop 200 x 30 cm
Soybean	30 x 5 cm, for rain fed 30 x 10 cm
Tomato	60 x 30 - 45 cm, 75 x 60 cm and 75 x 75 cm
Brinjal	75 - 90 cm x 60 - 75 cm
Chilli	45 - 60 cm
Okra	45 x 20 cm, 45 x 30 cm, 60 x 30 cm
Onion	15 x 8 -10 cm
Pumpkin	of 2.5 x 2.0 m
Bottle gourd	1.0 - 1.5 m
Bitter gourd	3.0 x 3.0 m
Potato	30 x 5 - 10 cm and 45 x 10 cm.

speed for planters

Potato planter	- >3.5 km/hr
Sugarcane planter	- 0.4 - 4 km/hr
Vegetable transplanter	- 1.5 ha/8 hrs
Paddy transplanter	- 250 - 320 man - ha/hr

Field operation of row crop planter, maize planter and cotton planter

Objectives: At the end of this lesson you shall be able to

- state the operation of planter
- describe the operation of row crop planter
- describe the methods of planting.

Operation of planter

In order to have a good quality work the planting material and the fertilizer should be placed at uniform depth and uniform quantity in all the furrow openers without causing any damage to the planting material. No furrow opener should be left opened and soil cover should be compacted firmly to promote easy germination. This can be obtained by carrying out the following operation procedure

Employ the standard hitching procedure for mounted implements. Reverse the tractor to seed cum fertilizer drill. Attach the left link, then the right link by adjusting the length of the right left arm, the top link and stabilizer chain after centering the equipment.

After the equipment is hitched to the tractor make the preliminary adjustment and carry out the daily maintenance.

Now fill the seed and fertilizer boxes 3/4th of its capacity, also assure that planting materials are free from clods etc.

Lift the equipment and rotate the drive wheel to ensure that planting materials are falling freely from the metering device, seed tube into the furrow opener.

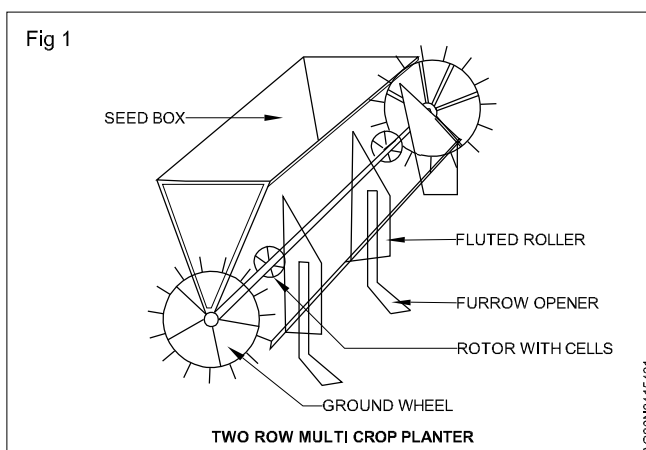
Take the equipment to the field; select the point from where the operation is to be started. As the tractor enters the field lower the equipment using the position control levers.

Check that the drive wheel is touching the ground fully, if not, lengthen the top link. Then continue driving the tractor for about 10 meters distance and stop again. Check to see the drop of planting material and fertilizers. Also check the penetration of furrow openers. If the desired depth is not obtained adjust the position control lever, till the desired

depth of planting is obtained. Continue the above sequence of operation at the other end of the field to assure best efficiency or output from the equipment.

Once the check and adjustments have been made, divide the field into lands of approximately 25 - meter width and mark the land at both the ends along with the field. The headland should be 1.5 times of the total length of tractor with equipment attachments from the outer end of field for mounted type drills. Now start the operation along one side of the first land leaving a strip of land equal to the headland. Make the adjustment in the depth if necessary and level the settings. At the end of the first pass take a left - hand turn in the head land at a distance slightly greater than the most convenient turning circle of the tractor. After the second pass again take a left hand turn and continue the operation on the left side of the first pass. Continue in the same manner and finish the operation in the first land, then move to the second land and so on.

Operation of row crop planter



Three - row inclined plate planter is a multi - crop planter for planting of bold and small seeds. The plate thickness, number and size of cells on seed plate vary according to seed size and desired plant - to - plant spacing (Fig 1).

Shoe type furrow openers ensure deeper seed placement in moist zone for sowing under dry land conditions. Modular seed box- furrow opener units are adjustable for sowing seeds at different row - to - row spacing. Drive to seed metering mechanism is transmitted from ground wheel through chain and sprockets. Ground wheel and power transmission system are fixed on the main frame. An optional fertilizer box with fluted roller type metering system can also be mounted on the main frame for application of granular fertilizers. Power from ground wheel is transmitted to the counter drive shaft through a set of chain and sprockets. Drive ratio between ground drive wheel and seed plate can be changed, by selecting appropriate size of sprocket on wheel axle or on counter and main drive shaft.

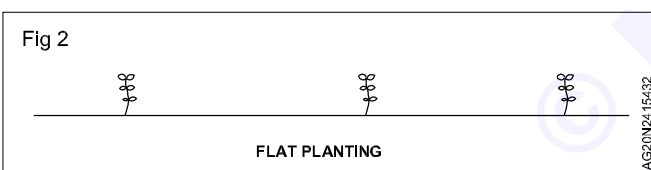
The operation is same in maize and cotton planters.

Methods of planting

The planting is carried out in various methods.

Flat land planting

A smooth level surface is used in flat and planting which is usually prepared by plough and harrow. Planters are then used to place seeds at the desired depth. This method is commonly used for maize planting (Fig 2).



Field operation of sugarcane planter

Objectives: At the end of this lesson you shall be able to

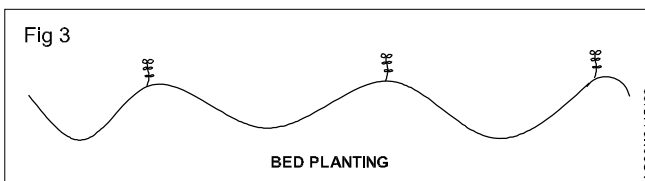
- state the operation of sugarcane planter
- state the operation of sugarcane cutter planter.

Sugarcane planter

It is used for planting sugarcane sets. Desired spacing between row to row and plant to plant is maintained for sugarcane planting (Fig 1). The fertilizer and chemical pesticides can be applied simultaneously. The machine consists of a hopper, two rotating distributor discs, two fertilizers, a pesticides tank with a distribution valves and two furrows openers. All these components are mounted on a frame and two wheels. The seed distributor box and applicator are powered from ground wheels through a set of roller chains and gears (not shown). Two persons are required to put sets in seed chute manually from the hopper. The machine is mounted on the tractor. It may require 4 - 6 men for field operations.

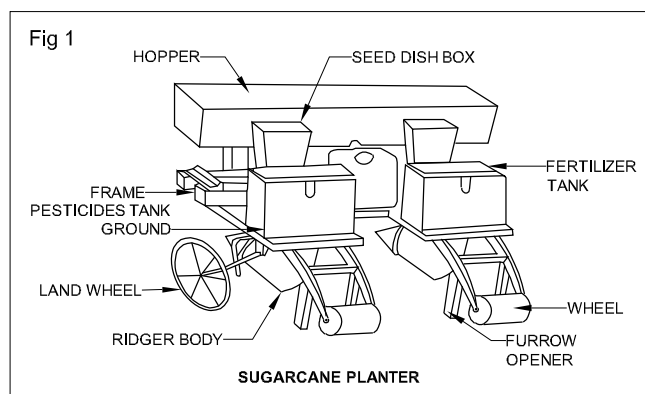
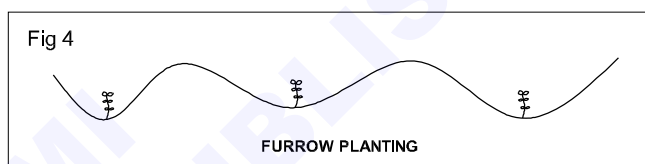
Bed or ridge planting

This method is common in irrigated areas and high rainfall areas to improve surface drainage. Ridge planting allows the soil to dry rapidly and is used as a guard against excess moisture. This method is commonly used for cotton planting (Fig 3).



Lister or furrow planting

Land preparation is same as that of ridge planting but instead of planting on the ridge, the seed is planted in the furrow or trench. This method is most common in semi - arid areas for row crops such as sorghum, maize and cotton. Furrow planting places the seed deep into moist soil and young plants in the furrow tend to be protected from the weather (Fig 4).



Operation of sugarcane planter

In this machine, two persons sitting on the machine lift the sets from hopper (1) and fill the compartment of roto - drums by sugarcane setts. The hopper is filled with

setts before starting the operation. The moving roto - drum drops the setts in the feeding chute (3), which place them in the furrows. Chemical and fertilizer are also applied side by side before covering the setts.

Operation of sugarcane cutting planter

For the operation, two labourers sitting on the machine feed complete sugarcane one by one into the sett cutting unit by picking from the seed hopper. The rotating blades cut the setts automatically before dropping into the furrows.

Fertilizer and chemicals are also applied simultaneously along with the setts, before covering of furrows. The furrow - opening unit has two ridgers (4) mounted on the frame (5) for opening the furrow. The machine has two - set cutting units one for each row. Each set - cutting unit consists of rotating blades (not shown), which cut the cane into desired size before dropping into furrows. Fertilizer metering action is of gravity type. Chemical application is through nozzles.

Maintenance and storage of planters and transplanter

Objectives: At the end of this lesson you shall be able to

- describe the maintenance and storage of planters
- describe the maintenance and storage of transplanters.

Maintenance of planter

Maintenance schedule

Daily

- Clean the furrow openers, covering device and seed tube.
- Apply grease to all existing grease points.
- Check that all the nuts and bolts are properly tightened.
- Remove the remaining fertilizer and clean the fertilizer system.
- Ensure the replacement of the parts, if any broken.

Periodically

- At the end of the season check the entire machine and make a list of broken and worn out parts and ensure its repairs or replacement.
- Thoroughly clean the planting material and fertilizer hoppers and then apply a coating of heavy oil on moving parts.
- Clean the furrow openers, tubes and the metering system.
- Fertilizer system should be thoroughly cleaned by flushing with water, dried properly and a coil coating should be applied inside and outside of the fertilizer attachment.
- Roller chains should be removed, tagged and stored in a can of light oil.
- Detachable link chain should be coated with oil.

Maintenance of potato planter

- Adjust the hitch clevis when the planter is not in level.
- Adjust the knives or coverers and for proper planting depth.
- Adjust the height of hitch when the planter is not running in level.

Maintenance of sugarcane planter

The fertilizer box must be emptied and washed thoroughly every day. Frequent tightening of nuts and bolts. Cane

cutting knives be checked and sharpened if needed. Furrow shoe should be replaced when worn out. Regular cleaning and lubrication of moving part. The machine should be kept in shed and covered after use. Annual painting is recommended. Insecticide solution container is cleaned before the planting season and care should be taken that no foreign material goes into the container during filling.

Maintenance of cotton planter

- Store planter in a shade after use
- Empty the planter after use and clean them thoroughly.
- Apply rust preventing oil to the soil engaging parts.
- Empty the seed hoppers and clean them after use.

Maintenance of maize planter

- Keep the unit clean
- Keep all nuts and bolts tight
- Never leave fertilizer in the hoppers because they are of corrosive nature. Empty them after the days work and clean them thoroughly.
- Empty the seed hoppers and clean them after use.
- i Lubricate the following greasing points with a grease gun
- ii Grease nipples on the fertilizer shaft bearings (one on each side - as in Escorts planter)
- iii Grease nipples on the fertilizer shaft drive wheels (one on each wheel)
- iv Grease nipples on the packer- cum - drive wheel of the seed furrow opener (one on each wheel)
- v Grease nipples on the marker disc hubs (one on each hub)
- vi Apply rust preventing oil to the soil engaging parts when storing the planter after the season.
- vii Store the planter in a shed.

Storage of planter in off season

Clean planter with a pressure washer or high pressure air especially important to wash off all starter fertilizer to prevent corrosion. Remove plates and store on a wood dowel

hung horizontally. Remove seed plate doors do not stack on top of each other, use original boxes for storage. Release tension on press wheel springs. Check for missing insecticide spoons or banders. Make a list of needed repairs and parts. Mouse proof seed tubes (fabric softener sheets in seed hoppers). Save all new planter plate boxes for warranty use referral. Keep track of how many acres are seeded on a set of plates (write the date of purchase in owners manual or on the plates themselves). These procedures will extend life of the planter and seeding mechanism and maintain optimum stand establishment.

Transplanters

Maintenance of paddy transplanter

After operation, wash the machine the same day. Remove any dirt or obstacles in the rotating parts. After washing, wipe the water off thoroughly and thoroughly lubricate the rotating and sliding parts. Be sure to grease any rust prone parts.

When the transplanter will not be used for a long time, service it according to the periodic maintenance schedule and then store it in a well ventilated place which is protected from direct sunlight and rain. Place wooden blocks of about 30 cm high under the planting section (floats). Fully charge the battery. It is recommended to detach the battery from the machine and keep it in a dark cool place. Remove fuel from the fuel tank.

Maintenance of vegetable transplanter

- Check the sowing rate of a drill before use.
- Do not reverse during operation to prevent the furrow opener being filled with the soil.

- Do not press too hard the coverer and rear wheel to prevent displacement of seed in the furrow.

Storage of transplanter in off season

Lubricate all the moving parts with the lubricating oil when the transplanter is not in use. The transplanter should be stored in shed, to prevent rust formation. The equipment should be under protective covering.

Trouble shooting and remedies of planters

Common troubles are listed below with their remedies and causes :

- Sometimes, when new seed plates are attached, they do not move freely. It may be due to improper tightening of wing nut. Place one or more shin washers on to the seed plate gear post before fitting the cover plate.
- During operation, the furrow opener becomes more heavy due to seed and soil accumulation. It is due to improper seed bed preparation and not selecting suitable type of furrow opener.
- Seed tubes become choked due to more trash and knots in the field as well as in the seeds; have a look periodically and make it clean accordingly.
- Fertilizer not being properly metered this may be due to choked passage or due to presence of more clods.
- Keep the planter straight behind the tractor to follow the tractor steering.
- Avoid using broken seeds. Make necessary adjustment for allowing no grain damage during metering.

Cage wheel

Objectives : At the end of this lesson you shall be able to

- understand the function of cage wheels
- types of cage wheels
- components of cage wheels.

General

This is an iron wheel, lugged with L angles. The tractor will not work satisfactorily in ploughing / puddling of rice fields due to slippage of rubber wheels. To overcome this difficulty iron wheels are introduced which are called cage wheels.

The iron lugs provide required grip and facilitate easy movement of tractor in rice puddled field. Half cage wheels are fitted to the rubber tyre wheels and used. For full cage wheels, tyre wheels are removed and used. The width of full cage wheel is 1 m and that of the half cage wheel is 0.5 m.

Types

Cage wheels are of two types viz., half cage wheel (Fig 1) and full cage wheel (Fig 2).

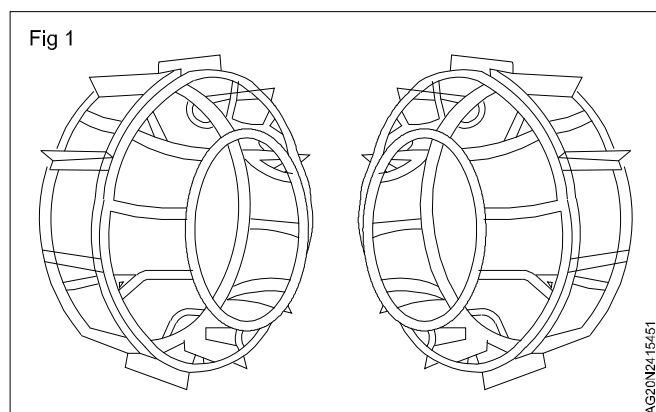
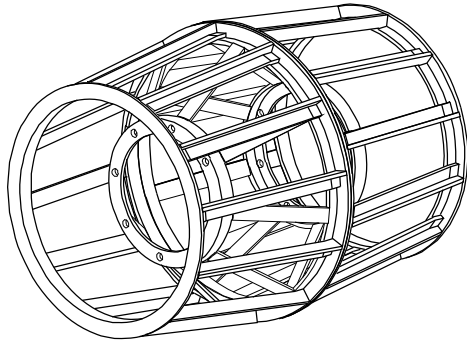


Fig 2



AG20N24-15/452

Half Cage Wheel

Full Cage

The cage wheel shall be of the following sizes :

- Type 1 - Suitable for 11'2/10-28 size of tractor tyres.
- Type 2 - Suitable for 12'4/11 - 28 size of tractor tyres.
- Type 3 - Suitable for 13'6/12 - 28 size of tractor tyres.
- Type 4 - S Suitable for 16'9/14 - 28 size of tractor tyres.

Material

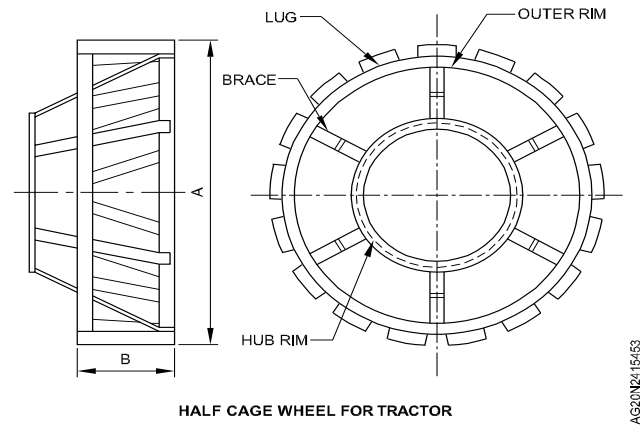
The material of various components of the half cage wheel shall be mild steel or any material having quality of at par with mild steel.

Dimensions

The wheel shall be so designed that when mounted on a matching tractor, the radial clearance between the dynamic radius of tyre and the cage wheel lugs, when the tyre is new and inflated to the recommended pressure, shall be minimum of 25 mm.

On the basis of the requirements the overall dimensions of various types of the cage wheel are standardised (Fig 3)

Fig 3



AG20N24-15/453

Components

Hub Rim - It is attached to the center of the tractor rim with the help of nut and bolts

Brace- It is used to join hub rim and outer rim and act as a support and bear few loads of the tractor

Outer Rim- it helps to take the side load of tractor and prevents shrinkage of the tractor in the puddle field

Lug - It is to provide the contact surface necessary to provide traction. As the tread lug enters the field contact area, or footprint,

Workmanship and finish

- The components shall be free from pits, burrs, cracks and other visual defects.
- The various components shall be rigidly attached and welding shall not be porous.
- The components shall be painted to prevent surface deterioration.

Marking

Each half cage wheel shall be marked with the manufacturer's name and registered trade mark, if any. Batch of code number shall also be marked.

Cage wheels may also be marked on the outer rim face as 'L.H.' or 'R.H.' as the case may be. Each half cage wheel may also be marked with the Standard Mark.

Pulverising roller and puddler

Objectives : At the end of this lesson you shall be able to

- state the components and working principle of puddling roller
- state the components and working principle of puddler.

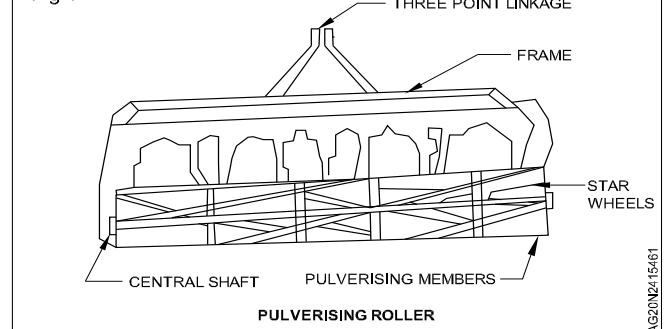
Pulversing roller

Uses

- It is used for puddling as well as dry seedbed preparation in two runs.
- Creates good puddle.
- It saves 20-35% fuel consumption and 20 - 30% water requirement in comparison to traditional method.

Components of pulverising roller

Fig 1

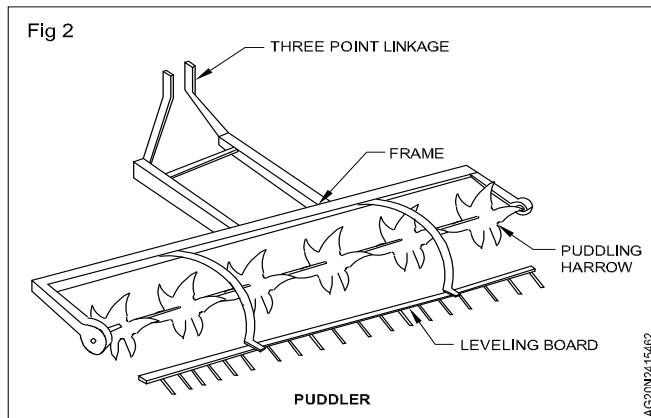


AG20N24-15/461

It consists of star wheels, central shaft, pulverizing members, mounting link and depth controlling tee (Fig 1).

The pulverizing members are similar to lawn mower blades and are inserted in the cast star wheels in such a way that it forms helical shape and progressively come in contact with soil. The roller is attached to the cultivator with the help of two mounting links having bearing housing on one side and tensile springs on other side.

Puddler



Uses

It is used for puddling of soil for paddy cultivation.

Components of puddler

It consists of mild steel angle iron frame, steel blades mounted on a shaft in a staggered fashion in straight position, handle and hitch arrangement (Fig 2)

Mild steel sheet

A mild steel sheet is provided on the frame so that the puddled splashes are not thrown on the operator during operation of the implement.

Shaft

The shaft carrying blades rotate in the bushes mounted on the frame.

Blade

The blades on the implement rotate and impart a lateral and turning action on the soil particles, thus achieving a good puddle.

Fertilizer applicator

Objectives: At the end of this lesson you shall be able to

- describe different types and components of fertilizer applicator
- explain about the operation of fertilizer applicator.

Agriculture fertilizer applicators : A fertilizer applicator / spreader consists of 4 main elements are as follows :

Hopper : Lowers the total center of gravity of the machine and facilitates the exit of the fertilizer.

Distribution : It is a tube that oscillates or served discs with pallets on which the fertilizer falls from the hopper. The element is driven through a hydraulic motor or through the PTO drive of tractor.

Dispenser : It is the element responsible for determining the amount of fertilizer that falls from the hopper to provide the optimal disc

Drive : They are driven through a tractor wheels carrying the machine.

There are three types of fertilizer applicators are used in the field. They are as follows :

- 1 Fertilizer spreader - distribute the fertilizer evenly with a low capacity of work
- 2 Centrifugal spreaders - very simple and low cost & achieve a homogenous distribution of fertilizer.
- 3 Pneumatic fertilizer spreaders - it is very efficient and expensive, it is suitable for big forms.

Constructional details of fertilizer applicator

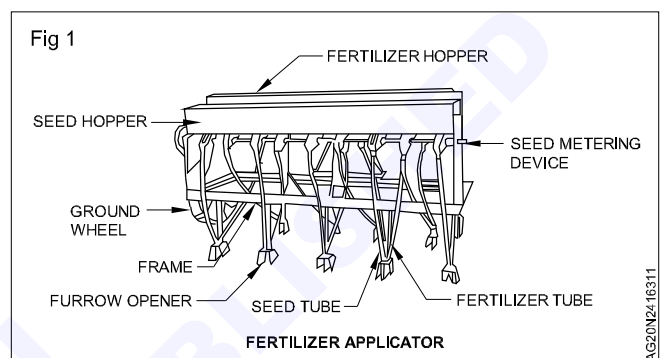
Fertilizers are widely used in horticulture to provide plants with the foods they require for economic growth. Distributors are used in order that fertilizers can be spread evenly over large areas so that each plant gets an equal share.

Good fertilizer applicators should meet the following requirements and these should be considered when selecting a new machine.

- They should be able to spread both granular and powdered fertilizers at a wide range of applications and rate of $\frac{1}{2}$ to 10 ounces per square yard (17 to 335 grams per square meter).
- The application rates should be easily adjustable.
- They should be easily dismantled for cleaning
- They should be made of plastics and other non corroding materials.

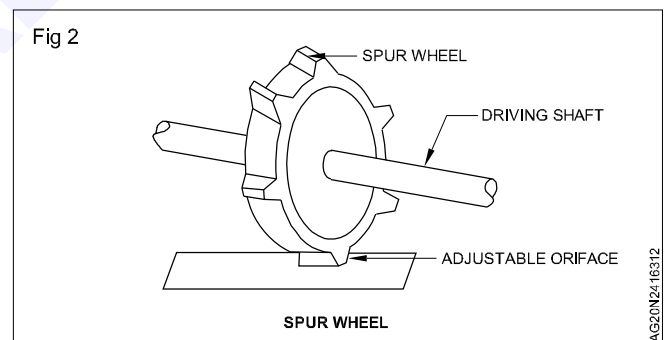
The fertilizer applicator consists of seed box, fertilizer box, seed metering mechanism, fertilizer metering mechanism seed tubes, furrow openers, seed rate adjusting lever and transport cum power transmitting wheel. A shaft drives the fluted rollers. Fluted rollers, which are mounted at the bottom of the seed box, receive the seeds into longitudinal groove fluted roller and expel them in the seed tube

attached to the furrow openers. By shifting the rollers side ways, the length of the grooves exposed to the seed, can be increased or decreased and hence the amount of seed sown in changed. The seed cum fertilizer application is popular in northern region of the country (Fig 1).

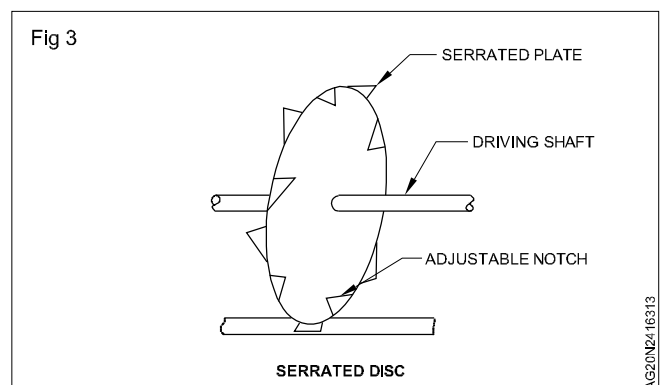


Fertilizer metering mechanism

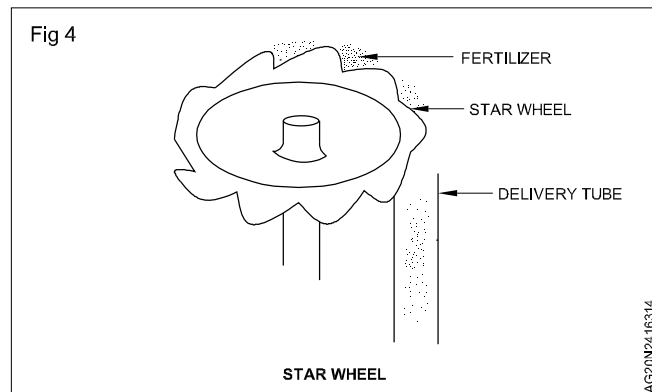
Spur wheel: The spur wheel is made of aluminum casting mounted on a square shaft. The width of the spur wheel is more than the aperture or notch to prevent the gravitational flow of fertilizer when the drill is in rest (Fig 2).



Serrated disc: The circular disc carrying the serration on the periphery rotates through an adjustable notch to meter the fertilizer. The system has a tendency to let the fertilizer flow gravitationally. It has an advantage of crushing the small clods of fertilizer, if it chocks the notch (Fig 3).



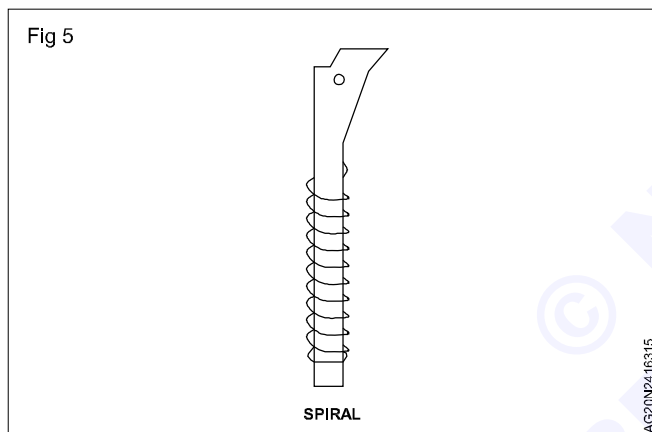
Star wheel is a horizontal disc carrying the stars on periphery meter the fertilizer eliminating the gravitational effect (Fig 4).



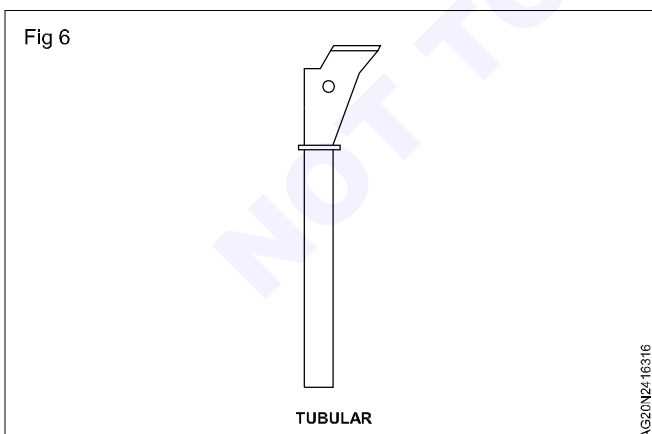
Seed/fertilizer dropping unit

It consists of cup, seed tube and seed boot. The fertilizer tubes in the use are as under.

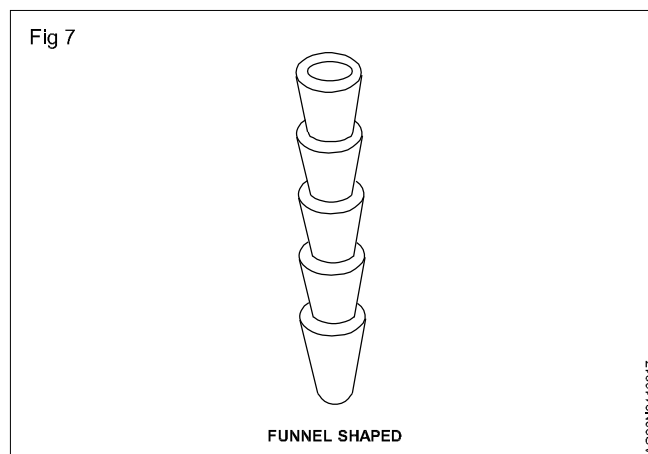
Spiral tubes : Made from steel strip. They are highly flexible and can be adjusted up to the height of furrow openers (Fig 5)



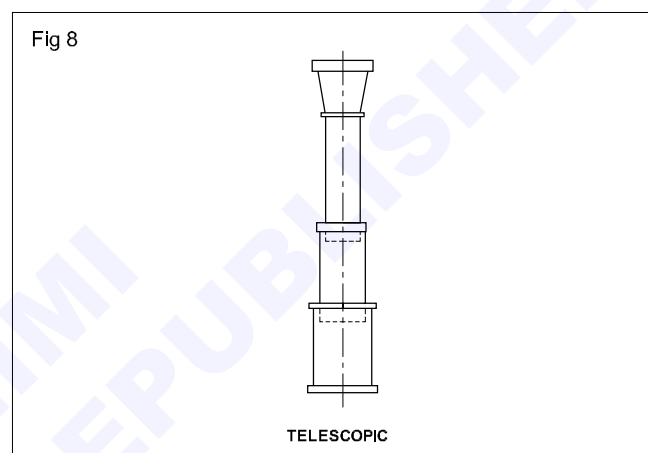
Polythene or rubber tubes: It is made of transparent plastic and found very useful as the clogging and choking of tubes are easily detectable (Fig 6).



Funnel shaped tubes : They are made up of flexible PVC and consists of a series of funnels individually suspended by chains. They are used to deliver material that does not flow freely, especially fertilizers (Fig 7).



Telescopic tubes : They are adjustable in height plastics and ensure a high degree of uniformity in sowings. They are adjustable in height but are not flexible (Fig 8).

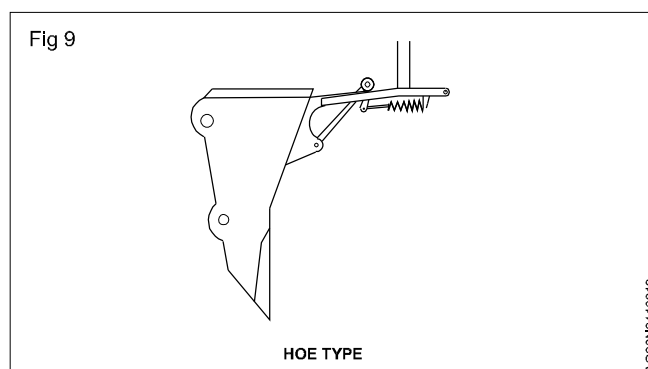


Types of furrow openers

It is used to open a furrow in the soil at uniform depth. The different types of furrow openers in use are as follows.

Hoe types

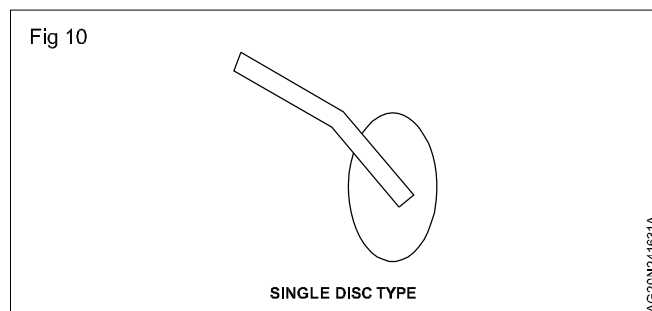
It is fitted with single point or reversible type shovels followed by single or double delivery boots, attached to it. It is suitable for light medium soil, free of excessive trash. This type of opener has a good penetration and when its shanks are equipped with automatic tripping mechanism (spring loaded) then it is very much suitable for stony and root infesting soil (Fig 9).



Shoe type : This type drops fertilizers in separate band at same depth. An inclined plate guides the fertilizer to the sides of the furrow wall. The fertilizer are placed 50 cm apart from each other. The fertilizer is sown in a band at the side in a band at the side of the seed at equal depth. The furrow opener makes a narrow shaped groove in the soil. The length of the shoes helps in compacting the bottom of the furrow. It has the main advantage that it causes minimum disturbance to the soil, break the soil clods and needs low draft to work with it.

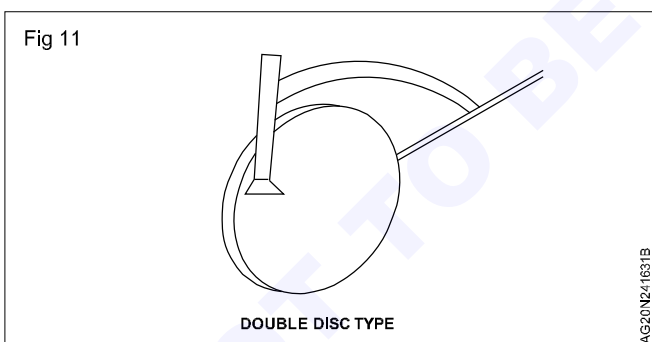
Single disc opener

A slightly curved disc, set to run at a slight where between penetrations is needed and seedbed contains the thrashes (Fig 10).



Double disc opener

In this type of furrow opener two disc facing each other at a slight angle from a cutting edge where it penetrates into the soil. The disc rotates as they are moved forward leaving a small centre ridge which causes seed to be deposited into row at about 25mm apart. These openers are especially suitable for deep sowing at relatively higher speeds. It is an ideal furrow opener for applying fertilizer in trashy seedbed (Fig 11).



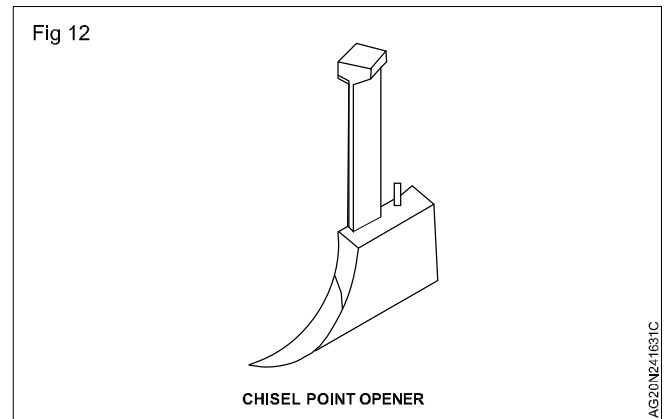
Chisel furrow openers

It is an opener made of a body with bar shape and has a sharp point projecting over the shoe. This type of furrow openers is especially suited for very hard and cloddy soils (Fig 12).

Furrow openers for placement of seed and fertilizer

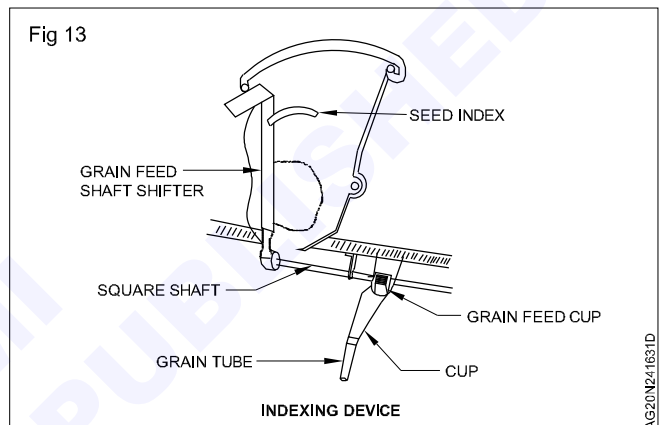
Fertilizer is recommended to be placed in a band 5cm from the seed at the same depth or 5 cm lower than the seed level. The recommended placement of fertilizer for this depth of seeding should be 8 - 12 cm.

Fig 12



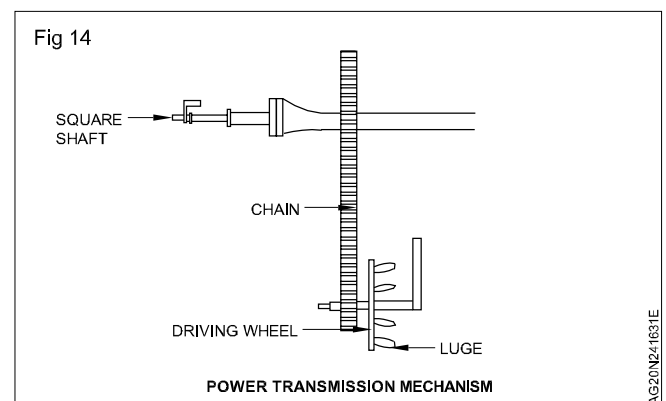
Indexing devices

A mechanical indexing device consists of a hand lever and semi - circle calibrated scale fixed to the box (Fig 13).



Power transmission mechanism

The side ground wheel or a center ground wheel receives the power from the ground and transmit it to the drive shaft and driven shaft of seed and fertilizer metering devices with the help of chain and sprocket or V - belts and pulleys arrangements (Fig 14).



Operation procedure

Reverse the tractor to seed cum fertilizer drill. Attach the left link, then the right link by adjusting the length of the right left arm, the top link and stabilizer chain after centering the equipment. Make the preliminary adjustment and carry out the daily maintenance. Fill the fertilizer boxes 3/4th of its capacity; also assure that seed and fertilizer are free from clods etc. Take the equipment to the field; select the point from where the operation is to be started. As the tractor

enters the field lower the equipment using the position control levers. Check that the drive wheel is touching the ground fully. Check the penetration of furrow openers. Start the operation.

Calibration of fertilizer applicator

Before taking a fertilizer drill/planter into the field it is very essential to calibrate its metering mechanism to obtain the required application rate per hectare or per acre of the crops to be planted. The following steps are followed in calibrating the fertilizer applicator

- Jack up the fertilizer and mark a reference point on the ground wheel.
- Measure the diameter of ground wheel. Let us say it is 'D' meter.
- Measure the working width of the drill or planter let us say it is 'W' meter

$W = n \times d$ Where,

n = no. of tynes

d = distance between two tynes (m)

Adjusting the lever on the indexing device till we get the fertilizer applicator rate, recommended for a particular crop under planting or sowing.

Care and maintenance of fertilizer applicators

- Check the suitability of metering systems
- Calibrate the metering system to obtain the desired seed rate
- Placement of seeds at proper depth.
- Check the performance of the attachment
- Check the corrosion of parts

Don't keep fertilizer in the machine overnight.

Don't keep the distributor outside overnight or when not in use.

Types of centrifugal pump and irrigation systems

Objectives: At the end of this lesson you shall be able to

- describe the sources of irrigation water
- describe the methods of irrigation and types of pump
- state the types and components of centrifugal pump
- dismantle and assemble the centrifugal pump.

Sources of irrigation water

Surface sources of irrigation water

Surface sources of farm irrigation water include streams, lakes and water - user organization distribution facilities. Another source of irrigation water that is becoming increasingly important is industrial and agricultural waste waters and sewage.

Streams

Flowing streams are an important source of irrigation water. Where stream - flows are large enough to meet irrigation demands throughout both wet and dry years, water needed for irrigation may be directly withdrawn from the stream. Pumping plants are used when it is necessary to "lift" stream flow to a higher elevation and or to pressurize pipelines.

Lakes

Lakes are another source of water for irrigation. As with streams, gravity diversions and pumping plants are used to withdraw water. Several years of water surface elevation data are needed to establish the suitability of a lake for irrigation and to design diversion structures and pumping plants. There are often legal barriers to the use for lakes for irrigation, such as prior water rights, laws mandating minimum water levels, and recreational rights.

Ground water sources

Ground water is water that occupies the voids within rocks and the soil. Subsurface material containing ground water may be divided into zones of saturation and aeration. Voids within the zone of saturation are completely filled with water, while the zone of aeration consists of voids occupied partially by water, ground water for air. Because only the zone of saturation contains drainable water, ground water for irrigation comes from the zone of saturation (and not from the zone of aeration).

Wells

An irrigation well is a conduit that conveys water from an aquifer to the ground surface (drainage wells provide water to an aquifer). Wells are either gravity, artesian, or a combination of gravity and artesian, depending on the type of aquifer supplying the water. Gravity wells penetrate unconfined aquifers, while artesian wells tap confined aquifers. Combination wells result when a well obtains water from confined and unconfined aquifers simultaneously.

Springs

A spring is a concentrated discharge of ground water appearing at the ground surface as flowing water. Springs may be the result of no gravitational forces such as those associated with volcanic rocks and deep fractures in the earth's crust. Such springs often discharge water that is highly mineralized and has elevated temperatures (e.g., hot springs and warm springs). Other major springs are the result of gravitational forces. The discharge of springs often fluctuates in response to variations in recharge rates. Perennial springs drain extensive permeable aquifers and flow throughout the year, whereas intermittent springs discharge only when there is sufficient recharge. Areas of volcanic rock are noted for their perennial springs of nearly constant discharge.

Methods of irrigation

Several methods of irrigation are used today depending on the water availability, the type of irrigated crop and the financial investment the grower is willing to make.

Flood irrigation

- A large amount of water is brought to the field and flows on the ground among the crops
- It is the cheapest method of irrigation
- It should be applied only to flat lands that do not concave or slope downhill so that the water can evenly flow to all parts of the field.
- Some of this wasted water accumulates at the edges of a field and is called run - off.
- In order to conserve some of this water, growers can trap the run - off in ponds and reuse it during the next round of flood irrigation.
- A large part of the wasted water cannot be reused due to massive loss via evaporation and transpiration.

Flush salts out of the soil which is important for many saline intolerant crops

Furrow irrigation

- Furrow irrigation is actually a type of flood irrigation in which the water poured on the field is directed to flow through narrow channels dug between the rows of crops.
- Like flood irrigation, furrow irrigation is rather cheap in areas where water is inexpensive.

It is a more expensive type of irrigation requiring more complex machinery than flood irrigation but it utilizes water more efficiently reducing the amount of water needed to irrigate a field.

- Even more water is lost through evaporation in spray irrigation compared to flood irrigation and plant diseases due to excess moisture can occur at over watering.
- A long hose is set to a water source on one side and on the side reaching the field, water is released through spray guns.

Drip irrigation

- It may be the most expensive method of irrigation.
- It is most advanced and efficient method in respect to effective water use.
- Usually used to irrigate fruits and vegetables, this system consists of perforated pipes that are placed by rows of crops or buried along their root lines and emit water directly onto the crops that need it
- As a result, evaporation is drastically reduced and 25% irrigation water is conserved in comparison to flood irrigation.
- It is also allows the grower to customize an irrigation program most beneficial to each crop.

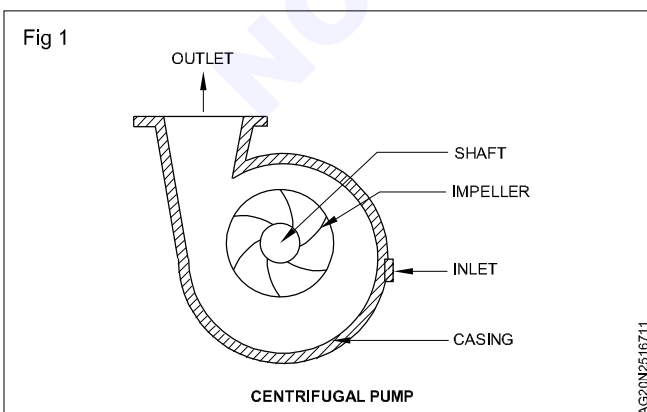
Water high in salts should be filtered before use since otherwise they may clog the emitters and create a local buildup of high salinity soil around the plants if the irrigation water contains soluble salts.

Irrigation pump types

The pump is a mechanical device, which raise the energy level of various fluids by converting the kinetic energy imparted to it by the prime mover into hydraulic energy. The prime mover may be man/animal pair, I.C. engine, electric motor, wind or tidal power.

- Irrigation pumps can basically be classified as
- Positive displacement pump
- Variable displacement pump

Centrifugal pump



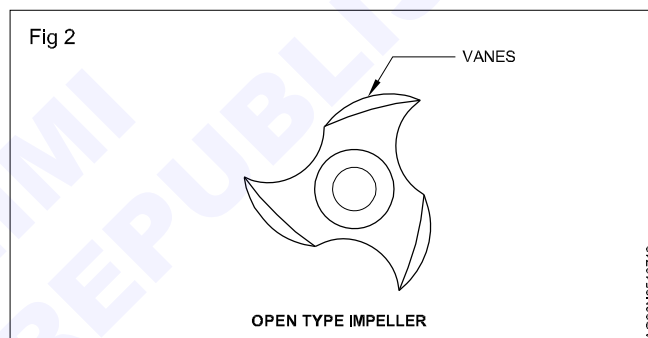
Centrifugal pump comes under variable displacement pump category i.e. as the pumping head increases the rate of pumping decreases. Centrifugal pump receives energy from its prime mover and imparts it to the liquid being pumped by centrifugal force. The liquid is forced into the impeller by atmospheric pressure, once the impeller starts rotating it forces out the water present in the casing as well as suction line, thereby creating a pressure drop in the suction line (Fig 1).

Components of centrifugal pump

The pump has following components

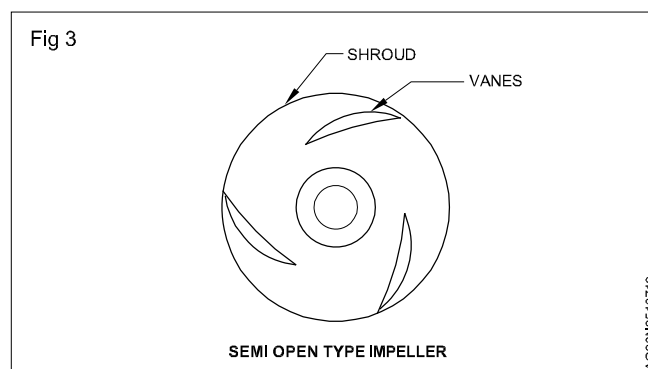
Impeller: The impeller is the most important part of the pump and is responsible for the performance of the pump. These are made up of bronze, cast iron or steel. From mechanical design point of view the impellers are classified as

Open impeller: In these impellers curved vanes are attached to a central hub for shaft mounting without any shrouds of side - walls. Open impellers are used in small size pumps mostly for abrasive liquid (Fig 2)

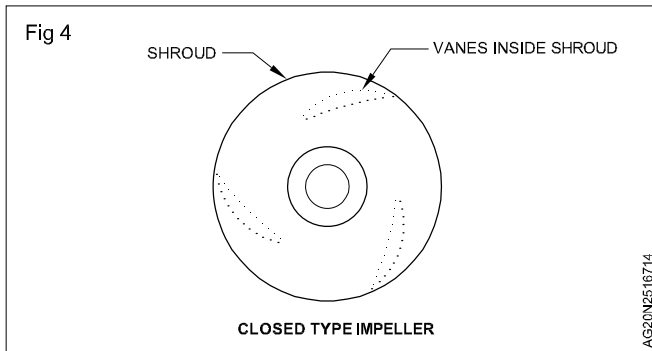


Semi - open impellers

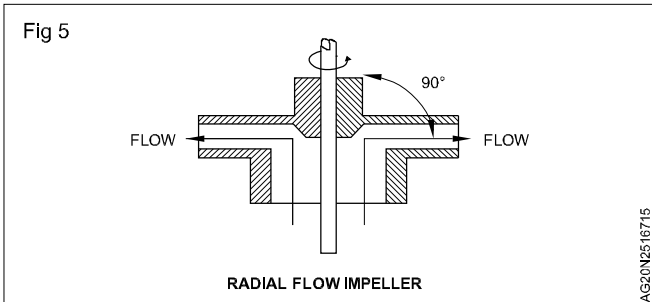
This type of impeller has got shrouding wall on one side only. These impellers are used in the pumps for sewage disposal. As the particle size of impurity in water increases, number or vanes is reduced (Fig 3)



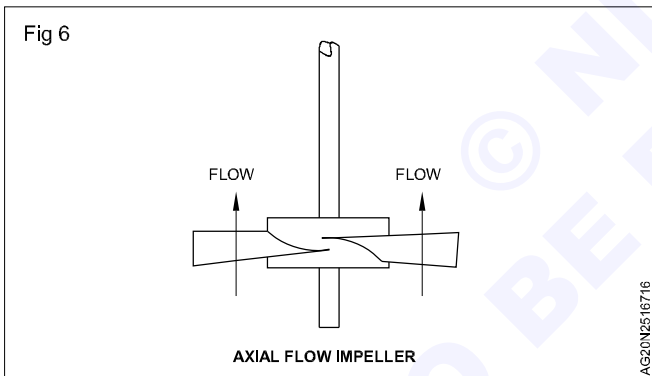
Closed impeller: All ordinary water pumps are provided with closed type impeller in which vanes are enclosed by shrouds on both sides (Fig 4)



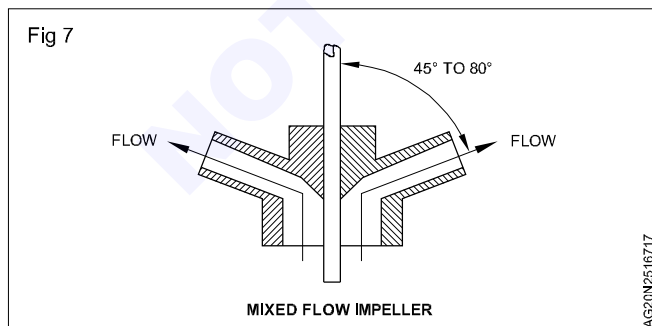
Radial flow impeller: Liquid enters radial flow impellers in a plane parallel to the axis of rotation and is discharged at 90° to it (Fig 5).



Axial flow impeller: Impellers that receive and discharge water in a plane parallel to the axis of rotation are known as propeller or axial flow impellers (Fig 6).



Mixed flow impeller : It receive water in a plane parallel to the axis of rotation and discharge it at an angle that is between 0 and 90° to the axis of rotation (Fig 7).

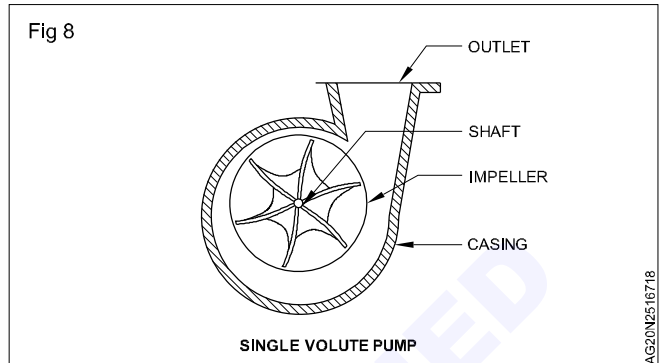


Casing It is made up of cast iron. The main function of the casing is to form a pressure at suction end may be as less as $1/10$ th of atmospheric pressure and delivery end

may be as high as 20 times the atmospheric pressure. Various types of casings are

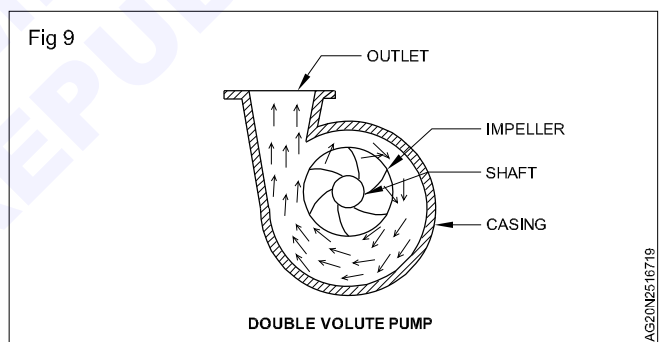
Single volute casings

Uniform or near uniform pressures act on the impeller when the pump is operated at design capacity (i.e operated at or near peak efficiency) (Fig 8).



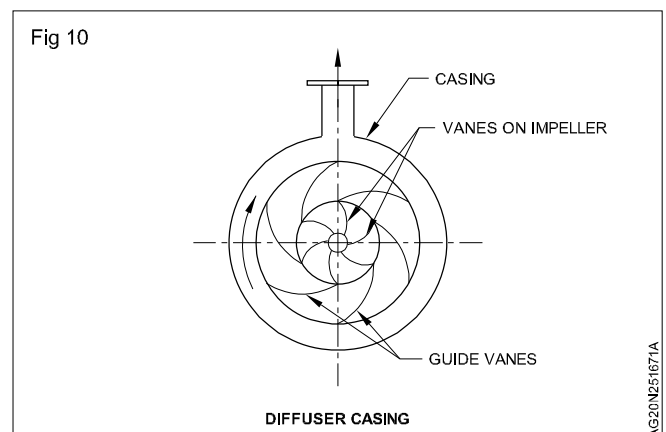
Double volute casing

It should be used when pumps are expected to operate at part - capacity for extended periods of time because radial forces are more balanced. It is also used in situations where the rib that separates the first and second volutes is needed to strengthen the casing (Fig 9).



Diffuser turbine casing

Stationary vanes surrounding the impeller that guide water from the impeller into volute or circular shaped casings. Fluid pressure usually rises as it passes through diffusers because of the progressive increase in cross - sectional area between vanes in the direction of flow. Diffuser vanes provide a more uniform distribution of pressure in the casing and are used in multistage pumps (Fig 10).



Shaft Power to the impeller is provided through shaft which is the single unit carrying all rotating parts of pump.

Stuffing box:

The purpose of stuffing box is to seal the space around the rotating shaft where it passes through the delivery casing of the pump. The stuffing box is entirely filled with packing, which is pressed tight by means of gland.

Bearings

Bearings are the mediums, which keep the shaft in correct alignment with the stationary parts under the action of radial and axial thrust.

Couplings

The prime - mover is connected to the pump through a coupling which can be either rigid or flexible. A coupling that neither permits axial nor radial thrust is called rigid coupling where as flexible coupling is a device that connects the two shafts for transmitting torque without

slip, capable of absorbing disturbances in motion arising out of misalignment.

Advantages

- High efficiency over a range of operating conditions.
- Easy to install.
- Simple, economical and adaptable to many situations.
- Electric, engine or tractor power can be used.
- Does not overload.

Disadvantages

- Suction lift is limited. It needs to be within 4m of the water level.
- Priming required.
- Loss of prime can damage pump.
- If the TDH is much lower than design value, the motor may overload.

Installation, operation, adjustments, repair & maintenance of Centrifugal pump

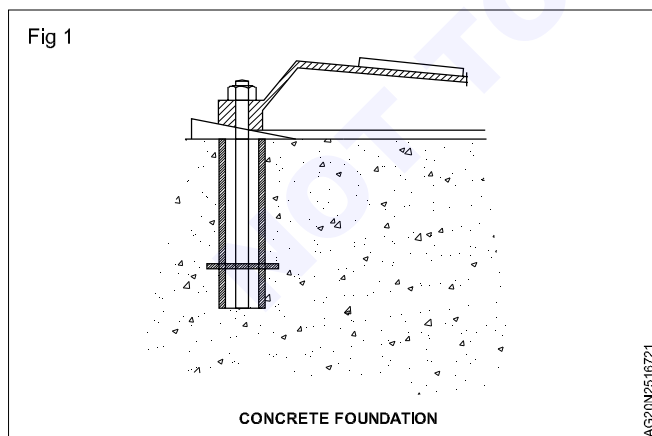
Objectives: At the end of this lesson you shall be able to

- describe the installation and operation of centrifugal pump
- state the adjustments of centrifugal pump
- describe the repair and maintenance of centrifugal pump.

Installation of centrifugal pump

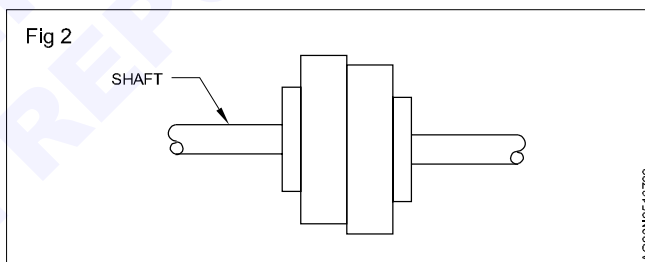
Proper installation of a centrifugal pump ensures its prolonged trouble free service.

Foundation the pump is connected with the prime - mover the foundation is responsible for the alignment also. The foundation should be made of concrete in the ratio 1:3:5 of cement sand and concrete. Steel girder and wooden beams are also used as pump foundations. For fixing the bolt into the foundations, pipe sleeves should be used (Fig 1).



Alignment

The pump and power unit must be carefully aligned. The pump along with prime - mover supplied by manufacturer is fitted on the same base plate which is already aligned. After fixing the unit on the foundation the alignment should be checked (Fig 2).



Grouting: When alignment is confirmed then the foundation bolt should be moderately tightened, don't over tighten. Thereafter, the sides of the unit should be filled by concrete. Till the concrete is cured fully, the foundation bolts should not be fully tightened.

Pipe fitting

Suction and delivery pipes should be given support so that the flange bolts when tightened, the pump casing should not be strained.

Suction pipe

Suction piping should be as direct as and shortest as possible with minimum number of bends. Sharp bends should be avoided, and the joints are airtight.

At the other end of the suction pipe inside the water is the foot valve, which should be at least 60 cms away from the bottom and sides of the well.

Delivery pipe While selecting delivery pipe it should give the minimum friction loss. A check valve (Non - return) and a gate or sluice valve (Regulating valve) should be installed in the discharge line as near as possible.

Operation

- Prior to starting the pump
- Check the alignment of the pump
- Check the direction of rotation of pump
- Make sure that the gland is lightly and evenly adjusted and the pump shaft revolves freely when turned by hand.
- Check any leakage in foot valve.
- Check the lubrication points.
- **Priming:** Fill the suction line and casing with water so that the air inside it is removed.
- Once started, the pump practically requires no attention while running. Before stopping the pump, the discharge valve is closed in order to prevent water hammering.

Adjustments for centrifugal pump

Open impellers are frequently used in centrifugal pumps which pump liquids that contain suspended solid materials (slurries, paper stock, etc). They do not plug as easily as closed impellers and usually have a simple external adjustment to maintain the correct impeller clearance as internal parts wear.

- T wear plate to achieve high efficiency and good performance.
- Check the clearance and adjustments regularly to maintain good performance.

However, as the impeller is adjusted toward the suction wear plate, the clearance behind the impeller increases. Most open impellers have small vanes on the non - pumping side, called “back pump - out vanes”. These vanes act like another centrifugal pump and have the purpose of maintaining a low pressure at the stuffing box. Without these vanes, the stuffing box pressure would be close to the discharge pressure of the pump, which could result in contamination of the packing and low packing life.

- Adjust the impeller clearance, if pump performance is reduced.
- Check the suction - and back - side clearances, if packing life is reduced.
- Install thinner gasket between the pump volute and the stuffing box cover so that correct clearance can be achieved.

Maintenance

- Maintain the suction - side clearance for good pumping performance.
- Maintain also the back - side clearance for long packing life.
- Check the bearing and lubricate them every month
- Clean the bearing and other moving parts with kerosene or diesel
- Dismantle and clean thoroughly for replacing the wear and tear of each part every year.

Troubles and their remedies

Sl.No	Troubles	Causes	Remedies
1	No water delivered	Pump is not primed Discharge head is too high Suction lift too high Impeller or suction pipe Completely plugged Air pocket in suction line	Prime the pump Lower the discharge head Lower the suction height Clean the suction pipe and impeller Remove air by priming
2	Enough Water not delivered	Discharge head higher than anticipated Suction lift too high Impeller or suction pipe partially plugged Foot valve too small Insufficient submergence of suction inlet	Lower the discharge head Lower the suction height Clean the impeller or suction pipe Replace large foot valve Submerge inlet fully in water
3	Not enough pressure developed	Excessive amount of air or gas in liquid Impeller diameter too small Damaged impeller	Prime the pump Change the impeller Replace the impeller
4	Pump works for a while and then loses priming	Excessive amount of air or gas in liquid Air pocket in suction line Water seal tube clogged Water seal ring improperly located Suction lift too high Insufficient submergence of suction inlet	Pump needs priming Prime the pump Clean it Locate it in correct position Lower the suction height Submerge the suction fully in the water
5	Stuffing box leaks excessively	Packing is worn or improperly lubricated Packing improperly installed Incorrect type of packing Bent shaft	Replace the packing Install properly Change the packing Replace the shaft
6	Pump noisy or vibrates	Suction lift too high Impeller or suction pipe Partially plugged Foundation not rigid Lack of lubrication Bearing worn out	Lower the suction height Clean it Lay foundation strongly Lubricate the rotating parts Replace the bearings

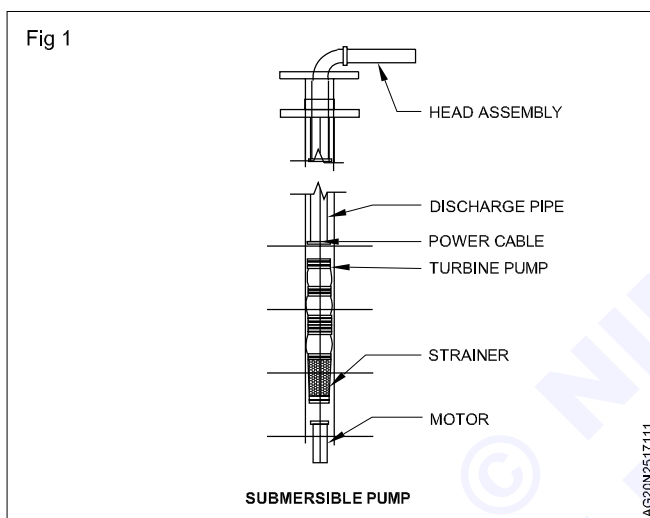
Construction and working principle of submersible pump

Objectives: At the end of this lesson you shall be able to

- state the components of submersible pump
- explain the boring a tube well
- explain the working principle of submersible pump.

Submersible pump

Submersible pump is nothing but a vertical multistage pump. This pump works on the same principle of variable displacement pump. The only difference is, the whole pump is submerged in water deep below the ground surface, thereby solving the problem of suction lift, since it is inside water.



Types of submersible pump

There are many types of Submersible pumps are used for various purposes. They are as follows

- Irrigation submersible pump
- Sand submersible pump
- Sewage submersible pumps
- Solar submersible pumps
- 12 volt submersible pumps
- Water submersible pumps

Components of submersible pump

Pump construction

The submersible pump consists of motor and pump assembly, a discharge column, and a water proof cable to carry the electric current to the motor submerged in water.

Pump element

The pump element consists of a propelling shaft made of stainless steel generally and on it is mounted the impeller made of bronze which generally is a closed type. Sometimes a semi - open type is also used.

Electric motor

The submersible electric motor has the same diameter as pump bowl, but much longer than an ordinary motor. It may be dry or wet type squirrel cage induction motor. In dry type, the motor is enclosed in a steel case filled with light oil having high dielectric strength. The wet type motor is to be filled with water during installation, which acts as a lubricant for the bearings during the first start.

Suction case with strainer

The suction case shall be fitted with a strainer made of corrosive resistant material.

Non - return valve: Non return valve is provided above the pump discharge case.

Coupling

A suitable coupling should be provided in between motor and pump.

Working principle

In this pump the water enters axially and comes out radially through the impeller i.e., the water enters through the center of the impeller (impeller eye) and comes out through the periphery. Since it is a multistage pump. i.e. another impeller is vertically above the first or the lower impeller, so it is necessary to change the flow of the liquid axially upward (to the impeller eye of the second impeller). The pump is close coupled to a small diameter submersible motor directly below the intake of pump. The pump element and motor operates entirely submerged in water. These pumps can lift water from a depth of 150m.

Installation, operation, adjustments, repair & maintenance of submersible pump

Objectives: At the end of this lesson you shall be able to

- describe the installation and operation of submersible pump
- state adjustment of submersible pump
- describe the repair and maintenance of submersible pump.

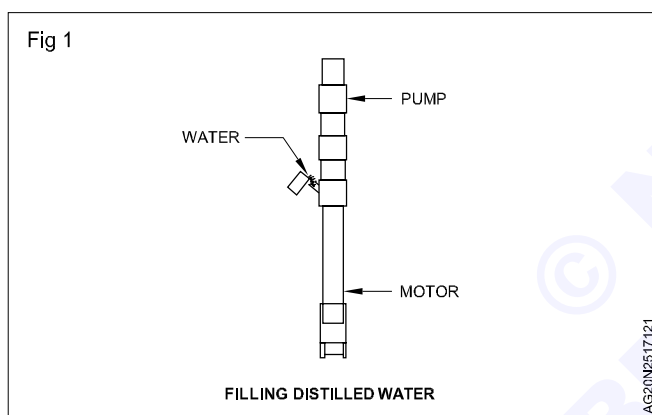
Submersible pump

Submersible pump is used in deep well or deep water sources, in which suction height is high. They are submerged inside the water source during installation and operation.

Installation and operation of submersible pump

The pumping set will be in two parts - one containing motor with ready connected cable. The other will contain the pumping set with non - return valve and cable guard.

- Clean the top of motor with kerosene after putting it vertically so that no dirt or grease should be present.
- Open the two water plugs provided on the motor adapter and fill the motor with cold clean and freshwater (Fig 1).



Insulation test

After rinsing the motor the insulation test is conducted as follows

Connect the megger's earth lead to motor adapter (while there is no dirt or grease to red, yellow and blue lead of the connecting cable by turn. When the handle of the megger is to be turned, it should be between 20 - 15 mega.

Continuity test

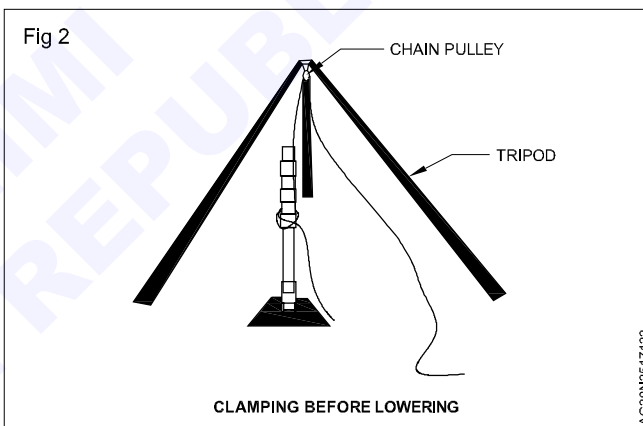
For star - delta connected motors (having six emerging lead) connect one lead of megger to red lead of connecting cable - 1 (R1) and other to red lead of connecting cable - 2 (R2) the reading should be zero. Similarly check between the blue lead (B1 & B2) and yellow lead (Y1 & Y2).

For motor with delta connections (having three emerging leads) connect one lead of megger to red and other to yellow and continuity will be indicated, the same procedure should follow in between red and blue and yellow and blue.

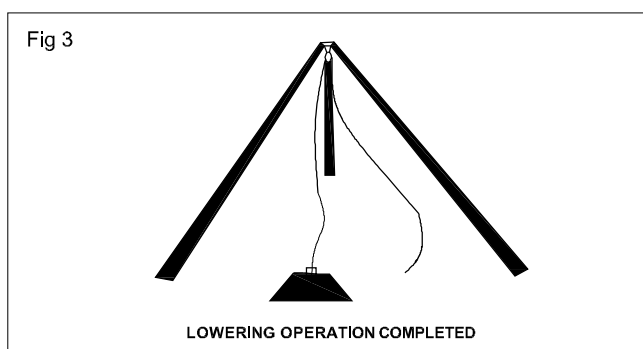
Coupling

After conducting the above test put the coupling on the sand guard with its circular groove on top. Similarly, for washing the pump pours about four gallons of water through non - return valve, so that the impellers and guide vanes are washed. Lift it vertically and slowly, lower it on the motor stands. Care should be taken so that the cable guards should match with cable. Tighten the nuts evenly so that no distortion takes place. For checking the alignment of pump and motor correct the pump rotating assembly when levered at the coupling with a screwdriver, which should lift slowly.

Lowering in the bore Now connect the first length of column pipe with the bottom of non - return valve and clamp column with supporting clamp (Fig 2).

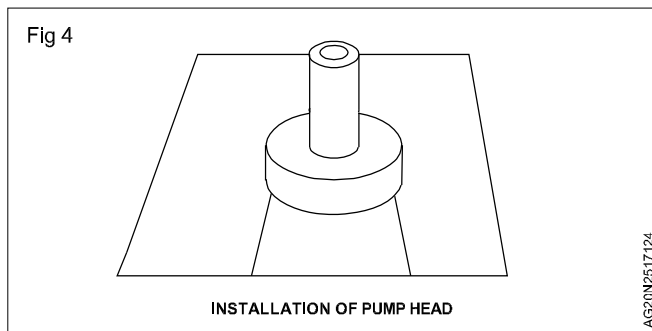


Lower the pumping set by means of chain pulley block and tripod, go on connecting the subsequent pipe lengths (Fig 3).



Fix the cable clip at the three meter interval at column piping to hold the cable - 1 position. During installation avoid distortion strain or pull on the cable. Otherwise the cable may be damaged. Lower the pump with additional length of pipe till pump reaches correct level in well. The pump should always be 3m below the water line in the

well and in no case it should rest in mud. Join the bend and sluice valve at the top, cover the open space so that nothing drops in the well casing to cause damage to the pump and install the head (Fig 4).



Operation

Before starting the pump

Check insulation with megger. Check all leads with megger to ground. Switch on the main, check the voltage, start the pump after rated voltage is obtained. Observe the phase indicating lamp, the glowing intensity of all the lamps should be same if not, do not start the pump incase of single phasing.

Perfect earthing should be done; mostly earthing wire is connected to delivery pipe.

After starting the pump

Check the direction of rotation and open the delivery valve fully. Check for vibration, power consumption and pressure gauge reading. Cable selection The cable used for the submersible motors should be PVC insulated copper or aluminum conductors.

Commissioning (Fig 5)

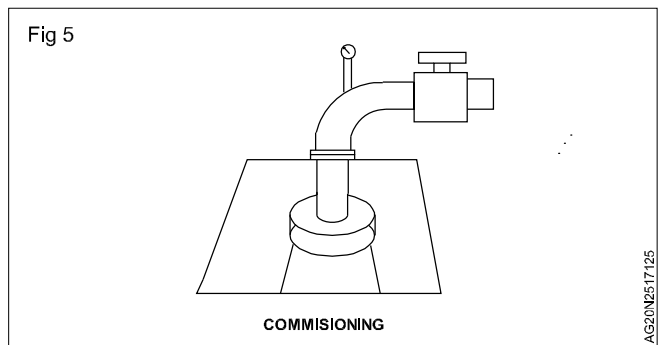
Adjustments of submersible pump

Remove the cover from the sump pump well. Shine the flashlight into the sump pump well. Visually check the well to insure there is no debris which might interfere with the impeller. Remove any debris that may have accumulated since your last maintenance check.

Inspect the inlet screen to insure it is free of any debris or obstruction. Remove any accumulated debris.

Pour water from the bucket into the well. Watch for the float to engage the float switch and trigger the pump. If the pump starts and the water level rapidly decreases, your sump pump system is in proper working order. Cover the sump pump well and prepare to inspect it again in one month. If the sump pump does not engage or if the water level does not decrease proceed to step four.

Unplug the sump pump from the electrical outlet. Inspect the float mechanism to insure there is nothing obstructing it. Adjust the sump pump by repositioning it in the well top revert the float from hanging. Plug the sump pump back into the electrical outlet.



Pour water from the bucket into the well. If the sump pump still fails to engage, the float and/or the float switch may need to be replaced. If the sump pump engages but does not shut off when the water level drops to normal, the float and/or float switch needs to be replaced.

Care and maintenance

Check the bearing, clean and lubricate them. Clean the pipe fittings and tighten the fittings if there is any leak. Clean the pump regularly from dirt, as advised by the manufacturer.

Bore a tube well

Bore well and tube well are very similar. Both are vertically drilled wells, bored into an underground aquifer in the earth surface, to extract water for various purposes. A bore well is a well 100 to 1500 ft deep in which PVC pipe of diameter 6 to 12 inches is used to extract ground water for irrigation purpose bore wells are constructed when low yielding ground water sources are found relatively close to the surface, usually under 30 meters. Bored wells are constructed using a rotary bucket angar.

Tube well

A tube well is a type of water well in which a long 100-200 millimeter (3.9 - 7.9 inch) wide stainless steel tube or pipe is bored underground. The lower end is fitted with a strainer and pump lifts water for irrigation. The required depth of the well depends on the depth of the water table. There are many types of tube well in our country. They are as follows.

- 1 Strainer type tube well, it is the most commonly used type of tube well.
- 2 Cavity type tube well is such a tube well, which does not require any strainer.
- 3 Slotted type tube well.

Working method of tube well

First a steel pipe with a sharp blade is inserted into the ground and used to dig into the soil. After the PVC tubes are slid into the narrow hole. At the base of the well are filters which strain out sand and allowing clean water to the sucked to the surface. Via a hand pump or electric submersible motor.

Method of Bore a tube well

Hand - operated or power driver earth auger are used for boring a well in shallow and unconsolidated aquifers. A simple auger has a cutting edge at the bottom of a cylindrical container or bucket. The auger bores into the ground with rotary motion.

Tools for bore a tube well

Air compressor, pneumatic rock. Drill, jet leg drill, jack hammer and mining tools. The various methods of drilling used for constructing deep tube wells are as follows.

- Cable tool method
- Hydraulic rotary method
- Reverse rotary method

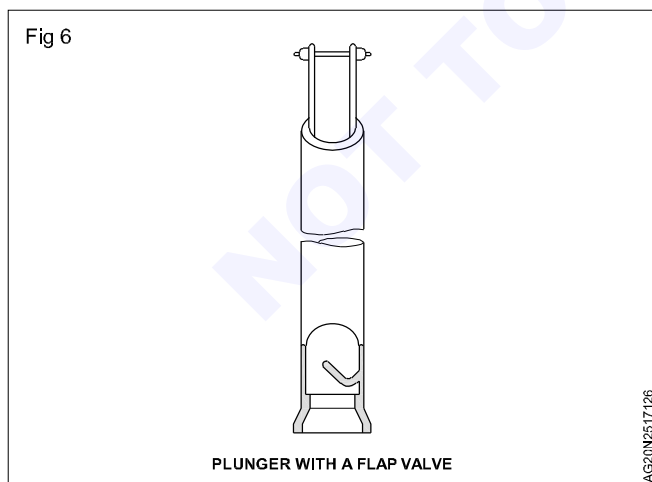
Drilling Method for Tube Wells

1 Percussion Boring Method

This method is suitable for the soft and fissured rock formations. This method consists in breaking and pulverizing the subsoil material by series of repeated blows with a cutter made of hard metal. The pulverized material mixes with water and it is then removed. Sometimes this method is also called cable tool method. Boring can be done manually or mechanically.

The blows are given by means of a plunger. The plunger consists of a hollow metal tube. A cutter is fixed to the bottom end of the plunger by riveting or welding. A ball valve made of steel is also provided at the bottom of the plunger. The valve such that it allows slurry of pulverized soil material in water to enter the plunger.

Once the slurry enters the plunger the valve closes and slurry is prevented from coming out. Thus the valve has only one way action. Sometimes flap valve may also be provided in the plunger. The purpose served is exactly the same as that of ball valve. Fig 6 Shows a flap valve. Thus plunger performs the function of a sludger and a bailer also.



The plunger can be lowered and raised in two ways:

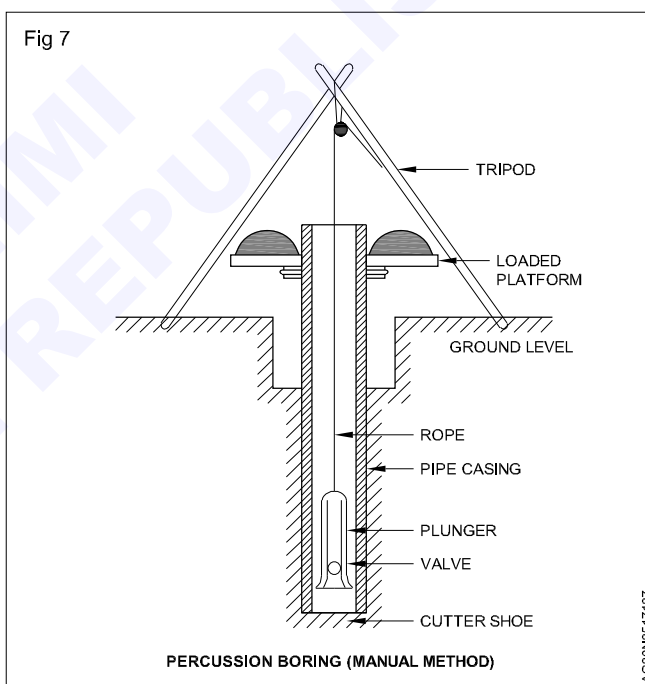
- 1 By rope system, and
- 2 By rod system.

In rope system the upper end of the plunger is attached to a rope. The rope runs over a pulley. The plunger is lifted up and released suddenly to give a blow. Rod system is similar in principle to the rope system. Only difference is rod replaces the rope and consequently the rod operating machinery is also changed. The disadvantage of rod system is, time is wasted in increasing or decreasing the rod length. The rod length can be increased or decreased by screwing or unscrewing small rod lengths.

The actual boring procedure by manual percussion method is as described below :

A pit is dug at the site where the tube well is to be sunk. The casing pipe with a cutter shoe is inserted in the pit. A platform is camped to the casing pipe. The platform is loaded by means of locally available material filled in jute bags.

Over the casing pipe a tripod is erected and a pulley is fixed to it centrally. A rope runs over the pulley. One end of the rope is attached to the plunger. The diameter of the plunger is slightly less than the casing pipe (say by 6 cm). the arrangement is clear from Fig 7



Before starting actual boring some water is poured in the hole. As the plunger gives blows during each blow slurry gets into the plunger. Blows are given repeatedly till the plunger is full of slurry. The plunger is then taken out and the slurry is removed by turning plunger upside down. The plunger is again lowered and the process repeated. Thus the casing pipe goes on sinking. When the length of casing pipe goes below the ground level sufficiently, additional pipe may be attached at the top of the first pipe. In order to increase working rate machine percussion, is used.

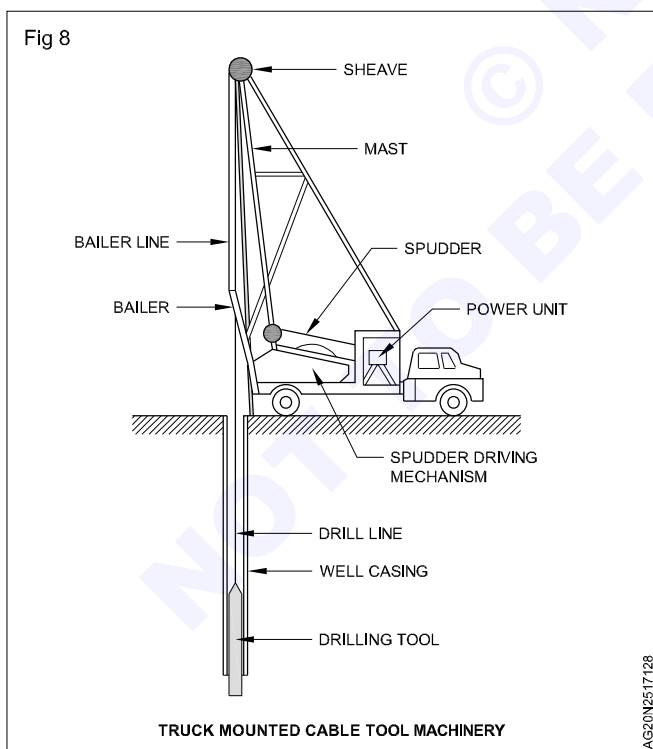
The material coming out is inspected carefully and a record is prepared, it is called logging. From the well log position of aquifers can be computed correctly. When the tube well casing pipe reached predetermined depth the platform

is removed and a pipe with strainers at the determined levels of aquifers is lowered in the hole. After lowering it up to required depth the strainer pipe is clamped. It gives support and prevents it from falling into the bottom of the hole. Then shrouding is started. In the beginning about 60 cm length of shrouding is done. Then the pipe casing is slowly removed by 30 cm.

The again 30 cm of shrouding is done and again pipe casing is lifted by about 30 cm. Thus the shrouding and pipe withdrawal is done slowly, successively and in small lifts of about 30 cm till the whole pipe casing is withdrawn. The amount of material required for shrouding per 30 cm length can be accurately calculated beforehand. It will depend naturally on the thickness of the gravel pack. Normally thickness of the gravel pack varies between 7.5 cm to 25 cm. The thickness of gravel pack should be such that it would not allow even finest particles to move.

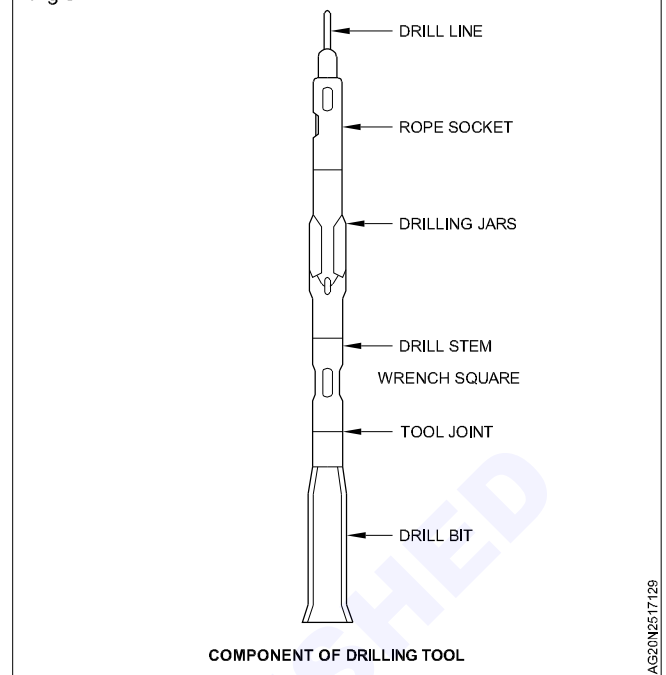
Machine Percussion or Cable tool Method

The machine used for tube well drilling is called a drilling rig. The rig for cable tool method is a truck mounted assembly from consideration of mobility and consists of a mast, a multiline hoist, a walking beam and an engine. Fig 8 shows the assembly. The string of tools includes drill bit, drill stem, drilling jars which serve as connecting links and rope socket for connecting drill line. Fig 9 shows components of drilling tool. Total weight of the tool varies from 100 to 2000 kg., because different types of bits are required for different rock formations. Length of drill bit varies from 1 to 3 m whereas drill stem is 2 to 10 m long.



The operation in principle is similar to manual method. The cable tool bit acts as a crusher for drilling in consolidated rocks. The drilling is performed by repeated blows of the drilling tool which makes about 40 to 60

Fig 9



strokes in one minutes. The drill line is rotated so that a round hole is drilled. As in the manual method water is added to the bore to form the slurry if the same is not present in the subsoil formation. After the bore is drilled by 1.2 to 1.5 m the drilling tools is removed and the slurry is taken out of the hole by means of sand pump or bailer.

The bailer has one way valve which permits slurry to enter the bailer but does not allow to escape. After the bailer is filled it is raised and emptied at surface. The length of the bailer also ranges from 3 to 12 m. In unconsolidated formations the well casing is inserted and simultaneously sunk to full depth of hole mainly. In solid crystalline rock formations the drilling rate could be as low as 2 to 3 m per day.

Drilling rate in loose flowing fine sand formations is equally low because it fills the hole as soon as material is bailed out. To check the sand in flow the hole can be kept filled with water. Drilling in unconsolidated formation with boulder is quite difficult because the boulders not only deflect the hole but they are hard to drill and prevent sinking of well casing. In soft formations, like sand stone or sandy clay, the drilling rate could be as high as 20 to 30 m per day. The bore is carefully logged to ascertain the position of various types of formation met with.

2 Rotary Boring Method

Hydraulic Rotary Boring Method

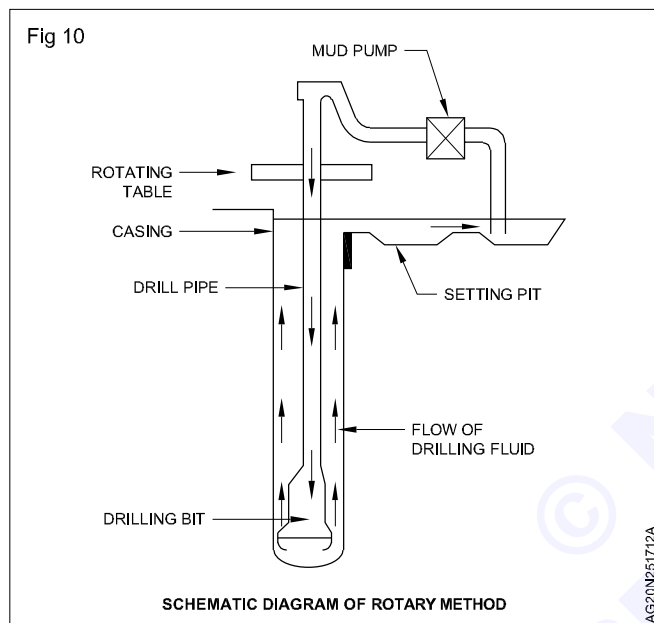
This method is generally called rotary boring method. This method can be successfully used for rock as well as unconsolidated formation. The method is therefore used for water well as well as oil well drilling. Oil wells are generally very deep and this method is well suited for them because unlike other methods the drilling rate is not dependent on the depth of the hole.

In this method drilling is done by means of rotating bits attached to lower end of hollow steel pipe. The steel pipe

is attached to a square section of a steel rod at the top which is called Kelly. Kelly fits in a rotating table at the surface. The rotating table is rotated by power. The powdered rock and cuttings are removed by continuous circulation of drilling fluid.

The hydraulic rotary drilling rig consists of a derrick or mast, a rotating table, a pump for injecting drilling mud, a hoist and an engine. The drill pipes are seamless steel tubings generally available in 6m lengths. The external diameter of the pipes ranges from 6 to 12 cm.

Generally adequate size of pipe is used because well drilling requires large quantity of drilling fluid in circulation. The drilling bits attached to the lower end of the drill pipe is provided with short nozzles to direct the jets of drilling fluid down the face of the blades of drilling bit. Fig 10 shows schematic diagram of rotary boring method.



The rotating table in which the Kelly fits in closely turns the drill. The drilling bit cuts through the formation and as the hole deepens the drill rod slides down. At this stage the Kelly is unfastened and pulled up to attach new length of pipe. The drilling fluid or bentonite (clay) slurry is pumped down through the drill pipe and out through the nozzles in the bit. The mud then rises to the surface through the annular space between drill pipe and the bore and removes the rock fragments and cuttings with it.

The drilling fluid performs following functions

- 1 It supports the walls of the bore and prevents caving.
- 2 It removes cutting from the bore hole.
- 3 It checks the inflow of groundwater into the well while drilling is in progress.
- 4 It cools the bit and lubricates the drill stem.
- 5 It prevents the cuttings from settling down on the bottom of the bore.
- 6 It softens the underground formation and speeds up drilling.

The drilling mud may seal low pressure water bearing formations it is necessary to control quantity of mud in the water. Once the drilling fluid comes to the surface, it is taken in a settling pit where rock fragments settle down. The cleaned fluid is re-circulated through the hole.

As boring progresses detailed logging of the subsurface formations met with is done. After the well is drilled to required depth a well pipe with strainer and blind lengths of determined sizes is lowered. Since the bore walls are coated with colloidal mixture of bentonite it becomes necessary to wash the walls.

It is called back-washing. For back-washing drill pipe with a collar of the size of the well pipe attached above the drill bit is again inserted. The pump forces the water containing calgon (sodium hexa-meta-phosphate) down the drill pipe.

The water rushes through the strainers and the calgon disperses the clay colloids deposited on the bore walls. To increase efficiency of back-wash the drill pipe is moved up and down to create surging action. The drilling rate by this method depends on type of subsurface formation penetrated and type of rig equipment used. Contrary to the cable tool method the rate of drilling by hydraulic rotary method does not depend upon the depth of the hole.

The rate of drilling in consolidated rock formations may vary from 10 to 15 m per day whereas in un-consolidated formations it may reach 100 to 150 m per day.

The main advantages of hydraulic rotary method are the followings

- 1 The drilling can go on continuously.
- 2 The drilling rates are quite high.
- 3 Casing pipe is not required. The mud forms a clay lining on the bore wall and it prevents caving.
- 4 When bore proves unsuccessful it can be abandoned right away as removal of casing pipe etc., is not involved.

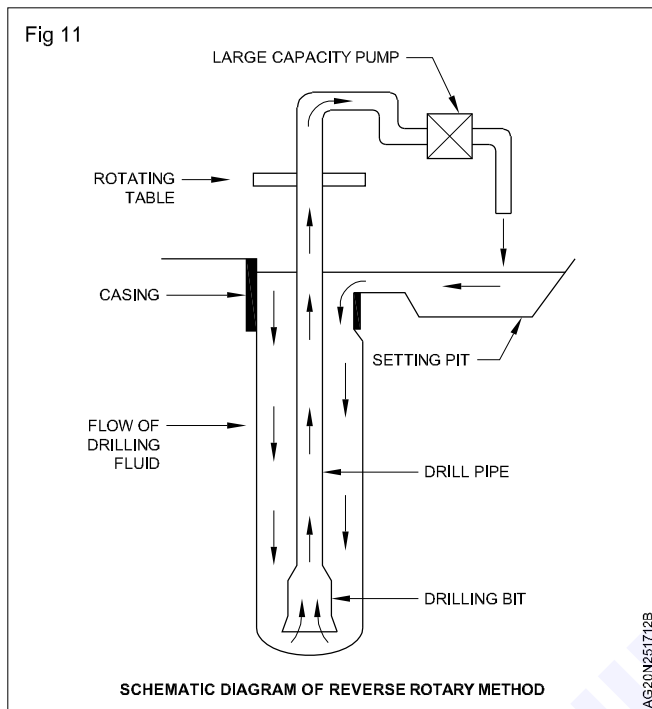
Reverse Rotary Boring Method

This method is called reverse rotary method because the flow of drilling fluid is reversed as compared to the (hydraulic) rotary boring method. The drilling rig used for reverse rotary method is similar to that used for rotary boring. There are however, two variations, The first is that the drill pipe is of larger diameter (say 15 cm) and second is that large capacity special pump with open blade rotors is used. The large diameter drill pipe enables as big 12 cm diameter size stones to be lifted up to the surface.

As drilling fluid only water is generally used. It moves into the bore hole through the annular space between the drill pipe and walls of the bore. The water picks up the cuttings and the mixture is sucked upward by the pump through the drill pipe. Due to force of suction the rising fluid has large velocity and it lifts with it big particles. Schematic diagram of the method is shown in Fig 11.

At the surface the mixture is discharged into a settling pit. The water picks up fine particles from the subsurface formations and it is not necessary to add bentonite or

any other mud to the water. The level of the drilling fluid inside the annular space should be kept up to the ground surface to prevent caving in of the hole. By this method it is possible to drill wells of big diameter say up to 150 cm. This is the cheapest method of drilling large diameter wells in soft unconsolidated formation made of sand, silt or soft clay.



Selection of Drilling Method

A Choice of particular drilling method depends upon:

- 1 Purpose of the well;
- 2 Quantity of discharge required;
- 3 Depth of water table
- 4 Type of subsurface formation; and
- 5 Type of equipment available.

Shallow wells of small diameter may be bored in unconsolidated formation by an auger operated manually.

Small capacity wells in unconsolidated formations may be drilled by self jetting well point method or water jet boring method.

All deep tube wells are constructed by drilling. Rotary methods are generally better for geological investigations whereas cable tool or percussion method is superior for study of water quality.

Method of revitalizing the tube well: The main components of this assembly are a air pipe of smaller diameter and a drop pipe of bigger diameter. The drop pipe is also called discharge pipe because the assembly is similar that of air lift pump assembly an air compressor is directly connected to an air tank, which in turn is connected to the air pipe through a quick opening valve.

In this method an assembly of air pipe of smaller diameter and drop or discharge pipe surrounding the air pipe is introduced into the well till it reaches nearly bottom of the first strainer pipe. The air pipe is so adjusted that its bottom end is about 30 cm about the lower end of discharge pipe. It is called pumping position of the air pipe.

The air is then compressed into the well to start pumping. The pumping is continued till the pumped water is free from sand. At this point air entry is cut off closing the valve. The tank is brought to full pressure by keeping the compressor on, in the meantime the air pipe is so lowered that now it emerges below the lower end of discharge pipe by 30 cm.

It can be called back washing position of the air pipe. Now the valve is quickly opened to allow sudden rushing entry of compressed air into the well. Because of heavy rush of air a surge of water is created, it forces the well water into the aquifer through the screen. The surge agitates the aquifer and dislodges the fine sand particles.

The air pipe is again raised inside the discharge pipe to a pumping position and as the pumping starts the direction of flow is reversed and now water enter the well through the soil. The entering water brings with it dislodged fine sand particles. The process of alternate air lift pumping and surging is continued till the qualifier is fully developed and sand flow is stopped. In the manner full aquifer is developed taking 1 to 2 m length of the screen at a time. Use the combined with surging bailing or pumping to improve its discharge.

Irrigation pumps and valves

Objectives: At the end of this lesson you shall be able to

- state the irrigation pumps
 - state the types of irrigation valve
 - state operation and maintenance of irrigation valves.
-

Irrigation pumps

Irrigation pumps are used to pump the water from lower to a higher level to raise the water pressure as required for irrigation piping system. Pumps can be classified into three major groups according to the method they use to move the water/fluid direct lift, displacement and gravity pumps.

Types of irrigation pumps

- Floating pumps/submersible pump
- Booster pump
- Turbine pump/Jet pump
- Submersible pumps
- End suction centrifugal pumps

Anyhow horizontal centrifugal pumps are the most common for irrigation. They are easier to install and inspect for maintenance than other types.

Selection of irrigation pump

Choosing an irrigation pump is based on the type of pump and also on the relationship between pump efficiency and the total dynamic head at a specific water flow rate. Many types of pumps are used in agriculture irrigation include centrifugal (above ground), deep well-turbine submersible, propeller type.

When selecting an irrigation pump consider the pumps operating conditions including.

- Type of water source
- Required water flow rate
- Total suction head
- Total dynamic head

Select the pump as the type of irrigation system, distance from the water source and size of the piping system will determine that flow rate and total dynamic head, if the application needs to lift water to the pump, a centrifugal pump must be used.

Above - ground centrifugal pumps are commonly used with surface water source or shallow ground water source surface is below the used limits of a centrifugal pump. The submersible pumps are used in Bore tube wells for irrigation must have three phase electrical power and wiring from the pump to the surface must be water tight with all connection sealed.

Propeller pumps are used for low lift, high flow rate conditions, propeller pumps cannot be used for suction lift as the impeller must be submersible in water.

Common prime movers in irrigation

Water lifting devices are usually termed as pumps, which are operated with the help of auxiliary power sources such as electric or mechanical. These pumps are capable of lifting large quantity of water to higher heads and are usually employed for the irrigation of horticultural crops. Commonly different types of irrigation pumps are used a prime mover of water for irrigation of horticultural. Water lifting devices are classified into four groups based on the kind of power commonly used for their operation. These are as follows (1) devices operated by human power (2) device operated by animal power (3) devices operated by other sources of power like hydro-power, wind power and solar energy.

Types of irrigation pipe.

There are different kinds of irrigation pipes commonly used in agricultural.

- Micro spray belt is used to bring water to the field through water pipes
- Swing pipe
- Polyethylene tubing
- Drip irrigation tape
- PE irrigation pipe
- PVC Pipe

The above types of pipes are used for different types of irrigation include. Sprinkler irrigation, surface irrigation, drip irrigation, sub irrigation, manual irrigation, center pivot irrigation and lateral move irrigation.

General

Irrigation valve is used to supply and control the flow of water in the pipe line.

Types of Irrigation valve

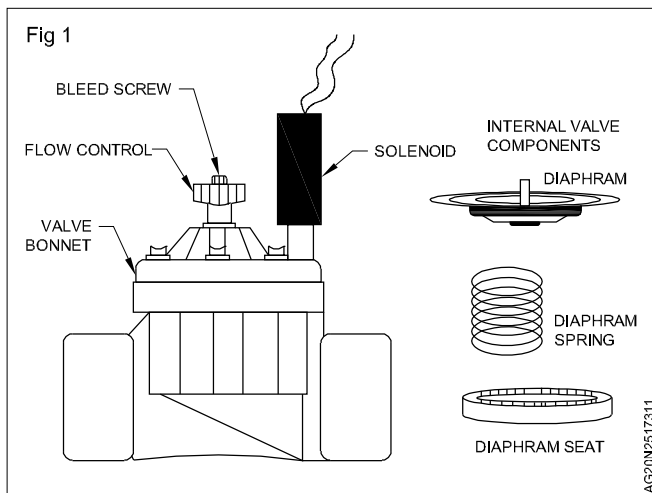
1 Emergency shut - off valve

This valve should be installed at the closest point possible to your water source, that is, the location where you tap in for the irrigation system. With this valve you will shut-off the water to the entire irrigation system when you want to work on the mainline or irrigation valves. The most commonly used valves for this purpose are "gate valves" because they are inexpensive.

2 Irrigation Control Valves

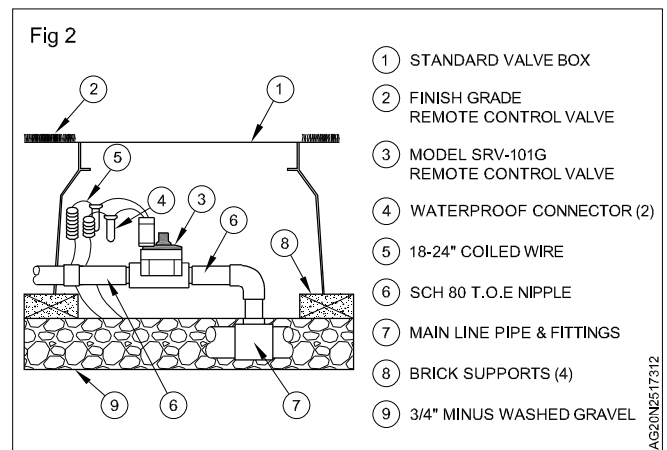
These are the valves that turn on and off the sprinklers, they also may be used for drip irrigation systems. Other names sometime used for them are irrigation valve, sprinkler valve, solenoid valve, and lawn valve. Sometimes they are incorrectly called Garden Valves. A garden valve is a manual valve that you connect a garden hose to it.

Operation



Water enters the valve from the system main line and exerts a force against the center of the valve's diaphragm. A small orifice in the diaphragm allows the water to flow through to the upper chamber between the diaphragm and the bonnet. The water continues to travel on through a port in the bonnet to the solenoid area. The solenoid has a light spring loaded metal piston that, when the valve is closed, covers the inlet port hole. The surface area that the water comes in contact with on top of the diaphragm is greater than the surface area on the bottom of the diaphragm, so the valve stays closed until the water in the upper chamber is released.

The sprinkler valves may be manually operated or they can be remotely controlled (automatic valves.) Manual control is simple, the valve has a handle that you use to turn it on and off using your hand as the power source. Remote control valves are either electric or hydraulic operated using a timer or other signaling device to tell them to open and close. Today almost all of sprinkler control valves are electric powered solenoid valves. The electric solenoid valve operates on 24 volt alternating current (vac) and is turned on and off by a timer called an "irrigation controller" or often just "controller"



Sprinkler valves come in both brass and plastic models. Most valves used today are plastic, but brass is not out of the picture. There is no doubt that a brass valve will last longer in most situations, especially if installed above ground in the sunlight. From an operational point of view both are reliable, especially for automatic systems.

Maintenance

Today's valves are pretty maintenance free. Almost all automatic valve failures result from installation or design problems.

Dirt in the irrigation pipes. Inside the valve there are very small water passages that lead to and from the solenoid. Water must flow freely through these small passages. If a grain of sand or glob of algae gets into these passages it can block them and the valve will fail to open or (more likely) fail to close. It is critical to flush all the dirt out of the pipes before installing the valves. A 100 to 200 mesh filter installed at the water source connection can also help keep out contaminants that comes in with the water supply.

Almost all valve solenoid failures are caused by water getting into the solenoid. The water gets into them through the wires. The solenoid wires have multiple strands of wires twisted together with insulation around them. Because they are twisted there are very small gaps between the wires which form passages along the length of the wire. Water is sucked up through these small passages and deposited into the solenoid by capillary action. Thus it is critically important that the wire joints on the valves be completely water proof so that water can't be sucked into the solenoid through the wires. You should water-proof the wire joints right after you test the valves!

Construction of sprinkler irrigation system

Objectives : At the end of this lesson you shall be able to

- state the components of sprinkler irrigation
- state the function of foggers/misters
- describe the types of sprinkler irrigation system.

Sprinkler irrigation

A sprinkler irrigation system uses pressure energy to form and distribute "rain like" droplets over the land surface.

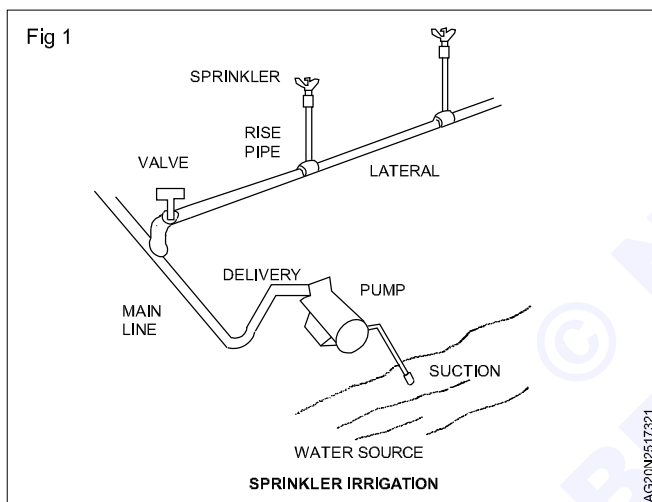
Although they are normally designed to supply the irrigation requirements of the farm.

In a sprinkler irrigation system, water is conveyed from a pump or other source of water under pressure through a network of pipes, called mainlines and sub mains, to one or more pipes with sprinklers called laterals. The sprinkler distributes the water over the land surface. The sprinkler irrigation has many advantages over the conventional irrigation methods.

- Soil conservation
- Use of land
- Efficient use of water
- Water saving
- Better crop yield and better quality
- Fertilizer application by mixing in water
- Frost protection with suitable additions

Components of sprinkler irrigation

The components of portable sprinkler system are shown through Fig 1. A sprinkler system usually consists of the following components.



Sprinkler irrigation system

Consists of sprinklers, main pipes, lateral pipes, coupling, pumping units, take off valve, fertilizer unit, and flow control valve and debris screen.

Main and lateral pipe lines

The main pipe line delivers the water from the pumping unit to the laterals. The lateral pipe unit delivers the water from the main pipe or sub - main pipe line to the sprinkler.

Coupling: Provides connection between two pipe lines and between pipes and fittings i.e. bends, tees, etc.

Risers: Galvanized iron pipe ranging from 1 - 2.5 cm in diameter. Height varies from 60 cm to 180 cm used to connect lateral pipe and sprinkler, to flow water at a certain height from sprinkler.

Pumping unit: Centrifugal pumps are used to lift the water from shallow water source or open well. In deep well submersible pumps are used.

Take off valve: It regulates and controls the pressure in the lateral lines. The valves must be used in the system

where significant pressure differences are existing at lateral take off points in the main line.

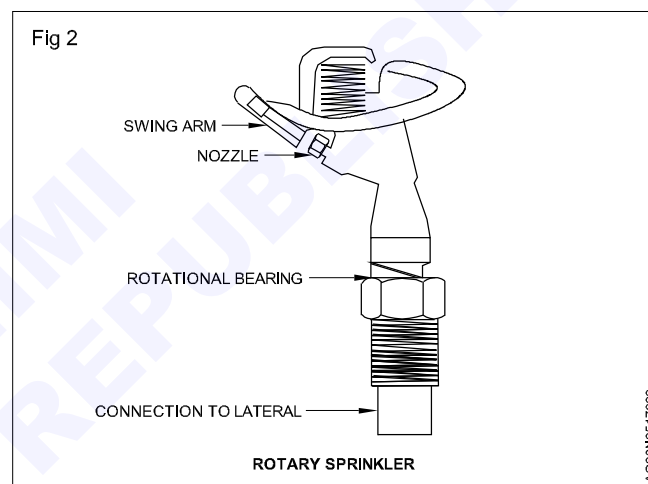
Types of sprinkler irrigation

Sprinkler systems are classified into the following two major types on the basis of the arrangement for spraying irrigation water.

- 1 Rotating head or revolving sprinkler system
- 2 Perforated pipe system.

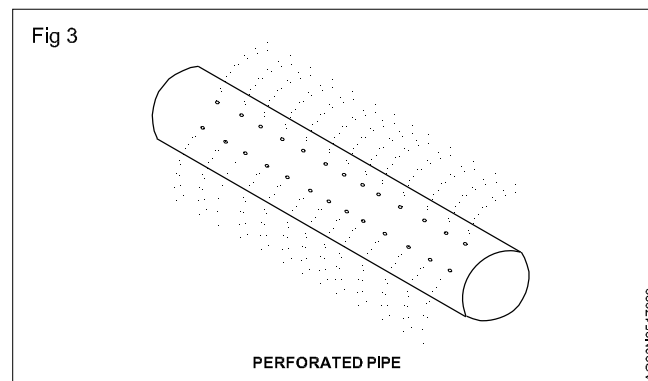
Rotating head or revolving sprinkler system (Fig 2)

Small size nozzles are placed on riser pipes fixed at uniform intervals along the length of the lateral pipe and the lateral pipes are usually laid on the ground surface. They may also be mounted on posts above the crop height and rotated through 900, to irrigate a rectangular strip. In rotating type sprinklers, the most common device to rotate the sprinkler heads is with a small hammer activated by the thrust of water striking against a vane connected to it.



Perforated pipes system (Fig 3)

This method consists of drilled holes or nozzles along their length through which water is sprayed under pressure. This system is usually designed for relatively low pressure (1 kg/cm²). The pipes are pierced with many holes of 1 - 2 mm diameter along the length, sending out the water under pressure in various directions.



Installation, operation, adjustments, repair & maintenance of sprinkler irrigation

Objectives : At the end of this lesson you shall be able to

- describe the installation and operation of sprinkler irrigation
- state the adjustment of sprinkler irrigation
- describe the repair and maintenance of sprinkler irrigation.

Sprinkler irrigation

In the sprinkler method of irrigation, water is sprayed into the air and allowed to fall on the ground surface somewhat resembling rainfall. The spray is developed by the flow of water under pressure through small orifices or nozzles. The pressure is usually obtained by pumping. With careful selection of nozzle sizes, operating pressure and sprinkler spacing the amount of irrigation water required to refill the crop root zone can be applied nearly uniform at the rate to suit the infiltration rate of soil.

Installation of sprinkler irrigation

General rules for sprinkler system design

- Main should be laid up and down hill
- Lateral should be laid across the slope or nearly on the contour
- For multiple lateral operations, lateral pipe sizes should not be more than two the diameter of laterals.
- Water supply source should be nearest to the centre of the area.
- Layout should facilitate and minimize lateral movement during the season.
- Booster pump should be considered where small portion of field would require high pressure at the pump
- Layout should be modified to apply different rates and amounts of water where soils are greatly different in the design area.

Installation of filter station

The sand filters are mounted on concrete foundation to avoid any collapse due to load and vibration. When screen filters are used, these should also be fixed firmly.

The pump outlet is connected to the filter using flange etc. however before filter provision for connecting fertilizer mixing tank and /or venturi pump is also made. When, gravel filter act as primary filter and screen or disc filters act as secondary filters. The fertilizer mixing tank/venture pump finds a place in between primary and secondary filters. The other side of the filter is connected to the main line by minimizing as much as possible, the use of elbows, bends etc. All the joints needs to be tightened and made leak proof.

Connecting main and sub - main

The main sub - mains are connected by using solvent cement. At the start of the sub - main, a gate valve and air release valve is also connected. At the end of each sub - main, a flush valve is connected.

Laying if laterals and fixing emitters

The bundle of lateral is placed on opposite side of the sub - main and is laid down along with the row of plants keeping a distance of about 12 cm away from the plants. The laterals should neither be given undue tension nor be kept slack. At the far end of the lateral an extra 1m to 1.5m length should be kept. The near end of the lateral is fixed to the sub - main through grommets. The grommets are made of rubber, which are fitted in the hole drilled in the sub - main for this purpose. The process of drilling hole in sub - main, fixing grommet in hole and connecting the lateral to the sub - main.

After laying the laterals, with the help of punch, holes are punched at pre- determined spaces and the emitters are pressed into it.

Care should be taken to flush the system at the end of sub - main and lateral otherwise the material drilled/ punched may block the emitters.

Commissioning of the system

After installation of the system it is to be commissioned as under

- Back wash filter till clean water is seen from the flush valve.
- Open all the gate valves and flush valves connected on the sub - main and flush it. Once it is over, close the flush valves.
- After flushing sub - main, open the end caps of laterals and flush them thoroughly. Close the end caps of laterals.
- The pressure gauge reading on the inlet and outlet of the filter must be checked. Normally the pressure at the inlet is 1.5 to 2 kg/cm². If the pressure difference is more, the by pass valve must be opened to regulate it.
- Once the pressure in the main and sub - main is stabilized, measure the discharge at 3 - 4 places. Buckets can be used to collect water at emitter's outlet.
- The working of air release valve must be checked.
- Once the system operates smooth fix up the venturi.

Pump prime movers

The prime movers most commonly used in pumping systems are electric motor and I.C. engine. Most centrifugal pumps and displacement pump are driven at constant speed except in some largest pumps where variable speed is required for adjustment in pump capacity.

Apart from prime movers, the transmission devices used in pump include flexible coupling rigid coupling, flat or V - Belt.

In order to start the pump, the torque developed by the prime mover should always be greater than the resisting torque of pump. When the prime movers torque and resisting torque of pump is equalized, the acceleration falls to zero and driver runs at constant speed. The power of the prime mover should be so chosen that it runs at its maximum efficiency and also ensure that the pump works at optimum efficiency.

Adjustments for sprinkler irrigation

Adjusting the master valve flow control until the flow control is either closed as far as it will go (usually clockwise) or the spray stream begins to droop. Then open the flow control back up (usually counterclockwise) slightly until the pattern reaches its full throw radius, then a little more for margin in case your supply pressure drops a few kg/ cm² in the future.

Adjusting the flow control on the station valves, since rotors require higher pressure to operate well, adjustments made up to this point will deliver too much pressure to the spray stations. Adjust each of the spray station valve flow controls by watching the spray pattern droop slightly while closing the flow control, then open it slightly to reach full radius.

Adjusting the radius screw on the top of the nozzle (spray sprinklers only - the radius adjustment on most rotors does not control flow at all).

Perform care and maintenance

- Check leakage from filter gasket, lid, flushing valve, fittings, etc. and stop immediately.
- Check the media filter and wash daily to remove silt and dirt accumulated.
- Open the valve of screen filter for few minutes silt and dirt.
- Perform acid treatment for the precipitation of depositing salts.

Maintenance

General principles regarding the maintenance of the pipes and fittings and sprinkler heads are given below.

Pipes and fittings

The pipes and fittings require virtually no maintenance but attention must be given to the following procedures.

- Occasionally clean any dirt or sand out of the groove in the coupler in which the rubber sealing ring fits. Any accumulation of dirt or sand will affect the performance of the rubber sealing ring.
- Keep all nuts and bolts tight.
- Do not lay pipes on new damp concrete or on piles of fertilizer. Do not lay fertilizer sacks on the pipe.

Sprinkler head

- The sprinkler heads should be given the following attention.
- When moving the sprinkler lines, make sure that the sprinklers are not damaged or pushed into the soil.
- Do not apply oil, grease or any lubricant to the sprinklers. They are water lubricated and using oil, grease or any other lubricant may stop them from working.
- Sprinklers usually have a sealed bearing and at the bottom of the bearing there are washers. Usually it is the washers that wear and not the more expensive metal parts.
- Check the washers for wear once a season or every six months which is especially important where water is sandy. Replace the washers if worn.
- After several season's operation the swing arm spring may need tightening. This is done by pulling out the spring end at the top and re bending it. This will increase the spring tension.
- In general, check all equipment at the end of the season and make any repairs and adjustments and order the spare parts immediately so that the equipment is in perfect condition to start in the next season.

Fault and remedies

Water flowing from a sprinkler head

After the system has shut off, if water continues to flow from a sprinkler head, it's typically an indication of a valve problem. Here are a few suggestions.

- If the water to the malfunctioning valve is turned on, shut it off.
- Using a pipe wrench, unscrew and remove the top of the valve.
- Check for particles of sand, dirt, etc., that could keep the valve from closing. Remove any particles found.
- Check for cracks or holes in the valve diaphragm.
- Check for particles on the valve seat and remove any that are found.
- Reassemble valve components.
- Check and replace the valve if not working properly.

Decrease in water pressure

- Replace the worn - out and leaked pipes for uniform distribution of water.
- Replace the sprinkler head with a PVC cap screwed onto the riser for recovering the problem of bubbling or springing from the ground area.

Total system failure

Sprinklers fail to come ON, there's a good possibility sprinkler system control is at fault.

Remedies

- Do a manual “start” on one of the zones.
- Check all the control’s wiring connections.
- Reset the control by disconnecting, then connecting to its power source.
- Check to see that the control knob is in the right position.

Fogger and misters: The fogging/misters system is a method between air and it is humidification and soil irrigation environment control in short time by using fogging

/ misters. Fogger and misters are used to maintain humidity or temperature control in green house, shade house misters & foggers is very easy to install and reliable performance is a common feature it can be supplied with leakage prevention device, for pulsed operation and to prevent low head drainage, it is ideal for plant propagation. It is recommended for climate control in green house/ shade house and also suitable for crops require maintaining micro climate in the canopy area.

Fogger provides optimal cooling or humidifying of green houses, reduces greenhouse temperature increases greenhouse humidity. (Example: Sprayer)

Construction of drip irrigation system

Objectives : At the end of this lesson you shall be able to

- state the construction of drip irrigation system
- state the types of filters and emitters used in drip irrigation.

Drip irrigation

Drip irrigation is the slow, nearly continuous application of water as discrete drops. Water can be applied at a single point (small wetted area) on the land surface through devices called emitters or as a line source from either closely spaced emitters or tubes with continuous or equally spaced openings that discharge water a drop at a time.

Importance

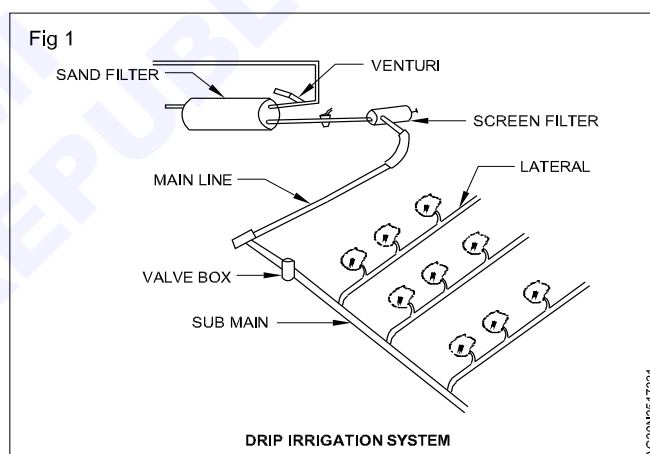
- Increased water use efficiency
- Better crop yield
- Uniform and better quality of the product
- Economical efficient use of fertilizer
- Less weed growth
- Can be used on undulating areas
- Labour saving
- Better use of poor soils
- Soil erosion minimized

Structure of drip system

A schematic view of the drip system is shown in figure 1. The water from the source is lifted through pump and after getting filtered passes to main and sub - main plastic pipes, from where it is distributed in the entire field through small diameter plastic tubes known as laterals. These laterals run parallel to each other on one side or both sides of sub mains. Small plastic emitter also known as drippers are either directly fixed on the laterals or through micro tubes supplying water to individual tree/plant. An additional tank used for injecting fertilizer in the flowing water is also connected through a injecting device. Normally, the injecting device is a venturi and works on the principle of pressure difference.

Components of drip irrigation unit (Fig 1)

- 1 Head this consists of
 - Pumping station
 - Filtering unit



- 2 Main line and sub main lines
- 3 Laterals
- 4 Emitters
- 5 **Auxiliary items:** Vacuum breaks, pressure gauges, water meters, flush valve and pressure regulators, check valves.

Pumping station

Depending upon the field size, number of trees, availability of water, recoup period (in case of well), water requirement of trees and availability of power, suitable pump is selected.

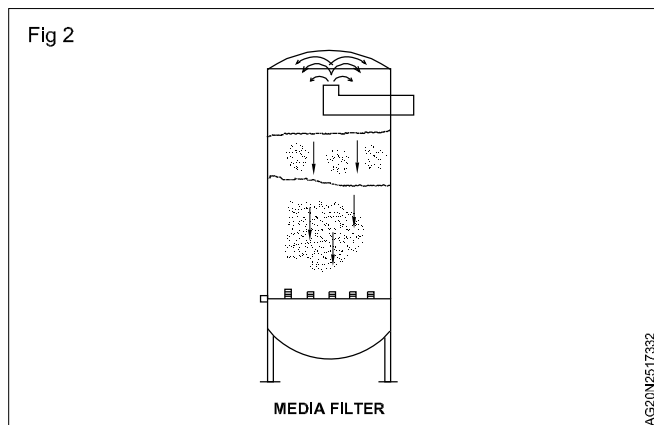
Filtering unit

The filtering unit comprises the heart of the system. The orifice through which the droplets of water reach the soil surface and ultimately the fibrous root zone is too small, which becomes conducive to frequent clogging due to the sand and organic impurities like algae, fungi, bacterial slimes, etc.

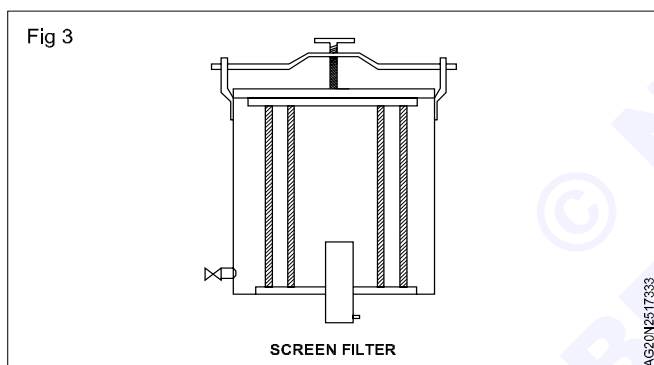
Following types of filters are used in the drip system

- Media filter
- Screen filters and
- Disc filter
- Centrifugal filters.

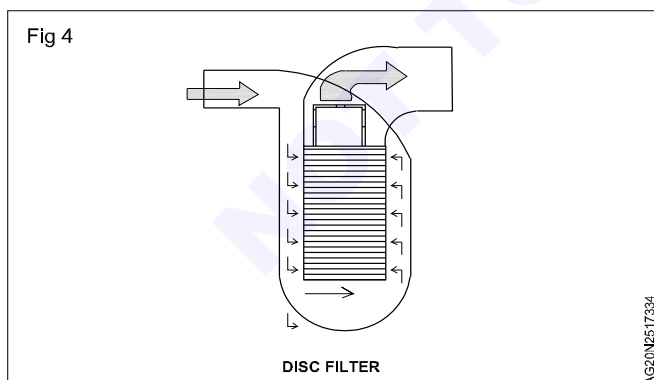
Media filter: Consists of beds of basalt and quartz with gravel size (1.5 to 4 mm) which are laid one above the other to filter organic contaminants from filter (Fig 2)



Screen filter: Made of metals, plastic or synthetic cloth. Used for primary filtration (400 microns) and secondary filtration (150 microns) (Fig 3)



Disc filter: Attached with number of plastic discs having fine radial grooves (Fig 4)



Centrifugal filter consists of a funnel shaped epoxy coated MS body which is connected to a connecting tank at a bottom, to collect sand from water (Fig 5).

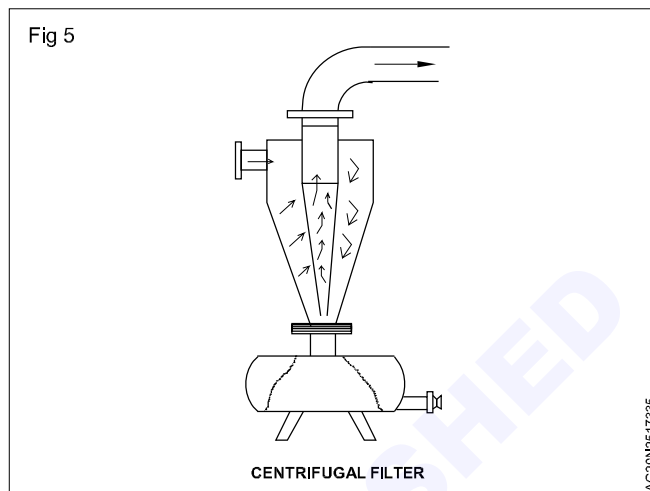
Main pipe

The main pipe line made of P.V.C conveys water from the source to the main central points in the field and supplies

the required discharge to each sub main. The diameter of pipes varies from 25 mm to 75 mm depending upon the area, crop, water requirements etc.

Sub - main

These lines serve as mediator between laterals and main lines. These are also made of PVC.

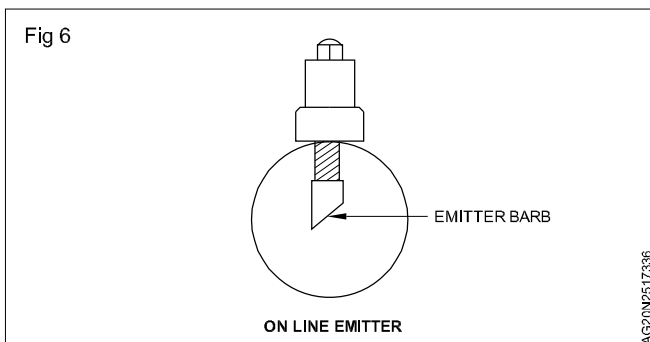


Laterals

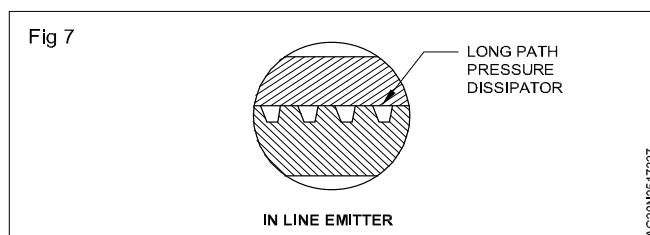
Laterals conveys water from sub - main to drippers/emitters. It is made of flexible PVC, DPE or UDPE having different sizes e.g. 12 mm, 16 mm, and 20 mm (O.D.). Drippers are fixed on the pre - determined spacing on the laterals or connected to lateral by micro tubes. In addition to these laterals improvement of laterals twin bore pipes and pipes with tiny perforations are also available.

Emitters

On - line emitters Barbs obstruct flow and create more head loss in the laterals but easy to replace (Fig 6). It is a button type emitter and most versatile system. This can be buried.



In - line emitter Less head loss but difficult to replace (Fig 7)



Installation, operation, adjustments, repair and maintenance of drip irrigation

Objectives: At the end of this lesson you shall be able to

- describe the installation and operation of drip irrigation
- state the adjustment of drip irrigation
- state the repair and maintenance of drip irrigation.

Drip irrigation

The water from the source is lifted through pump and after getting filtered passes to main and sub - main plastic pipes, from where it is distributed in the entire field through small diameter plastic tubes known as laterals. These laterals run parallel to each other on one side or both sides of sub- mains. Small plastic emitter known as dripper are either directly fixed on the laterals or through micro tubes supplying water to individual tree/plant.

Installation and operation of drip irrigation

The success of the drip system is not confined to sales, of the equipment by the manufacturer/dealers but proper installation, commissioning and frequent after sales services are very much essential each crop whether an annual crop or horticultural crop, the system is designed specially for the location by the supplier. However, in order to reduce the user, owner of the system, it is necessary to provide certain guidelines so that they can also become vigilant and the system so installed gives trouble free service.

As per the layout plan trenches for laying main and sub main needs to be dug to a minimum depth and width of 45 cm each. The installation is followed in the following three steps.

- Fitting of filter station
- Connecting main and sub mains
- Laying of lateral with dripper

Installation of filter station

The sand filters are mounted on concrete foundation to avoid any collapse due to load and vibration. When screen filters are used, these should also be fixed firmly. The pump outlet is connected to the filter using flange etc. However, before filter, provision for connecting fertilizer mixing tank and or venture pump is also made. When, gravel filter as primary filter and screen or disc filters as secondary filters are being used. The other side of the filter is connected to the main line by minimizing as much as possible, the use of elbows, bends etc. All the joints need to be tightened and make leak proof.

Connecting main and sub main

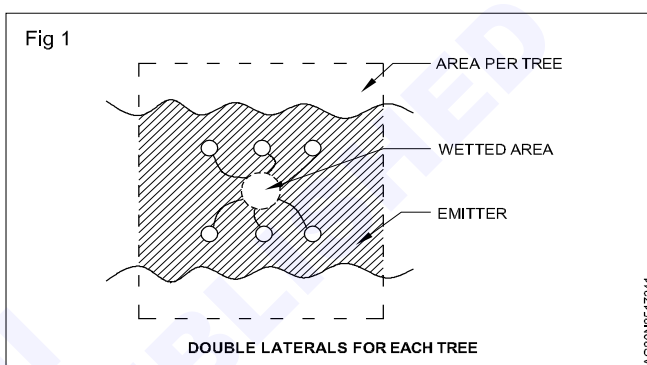
The main and sub main are connected by using solvent cement. At the start of the sub main, a gate valve and air release valve is also connected. At the end of each sub main, a flush valve is connected.

Laying of laterals and fixing emitters

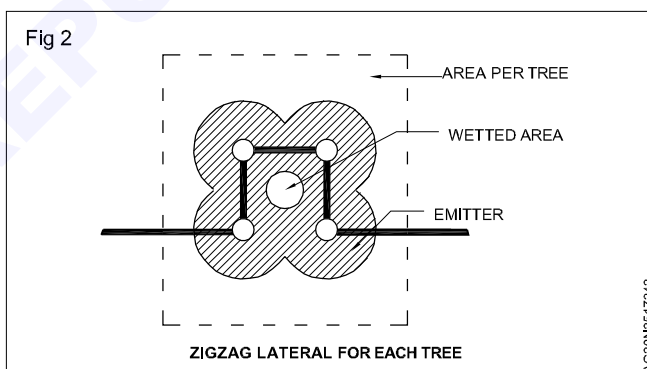
The bundle of lateral is placed on opposite side of the sub main and is laid down along with the row of plants keeping a distance of about 12 cm away from the plants.

The laterals should neither be given undue tension nor be kept slack. At the far end of the laterals an extra 1m to 1.5 m length should be kept. The rear end of the lateral is fixed to the sub main through grommets. The grommets are made of rubber which are fitted in the hole and connecting the lateral to sub main. The various types of laterals are

Double laterals for each tree (Fig 1)



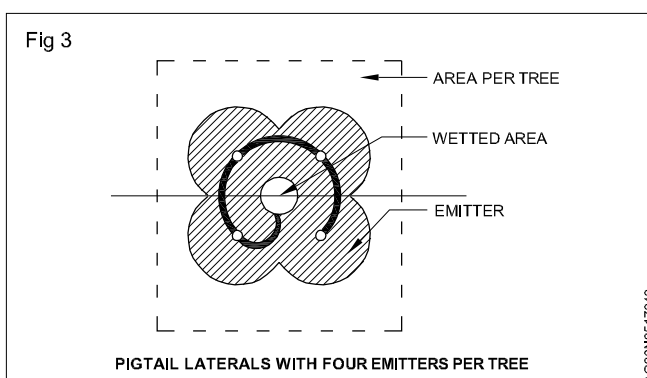
Zigzag lateral for each tree (Fig 2)



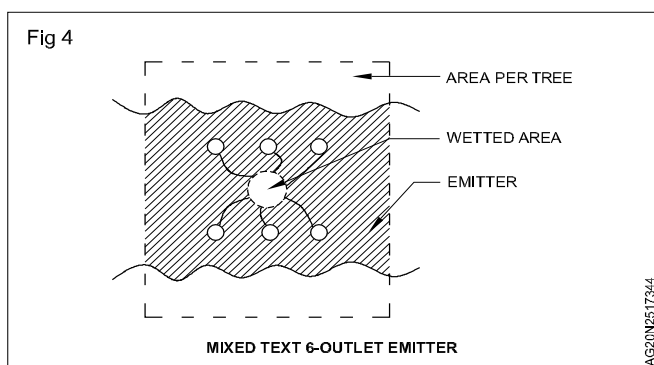
Pigtail lateral with four emitters per tree (Fig 3)

Multi text 6 - outlet emitter (Fig 4)

After laying the laterals, with the help of punch holes, are punched at pre-determined spaces and the emitters are pressed to it.



Care should be taken to flush the system at the end of sub - main and lateral otherwise the material drilled / punched may block the emitters.



Commissioning of the system

After installation of the system it is to be commissioned as under

- Back wash the till clean water is seen from the flush valve.
- Open all the gate valves and flush valves connected on the sub main and flush it. Once it is over, close the flush valves.
- After flushing sub main, open the end caps of laterals and flush them thoroughly. Close the end caps of laterals.
- The pressure gauge reading on the inlet and outlet of the filter must be checked. Normally the pressure at the inlet is 1.5 to 2 kg/cm² and on the outlet around 1kg/cm². If the pressure difference is more, the by pass valve must be opened to regulate it.
- Once the pressure in the main and sub main is stabilized, measure the discharge at 3 - 4 places. Buckets can be used to collect water at emitter's outlet.
- The working of air release valve must be checked.
- Once the system operates smoothly fix up the venture.

Adjustments for drip irrigation

- Flush the lines after installing a new system and after making any repair.
- Clean the filters. Open the flush valve (if it has one) to clean out grit. Inspect the screens for algae and deposits. Scrub them with a toothbrush (be gentle with nylon and fiberglass screens).
- Place a ¼ - or ½ - inch - diameter tablet (not a 2 - inch one) or about 1 teaspoon of granular chlorine inside each filter and turn on the system for its full cycle. Open the end caps to flush the lines of dead algae.

Don't use liquid chlorine it moves through the system too quickly and may harm sensitive plants.

- Check emitters for clogging and sprays for askew.

- Pull the clogged emitters out and replace it.
- Inspect lines for leaks and repair them.
- Adjust automatic controller for watering schedule.

Don't be afraid to experiment a controller is quite simple to program.

- Run the drip system overnight to leach salts out of root zones.

Care and maintenance for drip irrigation

- Inspect and clean the filters frequently for clogging. Remove the screen from the casing and scrub it with a soft bristled tooth brush to remove sediment. Replace if damaged.
- Clean and replace the clogged emitters.

General maintenance

In order to keep the system running and to get best out of it, it is necessary to keep a watch on the system. Any leakage from filter gasket, lid, flushing valve, fittings, etc. Must be stopped immediately. Similarly, it should be ensured that the drippers are not disturbed. Changing the location frequently with a view to cover more area under wetting in fact harms the growth of plant/tree.

Media filter

In order to remove the silt and other dirt accumulated, the filter should be back washed daily for few minutes before running the system. In addition to this, weekly the back wash water should be allowed to come out through the lid instead of valve. While back washing stir the sand bed gently without causing any damage to the filter elements.

Screen filter

The screen filter is provided with a flush valve. This valve must be opened for few minutes allowing the silt and dirt to go out. The filter elements should also be taken out and cleaned in running water. Similarly, the rubber seal must be cleaned, while fitting the rubber seal care should be taken, otherwise it may get damaged.

Sub main and lateral flushing

In spite of the provision of filters in the system, sometimes the silt also gets a way and settles into the sub main and laterals. Similarly, organic materials i.e. algae and bacteria also helps in formation of slimes. These things can be flushed by first opening the flush valve and then the head caps of the laterals until clear water is visible at the outlets.

Chemical treatment

As started above the drippers do get clogged due to dissolved salts like carbonates, bicarbonates, iron, calcium and manganese. In addition to these salts, the bacterial slime and algae also causes the drippers to clog.

The only remedy to clean the dripper is chemical treatment, which means passing of chlorine and/or hydrochloric acid in the system. Depending upon the quality of water being used interval between two successive chemical treatments can vary. A good user and attentive operator always keeps

a vigil on the discharge from the dripper and measure time to time. Whenever a he feels that the discharge is reducing, he may apply chemical treatment.

Acid treatment

Acid treatment is suitable for the following types of problems.

Precipitation of magnesium and calcium salts

Whitish film on the inner walls of laterals or drippers is due to the presence of these salts in the water. This problem can be solved by injecting hydrochloric acid in the system.

Precipitation of calcium carbonate:

So long as the system is in operation there is no problem due to calcium bicarbonates available in the water. However, when the system is put off and the drippers get dry a white crust causes the drippers to get blocked. A acid treatment is a solution to this problem also.

Precipitation of manganese

Dark black or dark brown deposits are caused due to the presence of manganese in the water. The acid treatment is a remedy to it.

Procedure for acid treatment

Different companies suggest different rate of flow and concentration for acid treatment. One of the Re-

commendations to inject 2% solution by vol. of technical hydrochloric acid (36%) for about half an hour.

The volume of the entire system must be calculated so that sufficient acid will reach each dripper and this volume is doubled to guarantee complete flushing. The solution is introduced under low pressure at a very low rate of flow so that acid will be in contact with the drippers for about 30 minutes. This is done by placing the solution level about 1m above the filter. Then the system is leached at the higher pressure for about ten minutes. The small quantity of acid solution leaching the dripper is not harmful to the soil or plants.

The guidelines suggested by leading a drip manufacturer Jain irrigation, Jalgaon is to pass the HCL by a venturi system, regulate the flow by valve and check the pH value of the water by pH paper and regulate it till at the nearest drip it reaches 4 pH. Check it at the last drip of the system. Keep it running for ½ hr. Stop the system and keep the acidity liquid for 24 hours before flushing.

Precautions

- Acid is harmful and therefore it must be handled carefully.
- While preparing a solution it must always be kept in mind that acid is to be mixed in water.
- The equipments used to handle acid must be resistant to acid.

Troubles and remedies

Faults	Causes	Remedies
There is no water coming from an emitter	Emitter is clogged	Clean or replace emitter
One part of drip zone is dry	Not enough emitters in that area emitters. Kinds in the poly tubing	Add emitters or replace with higher - flow Inspect the line and straighten if needed.
Part of the zone is too moist	Too many emitters in that area	Reduce the number of emitters in that area or replace them with lower - flow emitters. Add a pressure regulator to the line.
Emitters come loose	Too much pressure in the system	Add more emitters
Container plants are too dry	Not enough irrigation	Put containers on a separate zone. Increase irrigation time
Container plants are too wet	Too much irrigation	Remove some of the emitters Put containers on a separate zone. Decrease irrigation time

Power tiller

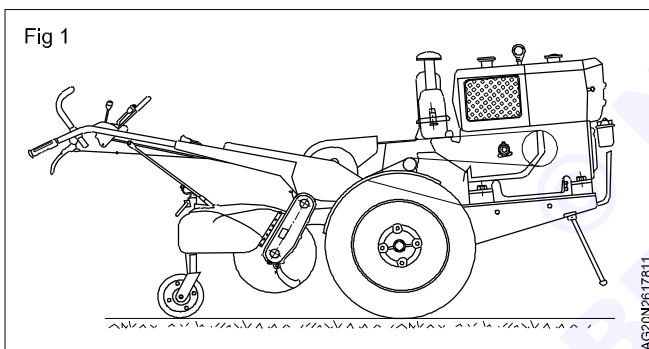
Objectives: At the end of this lesson you shall be able to

- state the types of power tiller
- describe the constructional details of power tiller
- state the function of power tiller with different attachment.

Power tiller and their uses

Power tiller is a walking tractor widely used for rotary cultivation in wet puddle soil. It replaces the animal power more effectively. It is a machine completed with 1.5 HP to 3.5 HP engine and it is designed as such to push forward or backward various agricultural equipment power tiller is capable to perform the operation of different farm implements operation such as rotary, puddler, leveler, trailers, plow disc and threshers.

Power tiller (Fig 1) helps in preparing the soil, sowing seeds planting seeds, adding of spraying the fertilizers, herbicides & water. It also helps in pumping water, harvesting threshing and transporting crops it's maintenance is cheaper and economical to use and also requires less space.



Types of power tiller

On the basis of power tiller work, they divided into three categories.

Mine tiller

It is best suited for gardeners with limited strength.

Mid sized front line tillers

It is used for moderate tilling work with great ease.

Large sized rear time tillers

It is used for the large field work

Components of a power tiller

The power tiller consists of the Engine, transmission gears, clutch, brakes and rotary unit. All the power tillers are fitted with I.C.Engine.

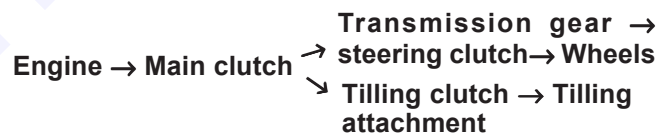
Operation of power tiller

The operation of a power tiller involves walking behind the machine on a tilled or puddle land continuously for hours.

During peak seasons of seedbed preparation, farmers operate power tillers even for more than 8hrs a day. The operator has to guide/control the forward movement of the machine by actuating hand clutches provided on each handle or sometimes by pushing/pulling the handles towards sides. The operator sometimes lifts the rear portion of the machine to take sharp turns at the headlands. The main clutch is a lever on the handle. The lever can be shifted to on or off position while operating in the field. When the lever is shifted to on position, the power from the engine is transmitted through the main clutch to the various parts of the power tiller. When the lever is shifted to off position the power from the engine is cut-off from the rest of the transmission.

Power Transmission in a power tiller

For operation of power tiller, the power is obtained from the IC Engine, fitted on the power tiller. The engine power goes to the main clutch with the help of belt or chain. From main clutch, the power is divided in two routes, one goes to transmission gears, steering clutch and then to the wheel. The other component goes to the tilling clutch and then to the tilling attachment. The flow diagram for transmission of power is as below.



V-belt, is usually used to transmit power from the engine to the main clutch, because V-belt has very high efficiency and it works as a shock absorber also. The power tiller remains an essential mode of power for farming operations, especially in land preparations. The machine saves time and improves the land productivity. Wetland tillage in rice hand cultivation is the main operation for which this machine is employed.

Attachments of power tiller: Several types of attachment are used to attach with power tiller. Power tiller provides enormous amount of power at a low cost. The following attachments are used by the farmers.

- 1 Cage wheel
- 2 Plough
- 3 Extension wheel
- 4 Water pump

- 5 Vegetable digger
- 6 Tyne cultivator
- 7 Seed cum fertilizer
- 8 Sprayer unit
- 9 Slasher cum insit shredder
- 10 Ridger (Furrower)
- 11 Threshers
- 12 Reaper
- 13 Leveler
- 14 Cultivator
- 15 Two share plough

- 16 Shorter rotary
- 17 Trailer
- 18 Power tiller operated generators
- 19 Auger digger

The power tiller is capable of primary and secondary tillage operation and it is most suitable for operations in hilly regions, wet conditions and for small holdings. The light weight of power tiller is a favorable factor for working in wet and dry land conditions. The external attachments made on the tiller depending on the nature of agricultural field work. This equipment is used as a multipurpose machine.

Method of power transmission for different field operation with different attachment

Objectives: At the end of this lesson you shall be able to

- state the operation of power tiller
- state the attachment of implements of the power tiller.

Operation of power tiller

Driving instruments, control levers and switches are arranged as below. Most of them are located on or near the handle for easy control.

- a Main clutch lever
- b Speed change lever
- c Rotary speed change lever
- d Steering clutch lever
- e Throttle lever
- f Engine stop switch
- g Light switch
- h Brake operating lever
- i Gauge wheel adjusting crank handle
- j Auxiliary handle

Functions of the basic driving installation and their control are as follows.

Main clutch lever

Main clutch lever can be shifted to the position of “in” and “off”. When the lever is moved to “off”, the driving power from the engine is cut off, and all the operating parts stop revolution.

Therefore, main clutch lever is used to stop the power tiller with engine operating, and to select the desired speed change gear.

Speed change lever

Travelling speed ranges are indicated on the speed change plate. Only after main clutch was cut off, the speed change lever can be controlled to the desired position of speed.

When power tiller is started to run, it should be avoided to start in the high-speed gear. First the low speed gear should be used, then gear speed to be changed towards high-speed gear gradually.

While power tiller is not operated, sure the speed change lever must return to “neutral” position for safety.

Rotary speed change lever

Many power tillers are provided with a rotary speed change lever, which is independent from the control lever of transmission gears, in order to select most suitable operating speed of rotary shaft.

When lever is shifted to “high”, tilling pitch becomes high and soil is pulverized more fine.

When lever is shifted to “neutral”, revolution of the rotary is stopped, and we can drive power tiller without tilling operation. It is very dangerous to move back power tiller with rotary operating. Make it a habit to return the lever always “neutral” at backing time.

Steering clutch levers

Control lever is positioned under the grip of each handle, right-hand side lever and left-hand side lever separately.

When the left lever is gripped, the left side steering clutch is cut off and left side wheel is stopped, so that turning to left becomes easy.

To make right turn, the right-hand side lever has to be applied.

If it is difficult to disengage or engage the clutch, turn the adjusting screw and locknut to adjust the length of control wire.

Methods of rotary tilling

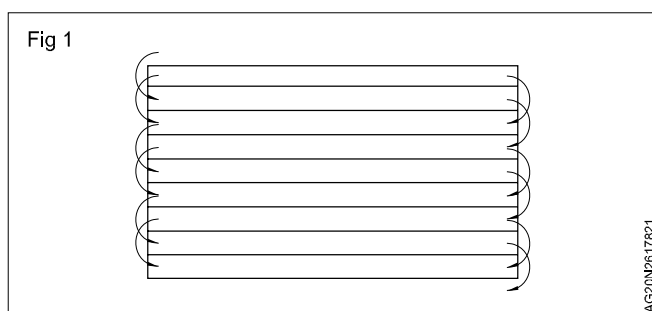
Travelling direction and order of power tiller at field is rather free than that of plough, because in the case of ploughing the turning direction of furrow soil limits the direction and order of tractor's travel.

We can apply several kinds of tilling method, plane tilling, ridge-make tilling, ridge - break tilling and transformed tilling methods of them.

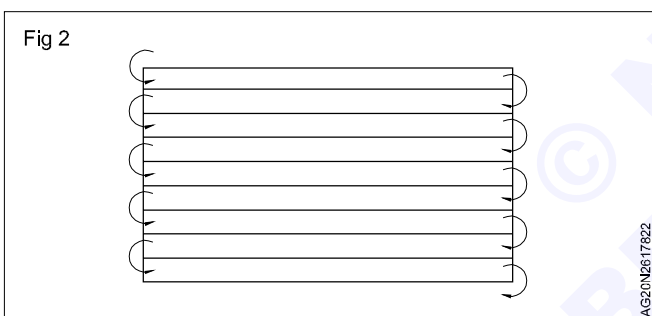
Plane tilling

Normal method of rotary tilling is plane tilling. For plane tilling, travelling order of the machine is classified into three methods.

a Alternate tilling method (Fig 1)



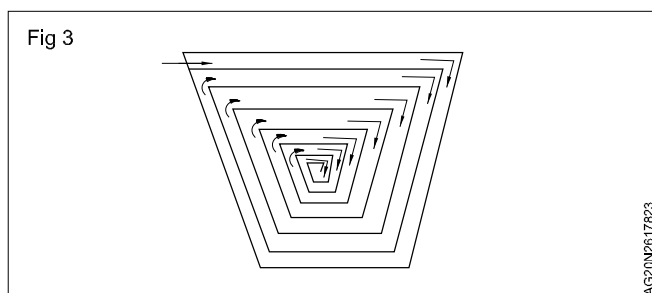
b Return tilling method (or) continuous tilling method (Fig 2)



c Circular travel tilling method (Fig 3)

Travelling order of each method is shown in the fig 3. In the case of (a) and (b) two runs in which around the field have to be left. And this left area of two runs is finished up by method of circular traveling at the last.

Among the above three methods, method of (a) is often applied to the wet-soft paddy field, because it is comparatively easy to keep running stability of the machine. But wheels pass over the place, which was previously tilled, so the machine will sink down a little more than the former running. In other words, tilling depth becomes deeper than the previously tilled part.



Therefore, it is necessary to raise the rotary a little to get the same depth of tilling. Crank handle of the gauge wheel is used to adjust the tilling depth.

Method (b) is simple and efficient at the normal field condition. However, this method requires comparatively high operation skill, because one side of wheels run on the previously tilled land and apt to sink down.

Moreover, operator has to make sharp turns at the head land.

Method (c) has the same trouble with method (b) that one side wheel must run on the tilled soft land. But travelling order of the power tiller is simple, and this method can be applied to irregular field as shown in the figure.

Puddling

To carry out efficient puddling job, it is recommended that puddling rakes or leveling board is attached to the rear of rotary tiller. At some conditions, special puddling wheels or paddy field rag wheels are used effectively.

Three kinds of traveling method can be practices.

- 1 Crosswise running
- 2 Zigzag running
- 3 Diagonal running

Ridging

Generally, methods of ridging are classified into three kinds of ridging method as below

- 1 Ridge with core
- 2 Ridge by every other row method
- 3 Ridge after plane tilling

To practice method (i) a ridge is attached to the rotary tiller and ridging operation is performed together with rotary tilling job.

This ridging method is very efficient and drainage effect is good at the wet paddy field.

Ridge run between the cores and the soil which was tilled by rotary is thrown outside to cover the cores.

As to the method (ii) first make the tilling lines face inwards and attach the rare two wheels to the rotary tiller. Rotary tilling is performed in the alternate tilling method.

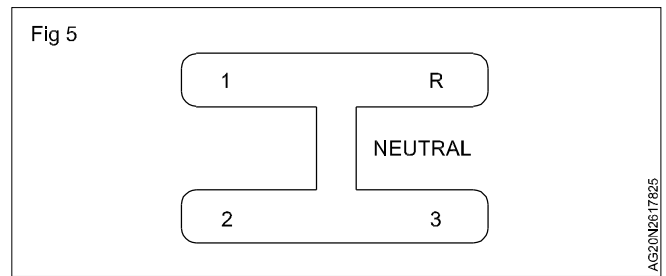
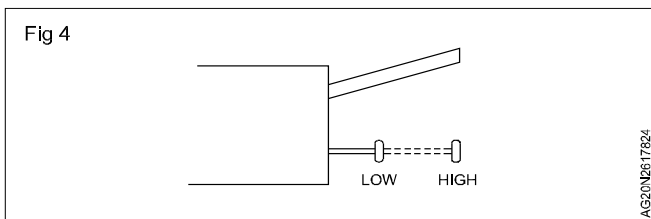
Then turn the tilling tines outside and attach the ridger to rotary tiller. In this running, the soil is thrown on the previously tilled parts to make ridge without core.

The features of this method are that the soil will be uniformly pulverized but there is restriction on the width of ridge.

Method (iii) is carried out in two stages of job. First, the whole area of the field is tilled by ordinary rotary tilling method Next, turn the tilling tines outwards and set the ridge to do the ridging work.

By this method, the width of ridges can be made to any desired with, however this ridging method will be very inefficient.

For tillage operations forward and reverse gear should be selected in the low speed mode only. Selection in high speed mode will result in poor tillage or excess load on engine (Fig 4 and 5)



Weeds and their control

Objectives: At the end of this lesson you shall be able to

- describe the weeding and common type of weeds implements
- state the intercultural operations
- explain the care and maintenance of intercultural operation.

Weeding

Weeding is the process of eliminating competition of unwanted plants to the regular crop in respect to nutrition and moisture. So that crops can be grown profitably. It also facilitates other operations like irrigation and fertilizer application. Hence, animal drawn three - tine cultivator is used which can cover one hectare per day.

Advantages of weeding

- Conservation of soil moisture.
- Reduced competition for nutrients and water.
- Purity of seed can be maintained.

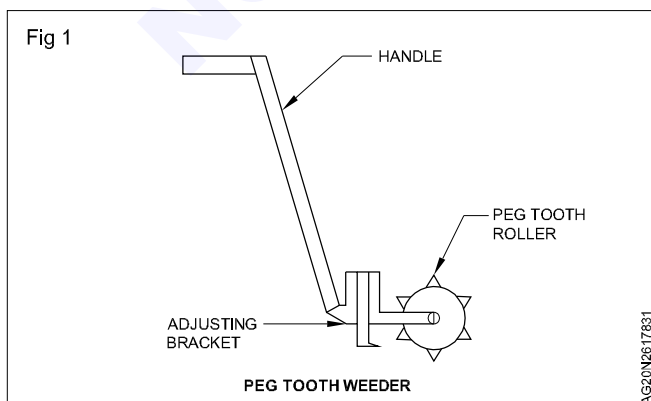
Weeding implements

Peg type weeder

It is a dry land weeder with long handle (Fig 1) is suitable for weeding in row crops in rain fed and garden lands. It is easily operated by a man or woman. The weeder is useful and economic under ideal conditions; i.e. when the soil moisture content is about 10% - 15%. It performs well in plain fields where the weeds are shallow rooted and the land is not too thickly infested with weeds. It can also be used with some experience for removing weeds in ridges and furrows. It is suitable for black soil, clay and clay loam.

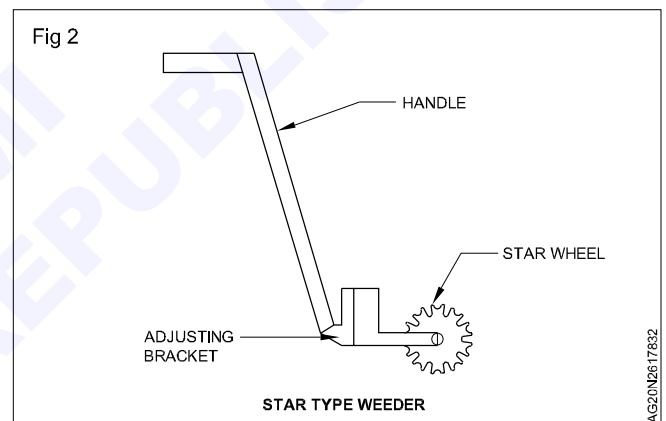
Adjustments

The blade can be adjusted to the desired angle and depth by removing four bolts and nuts. The peg permit the movement of the roller in clay soil without getting clogged.



Star type

The function and operation are similar to the peg type weeder excepting that the star type roller (Fig 2) facilitates easier operation of the weeder in loamy and sandy soils.

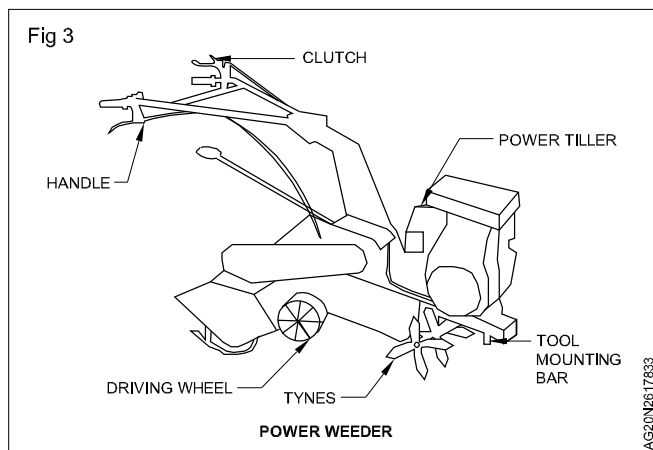


Methods of weed control

- Test the nature and intensity of weeds in the orchards
- Check the adjustments of the weeder
- Operate the weeder
- Remove the weed

Constructional details of power weeder

The self-propelled weeder consists of a box section chassis, 3 - hp petrol - start - kerosene - run engine, transmission system, drive wheels, tool mounting bar of 70 x 70 mm size. The engine, gear box and tool mounting bar are fixed to main chassis. The gearbox with transmission system is mounted in the middle of chassis. Two steel lugged drive wheels of 500 mm diameter 110 mm width are mounted on both ends of hexagonal shaft connected to transmission box. Inside the transmission box power is transmitted through chain and sprockets or two hexagonal drive shafts/axles. The tynes are adjusted according to the row spacing of the crop and depth of operation (Fig 3).



Operation procedure

- Mount the engine on front side of the chassis for proper foundation.
- Mount the tynes on the tool bar with clamps.
- Fit the V - shaped weeding sweeps of on the tynes.
- Transmit the power from engine to gearbox through V - belt and pulleys.
- A lever operated clutch/idler pulley is used for tightening/loosening of V - belt.

- The tynes are adjusted to the raised position so they do not dig into the ground and the weeder is transported to the field.

Calibration

- Adjust the depth of operation, by raising or lowering the tynes.
- Adjust the tynes slidly for the spacing between the sweeps.
- Adjust the wheel thread (spacing between two wheels) from 400 to 650 mm to suit the row - to - row spacing of different crops.

Care and maintenance

- Lubricate the transmission and rotary driving gear case.
- Adjust the main clutch, steering clutches, tynes and brake.
- Check the power tiller before use.

Pull main clutch lever to discharge position, select forward/reverse speed and gently push the gear shift lever to the appropriate slot.

Gear position	Recommended operations
Low - neutral	Parking, storage and while starting.
Low - 1st	Heavy weeding at full depth of 5" (125mm), Earthing - up, moving-up or down or ramp.
Low - 2nd	Medium weeding about 3" depth (75 mm). seed drill usage
Low - 3rd	Light weeding about 2" depth (50 mm), seed drill usage, spraying attachment, etc.
Low - reverse	Reverse movements, heavy Earthing – up and trench cutting in certain type of soils.
High - neutral	Moving about from place to place by
Hight - 1st	For slow transportation using trailer.
High - 2nd	For trailer haulage only
High - 3rd	For trailer haulage only
High - reverse	For trailer haulage only

Premergence and post emergency application of herbicides:

The Premergence and post emergence application of herbicides used for weed control in direct seeded rice consist of nitro fen, bitachor, pendimethalin, thiobencarb and oxyfluorfen, oxidaizen, the post emergence herbicides includes bispyribac sodium, pyrazosulfuron, ethoxysulfuron ethyl ethorysulfuron, butachior, penoxsulam and acetochior.

Commonly used herbicides in index:

- 1 **2.4- dichloropnenoxy acetic acid:** It is selective trans located herbicides and most widely used to control weeds (Broad leaf weeds) in cereals and sugarcane as post emergence application it is easy to apply and non-poisonous to human beings and animals, it is applied @ 1 to 1.5 kg ac/ha in 500 to 600 liters as post emergence spray.

- 2 **2,4,5-Trichlorophenoxy acetic acid and 2,4,5 Trichloropropionic acid:** The above herbicides are similar in properties and mode of action and useful for controlling bushes and woody weeds.
- 3 **Dicamba:** It is selective translocated herbicides and it is useful to control broad leaf weeds and used @ 0.5 to 3kg 9.1/ha as post emergency spray.
- 4 **Sinazine:** This herbicides translocated and as pre-emergence spray for killing broad leaf weeds and grasses sugarcane, maize, jowar, potato, grapes etc. The selective rates are 0.5 to 2.5kg a.1/ha in 500 to 600 liters of water. Atrazine is more useful in dry farming areas.
- 5 **Mertibuzine:** It is broad spectrum selective herbicides with both, soil and shoot activity and found useful in sugarcane, potato, tomato, soybean, etc.
- 6 **Paraquat:** It is useful in sugarcane before germination and as direct spray after germination in sugarcane and orchards. It is useful as follow, application before sowing and also in non - cropped areas.
- 7 **Benthiocarb or Thiobencarb:** It is effective for control echinochloa SPP in rice. It is used as pre-emergence spray @ 1 to 2kg 1\ha.
- 8 **Alachlor:** It is very annual grasses and certain broad leaf weeds in groundnut, soybean, cotton, potato, sugarcane and vegetables. It is applied @ 1 to 2kg ai/ha.
- 9 **Bitachor:** It is selective pre-emergence herbicides used in seedbed and transplanted rice for control of Echinochloa SPP and most other annual weeds. The common rates are 1 to 5kg ai/ha. Up to 3 to 5 days, after sowing in seeded rice and upto 10 days, after transplanting in transplanted rice.
- 10 **Fluchloralin:** It is selective pre emergence herbicide effective against large number of annual weeds in cotton, soybean, jute, chickpea, sunflower, onion and certain solanaceous vegetables. Pre-planting soil incorporation of the herbicides give better results as it is volatile. It is applied @ 1 to 1.5kg a.i/ha.
- 11 **Pendimethalin:** It is primarily selective pre plant, soil incorporated herbicide found effective against number of annual weeds particularly grasses in cotton, soybean, groundnut and pea. It is also used as pre-emergence herbicide in maize, rice, small grains, onion and potato. The selective rates are 1 to 1.5 kg a.i/ha
- 12 **Glyphosate:** It is highly shoot mobile and weak residue herbicide and can be used against perennial weeds few days before sowing or as post emergence spray in non-cropped areas. Very effective to control perennial weeds like nut grass hariali etc.

Recommended dose is 1 to 3kg a.i/ha as post emergence spray, when seeds are in active stage of growth. It is useful for killing perennial weeds effectively in fruit crops and sugarcane as directed spray.

13 Weedicides application equipment: Spray equipments are used for application of herbicides. Herbicides are largely applied as spray. Several types of sprayers available from small hand operated to large ground and aerial sprayer.

14 Components of sprayer: The important components of sprayer are as follows.

- 1 Pump
- 2 Power source
- 3 Tank
- 4 Agitator
- 5 Distribution system
- 6 Pressure gauge
- 7 Pressure regulator

Pump: Pump is used for spray liquid must be atomized before it leaves the spray nozzle the pump provides the necessary pressure for this purpose.

Types of pumps

- 1 Air compression or pneumatic pump
- 2 Hydraulic or positive displacement pump

These pumps take in a definite volume of spray liquid and force it through the delivery system under pressure.

Source of power for pumps: Power is needed to run the spray pumps. The source of power as follows.

- Manual
- Traction
- Motor
- Tractor and air craft engine

Spray tank: The tank is provided with a large opening fitted with a strainer and cap to fill in the liquid.

Agitator: It is used for keep liquid spray homogeneous

Distribution System: It includes nozzle, spray lane, spray boom, house.

Nozzle spray pattern: Flat fan, solid cone, flooding tripe action, broadcast fan, blast, low volume and centrifugal.

Pressure regulator: Pressure gauge is provided to check the liquid spray through the pump.

Trouble shooting is weedicides application equipment

Sl. No	Defects	Remedies
1	Pump failure	Repair
2	Pump power service failure	Check/repair
3	Liquid tank delivery unit block	Repair/replace
4	Agitator defective	Repair/replace
5	Liquid distribution system failure	Repair
6	Pressure gauge defective	Replace
7	Pump regulator defective	Replace
8	Spray nozzle jam	Clean
9	Low air/ hydraulic pressure	Check/repair

Precautions in handling weedicides

- Always follow the daily and periodical maintenance of the equipment as per manufacturers recommendation.
- Clean the weedicides application equipment.
- Connect the power source with sprayer.
- Fill the weedicides in pump tank.
- Mix the weedicide with water as per proper ratio mentioned as per weedicides manufacturers.
- Test and set the weedicides spray pattern as required for particular plants.
- Use the PPE while operate the weedicides application equipment.
- Follow the air flow direction while apply weedicides in field.

Power tiller Trade curriculum and section safety precaution

Objectives: At the end of this lesson you shall be able to

- state the trade curriculum
- follow the safety precautions in trade section
- identify the range of machinery used in the trade.

Introduction to the trade curriculum

Mechanic agricultural machinery trade curriculum is developed by central staff training and research institute, Kolkata under guidance of Indian ministry of skill development and entrepreneurship. Trade curriculum is designed for sowing, plantry, harvesting and threshing equipments, electrical motor used on the farm, sprayers dusters, repapers, diggers hay boiler, prime movers test and troubleshoots functionality of major components working principle and operation of the equipment is described in a simple language and better understanding this trade curriculum is supported to achieve good knowledge of machinery and their function help to continuing technical education as well as for various entrance examination.

Safety precautions to be observed in the section

- Maintain the class room discipline as per institute rules and regulation.
- Read the rules and regulation institute and follow it.
- Maintain the trade machinery (daily, weekly, monthly, and periodical maintenance as per machine manufacturer instruction)
- Clean the machinery before and after use.
- Follow the instructors guide line to use the trade section with machineries.
- Use the personal protective equipment while operate the farm machinery.
- Use the proper size spanners to avoid slippage while work on the machine.
- Read the particular machinery user manual for get more information about the machine.

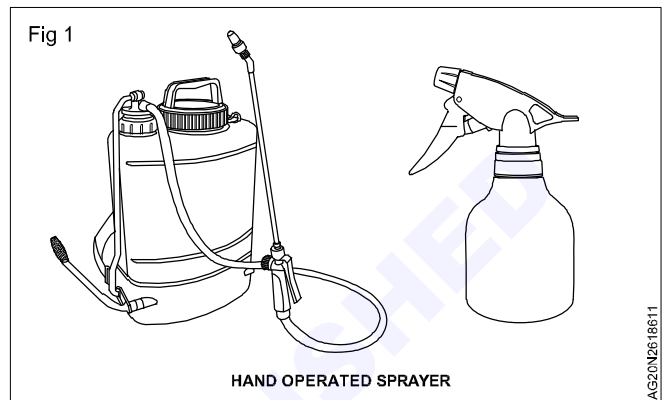
Range of machinery used in the trade and their features

Farm machinery comes in various shapes and sizes these equipment are designed to perform the entire range of farm activities. Farm equipment are helpful to benefit of large scale production.

Crop protection equipment

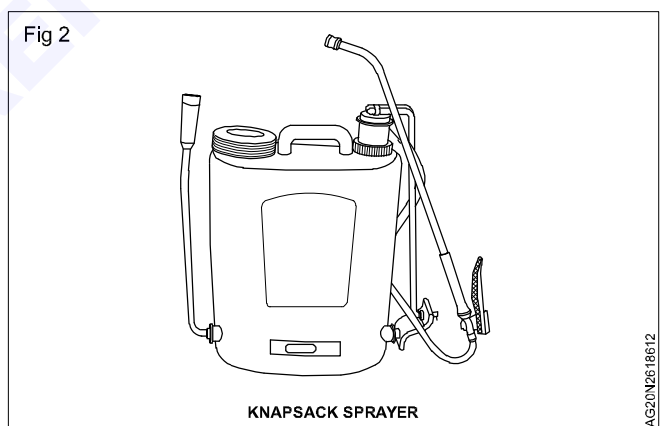
1 Sprayer

a Hand operated sprayer (Fig 1)



1 Knapsack sprayer

Knapsack sprayer is a spraying apparatus carried on shoulder consisting of a knapsack tank together with pressurizing device, line and sprayer nozzle, used chiefly in spraying fungicides or insecticides can be operated by hand as well as power. (Fig 2)



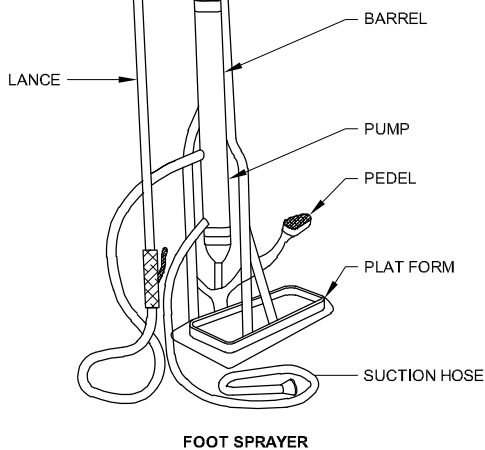
2 Foot operated sprayer

Foot operated sprayer is a spraying apparatus consisting of a with pressurizing device, long pipe line and sprayer nozzle and separate container used chiefly in spraying fungicides or insecticides operated by foot only. (Fig 3)

3 Bucket sprayer

Bucket sprayer is a spraying apparatus consisting of a bucket instead of tank placed on a ground together with pressurizing device, line and sprayer nozzle, used chiefly in spraying fungicides or insecticides operated by hand. (Fig 4)

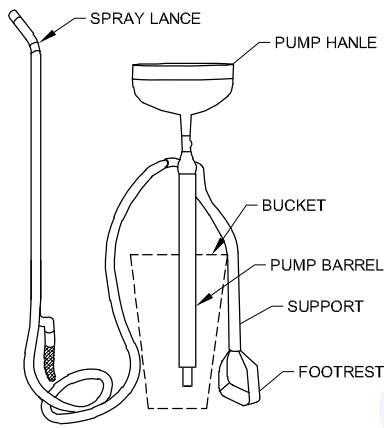
Fig 3



FOOT SPRAYER

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Fig 4



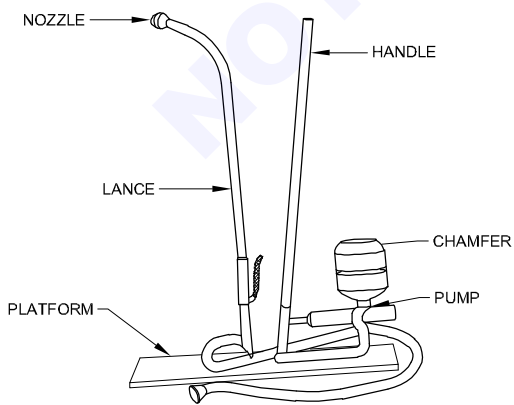
BUCKET SPRAYER

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4 Rocker sprayer

Rocker sprayer is all purpose sprayer is suitable both for small & large scale spraying on field crops, orchards, tea, coffee & rubber plantations. Delivery hose is 8 meters long & trigger cut-off device, extension rod 90 cm long with goose neck bent & nozzle as required. This is also operated by hand. (Fig 5)

Fig 5



ROCKER SPRAYER

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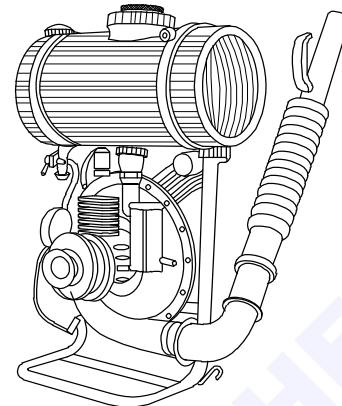
b Power operated sprayer

The following sprayers are operated by power

i Engine operated knapsack sprayer

Its pump operated by small petrol engine. To store petrol there is a small petrol tank. (Fig 6)

Fig 6



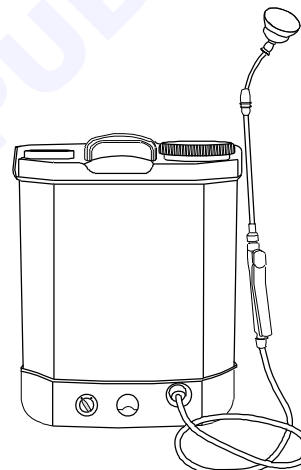
ENGINE OPERATED KNAPSACK SPRAYER

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ii Battery operated

It is a knapsack sprayer run by a battery operated electric motor. (Fig 7)

Fig 7



BATTERY OPERATED SPRAYER

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iii Tractor mounted sprayer

This sprayer is mounted on tractor and driven by three points hitching with the draw bar. The pump of sprayer is operated by PTO shaft. (Fig 8)

Fig 8



c Self-propelled sprayer

This sprayer is operated by own power unit (engine). Power unit drive the sprayer pump and provide itself the movement to sprayer in fields. (Fig 9)

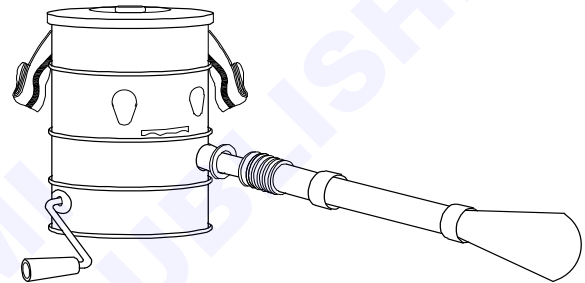
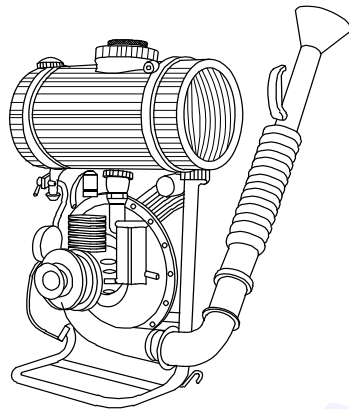
Fig 9



Duster

- a Hand operated duster (Fig 10)
- b Power operated duster (Fig 11)
- c Tractor mounted and operated (Fig 12)
- d Tractor driven duster (Fig 13)
- e Air craft duster (Fig 14)

Fig 10



HAND OPERATED DUSTER

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Fig 11



Fig 12



Fig 13



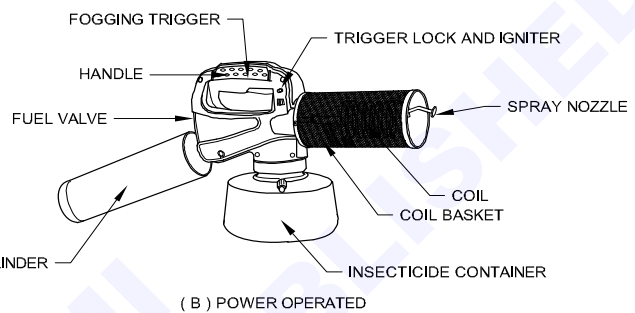
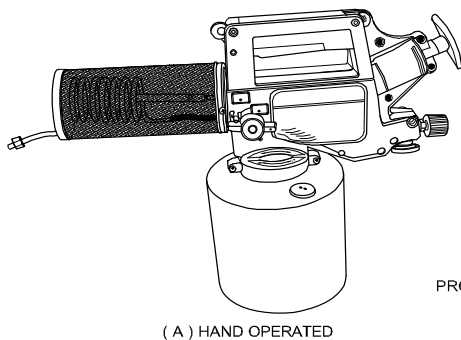
Fig 14



Fogger

a Hand operated (Fig 15)

Fig 16



Harvesting equipments

1 Root crop harvester

a Potato digger (Fig 16)

Fig 16



b Groundnut digger (Fig 17)

Fig 17

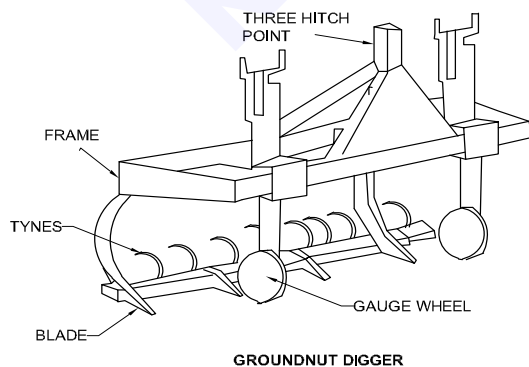


Fig 18

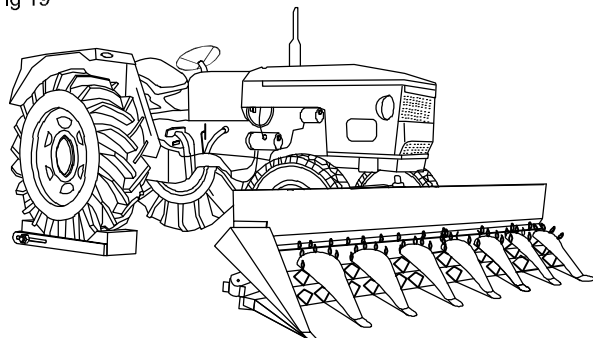


2 Cereal harvesting machines

a Combine harvester (Fig 18)

b Vertical conveyor reaper (Fig 19)

Fig 19



c Reaper cum binder (Fig 20)

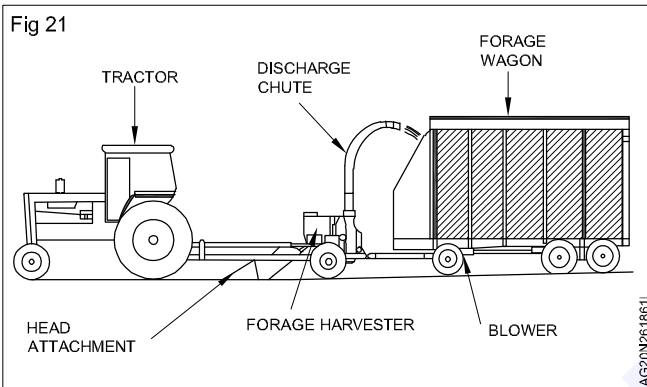
Fig 20



3 Forage harvester

a Forage harvester (Fig 21)

Fig 21



b Chaff cutter (Fig 22 & Fig 23)

Fig 22

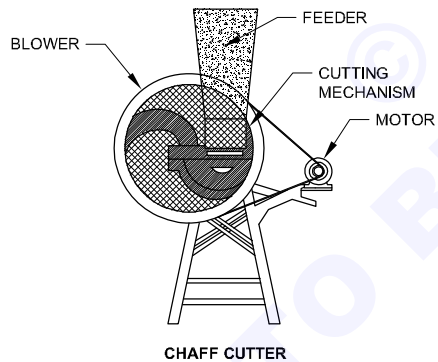


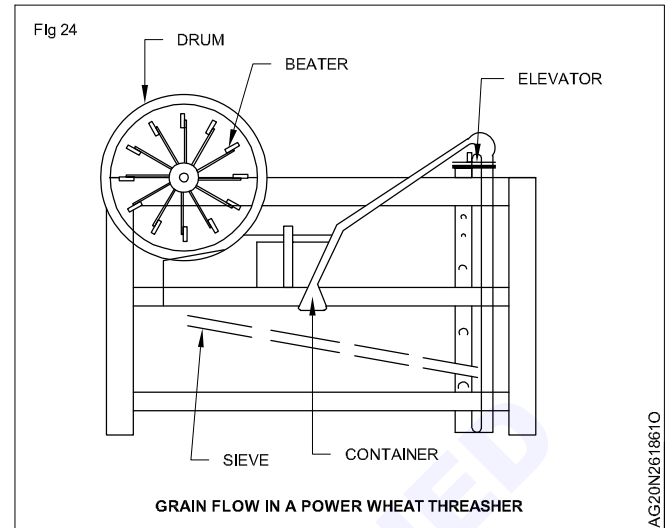
Fig 23



4 Threshing/Cleaning machine

a Wheat thresher (Fig 24)

Fig 24



b Paddy thresher (Fig 25)

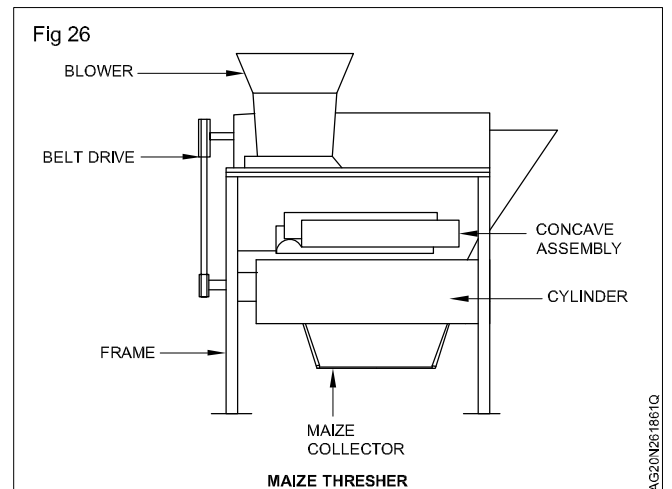
Fig 25

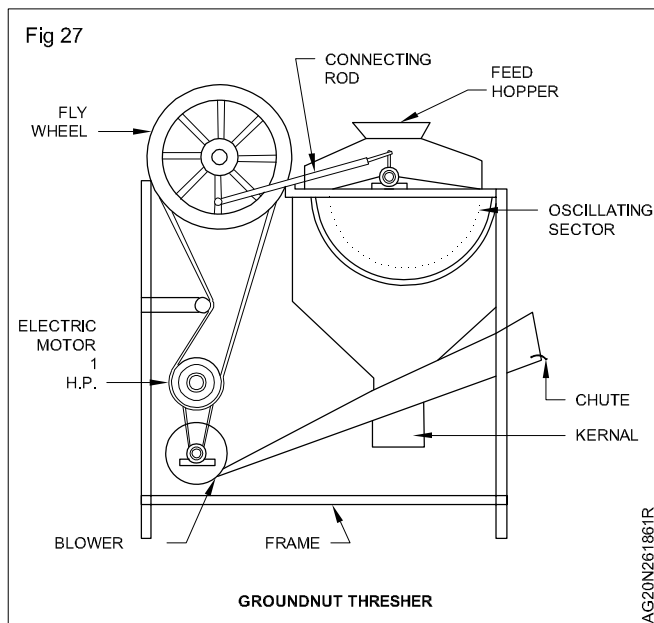


c Maize dehusker cum thresher (Fig 26)

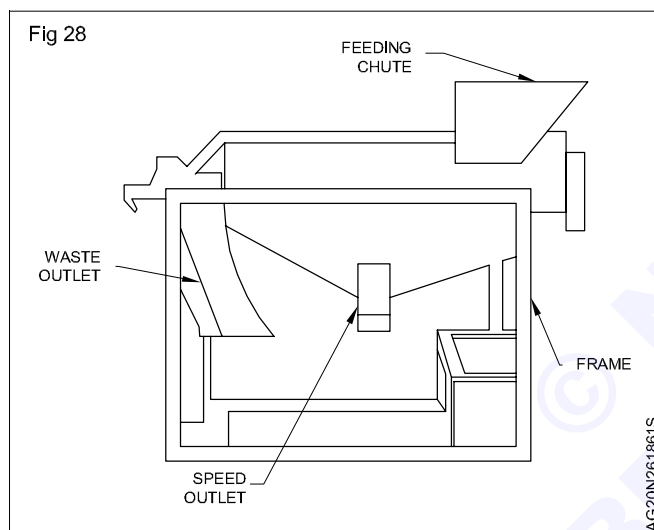
d Groundnut thresher (Fig 27)

Fig 26





e Oilseed thresher (Fig 28)

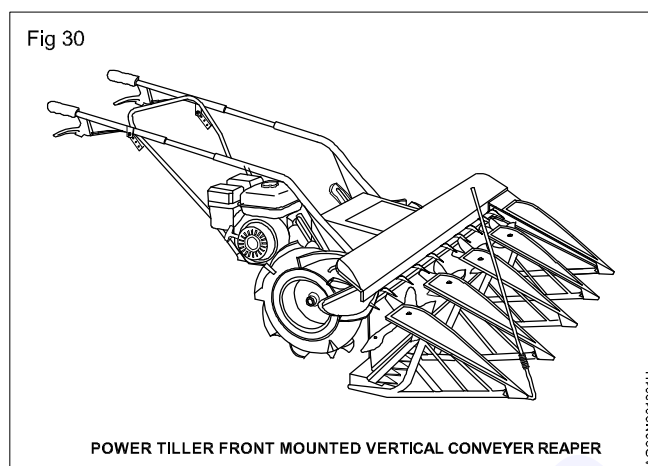


f Winnower (Fig 29 & 30)

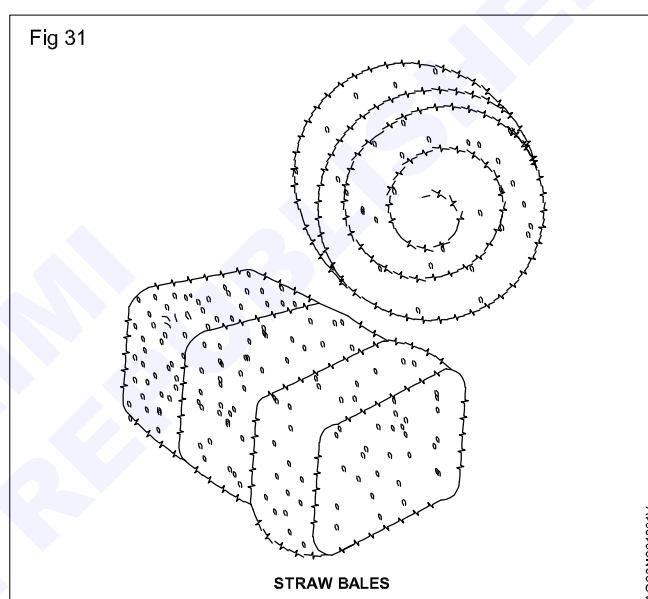
5 Residue management machinery (Fig 31)



a Straw reaper (Fig 30)

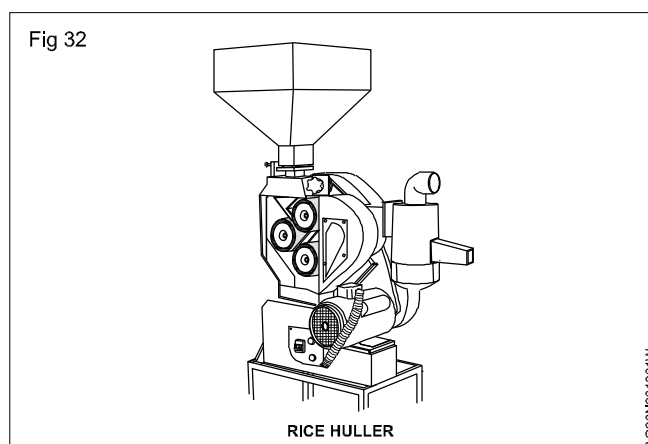


b Straw bales (Fig 31)

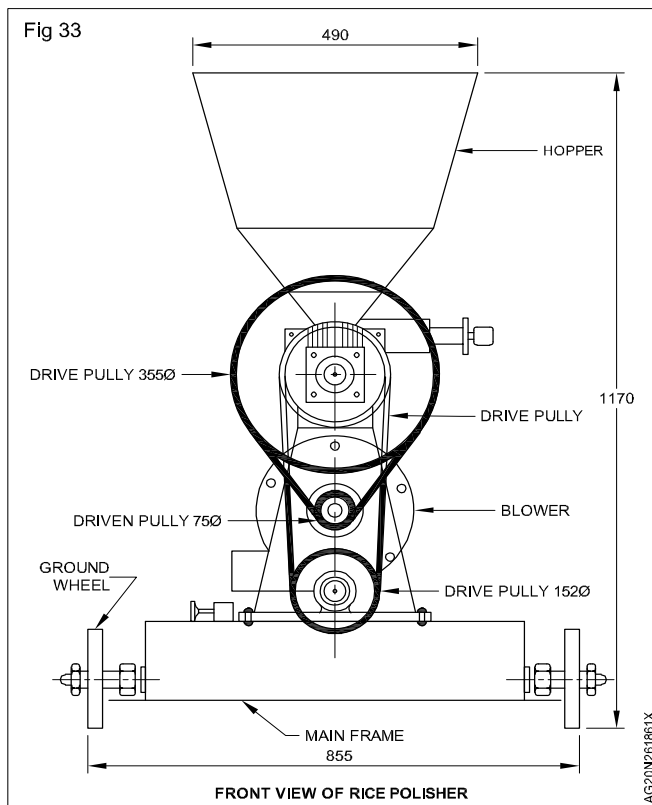


Post harvesting equipment

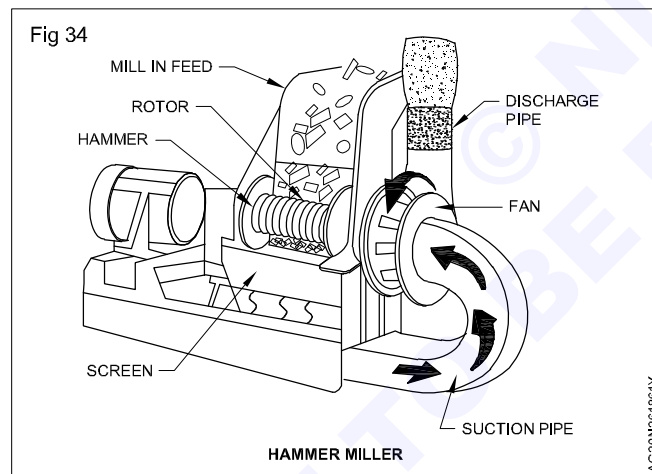
1 Rice huller (Fig 32)



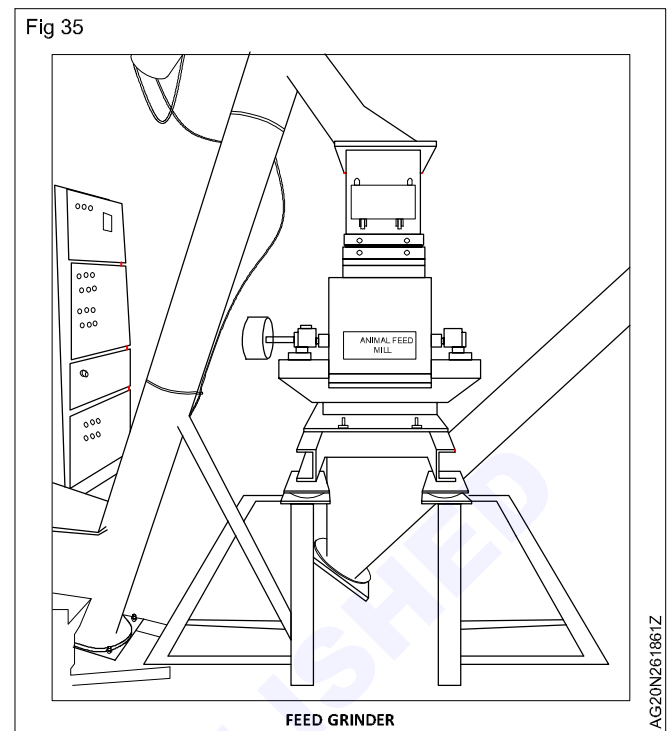
2 Rice polisher (Fig 33)



3 Hammer miller (Fig 34)



4 Feed grinder cum mix (Fig 35)



Precautions for handling farm machinery

- Select the suitable machinery for particular farm works.
- Select the power source to operate the farm machinery.
- Clean the machinery before and after use.
- Adjust the necessary adjustment before use and during operate the machine in the field work.
- Follow the safety precautions of equipment as per direction given by the equipment manufacturers carry out the daily, weekly, monthly, periodical brake down, and storage maintenance as specified by machine manufacturers.

Farm electrical motor

Objectives: At the end of this lesson you shall be able to

- state the farm used electrical motors and their construction details
 - state the care and maintenance of electrical motor and starters
 - state the installation of motors.
-

Introduction: An electrical motor is a machine that converts electrical energy into mechanical energy. It is used for generating torque to lift loads, move objects and various farm mechanical works. An electrical motor is mainly classified into three types. They are as follows

- A.C motors
- D.C motors
- Special motors

A.C motor: A.C motor is classified as synchronous motor, Asynchronous motor further synchronous motor is classified as single phase motor and three phase motor. synchronous motor is classified as reluctance motor and hysteresis motor.

Asynchronous motor is classified as induction motor and commutator motor, further induction motor is classified as a squirrel cage induction motor, slip ring motor or wound rotor induction motor, capacitor start induction run motor. Capacitor start and capacitor run motor. Commutator motors are further classified as a A.C series motor, A.C compensated series motor repulsion motor, repulsion start induction run motor.

D.C motor is classified as brushed D.C motor, brushless D.C motor, coreless D.C motor and special motor.

Brushed D.C motor types

- Separately excited D.C motor
- Self excited D.C motor
- Series wound motor
- Shunt wound motor
- Compound wound motor
- Permanent magnet D.C motor

Types of special motors

- Servo motor
- Direct drive motor
- Linear motor
- Stepper motor
- Universal motor

The basic working principle of A.C motor is the rotating magnetic field (RMF) generated by the starter winding

When alternating current is passed through it, the rotor having its own magnetic field and rotor follows the RMF of starts rotation, Further A.C motor classified as single phase motor and three phase motor.

Construction detail of single phase motor

Single phase induction motor utilizes a capacitor in series with its auxiliary winding to generate extra torque during its start up. Capacitor is only used for starting the motor and it is disconnected once the motor reaches near synchronous speed using a centrifugal switch.

Construction detail of three phase motor

The three phase induction motor mainly consists of two parts (1) stator (2) rotor. The stator is a static part and rotor is rotating part, both are separated by a small air gap, which varies from 0.4 mm - 4mm depending on shaft of motor. Rotor is mounted on shaft of the motor. There are two types of rotors (1) squirrel cage motor (2) phase wound motor. Stator consists of steel frame, which encloses a hollow, cylindrical cone, made up of thin lamination of silica on steel to reduce eddy current loss and hysteresis loss. A large number of slots are cut on the inner periphery of the core. The stator conductors are placed in these slots, which are insulated from each other and also from the slots. The conductors are connected as a balanced star or delta winding. The windings are wound for definite number of poles depending on the requirement of speed. If high speed needed the winding is wound for less number of poles and vice versa.

Selection of motor for farm work : There are several characteristics in electrical motors. When selecting motors consider the voltage, current, torque and RPM. mechanical power are most important. Current is the power for motor and too much current will damage the motor. For D.C motor operating and stall current are important.

Care and maintenance of electrical motor

A well planned preventive maintenance is the key for long life operation of electric motor.

Frequent checks

- Clean the motor of any dust or oil.
- Check oil rings.
- Check the bearing gears.

- Check the starter switch, fuses and motor mounting.
- Check the drive belt tension.
- Check and replace brushes.
- Check and grease in ball or roller bearings.
- Check operating speed.
- Test the current input and compare it with normal requirement.
- Check the absence of vibration.
- Check the frequency. It should be limited 5% above or below the standard frequency.
- Check the motor grounding.
- Motor load should not exceed the rated load.
- Drive should be selected carefully.
- Motor should be protected from dust, moisture and excessive humidity.
- The amperage temperature should not exceed 40°C.

Different types of starter

There are different types of starter switches. They are used to start and stop the electrical motors. Starter switch allow to make and break current rapidly. The starters are as follows

- Manual starters
- Magnetic starter
- Rotor resistance starter
- Stator resistance starter
- Auto transformer starter
- Start delta starter
- NEMA rating starter

The motor starter is used for control short circuit protection, over load protection, disconnecting and breaking the motor power supply.

Fuses and their capacities: An electrical current heats the wire when the current passes through it. The amount of heat depends upon the current and resistance flows through the wire. The heating effect of circuit is limited by the fuse. If this limit is not controlled, the circuit farm motor will be over loaded causing severe damage to the motor.

Fuse is used between the electric circuit to protect electrical devices used by electrical power. Fuse is a weakest portion in electrical circuit. A fuse opens the circuit

A fuse opens the circuit by blowing out, when current flows overload in the circuit.

Fuse elements are made by lead - tin or tin - copper alloy wire in strip of correct amperage for each circuit. The fuse is assembled in fuse carrier of glass or ceramic material. A soft fine wire or strip carries the current from one end to another end. The conductors are designed to carry the current at specified maximum limit. If the flow of current value exceeds the limit prescribed on the fuse, the fuse wire melts and opens circuit and prevents the motor from damage.

Installation of motors: Induction motor is mostly used in agricultural process. Single phase and three phase are used depending upon the farm requirement. The following points must be considered while installing a farm motor.

Base for mounting the motor

Motor is installed on suitable base fixed on a levelled surface. Ensure the motor base mounting tightness.

Types of drives

The motor is connected to load of pulleys and belts or by direct coupling. When the load is connected with the motor by a direct coupling the load is driven at the same speed of the motor being pretty high, all the farm machines are not directly coupled with motor because some farm machines work on slow speed also. Centrifugal pumps, grinder wheels, fans are directly coupled with motors. Pulley and belt drive is commonly used for farm work.

When the motor is very close to the equipment or mounter on the equipment 'V' belt drive is used. Flat belt drive is used when an equipment has already flat pulley or when the equipment pulley is large enough to get proper speeds. When motor is located at some distance from the driven machine, flat belt drives are recommended.

Safety precautions of farm motors

- Properly place the farm motor on the surface.
- Ensure the farm motor mountings.
- Ensure the motor power connections and on/off switch.
- Ensure the pulley and belt drive and their alignment.
- Protect the motor from dust and moisture.
- Ensure proper value fuse is used between the electrical circuit.
- Don't overload the motor, it is a cause for motor damage.

Sprayers, dusters and their constructional details

Objectives: At the end of this lesson you shall be able to

- **state the types of sprayers**
- **state the working principles of sprayers**
- **describe the calibrations of sprayers**
- **state the method of sprayer operation.**

Introduction

Sprayer is a machine used to apply liquid chemicals on plants to control pest and diseases. sprayer can also be used to apply herbicides to control weeds and to apply micro nutrients to enhance plant growth

Selection of spraying equipment

While selecting equipment for spraying operation, the following factors should be considered:

- Frequency of application of pesticide
- Availability of manpower
- Total area to be covered
- Cost of operation
- After sales service facilities
- Durability of the equipment

Types of Sprayers

There are different types of sprayers are used in the farm work. They are as follows

- Hand held sprayers
- Nozzle and pump of hand
- Back pack sprayer
- Knapsack hand sprayer
- Stainless steel and brass knapsack sprayer
- Brass tank knapsack sprayer
- Stirrup sprayer
- Rocker sprayer
- Hand operated compression sprayer
- Pedal operated pump sprayer
- Knapsack power sprayer
- High power pump for sprayer
- Trailer sprayer (with hyder super poly tank)
- 300 gallon 3pt mounted sprayers
- Tractor mounted field sprayers
- Trailer type orchard sprayers

Based upon the volume of liquid handled sprayers may be classified into three types. They are as follows

- High volume sprayer (more than 410 litres/ha)
- Low volume sprayer (5 to 400 litres/hectare)
- Ultra low volume sprayer (less than 5 litres/ha)

The sprayer selection depends up on type of vegetation kinds of pests and approach to the field.

The main functions of a sprayer are

- Breaking the chemical solution into fine droplets of effective size.
- Distributing the droplets uniformly over the plants
- Applying the chemicals with sufficient pressure for positive reaching the plants
- Regulating the amount of liquid applied on plants to avoid excessive application

Desirable quality of a sprayer

A good sprayer should possess the following qualities

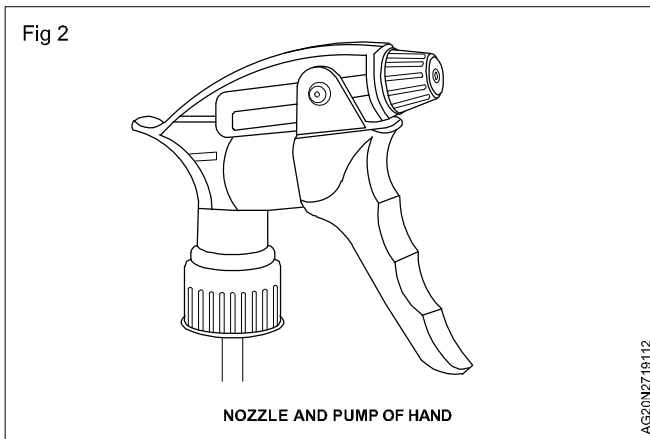
- It should produce a steady stream of spray material in desired droplet size so that the plants to be treated may be covered uniformly.
- It should deliver the liquid at sufficient pressure so that the spray solution reaches all the foliage and spreads uniformly over the plant body.
- It should be light in weight yet sufficiently strong, easily workable and repairable.

Different sprayers at a glance

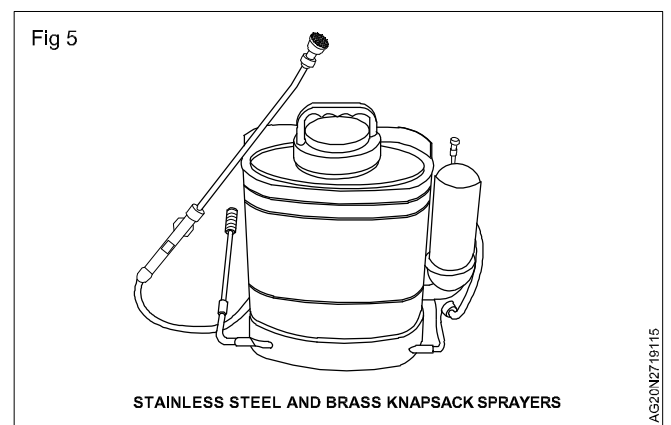
Hand - held sprayers (Fig 1)



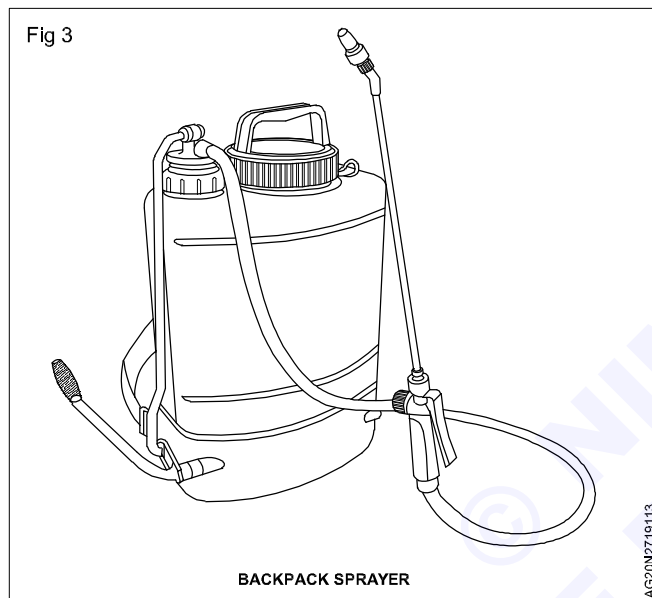
Nozzle and pump of hand (Fig 2)



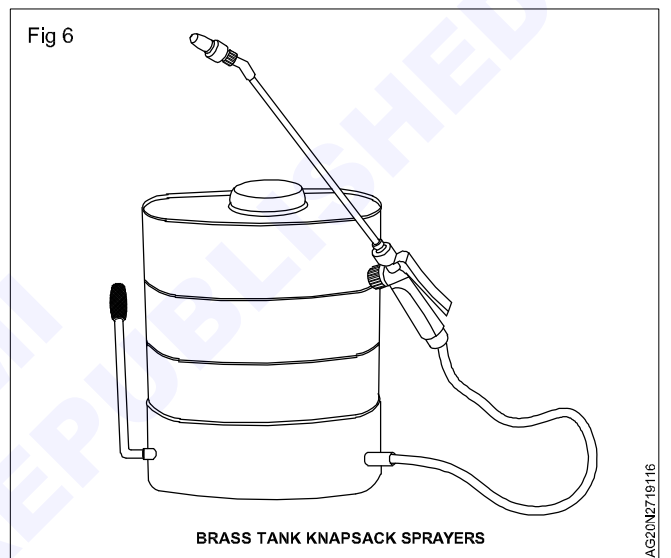
Stainless steel and Brass knapsack sprayers (Fig 5)



Backpack sprayer (Fig 3)



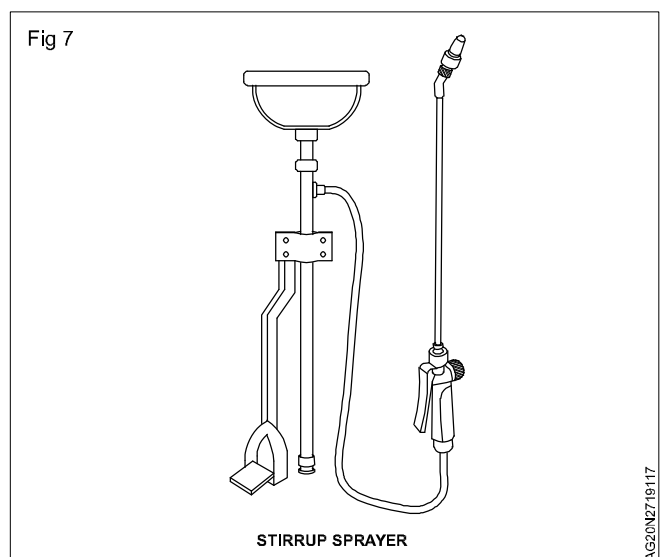
Brass tank knapsack sprayers (Fig 6)



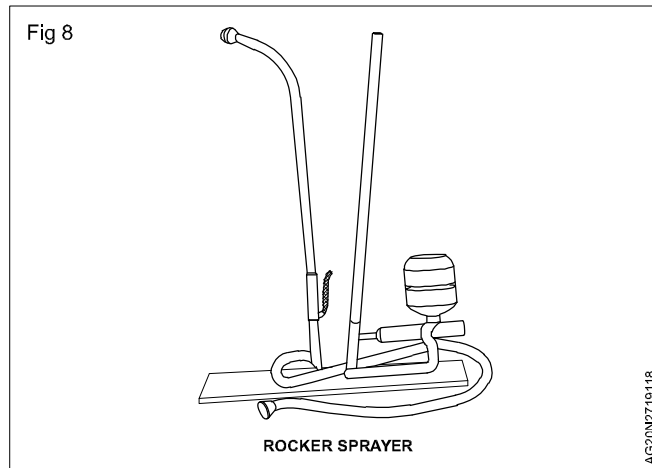
Knapsack hand sprayer (Fig 4)



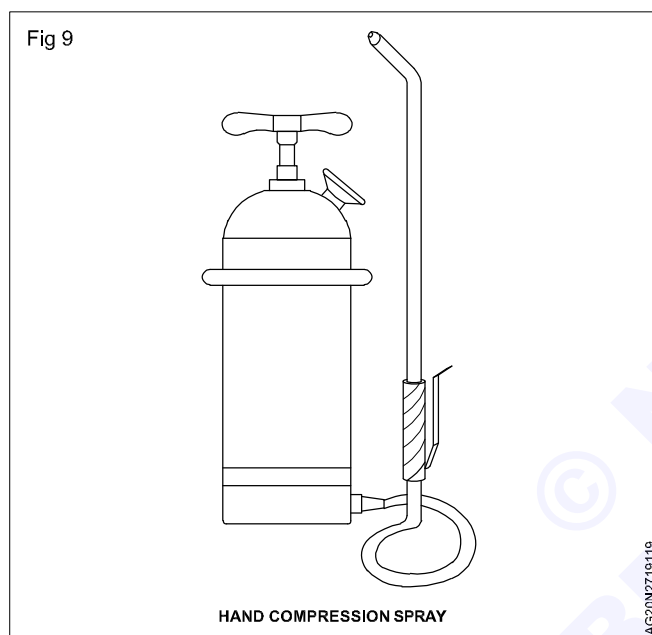
Stirrurp sprayer (Fig 7)



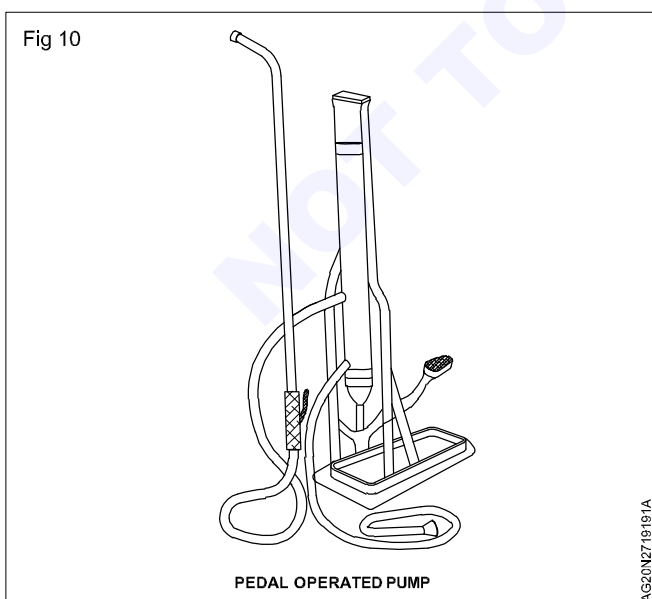
Rocker sprayer (Fig 8)



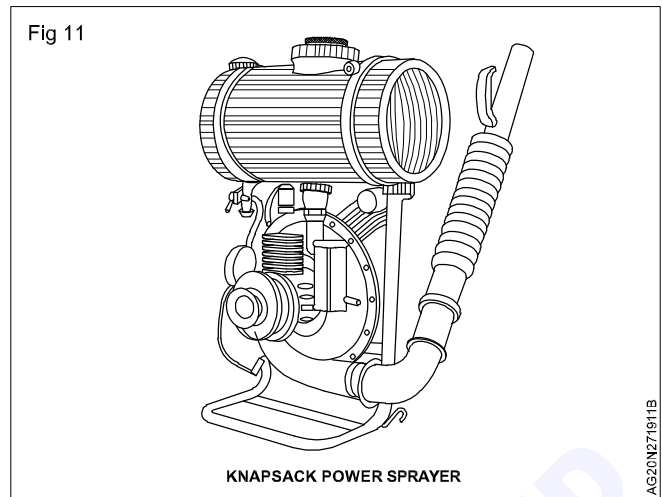
Hand compression spray (Fig 9)



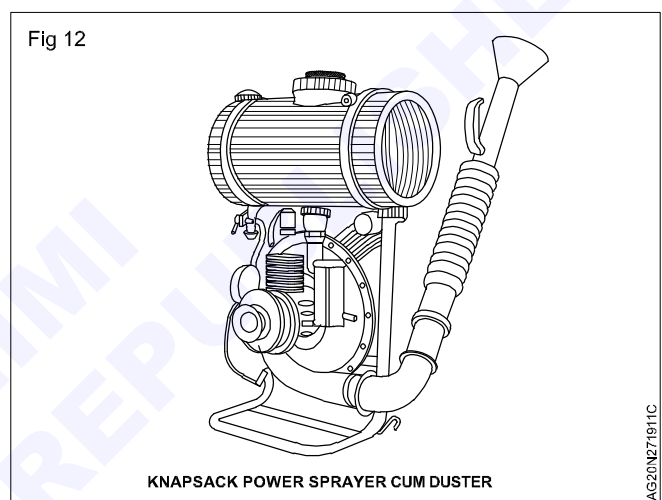
Pedal operated pump sprayer (Fig 10)



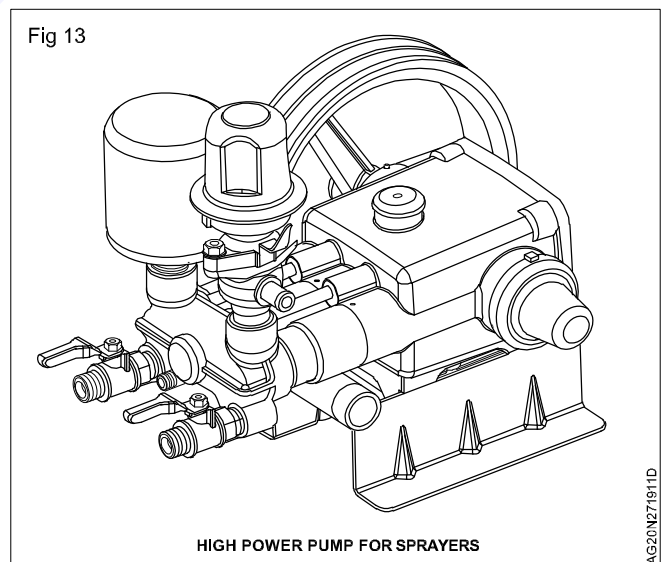
Knapsack power sprayer (Fig 11)



knapsack Power Sprayer cum duster (Fig 12)



High power pump for sprayer (Fig 13)



Trailer sprayer (with Snyder super ply tank) (Fig 14)

Fig 14



300 gallon 3pt. mounted sprayer (Fig 15)

Fig 15



Tractor mounted field sprayers (Fig 16)

Fig 16



Trailer type orchard sprayer (Fig 17)

Fig 17



Basic components of a sprayer

Components of a sprayer are as follows

- 1 Pump
- 2 Chemical tank
- 3 agitator
- 4 Air chamber
- 5 Pressure gauge
- 6 Pressure regulator
- 7 Valves
- 8 Strainer
- 9 Suction line
- 10 delivery line
- 11 Nozzles

Pump : A pump is a device used to move fluids, such as liquids or slurries, or gases from one place to another. A pump displaces a volume by physical or mechanical actions. Most hydraulic sprayers are equipped with positive displacement pumps capable of developing pressure, required for spraying jobs. The discharge capacity of these pumps is approximately proportional to speed. A pressure relief valve or by-pass valve is required to protect these positive acting pumps from damage when the discharge line is closed and the convenience of the operator.

Tank : It is the container to hold the chemical solution. It is made up of PVC, brass etc., It is usually made of metal sheet or synthetic rubber or plastic having good resistant quality against corrosion, erosion and similar actions. The size of the tank varies according to pump capacity and the requirements.

Agitator : It is a device which stirs the solution and keep the contents in homogenous condition. Positive agitation of spray material in the tank is essential to permit using full range of spray materials including powdery emulsions, fungicides, cold water paints or other spray material. The propeller of the paddle type mechanical agitators or hydraulic agitators are very common.

Air chamber: In a reciprocating type pump, an air chamber is provided on discharge of the pump to level out the pulsations of the pump and thus providing a constant nozzle pressure.

Pressure gauge: It is a dial gauge which indicates pressure at which the liquid is delivered from the pump. A pressure gauge properly calibrated, within the pressure range of pump is provided on the discharge line to guide the operator for making proper adjustment of the pressure at site.

Pressure regulator : The pressure regulator serves several important functions. It is the means of adjusting the pressure as required for any job within the pressure range of the pump. With the positive displacement type of the pump, it also serves as a safety device in automatically unloading the excess pressure by directing the unused discharge flow from pump back to the tank.

Valves : valve is a device that regulates the flow of liquid (Gases, liquids, fluidized solids, or slurries) by opening, closing, or partially obstructing various passage ways.

Cut - off valve : Cut- off valve is provided in the delivery line to control the flow from the pump.

By-pass valve : It is provided in the delivery line to by-pass the flow from pump to tank when flow in delivery line is reduced than the pump capacity.

Relief valve : It is an automatic device to control the pressure of fluid or gas within a range of predetermined pressure.

Strainer: It is a small circular plastic ring with nylon wire mesh to filter any dust particles coming with chemical solutions. It is included in the suction line between the chemical tank and the check valves. In some sprayers strainers are provided at the mouth of the chemical tank eg., Knapsack sprayers.

Nozzles : It is component which breaks the fluid into fine droplet. Atomization of spray fluid is usually achieved by discharging the liquid through an orifice called nozzle under pressure. Atomization is also achieved by breaking up the jet of the liquid with the blast of air.

Spray gun : It is a hand held metallic or PVC pipe to one end of which the nozzle is fitted and a flow cut- off valve and a handle are fitted at the other end. The delivery hose is connected to the spray gun. It conducts the fluids from the delivery hose to the nozzle. The operator holds the gun and does the spraying job. Area of coverage by a spray gun is less compared to the coverage of a spray boom. Spray guns are used with low power sprayers eg., Knapsack sprayers, rocker sprayer.

Spray boom : It is along metallic or PVC pipe to which several nozzles are fitted with. The delivery hose is connected to the spray gun. High power and high capacity sprayers are spray booms. The coverage is larger compared to spray guns. Booms are usually mounted on suitable structures and used eg., Tractor operated sprayers, power tiller operated sprayers.

Over- flow pipe : It is a conduit pipe through which excess fluid from a pump is by- passed in to chemical tank by the action of a relief valve or pressure regulator.

Component of a nozzle

Nozzle body: It is a main component which encloses all the other components of the nozzle.

Swirls plate : It is a metal disc with two tangential holes which imparts a swirl or rotation to the liquid passing through it.

Nozzle disc : It is a component which breaks the fluid into a fine droplet. It is a flat disc with an orifice at the centre. When the spray solution reaches the discs from the swirl plate the disc builds up the pressure on the fluid and when the fluid passes out of the orifice, it breaks into fine droplets. The disc has a specific design to impart a hollow cone or solid cone or a flat fan type of discharge to the outgoing fluid.

The popular nozzles are a) hollow cone b) solid cone c) fan or flat type.

Strainer : It is a small circular plastic ring with nylon wire mesh to filter any dust particle coming with the chemical solution

Spacer : There are two number of runner / plastic rings placed in between nozzle plate and swirl plate and between swirl plate and strainer for effective travel of the solution.

Ultra low volume sprayer

ULV sprayer is used to spray chemicals on row crops like cotton, cowpea, groundnuts, tobacco and vegetables. It is ideally suited for home gardens. It is hand held sprayer with a spinning/ rotating disc designed for ultra- low volume (ULV) and controlled droplet application of insecticides, fungicides, pesticides, herbicides and all liquids. Rotating disc technology ensures efficient liquid atomization to give appropriate droplet size. ULV formulations are applied at only 2.5- 7.5 liters/ha. One hectare of crop can be treated in around 2.5 hour.

Hand Atomizer

This sprayer is also ideally suited for home gardens and small fields . It consists of a container of 0.5 to 3.5 liters capacity a built in air pump, pressure gauge, nozzle and flow cut off lever. The tank is to be filled with 3/4th volume. The pump is operated to build pressure in the tank of 0.15- 0.3 kg/cm². When the flow is cutoff lever is pressed, the fluid passes through the nozzle and spraying is done. The application rate ranges from 45- 100 liters/ha.

Fig 18



HAND ATOMIZER

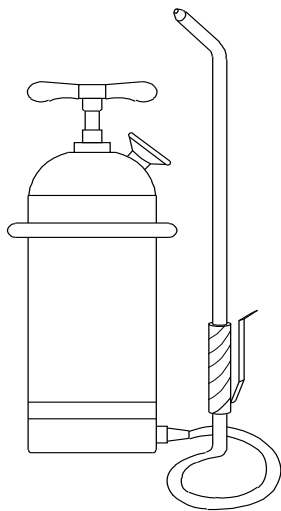
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Hand compression sprayer

is suitable for applying chemicals for fields crops and lawns. Similar to hand atomizer this sprayer also consists of a tank of 10-12 liters capacity for holding spray material, a vertical air pump, pressure gauge, filling port, spray lance, nozzle and flow control lever. The chemical tank is

filled 75-80 % volume. The pump is operated to pump air in to the tank to build pressure up to 2.0- 3.5 kg/cm² when the flow is cut off lever is pressed, the sprayer is carried on the shoulder of the operator. The application rate ranges from 45- 100 liters/ ha.

Fig 19



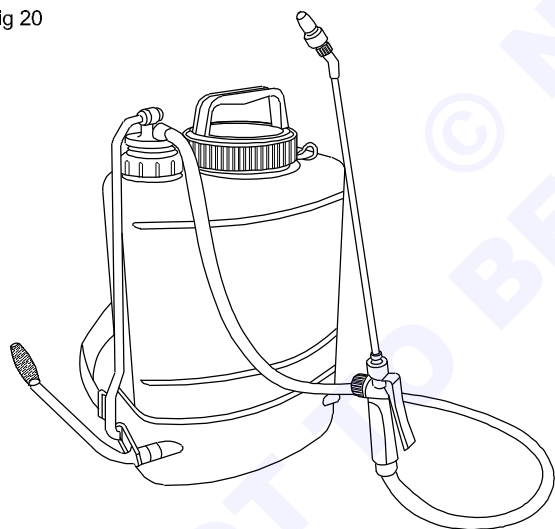
HAND COMPRESSION SPRAY



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Knapsack sprayer (Hand operated)

Fig 20



KNAPSACK SPRAYER (HAND OPERATED)

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This sprayer is suitable for applying chemicals to several field crops. The operator carries the sprayer on his back and hence the name knapsack sprayer. It has a flat or bean shaped tank of 10-15 liters capacity, hydraulic pump fitted inside the tank, a handle to operate the pump, agitator, filter, delivery hose and spray gun with nozzle and flow control lever. The tank is made up of brass or PVC material. The tank is filled with chemical solution when the pump is operated, it draws the fluid through the suction hole and delivers it to the spray gun, when the cut off lever is pressed spraying is done through the fine

droplets. The pressure developed in these sprayers depends on the pump and varies from 3-12 kg/ cm². The application rate is 500 liters/ ha. The coverage is 0.5 -1.0 ha/day.

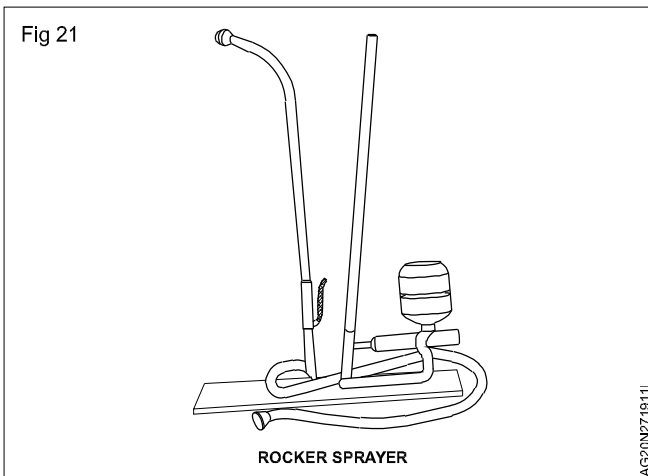
Salient features of the knapsack sprayers

- 1 Useful to develop high pressure with less effort.
- 2 Light in weight and easy to carry on the back of the operator.
- 3 High work rate and economical.
- 4 Robust and simple to maintain.
- 5 Both left and right hand operation
- 6 10- 15 liters capacity.
- 7 Easy to spray chemicals.

Rocker sprayer

Rocker sprayer is mainly used for spraying fruit trees in orchards, coconuts and areca nut trees, flower gardens and cotton and tapioca fields. It consists of pistol type pump, a platform with fork, a lever to operate pump, pressure chamber, suction hose with strainer, delivery hose, and a spray gun with flow control knob and nozzle. The pump builds up the pressure up to 14-18 kg/cm² which facilitates the use of the sprayer for tree spraying. The pressure chamber helps for continuous spraying. The chemical is taken in a separate container and the suction hose is kept in the chemical container. When the pump

is operated, it draws the fluid through the suction hose and delivers it to the delivery hose through the pressure chamber. When the flow control knob is turned, the fluid is sprayed through the nozzle. The output of the sprayer is 70-90 liters/hr with one nozzle. Coverage is about 1.5 ha/day.



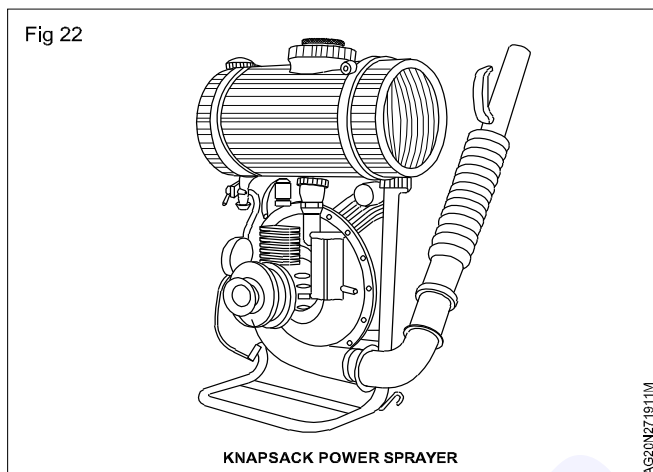
Foot or pedal operated sprayer

The foot or pedal operated sprayers, as they are commonly called, consist of a plunger assembly, stand, suction hose, delivery hose, spray gun with nozzle etc., One end of the suction hose is fitted with strainer and the other end is connected to the pump inlet opening. Similarly, the delivery hose is fitted at one end of the delivery opening of the pump and the other end to the spray gun. Constant pedaling is required for continuous spray. It develops the pressure of 21 kg/cm^2 . The chemical is taken in separate container and the suction hose is kept in the chemical container. When the pump is operated by foot, it draws the fluid through the suction hose and delivers it to delivery hose. When the flow control lever is pressed, the fluid is sprayed through the nozzle. Agitation of the chemical solution is done by supplying a portion of air from the blower. The discharge rate with one nozzle is 110-135 l/hr and coverage is 1.0 ha/day.

Knapsack motorized mist blower cum duster

It is a simplest engine driven sprayer used in agriculture. It is carried on the back of the operator. It is used for spraying all types of field crops most popularly paddy, ground nut, cotton and vegetable crops. It consists of a 1.2 -3.0 hp high speed petrol engine, a blower, 12 lit chemical tank, delivery hose, flow regulator knob and a plastic atomizer grate. The tank is filled with the required chemical solution. When the engine is started the blower generates a high velocity of air to which the chemical solution is fed. The chemical mixed air stream is broken in to fine droplets at the atomizer grate and sprayed, changing few parts the sprayer can be converted to a duster.

Motorized Knapsack sprayer



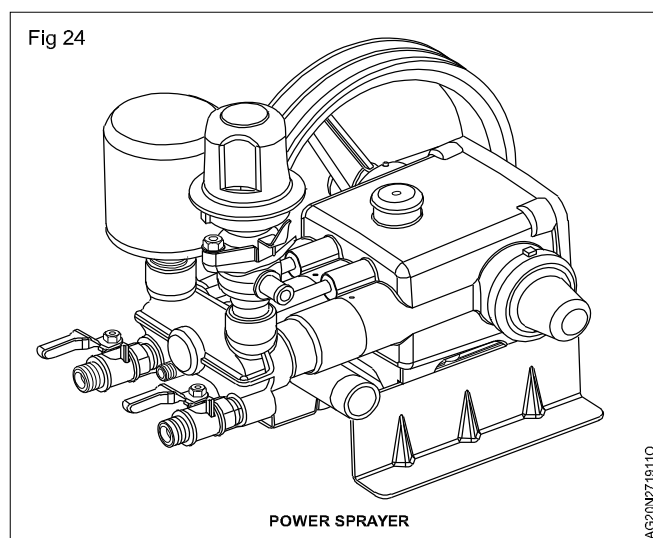
Motorized Knapsack sprayer spraying chemicals to wheat crop



Conversion of a mist blower in to a duster

- 1 Replace the liquid delivery hose by a bigger diameter pleated hose to carry the powdery chemical from the tank into the airstream.
- 2 Provide an air distributor at the bottom of the tank for stirring and keeping the chemical in suspended form.

Power sprayer



It is a heavy duty and efficient sprayer. It consists of a triplex pump with stainless steel piston with oil bath lubrication. It can develop 250 to 350 pressure and can

deliver the solution up to 15 m. It can be powered by 3HP or electric motor. It is convenient to spray with 4-6 spray lances at a time using the sprayer. There are sprayers that can be operated by tractor PTO as well as by a power tiller.

Sprayer calibration

Calibration of the sprayer is performed to determine the exact application rate of a chemical. During calibration, the sprayer tank is filled with clean water and not with the actual chemical liquid. The sprayer is operated over a strip of 100 meter long and the time required to travel this distance, say X minutes, is noted. Thereafter, the sprayer is operated for this X minutes keeping the tractor stationary and maintaining the same engine speed and pump pressure. The liquid discharged through each nozzle are collected and measured. The most accurate calibration is performed by measuring the output from each nozzle at desired pressure and speed of the operation. The output of each nozzle should be approximately the same with a maximum variation of 5%. In order to check the discharge from all the nozzle, a patternator can be placed under the boom of a tractor driven sprayer and discharge from each nozzle is collected to find out the variation in discharge among all the nozzles used.

Tractor operated air assisted sprayers

In air assisted sprayers, the droplets are carried by the stream of air generated by a PTO operated blower or fan. Basically, the air assisted sprayers are of two types. namely, aero blast sprayers and air sleeve boom sprayers. Following are the advantages of air assisted sprayers over hydraulic sprayers:

- i Increased penetration in dense crops.
- ii Improved work rates through the use of lower spray volume rates. (l/ha)
- iii Reduction in drift in the range of 50-90 %
- iv Being able to control the deposition of spray on the target location.

i Tractor operated mist sprayers

It is also known as aero blast sprayer and is a viable to hydraulic sprayer. It helps in chemical application on targets far from the sprayer. It applies the same quantity of chemical in $1/10^{\text{th}}$ volume compared to a hydraulic sprayer. Air stream is used to carry the spray liquid onto the plant canopy. In order to generate sufficient air stream blower is provided which gets its drive from the tractor PTO through suitable drive. Turbulence of the out coming air blast causes through the mixing of spray fluid and air. The spray laden air proceeds from sprayer to displace original air in plant canopy. Air blast distributes the chemical uniformly in the swath. The effective working width is about 13 meter. The effective field capacity of such sprayers may range from 2-2.5 ha/4.5ha for orchards at an average speed of operation of 1.8 to 2.2 km/h. Aero blast sprayers have been designed for economic and effective application of chemicals in orchards, grape gardens, vegetables and cotton crops.

ii Tractor operated air sleeve boom sprayer

The control of pests can be achieved effectively if pesticides are properly applied at the correct rate, at the right time and on target appropriate equipment. In field crops like cotton the pest attacks on the lower side of the leaves and mostly at the time of boll formation. The sprayers with conventional sprayers do not enter at the bottom position of the plant canopy and upper and lower side of the leaves. For this purpose, tractor operated air sleeve boom sprayers have been designed for chemical application in cotton crop. The principle of working of the sprayer is totally based on the replacement of air with in the canopy of plant with spray laden air.

Fig 25



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Safety precautions of spraying

Before spraying

- i Read instructions given in manual of the pesticide and equipment.
- ii Check the spraying equipment and accessories which are to be used.
- iii Ascertain that all the components are clean, especially filling and suction strainer, sprayer tank, cut-off device and nozzle.
- iv Replace the worn out parts and rings, seals, gaskets, worn out nozzle tip, hose clamps, valves etc.,
- v Test the sprayer and ascertain whether the pump is providing the required output at rated pressure.
- vi Check the nozzle spray pattern and discharge rate.
- vii Make sure that appropriate protective clothing is available for the use during chemical application.

During spraying

- i Make proper protective clothing/ gadgets to avoid skin, eyes and mouth exposure.
- ii Mix the chemical in correct quantities
- iii Liquid formulation should be poured carefully to avoid splashing.
- iv Selection proper direction, while spraying in the field to avoid/ minimize drift and inhalation.
- v Hold the spray lance boom at proper height to avoid minimize drift.

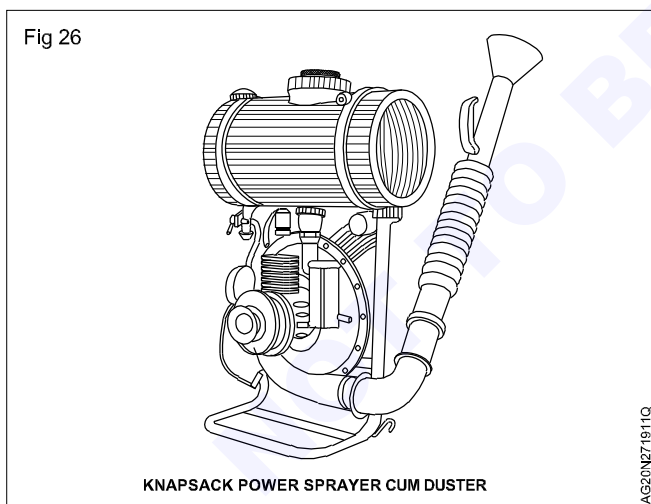
- vi Do not spray in high wind, high temperature and rain.
- vii Never allow children to be near during mixing.
- viii Select recommended operating speed and pressure.

After spraying

- i Clean buckets and other appliances used during preparation of the spray solution.
- ii Do not use empty pesticide containers for any other purpose instead destroy them.
- iii The residual chemical from sprayer tank should be disposed of in pits made for this purpose preferably on waste land and away from water bodies.
- iv The remaining chemical should not be poured into irrigation channel/ canal or pond.
- v Always clean the sprayer properly after use, lubricate / grease it and then keep in the store room.

Sprayer care and maintenance

- i Sprayer should be checked properly and maintained well during the spraying season to have trouble free application of chemicals.
- ii Clean the sprayer thoroughly daily after completing the work including the filters and nozzles.
- iii All moving components should be lubricated properly as per the schedule.
- iv Worn out, broken and damaged parts should be replaced on priority basis.
- v The pump should be greased and checked for its proper functioning.
- vi Leaking joints must be attended properly to avoid wastage of the chemical.
- vii While filling the chemical solution care should be taken that no foreign material enters into the tank.



Duster

Duster is a machine used to apply chemicals in dust form. Dusters make use of air stream to carry pesticides in finely divided form on the plants. A duster essentially consists of

- 1 hopper
- 2 agitator

- 3 feed control
- 4 fan or blower
- 5 delivery nozzle

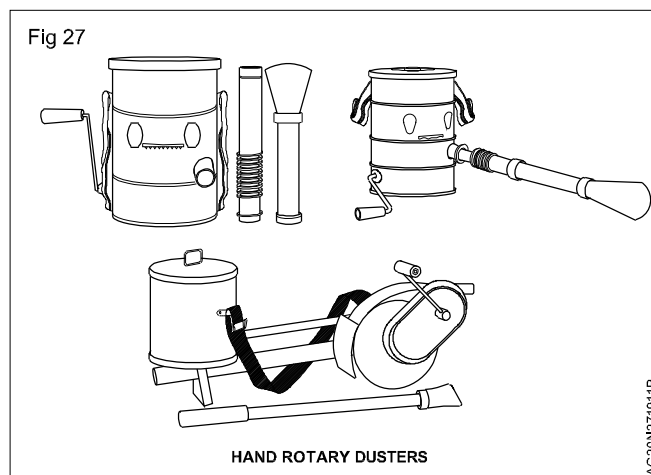
Types of dusters

- 1 Plunger type
- 2 Knapsack type
- 3 Rotary type
- 4 Power operated duster

1 Plunger type: It is a simple duster with a small piston. The piston drives a current of air over the dust in the hopper. The dust is carried away through a delivery spout. Small hand pump dusters are of this type and are available only where the area to be dusted is small like vegetable gardens.

2 Knapsack type: It is a duster with the powder container carried on the back of the operator. Knapsack dusters have a hopper through which a current of air is blown to pick up the dust. The air current is produced by a lever operated leather bellows. Shoulder straps are used to carry in the field. These dusters are suitable for small areas.

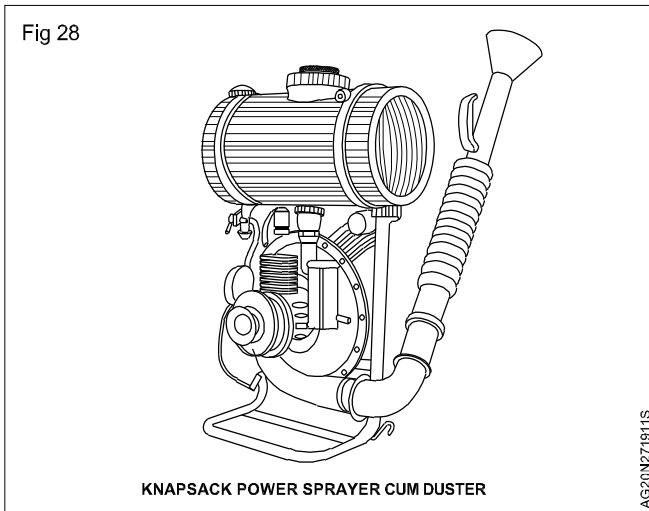
3 Rotary duster: Hand rotary dusters are useful to apply chemicals which are in powder form. It consists of a hopper, a fan, a gear box, handle, delivery hose and a deflector plate. When the handle rotates the fan rotates at high speed and draws air from outside. The chemical from hopper is fed in to the air stream in the suction side of the fan. The chemical mixes with the air, through the delivery line is applied on the plants. The rate of delivery can be regulated. It is used to apply powdery chemicals to vegetables, sorghum crops etc.,



Power operated dusters

Power operated dusters mainly consist of a power driven fan, a hopper and delivery spout. The fan creates a strong air flow which causes the dust to blow off from the hopper to a considerable distance vertically or horizontally. Direction of dust is regulated by a movable spout suitably fitted with the unit. This type of dusters are used for large areas.

Fig 28



Ariel duster or crop duster

Ariel duster or crop duster; An air craft is used for dusting or spraying large acreages with pesticides. Ariel spraying and dusting permit prompt coverage of large areas at the moment when application of pesticide is most effective and avoid the need for wheel led vehicles that might damage crops. The technique was greatly improved in the 1960s with the development of ultra- low volume applicators, in which concentrated pesticides are distributed in amounts as small as 1 ounce per acre (70 grams per hectare)

Fig 29



Care and maintenance of the dusters

- Select the suitable dusters of sprayers for field operations.
- Use proper prime mower.

- Adjust the necessary adjustment before start work and during field operations as required spray pattern.
- Clean the sprayers and dusters after use.
- Thoroughly check the equipment for damages/ leakages.
- Maintain the equipment as specified by manufacturer.
- Use the standard parts to replace the damage parts.
- Use only recommended chemicals for spray.
- Wear the PPE while repair/ replace.
- Store the equipment in safety place.
- Lubricate the parts where it is needed.

Dusters Common accidents and their prevention method

- 1 When you are mixing or handling or spraying chemicals wear eye protector, gloves, long sleeve shirt and long legged pants.
- 2 Triple rinse empty pesticide containers and do not re use them Dispose the empty containers properly after rinsing.
- 3 Read and follow the label pasted on the pesticide chemical packing container.
- 4 Keep the label on each used container so everyone can read the precautions.
- 5 Always follow the application rate as directed on the protect label on the packing.
- 6 After the completion of work immediately wash with clean water and change your clothes, if pesticides are sprayed.
- 7 Was your clothes separately from other clothing after mixing and using pesticides to prevent cross contamination of yourself and your family.
- 8 Wash your hands before eating, drinking chewing gum or touching your nose or mouth.
- 9 Dusters sprayers leakage can inject fluid into your body although the injury may appear like a cut, which may lead to the need for amputation.
- 10 Splashing fluid into eyes on the skin can also cause serious injury.

Reapers and their uses

Objectives: At the end of this lesson you shall be able to

- state the reaper types and their functions
- describe the construction details of reaper
- state the field adjustments and their operations
- state the care and maintenance of reaper
- state the safety precautions and trouble shooting in a reaper.

Reaper: Reaper is a machine used for harvesting cereal crops mostly at ground level. These are operated by power tiller or tractor. A reaper basically consists of the following major components (1) Frame (2) Power transmitting unit (3) cutter bar.

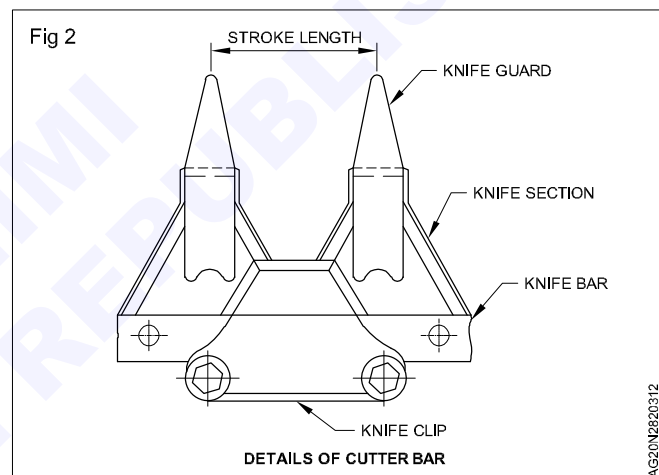
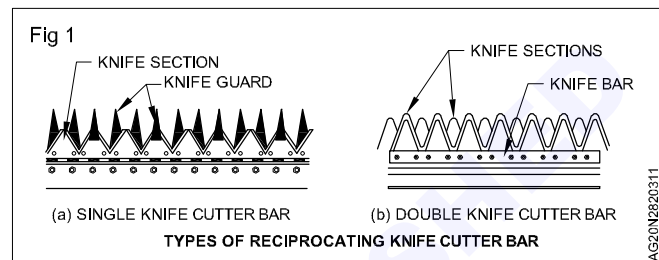
Frame: Reaper frame provides shape to the reaper and space for mounting different components of the reaper. It is made of mild steel having channel section (L section or I section).

Power transmitting unit: Reaper consists of gear box, crank wheel and pitman. Power is supplied to the gear box either from the engine or of power tiller or PTO of tractor through suitable arrangement and from there to crank wheel and cutter bar through the pitman. The function of the crank wheel is to change the rotary motion into the reciprocating motion to the cutter bar. The reciprocating motion is then transmitted to cutter bar of the reaper through pitman arm for harvesting the ground level crop. Pitman arm is a type of connecting rod which is connected to the crank wheel through crank wheel pin at one end and at the other end is connected to the cutter bar.

Cutter bar: Cutter bar is used to cut the crop and separate it from uncut crop. Reciprocating knife cutter bar also termed as sickle cutter bar. Cutter bar may be of two types namely single knife cutter bar and double knife cutter bar (Fig 1). Single knife is used in all types of harvesting cereals as well as fodder crops where the crop stalk is hard enough to provide necessary support for cutting. However, double knife cutter bars, without knife guards, are used only for cutting with succulent stem which does not provide necessary support required for cutting berseem, grasses, etc. It has advantage of dynamic balancing by having two exactly similar knife sections reciprocating in opposite directions and there by generating less vibrations than single knife section cutter bar. It can be operated at high forward speed and produces more uniform height of cut than single knife cutter bar.

Components of cutter bar

Fig 2 shows the basic components of a standard cutter bar. A cutter bar consists of following components.



Knife bar: It is a mild steel bar (minimum 0.35% carbon) of regular x section on which triangular based knife sections and knife head of a cutter bar are riveted. The knife bar is made to move back and forth with the help of crank wheel and pitman. The reciprocating motion of knife bar helps in cutting the crops in both directions during the advancement of reaper.

Knife section: It is the most vital section of the cutter bar which is triangular in shape and is made up of high carbon steel with 0.75 - 0.95% carbon. The knife section are riveted to the knife bar. The function of the knife is to cut the crop with its both cutting edges while reciprocating, namely, smooth edge type, top serrated type, and bottom or under serrated type. Smooth edged knife sections are used for the crops with fine smooth stems, for example wheat crop whereas serrated type knife sections are used for crops with coarse (fibrous) stem, for example, rice crop.

Knife guard: Knife guards are provided on the cutter bar. It protects the knife sections from being damage while harvesting the crop. The knife sections must stop in the centre of the knife guard during each stroke. It also divides

the crop being cut into smaller segments for easy cutting. It is made up of malleable cast iron, cast steel or forged steel.

Ledger plate: It is hard metal inserted in the knife guard over which knife section moves to provide a scissor like action for cutting the crop. The modern knife guards may not have separate ledger plate instead their lower face is made sharp enough to act as a ledger plate. The clearance between knife plate and ledger plate is kept in the range of 0.50 - 1.0 mm for better cutting. Hair pinning effect may occur, instead of pure cutting, if clearance is more.

Knife clip: Knife clips are provided to hold the knife section, along with the knife bar, down against the ledger plate for proper cutting of the crop. It also presses the cutter bar against being lifted up due to the pressure of crop at the time of cutting.

Shoes: A shoe at the both the ends of cutter bar is provided to regulate the height of cut above the ground level in case of side mounted cutter bar. This also results in easy sliding of cutter bar on the ground. The inner shoe is larger in case of outer shoe, in the case of front mounted cutter bar, the shoe helps in separating the crop being harvested with the rest of the crop.

Types of Reapers: There are many types of reapers which are used in farm harvesting works. They are as follows

- Self propelled vertical conveyor reaper
- Tractor mounted vertical reaper
- Self propelled riding type vertical reaper
- Self propelled - reaper cum binding reaper
- Self propelled binding harvester.
- Shrub master
- Animal drawn reaper

Self propelled vertical conveyor reaper: It consists of crops row divider, star wheel cutter bar, and a pair of lugged canvas conveyor belts and a handle fitted with a clutch and brakes. These types of machines cut the crops and conveys it vertically to one end and with draws the crops on the ground uniformly. Collection of crops for making bundles is easy and it is done manually. Self propelled walking type, self propelled riding type, and track mounted type vertical conveyor reaper are also available. These types of reapers are also suitable for crops like wheat and rice. In this reaper there is no shattering of crop.

Tractor mounted vertical conveyor reaper (Fig 3 & 4)

This machine consists of a 76 mm pitch reciprocating cutter bar assembly seven crop row dividers, two vertical conveyor belts fitted lugs, pressure springs, pulleys and gear box for power transmission system. The crop row dividers are fitted in front of cutter bar assembly and the wheels are mounted over the crop row dividers. The machine is mounted in front of the tractor and the power to the machine is given from tractor PTO with the help of intermediate shaft running beneath the chassis of the

Fig 3

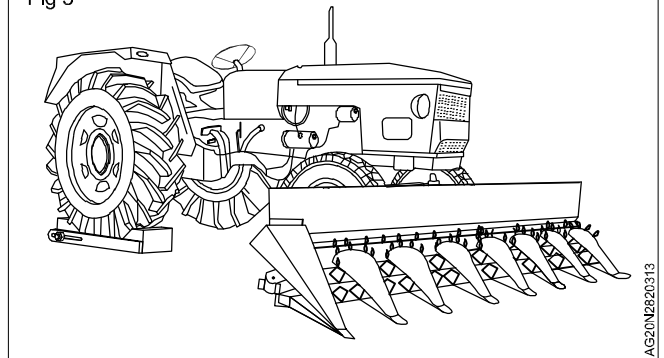
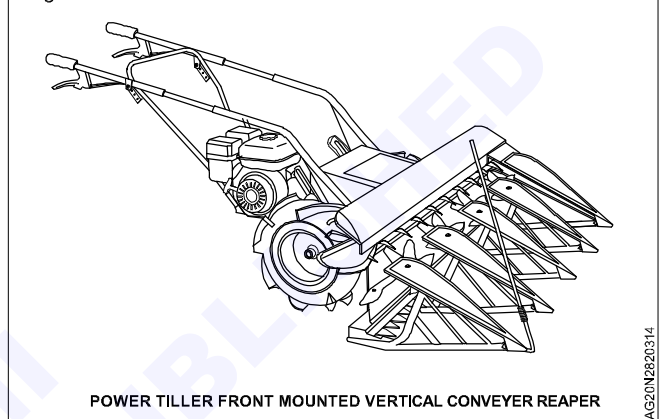


Fig 4



tractor and coupling shaft. Height of the machine above ground is controlled by the hydraulic with the help of pulleys and steel ropes. After the crop is cut by the cutter bar. It is held in a vertical position and delivered to one side of the machine by lugged belt conveyor and fall on the ground in the form of window perpendicular to the direction of the movement of the machine.

Self propelled riding type reaper: This type of machine is self propelled unit in which the operator rides on the machine. Drive is given by two large pneumatic wheels and steering by rear idlers. The prime mover is a 6 hp/ 4.5 KW diesel engine, convergent clutch brake, steering hydraulic system and simple power transmission are provided for ease of operation. It consists of crop row divider, star wheel cutter bar, conveyor belt and wire spring etc. This reaper has two forward and one reverse speed.

Self propelled reaper binder: It consists of a frame, cutter bar, handles fitted with clutch and brakes seat, for the driver, two drive wheels, one wheel below the seat for steering crop gathering unit and twine. The cutting unit of this type of reaper may be disc type or cutter bar type. After cutting the crop is conveyed vertically to the binding mechanism where it is tied by the twine and released to the ground in the form of bundle, Self propelled walking type models are available but these are not popular due to high cost of twine reaper. The twine reaper binders are suitable for rice and wheat.

Self propelled combine harvester: Various kinds of combined harvesters having 2 to 6 meter long cutter bar are commercially available. The functions of the combine harvester is to cut, thresh, winnow and clean grain/seed.

It consists of header unit, threshing unit, separation unit, cleaning unit and grain collection unit. The function of header unit is to cut and gather the crop and deliver it to threshing cylinder. The reel pushes the straw back on to the platform. While the cutter bar cut it. The crops are threshed between cylinder and concave due to impact and rubbing action. The threshed material is shaken and tossed back by the straw rack so that the grain moves and falls through the openings in the rack on to the cleaning shoe. While the straw is discharged at the rear. The cleaning mechanism consists of two sieves and a fan. The grain is conveyed with a conveyor and collected in a grain tank.

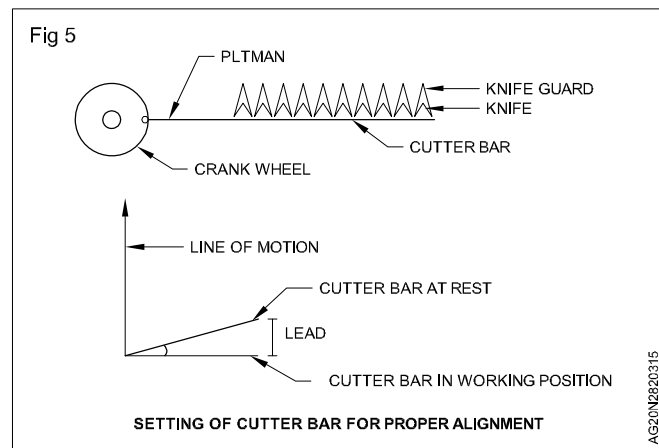
Shrub master: It consists of cutting blades fixed to the rotating bar, gear box for transmission of power at right angle, universal joints with telescopic shaft to connect the tractor PTO and gear box adjustable skids for controlling cutting height of shrubs or grass, safety guard and hitching frame. It is operated by tractor PTO. The bar having cutting blades fixed at the ends is mounted on the gear box shaft. Thus, the rotary motion of the gear box provides rotary motion to the bar. The cutting blades mounted on the bar swing open to the cutting position due to centrifugal force as the bar rotates in horizontal plane. The cutting takes place purely through impact and blades need not be sharp edged. The blades are made of medium carbon steel or alloy steel hardened.

Animal drawn reaper: It consists of cutter bar of 1.05 m length. The power to drive knife bar is given from the ground wheel by means of gear box crank and connecting rod mechanism. As the machine is pulled forward by a pair of bullocks, a reciprocating motion is imparted to the knife bar with a peak cutting velocity of about 100m/min. The crop is cut due to shearing action. The effective field capacity of mechanism varies between 0.2 - 0.3 ha/h.

Animal drawn engine operated reaper has a cutter bar of 1.35 m length. A two hp four stroke petrol engine operates the cutter bar. The drive to the cutter from engine is given through 'V' belts and gear box it can cover 0.2 - 0.4 ha/h with field efficiency of about 80%.

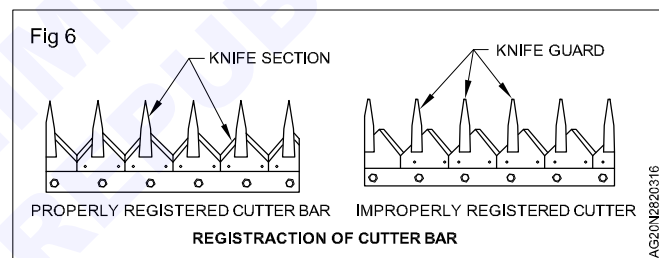
Cutter bar adjustments: There are basically two types of cutter bar adjustments, namely, alignment and registration which is to be done for proper cutting of crop.

Alignment: When the cutter bar is aligned then all three components namely knife bar, outer shoe and pitman should run in straight line, i.e. at 90° to the line of travel. When reaper mover operates in offset position meaning by to one side of the power source, then the crop exerts pressure on the cutter bar and due to this the outer end of the cutter bar is pushed backward disturbing the alignment. To overcome this problem, generally, the outer end of the cutter bar is kept little ahead is known as lead. By providing the lead, when crop pushes the cutter bar backward then the outer and inner cutter end of cutter bar comes in a straight line making correct alignment. In general, the cutter bar is set at 88° from the line of travel in idle position that means a lead of about 2° or 2 cm/m length of cutter



bar is provided. Proper alignment i.e. position of cutter bar during work and rest has been shown in Fig 5.

The problem of the cutter bar alignment does not occur where cutter bar has been fitted/ mounted in front of the power source like tractor front mounted or power tiller front mounted vertical conveyer reapers or combine harvesters. In these cases, the power source is fitted to one side of the cutter bar from its the power source is fitted exactly in the centre of the cutter bar therefore, the crop load exerted from one side of the cutter bar from its centre is almost balanced by the crop load exerted on



the other side. This is the reason why harvesters having front-mounted cutter bars are provided lead.

Registration (Fig 6)

As the pitman moves the knife section with knife bar back and forth, then the centre of the knife section must stop in the centre of the knife guard at the end of the each stroke. If this is so, then it is said that the cutter bar is properly registered vice versa. If cutter bar is not properly registered then uneven cutting of crop and frequent clogging of cutter bar takes place. Also due to improper registration the crop plants are knocked down by the cutter bar instead of being cut. In order to address this problem of improper cutter bar registration, the length of pitman is adjusted in such a way that the knife sections rest exactly in the centre of each knife guard during each stroke length. Stroke length is linear distance travelled by the knife section from the centre of one knife guard to the centre of adjacent knife guard. The value of stroke length is 76.2 mm.

Care and maintenance of the reaper

- Clean the residual weeds and dirt on the reaper.
- Check the reaper for nuts and bolts looseness if need retighten it.

- Check the connecting pieces of looseness.
- Add lube timely in the engine, binding device and cutter bar.
- Check the cutter bar knife for sharpness, if need be, re-sharpen the knife.
- Blow of machine daily before and after use.
- Grease before and after washing.
- Pay attention to the pulleys.
- Check the frame of the reaper.
- Check the gear box and pitman connecting linkage.
- Adjust the reaper as specified by manufacturers.

Precautions in reaper working and transporting

- Clean and check the reaper before the start of work.
- Lubricate the moving parts of reaper.
- Check the reaper mounting nut and bolts.
- Wear personal protecting equipment while operating the reaper.
- Don't allow the children or unknown persons to operate the reaper.

- Keep the children away from the reaper while operating the reaper in field work.
- Follow the reaper manufacturers machine operating instructions.
- Do not operate any external controls unless you have been instructed to do so.
- Use the warning signal that you are going to start the reaper.
- Take extra care when using PTO driven machine.
- Ensure safe guards are in place and they are properly chained, lubricated and free from defects.
- Ensure the tractor or reaper does not move causing PTO shaft to separate.
- Follow the safe step whenever possible.
- Check where assistants are working and make sure you can see them.
- Know and recognize the dangers of the slopes.
- Don't drive the reaper on slopes until you are properly trained.
- Lift the cutter bar while transporting the reaper one place to another place.

Reaper trouble shooting

Defects	Remedies
Reaper frame damaged	Repair/replace
Reaper components loose mountings	Tighten it
Gear box noise	Repair/top up oil
Crank wheel bearing noise	Replace
Pitman arm bent	Replace
Cutter bar knife damaged	Replace
Cutter bar knife less sharpen	Sharpen the knife
Knife guard damaged	Replace the knife
Knife mounting loose fitting	Tighten it
Knife clip damaged	Replace
Less clearance between knife section ledger part	Adjust the clearance
More clearance between knife and ledger plate/hair pinning cutting effect	Adjust the clearance between knife section and ledger plate.
Hard sliding of cutter bar	Replace shoe provided in both ends of the cutting bar.
Power transmitting unit not work	Check and repair

Threshers and their functions

Objectives: At the end of this lesson you shall be able to

- state the types of threshers and their functions
 - state the working principle and construction details of threshers
 - state the threshers adjustment and operation
 - describe the thresher prime mover and driving system
 - state the troubles and their remedies of thresher.
-

Introduction: The process of loosening the grain and separating them from straw is known as threshing. Threshing involves either rubbing action, impact action or stripping action to loosen the grain from heads/ pods of the crop.

A crop can be threshed by using human power, animal power, or mechanical power. Each method has its own style. There are different types of threshing methods used for threshing a crop they are as follows

- Manual threshing
- Threshing by animals
- Tractor treading
- Threshing by power thresher
- Threshing by combined harvester

Manual threshing: It is slow and labor consuming process. The harvested crop is dried and thereafter beaten either by stick or against floor / wooden log to loosen the grain from the pod. It is adopted for very small quantity of harvest.

Threshing by animal treading: The dried crop stalk is spread on a clean threshing floor in the form of thick circular layer. The bullocks are tied together with a rope and then one end of the rope is tied to the pole fixed in the centre of the threshing floor. Then the animals made to move round and round in circular path over the crop on the threshing floor. The crop is trampled by the animals continuously till a homogenous mixture of grain and chaff is prepared. Later on the grains are separated from the straw by winnowing.

Tractor treading: Different kinds of threshing machine is used for trampling the crop on the threshing floor. The dried harvest is spread on the threshing floor and the tractor is made to move on it in a circular pattern. Due to the circular movement of tractor the grain is separated with the help of winnowing fan.

Threshing by power thresher: Different types of threshing machine is used for threshing of variety of crops. The energy requirement is lesser than the other methods of threshing. During threshing grain loss in terms of broken grain, unthreshed grain, blown grain spilled grain etc., should be minimum.

Threshing by combine harvester: Combined harvester is also used in their stationary mode for threshing the crop. This machine is made to stand stationary near threshing floor and the crop is fed to the header unit manually. The threshing and separation of grain takes place as used in a combine harvester.

Working method of mechanical thresher: The crop is fed from the feeding tray into the threshing cylinder. The threshing cylinder is fitted with spikes/bars/ hammers or wire loops around its periphery, according to the type of thresher. Below the cylinder there is a concave and it covers the lower portion of the cylinder. The cylinder rotates at high speed and thus the crop is threshed and the entire or a portion of threshed material falls from the concave on top sieve of cleaning system. Due to reciprocating motion of top sieve lighter material accumulate at the top and the grains fall at the bottom sieve. In case of spike tooth thresher an aspiration blower sucks out the lighter material from the top sieve and throws it out the lighter material from blower out let. The sieves help in further cleaning of grain by allowing heavier straw to overflow. The power thresher is generally designed according to the type of threshing to the type of threshing cylinder fitted with the machine. The major types of threshers are as follows

- Drummy type
- Hammer type
- Spike tooth type
- Rasp bar type
- Wire loop type
- Axial flow type
- Syndicator type

Thresher performance depends upon the following

- Concave length
- Cylinder diameter
- Cylinder speed
- Cylinder concave clearance
- Feed rate

- Moisture content
- Time of day

Power transmission: Electric motor power is used for the operation of the thresher and motor is mounted on the thresher frame. The power from the motor is transmitted by 'V' groove belts to one end of the counter shaft. From this end, the power is provided to the blower, feeder, conveyor, auger and elevator as well as to the straw walkers and sieve unit through separate arrangements of 'V' belts for the respective components from the other end of the counter shaft power is supplied to the threshing cylinder by means of a set of variable pulley drives. In case, a tractor is to be used proper source, a flat pulley of the same diameter as that to the PTO pulley of the tractor is fitted on one end of counter shaft in place of V groove pulley.

Thresher adjustment and operation

- Provide specific space between the components.
- Adjust the crop feeding trough with a feed opening as specified by the machine manufacturer.
- Set the upper and middle sieves at the horizontal and set bottom sieve at 30° inclination from the horizontal.
- Set the proper air flow of the blower.
- Adjust the screw conveyor and adjust the feeding gap correctly.
- Adjust the header pulley to provide proper tension to the elevator belt.
- Reduce the feeding amount and feed evenly.
- Correctly adjust the threshing gap and replace the severally worn parts in time.

Trouble shooting of multifunctional thresher

Sl.No.	Defect	Causes	Remedies
1	Poor threshing	Defective power transmission Hard threshing variety	Repair/ replace Use stripper bars
2	Too much broken straw on oscillating screen	Over threshing High engine speed	Remove stripper bars if found problem remains remove some peg teeth from cylinder. Reduce the engine speed.
3	Threshing is not clean	Feeding amount is too large. Threshing gap is too large Roller drum speed is too low Grain is too wet.	Reduce the feeding amount. Adjust the gap. Increase the speed. Use the dry grains
4	Poor grain cleaning	Blower from speed is low. Fan belt loose Fan pulley screw loosen.	Repair/ replace Adjust Tighten it.
5	Too much broken grain	Threshing gap is too small. Roller speed is too high.	Adjust the thresher gap. Reduce the roller speed
6	Too many grains discharged	Exhaust air volume is large Concave plate hole is blocked	Reduce the volume Open the hole

Safety precautions of thresher

- 1 Run the thresher idle for some time to allow the removal of any remaining material from inside, after the work.
- 2 Disconnect the prime mover and manually remove the remaining grain chaff or straw from the thresher.
- 3 Remove all rubber belts, clean and tag them at any safe place.
- 4 Wash, clean and dry the thresher thoroughly.
- 5 Repaint the thresher where necessary and apply a coat of grease or used engine oil to avoid rusting.
- 6 Clean all the lubricating points, specially grease cups and bearings with kerosene and refill with new grease or oil.
- 7 Store the thresher in a dry shed or cover with a water proof canvas or tarpaulin.
- 8 Dismantle the sieves and store separately.
- 9 Tack the thresher over wood blocks or bricks, if the tyres are pneumatic.
- 10 Follow the thresher manufacturers operating instructions
- 11 Use the personal protective equipment to avoid health problems.
- 12 Periodical maintain the thresher as schedule in the manual
- 13 Check the machine before and after use for any defects.
- 14 Clean and apply anti rust solutions before storage it in section.

Components of threshers

Objectives: At the end of this lesson you shall be able to

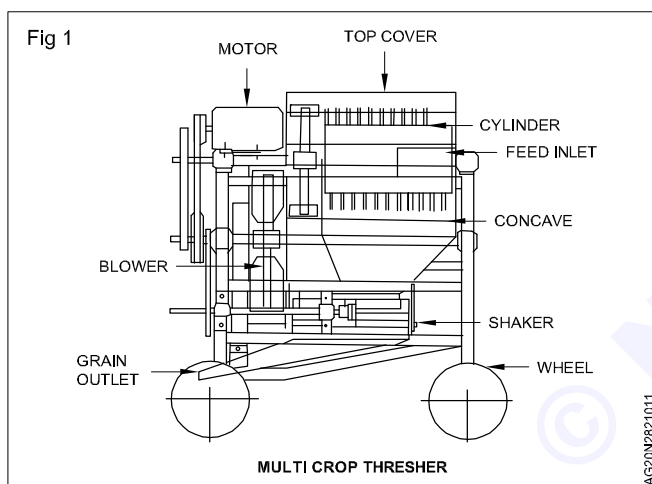
- describe the components and uses of
 - multi crop thresher
 - paddy thresher
 - maize thresher
 - sun flower thresher
 - axial flow groundnut thresher
 - axial flow vegetable thresher

Multi crop thresher

It is constructed with a feeding unit, winnowing device, separating sieves, and handling unit (Fig 1). It is covered with top cover and grain outlet is also provided at the bottom. It is operated by motor.

Uses

It is used as threshing different crops like wheat, paddy, sorghum, bajra, ragi, oil seeds and pulses.

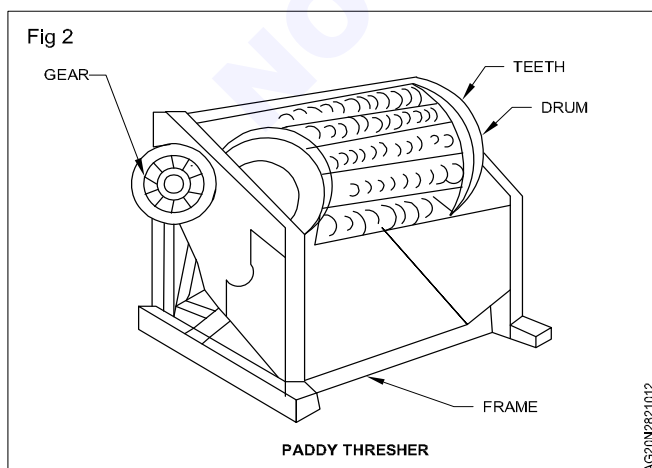


Paddy thresher

It is constructed with well balanced cylinder with a series of threshing teeth fixed on wooden slots, power transmission unit, grain outlet, concave screen air inlet control plate and blower (Fig 2).

Uses

It is used to separate the paddy grains from the panicle by the threshing teeth. The separated grains are cleaned from air blowing system.

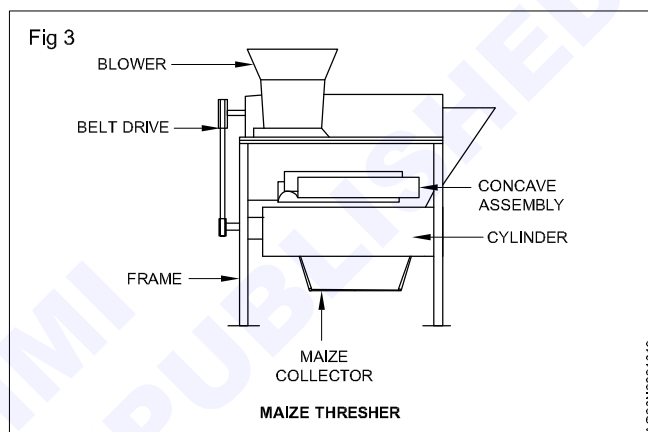


Maize thresher

It consists of beater cylinder, belt drive, blower, frame, concave assembly and maize collector (Fig 3).

Uses

It is used for shelling maize cobs and pre cleaned.

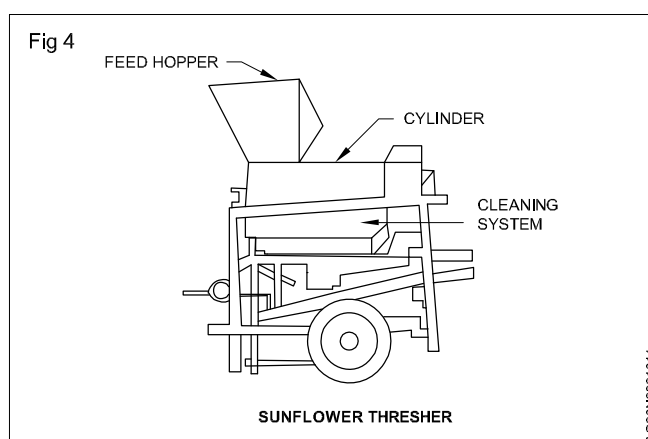


Sun flower thresher

It consists of a feeding unit, winnowing device, separating sieves and handling unit. (Fig 4) The thresher is fixed on the steel frame.

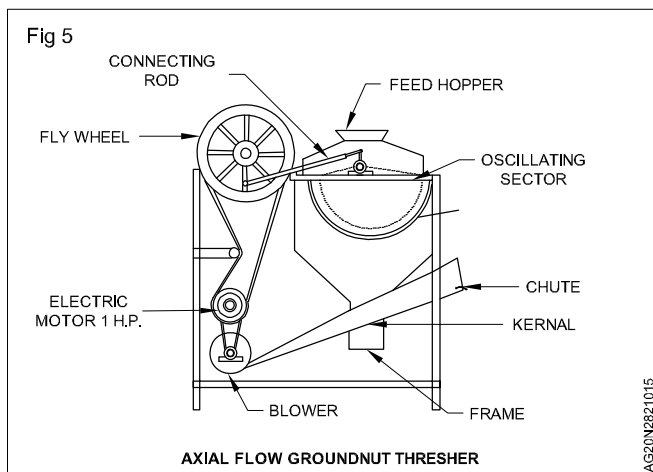
Uses

It is used to thresh the sunflower seeds from the head and precleaned from chaffs and dusts.



Axial flow groundnut thresher

It consists of oscillating sector with sieve bottom, handle, cast iron peg assemblies, and concave screens. (Fig 5). An electric motor is also fitted with the equipment, which is connected to the blower and fly wheel by the belt.



Uses

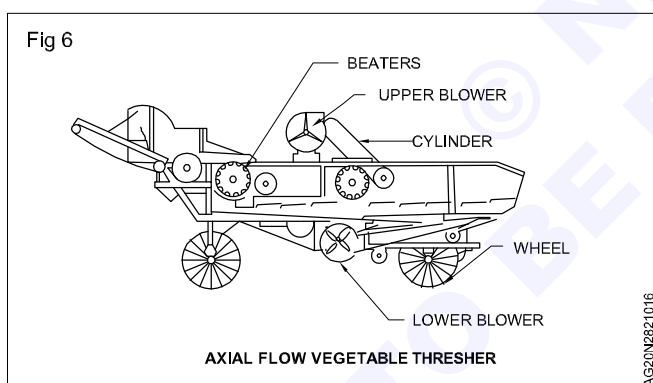
It is used to thresh and shell the groundnut kernels from the pods. Then, the kernels are pre cleaned from the ground shells, chaffs and dusts.

Axial flow vegetable thresher

It consists of rotating screen mesh drum of 1.5 - 1.7m in diameter, a rotating cylinder with short lengths of paddle type beaters inside the drum screen, feed hopper discharge spout and mounting frame. (Fig 6)

Uses

It is used to thresh bhendi, peas, cabbage, lettuce, celery, spinach, cauliflower, asparagus and beans.



Safety to be observed during power thresher operation

The following safety points must be followed to prevent accident while threshing

- 1 All the moving parts of the thresher must have guards to avoid wrapping of clothing.
- 2 There must be proper illumination near and around the threshing place, if threshing is being done during night hours.
- 3 The operator must not be under the influence of alcohol or any type of intoxicant.
- 4 The thresher should have properly designed, as per BIS recommendations, feeding chute.
- 5 Adequate fire protection should be provided near the threshing floor.

- 6 The operator should not work continuously for long time. He should take adequate rest.
- 7 The operator should not try to forcibly push the crop stalk in the feeding chute.
- 8 Do not try to cross the moving belts or other components in motion.
- 9 The thresher should be set properly levelled with wheels firmly anchored on the ground to provide better stability during its operation.
- 10 Proper platform should be made for facilitating smooth feeding of the crop and for preventing the falling down of the operator.
- 11 The direction of the out let of the bhusa should be kept in the same direction as that of the wind.
- 12 As far as possible the cordon shaft transferring PTO power to the thresher should be checked properly aligned with the input shaft of the thresher.
- 13 Thresher should be checked thoroughly for loose nuts and bolts, worn out belts, guards protecting the moving components of threshing operation.
- 14 No one should be allowed to wear loose clothing while feeding the crop in to the thresher.
- 15 Smoking and lighting fire should strictly avoided near the threshing area.
- 16 Always buy a thresher with feeding chute and having chute dimensions as per BIS recommendations.
- 17 At the end of the threshing, the thresher should be run idle to ensure complete removal of the material fed for threshing.
- 18 The thresher should be stored after proper cleaning in a dry place preferable under shed with wheels jacked up to avoid rust on any kind of damage to the parts of tyres.

Safety to be observed during thresher installation

While installing the power thresher for threshing operation the following points should be taken into consideration.

- 1 The thresher should be installed in a level position and must be properly anchored.
- 2 The cordon shaft while transmitting power through tractor PTO must be properly aligned and should have cover on it.
- 3 The power transmitting belt should be properly aligned with the thresher main pulley.
- 4 The outlet of bhusa should be aligned with direction of the windy.
- 5 Before using the thresher, the necessary parts should be lubricated properly.
- 6 Eccentricity of the shaking mechanism as well as slope of the sieve must be checked.
- 7 The thresher should be checked for proper threshing cylinder speed and concave clearance.
- 8 Instructions received from the manufacturer must be followed.

Mechanic Agricultural Machinery - Reapers, Harvesters, threshers, diggers and their uses

Combine harvester

Objectives: At the end of this lesson you shall be able to

- state the purpose of combine harvester
- state the advantages and limitations
- state the types of combine harvester
- state the purpose of combine harvester
- state the constructional details of combine harvester.

Introduction of combine harvester

Combine harvesting equipment is used for harvesting and threshing operation involves the process of cutting, laying, gathering, curing, transporting and stocking the crop. It also involves the process of recovery of the grain from the crop. The basic principles involved in cutting of a crop are as follows.

- Slicing action - cutting by using a sharp edge tool.
- Tearing action - cutting by using a serrated edge tool.
- Impact - cutting by a high velocity tool.
- Scissor like action - cutting between two sharp edges of a tool.

Purpose of combine harvester

- Feeding the crop, to be harvested, to the header unit.
- Harvesting the crop.
- Feeding the crop to the threshing unit.
- Threshing the crop.
- Separating the husk from the grain
- Cleaning the grain
- Conveying and storing the grain.

Advantages of combine harvester

There are many advantages of combine harvester, they are as follows.

- It reduces labor requirement.
- It reduces the drudgery involved in harvesting of crop compared to traditional method of harvesting manually.
- It reduces the possibility of crop being destroyed due to climatic conditions, like untimely rain, storm, fire, hazard and other similar incidents.
- It increases considerable saving time over conventional method of harvesting.
- It helps in harvesting the crop early in comparison to manual harvesting, providing ample time for seed bed preparation for the next crop.

Limitation of combine harvester

- The initial cost of a combine harvester is too high.
- Unadaptable to mixed farming as the maturity time is different for different crops.
- Small and irregular shaped fields cannot be harvested efficiently.
- Loss of straw place which could otherwise be used for feeding the cattle.
- Operation, repair and maintenance cost is relatively high.

Types of combine harvester: There are three major types of combine harvesters that are currently in use and is as follows

- Self propelled type
- Track wheel type
- Tractor mounted

Self propelled type: Thresher wheel harvester machines are excellent for farmers with hard soil. They are the standard type that is used commonly in India.

Track wheel type: These types are fitted with tracks instead of wheels. Tracks combines are commonly used for harvesting rice and some other crops from wet lands.

Tractor mounted combine harvester

This type of harvester is driven by tractor, that is mounted on top of the tractor. They work best on lands, where the soil is loose and farms are extensive. Though the structure of a combine harvester looks simple, they are functionally quite advanced.

Special purpose of combine harvester

The combine harvester is a machine designed to grow a number of agricultural crops effectively. This machine is used for winnowing, threshing and reaping activities in a single process of different types of crop harvesting. According to the type of harvested crops, it can be divided into wheat harvester, rice harvester, rice and wheat combine harvester, rapeseed combine harvester, corn combine harvester. According to the feeding amount the crop is divided into three types. They are as follows :

- 1 large
- 2 medium
- 3 small.

Selection method of combine harvester

- Combine harvester machine price should be low.
- Combine harvester's facility and quality should be very high.
- It should be suitable for all crops harvester.
- Grain loss should low than other machine.
- Machine maintenance cost should low.
- Machine life should be longer than other brand machine.
- Machine operation should be very easy.
- Machine spare part price should be low and easily available in the local market.

Construction details of combine harvester

Objectives: At the end of this lesson you shall be able to

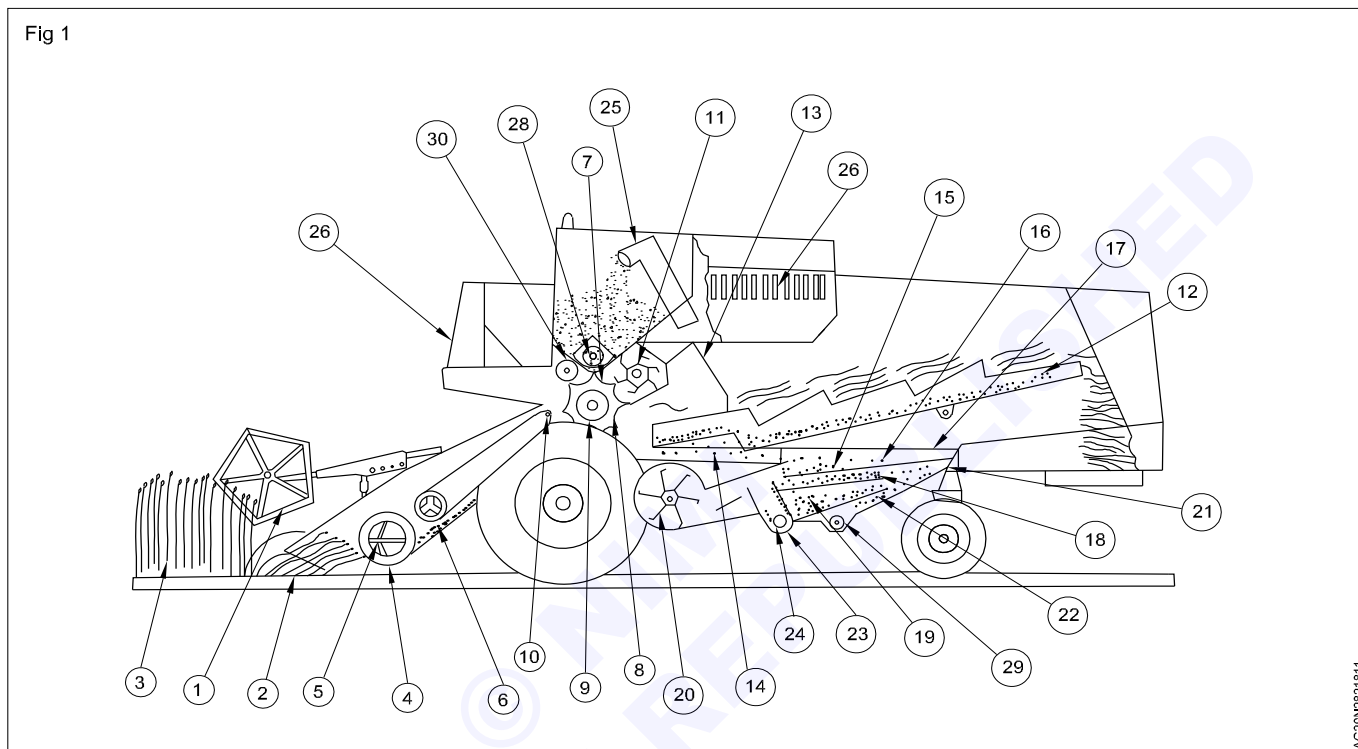
- explain the construction details of combine harvester.

Combine harvester

Combine harvester is a machine designed for harvesting, separating, cleaning, and collecting the grain while it moves over the land. All the five operations are carried out

in single operation of the harvester. The machine is versatile and with minor adjustments and can handle a variety of crops.

Construction details (Fig 1)



- | | |
|-------------------|------------------------|
| 1 Reel | 16 Strip screen |
| 2 Crop | 17 Chaffer box |
| 3 Dividers | 18 Return pan |
| 4 Auger | 19 Sieve |
| 5 Fitted prongs | 20 Blower |
| 6 Feeder channel | 21 Slide |
| 7 Threshing drum | 22 Inclined lead |
| 8 Basket | 23 Screw conveyer |
| 9 Degrading sheet | 24 Grain elevator |
| 10 Stone strap | 25 Bin feeder |
| 11 Guide drum | 26 Grain tank |
| 12 Straw walker | 27 Bin conveyer |
| 13 Baffle plate | 28 Discharge auger |
| 14 Step bed | 29 Ear conveyer |
| 15 Screen | 30 Upper ear conveyor. |

A Cutting system

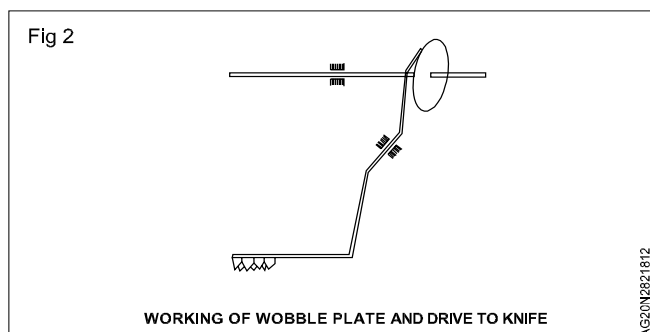
Cutter bar

Cutter bar assembly is mounted on the machine with the feeder channel can be lifted up lowered down with the help of hydraulic jacks. It has the following sub-assemblies:

- 1 Cutting blade
- 2 Auger
- 3 Feeder chamber
- 4 Reel

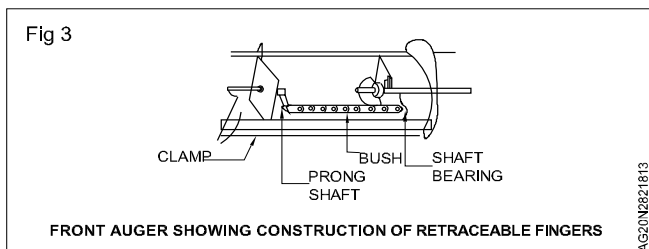
1 Cutting blade or knife assembly

It consists of steel bar to which are bolted fingers. Serrated knife moves to and from through these fingers and thus act as scissors to cut the crop. Various components of knife assembly shown in (Fig 2). The blade assembly operates at a speed of 1.2 to 1.5 m/sec. and gets it reciprocating motion through bell crank lever.



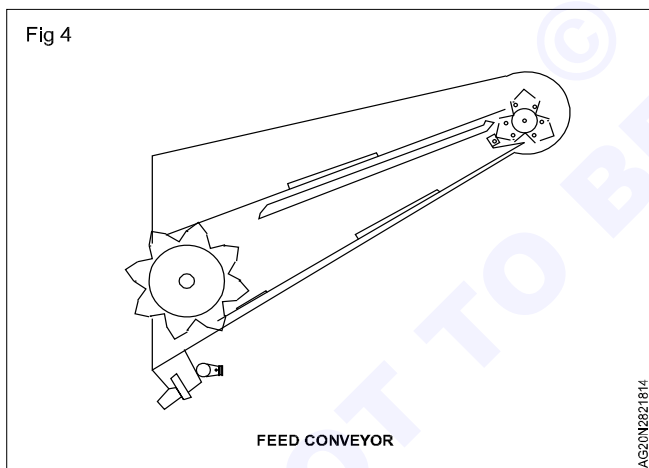
2 Auger

The crop cut by the knives and brought in by the take in sweep falls on the auger conveyor. Due to spiral movement (right and left hand flights fixed on the auger housing), the crop is brought to the centre of the auger. The fingers come out of the housing at the front, take the crop and push it to the conveyor chain of the feeder assembly. When fingers are in front of the feeder housing they retrace back in the housing thus making it easy for the feeder conveyor to take charge of cut crop. (Fig 3)



3 Feeder conveyor

The feeder channel takes the crop from the cutter bar. The tension of the conveyor chain is important and the lower conveyor chain and the lower shaft floats to allow feed material to move smoothly. Insufficient tension may cause jumping of the chains and can cause faster wear of the conveyor. The tensioning is adjusted by two setting screws, which are provided on both sides. Depending upon the length of the channel, the gap varies. The best setting is when one of the started bottom strip touches the bed. (Fig.4)



4 Reel

The function of reel is to hold the crop until it has been cut by the knives and lay it over the pan of the cutter bar.

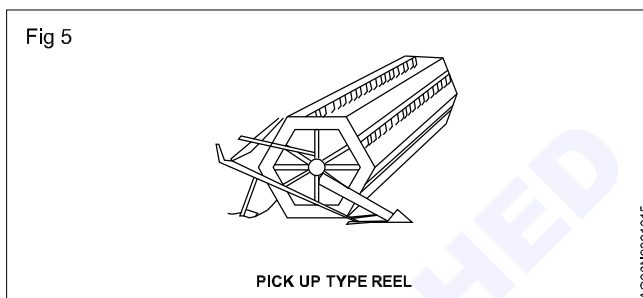
Types of reels

There are three types of reels, namely

- 1 Bat type
- 2 Tine type (pick up type)
- 3 Combined bat and tine type.

1 Bat type: In this type 4 to 6 wooden bats are fitted the crop when it is being cut. This type of reel cannot be used for lodged crop; it is not considered good as slapping action on the overripe crop makes the grain shatter.

2 Pick up type or tine type of reels: Pick up type reels are now - a- days a standard fitment on all the combines, it has spring tine fitment on all the combines, it has spring tine is fitted, the angle of which can be changed. These types of reels are very effective for standing crops. (Fig 5)



The reel must be square, level, at proper height and run at proper speed to feed the crop uniformly and steadily throughout its length on the cutter bar.

B Threshing system

This consists of stone trap, rear beater, cylinder and concave. The crop material, from the header assembly passes through the rotating cylinder and stationary concave where it is threshed and the bulk of grain is removed.

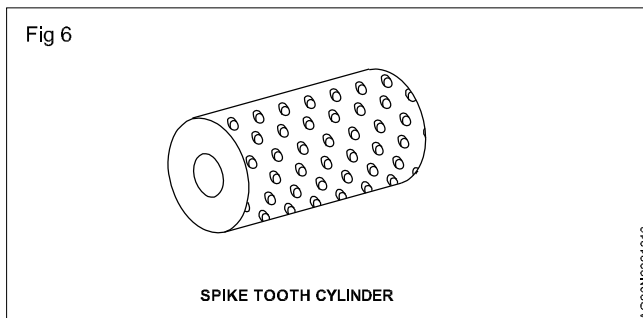
Cylinder

Three types of cylinder

- 1 Spike tooth
- 2 Rasp bar, or
- 3 Angle bar

1 Spike tooth cylinder (Fig 6)

The spike tooth is mostly used for rice or soya bean etc., where as a rasp bar cylinder is suitable for most of the grains. In spike tooth cylinder many steels are bolted or welded to the metal bars. The combination of spike teeth of cylinder and concave tear and shred the material and thus threshing takes place.

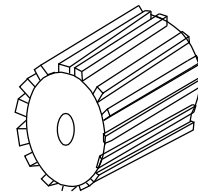


2 Rasp bar cylinder (Fig 7)

The rasp bar type cylinder consists of a number of corrugated steel bars attached to the steel bars. The

concave is grate consisting of parallel steel bars held together by curved sidebars. The direction of rasp corrugation of one bar is opposite to the other. The corrugations of the rasp create rubbing action of the crop.

Fig 7



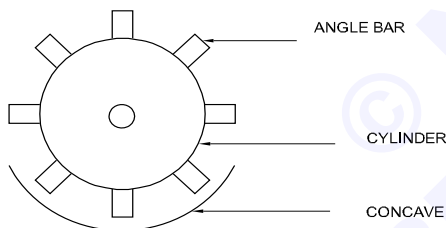
RASP/BAR CYLINDER

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3 Angle bar cylinder (Fig 8)

Depending upon the crop, the cylinder can be run at a variable speed between 600 and 1400 rpm. High speeds should be preferred for the crops that are difficult to be threshed, for example damp straw where as easy to thresh and sensitive crops the low speed should be used. The variable speed is possible with the help of variable pulleys. In addition to the provision of cylinder speed, the clearance between cylinder and concave is also adjustable and depending upon the grain size and moisture content, a well combination of cylinder speed and concave clearance gives satisfactory results.

Fig 8



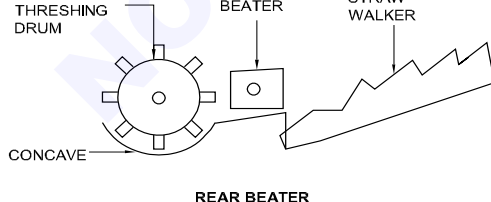
ANGLE BAR CYLINDER

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Rear beater

As shown in the Fig 9, a beater is an assembly, which diverts the straw coming from cylinder towards straw walker.

Fig 9



REAR BEATER

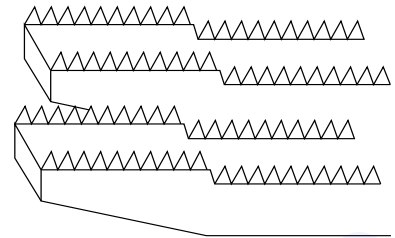
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Straw walker (Fig 10)

The straw assembly consists of four individual walkers, is mounted on a crank shaft at 90 to 180 degrees apart and thus oscillate to and from. The box like structures are in several steps and is inclined towards the rear. Serrated strips with the teeth pointing in travel direction are attached to

the walkers to improve the distributing of the threshed material over the whole walker area when combine is working on slopes. All the walkers have wide meshed sieve which allow loose grain to fall down on the return pan, which ultimately slides back to cleaning sieves.

Fig 10



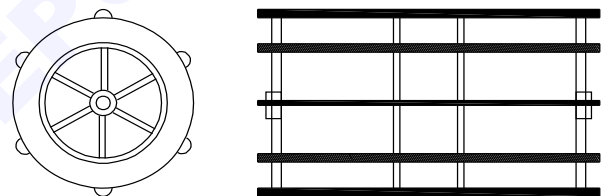
STRAW WALKER

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Threshing drum

The majority of modern combine- harvesters are beater bar threshers. The drum is provided with beater bars. The drums are open and consists of three spoked wheels, mounted on a shaft and provided with flat laths extending over the width of the cylinder and carrying 6 to 8 beater bars which are screwed in place. (Fig 11)

Fig 11



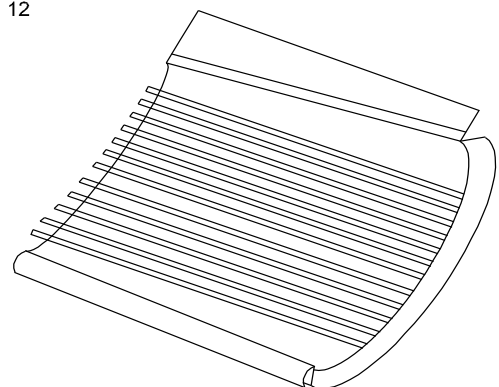
THRESHING DRUM

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Concave

The concave, which also consists of steel bars, is arranged below the drum (Fig 12). A great number of steel bars are placed side -by- side and fastened in such a way that a semi- circle is formed. A gap is left between any two bars, allowing the kernels to pass through. In the majority of cases, the concave consists of 12 and more steel bars, which are attached consists of 12 and more steel bars, which are attached b means of wire, forming unit.

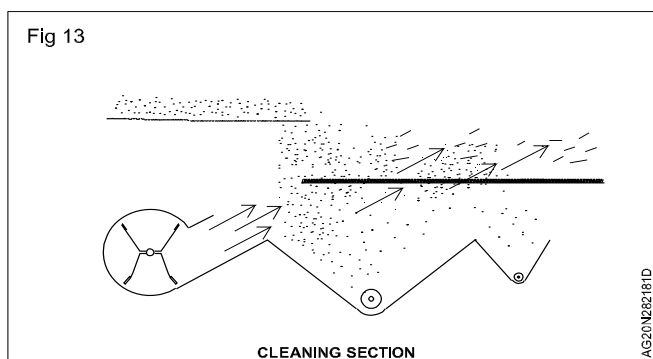
Fig 12



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C Cleaning system

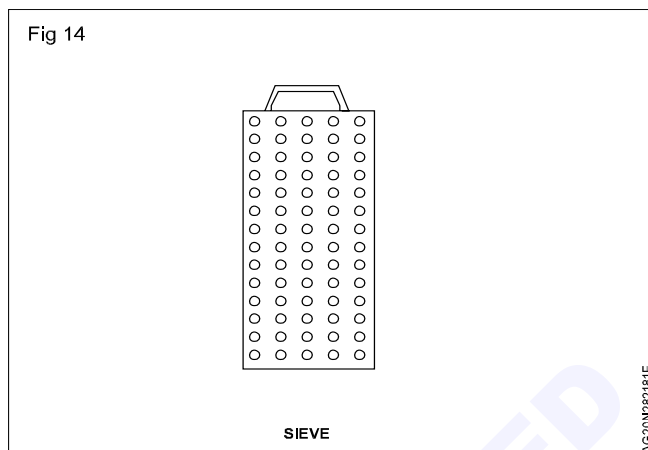
Two sieves, one over the other re arranged below the straw walkers. (Fig 13). The upper sieve is an extension of grain pan and its grain along with thrash from pan. The upper sieve has an adjustable aperture, which can be increased or decreased. The lower sieve, which is known as grain sieve has holes of the grain size and is not adjustable. The grain and thrash falling on upper sieve gets separated. The bigger the size of straw/chaff etc., is thrown away whereas grain with small pieces of thrash moves over grain sieve. The grain falling below is taken to grain auger and elevator.



Sieve

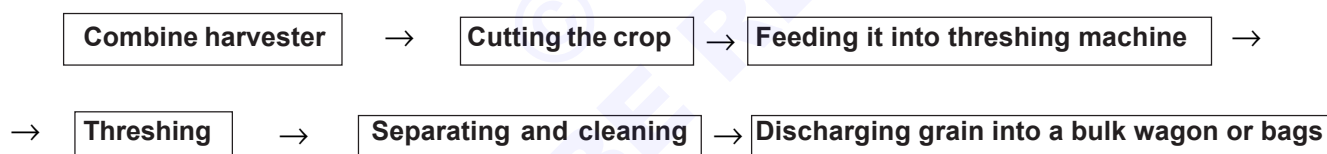
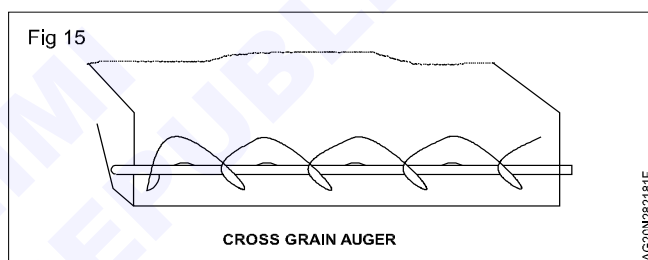
The cleaning unit usually consists of an upper and lower sieve (Fig.14). A fan is arranged under each sieve. The fan blows an adjustable current of air in to the space below the sieves. The air velocity should be high enough to carry the mixture to be cleaned on the sieves; at the same time the air flow separates chaff and other lighter particles

from grain, carrying off the lighter particles like chaff. The grain is allowed to drop through the sieve and, seen in travel direction, slides towards the end of the cleaning section a grain auger.



Cross grain auger

The grain auger transfers the grain to an elevator, provided with buckets or rubber flaps, which carries the grain into the grain tank of the combiner- harvester or to a sacking mechanism. (Fig 15)



Working principles and constructional details of combine harvester.

The following steps are used for flow path material of combine harvester.

Flow path material of combine harvester

In direct combining the reel pushes the standing stalk s against the cutter bar and delivers the cut material back on to the header platform or directly on to the inclined feeder canvas. In the platform cross conveyor (auger in this case) delivers the material to the feeder conveyor (usually chain type and slat type). The feeder canvas or feeder conveyor elevates the material and feeds it into the cylinder and concave assembly where the threshing and mush of the separation takes place. The seed and the chaff separated by the concave grate (and concave extension grate, if one is provided) fall directly on the oscillating grain pan or on to a conveyor.

The cylinder beater tends to strip the threshed material from the cylinder, aids in further separation at this point,

and directs the straw and remaining seed on to the straw (oscillating rack or rotary walkers). The check curtain or curtains prevent threshed seed from being thrown out of the machine by the beater or the cylinder. The straw carries agitates the material to be discharged from the machine. The material collected from the straw is collected by the grain returns pans (or a conveyor) and delivered to the grain pan at the front of the chaffer sieve.

The mixture of the threshed seed, un threshed head or pods, chaff and other small debris is moved from the grain pan onto the front of the oscillating chaffer sieve. an air blast directed upward through the sieves aids in separating out the free (threshed) seed and threshed heads and blows the light chaff out the rear of the machine. Most of the un threshed heads ride over the chaffer sieve and drop through the larger openings of the extension into the tailing auger. The tailing is then returned to the cylinder for re-threshing or sometimes, if the seed is easily damaged, to a point just behind the cylinder.

The free seed falls through the chaffer sieve and is further cleaned by passing through the shoe sieve, which has smaller openings. The cleaned seed is then delivered to the grain tank by means of the clean grain auger and elevator. Sometimes bulk handling of the seed is convenient the grain tank by means of the clean grain auger and elevator. Sometimes when bulk handling of the seed is not convenient the grain tank is replaced by a sacking platform. Two seed delivery spouts are provided in inverted arrangement that has movable hinged at the junction of two legs. When the sack on one spout is full, the gate is rotated by hand to close off this spout and direct the seed into the empty sack on the other spout. The filled sacks, after being sewed, are deposited on an incline chute or trough and then discharged on to the ground in groups of several sacks each.

Combine harvester power transmission and drive system: In the machine power is supplied to the gear box either from the engine of the power tiller or PTO of tractor through suitable arrangement and from there to crank and cutter bar through pitman. The function of crank wheel which is 15 to 20 cm in diameter is to change the rotary motion to the cutter bar. The reciprocating motion is transmitted to cutter bar. The reciprocating motion is transmitted to cutter bar of the reaper through pitman for harvesting the crop. The pitman is a type of connecting rod which is connected to the crank wheel through the crank wheel pin at one end it is connected to the cutter bar. The PTO rpm act as the prime motor to operate the cutting, threshing, conveying mechanism of the machine as well as to push the machine forward. at desired speed.

Main power transmission components employed in agriculture machines are:

- 1 V - belt drives
- 2 chain drive
- 3 gear drive
- 4 combination of gear and chain
- 5 belt and gear
- 6 gear and chain drives

B Power source used

- i **Pull type PTO operated combine:** These combine harvesters are pulled with tractor and in order to drive its various mechanisms. the power is taken from the PTO of a tractor. The smaller size combine of this type has a cutter bar length of 1.2 -3.4 meter. where bigger size may have cutter bar length up to 6. meter.
- ii **Pull type auxiliary engine operated combine:** This is a combine harvester where tractor power is utilized only to pull it forward during the harvesting operation. However, a separate engine is used to drive various mechanisms of combine harvester.
- iii **Self propelled combine harvester:** These types of combine harvesters have their own dedicated power source which imparts power for operating various mechanisms and also transmits power to ground wheel for its forward movement. Majority of the combine harvester available in the market are of self propelled type.

Workshop adjustment of combine harvester

Objectives: At the end of this lesson you shall be able to

- describe the workshop adjustments of combine harvester.

Combine harvester

Workshop adjustments

1 Checking the travel gear

Tyres

The tyre inflation pressure must be checked every day before commencing the work. When the inflation pressure has been lowered for operation on damp soil (e.g. for threshing rice), it must be checked before starting road operation. Inflate, if necessary.

Engine

i Fuel supply

The fuel supply can be checked through an inspection glass. The combine- harvester should be operated with normal diesel fuel. When filling observe strict cleanliness. It is recommendable to use a funnel with strainer or a filter cloth for fueling. When taking fuel from tanks, do not move the full tank otherwise that has settled on the bottom would be stirred up.

Take care that all auxiliary means such as cans, funnels, hand pumps and the like are kept clean and are not placed on sandy dusty ground or floors.

Besides general care, the filter must be cleaned at regular intervals.

Take care when cleaning the inspection glass that it does not become leaky, this will cause fuel losses.

ii Cooling water level

The coolant above should be about 3 cm below the upper edge of the filler cap. Only use clean water of low lime content for replenishing (rain water). If the engine temperature is too high because of an insufficient supply cooling water, allow the engine to cool down at the idling slowly replenish with cooling water otherwise cylinder head and cylinder block walls may crack due to sudden fall in the temperature.

The cooling water level should be checked daily, before commencing work and if necessary, one more at noon, especially on hot days, and when the radiator is clogged by dust and glumes.

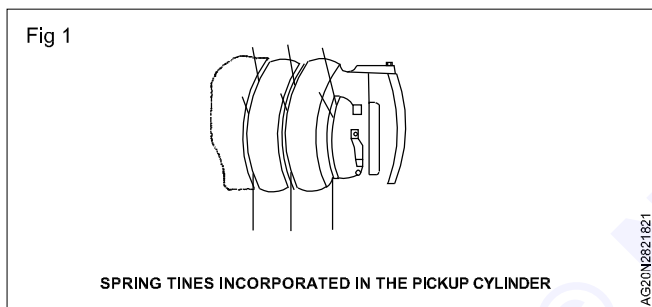
iii Oil level and oil pressure

The oil should be checked when the engine is stationary by means of a clean dipstick. The oil level should coincide with the marking, it should neither be lower nor higher.

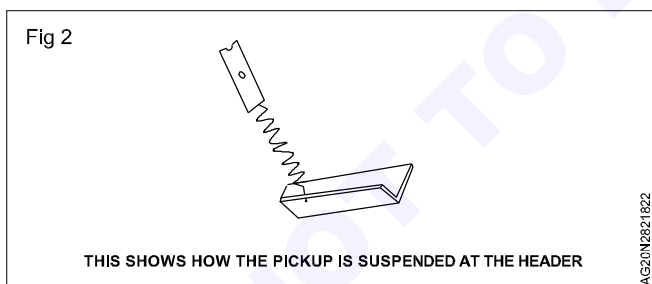
The oil pressure should remain within one to four atmospheres gauge pressures during operation and during idling, not fall below one atmosphere gauge pressure. When starting from cold, higher pressures may occur immediately after starting. If the oil pressure gauge fails to indicate immediately stop the engine and find the trouble.

2 Checking the header

Springs, one end of which is formed into times, are mounted on a disk which runs eccentrically. This ensures that the tines are pushed out of the lower end of the guide plates. after drawing material from the windrow into the table trough, the tines are partly withdrawn into pickup enclosure, emerging on the next revolution to take up the next revolution. to take up next portion of material from windrows.(Fig 1)



The rear part of the pickup is rigidly fastened to the header by means of a tie bar. The front part of the pickup is suspended at a spring (Fig 2) this ensures that the pickup motion adapts itself to the contour of the ground.

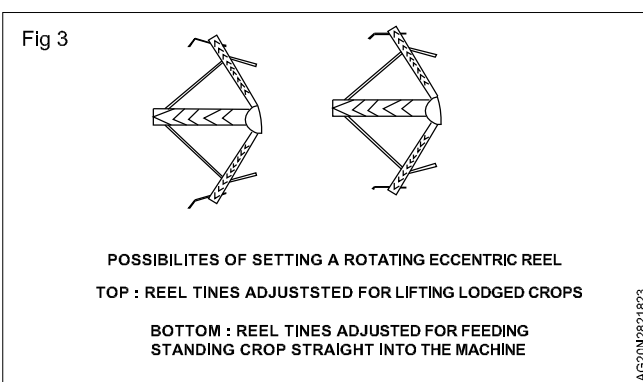


Knife servicing

The sockets must be adjusted in such a way that they protect from breakage when foreign particles are encountered on the other hand, they must not be slack that they slide on the balls when knife is in operation.

Table auger

Properly tensioned belts at the shaft of the auger prevent the material to be threshed for bunching.



Reel

The clamping jaws for fastening the reel tube must be properly tightened especially at the right hand side (Fig.3) If the auger at the table fails to pick up the material to be threshed properly, the reel must be set further ahead and the reel speed is reduced.

Elevator chains

The elevator chains must be checked for proper tension every day.

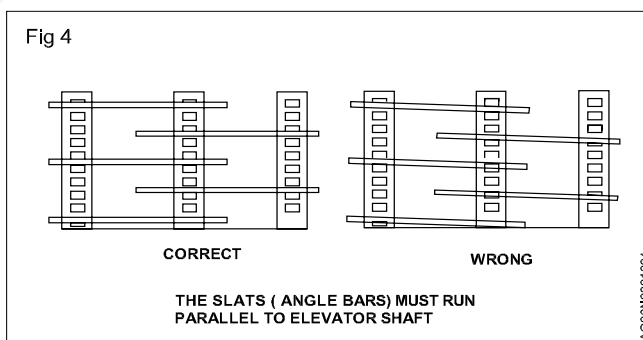
When tensioning the chains, care must be taken that the two adjusting screws are uniformly screwed down. It should be borne in mind that the new roller chains should not be applied to worn out sprockets.

The double sprockets driving discharge auger should be checked for tight fit every day.

To ensure the proper functioning of the straw walkers, the chains should be checked for proper tension at regular intervals.

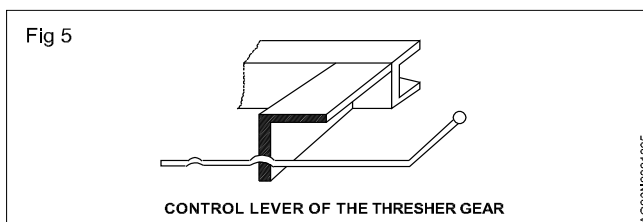
Inclined table elevator

The chain elevator must be checked for broken or heavily worn chain links repeatedly, especially in multi shift operation. (Fig 4)

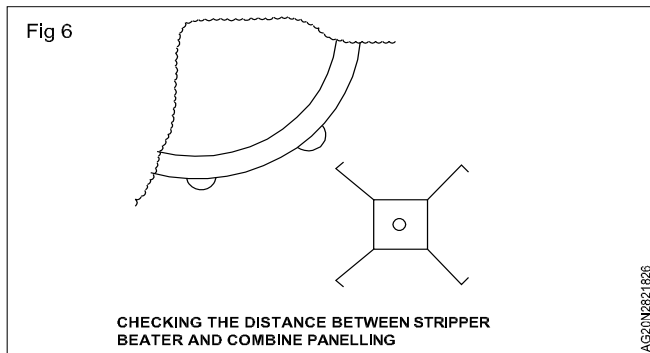


3 Checking the thresher unit

Before throwing the thresher drive into gear, the thresher clutch must be disengaged. (hand lever) (Fig 5)

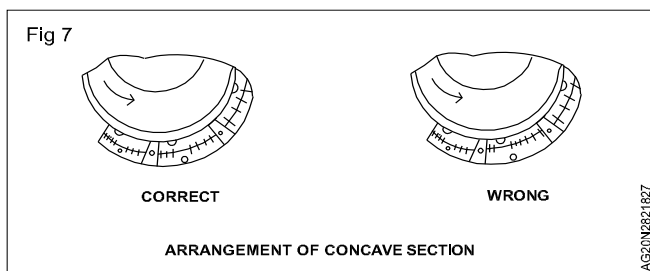


The distance between rear beater and paneling must be checked from time to time. (Fig 6)

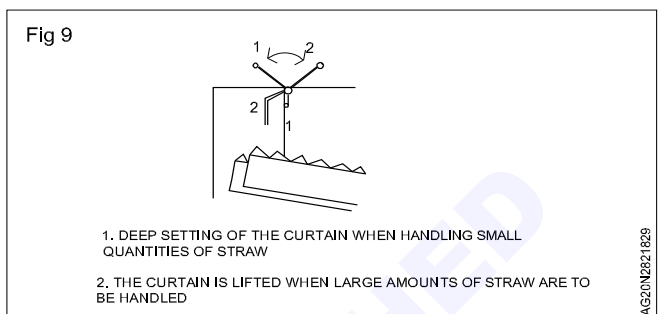
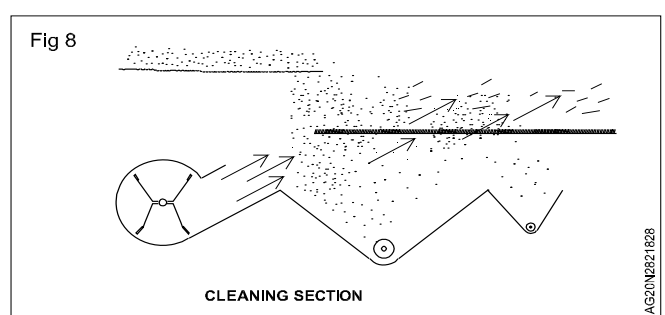


The speed is varied by adjusting the V belt pulley effected by lowering or raising the belt in the pulley groove.

When adjusting the gap between concave and drum, care must be taken to see that the adjustable concave sections are uniformly set (Fig 7).



When the threshing crops with a high moisture content, check the concave for clogged gaps between the bars every day. (Fig 8)



4 Straw walker

The curtains (Fig.9) at the end of the walker must be checked for rents every day before commencing the work. Rents in the curtains are primarily caused by unwieldy straw (eg. rape)

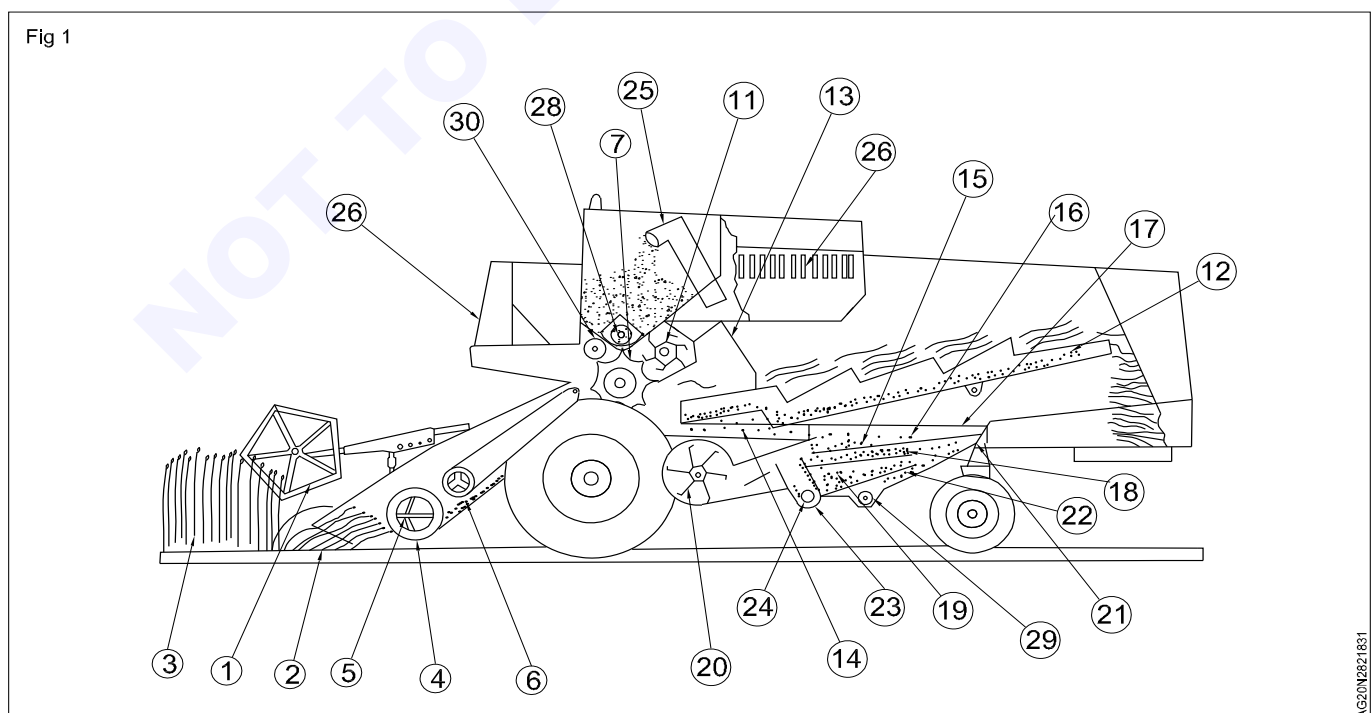
- 1 Deep setting of curtain when handling small quantities of straw.
- 2 The curtain is lifted when large amounts of straw are to be handled.

Field operations of different types of harvester

Objectives: At the end of the lesson you shall be able to

- describe the harvesting operation of the combine harvester
- describe the harvesting of the reaper
- describe the harvesting operation of corn harvester.

Operation of combine harvester



The machine in which all the operations connected with harvesting of crops are performed together is known as harvesting combine. These operations are basically classified as under:

- 1 Feed the crop to the cutting machine
- 2 Cut the crop
- 3 Feed the crop to the threshing unit
- 4 Thresh the crop
- 5 Separate the husk from the grain
- 6 Clean the grains
- 7 Convey and store the grain

The standing crop (2) is guided to the cutter mechanism by the reel (1) dividers (3) are also supplied to divide the crop which come to the machine and the rest standing in the field to be slightly pushed apart so that it is damaged by the machine.

The cut crop falls into the pan of the cutter bar, it has an auger (4) with right and left hand flights made on it which bring the cut crop to the centre of the auger. In the centre of the auger are fitted prongs (5) which convey the crop to feeder channel (6), chain and slats running in feeder channel take and feed the crop to the threshing unit.

Crop is threshed by threshing drum (7) and basket (8). To suit various crops and their threshing characteristics drum speed is variable and can be adjusted from the operators platform, so is the gap between the concave and drum which can be increased or decreased. For concave there are usually two adjustments, i.e., one is instantaneous which brings the basket close to threshing drum where as the other fine adjustment.

A degrading sheet (9) is also placed on the first two rows of concave, this shield can be swilled to block the first two rows of concave from the underneath and is operated from outside. For most of the crops, it is locked in off position.

A stone trap (10) is provided in front of threshing drum and concave so as to catch the stone caught by the cutter bar fed along with the crop. Stone being heavy in weight drops in the stone trap and remains there to be taken out during the service of the machine.

The threshed straw is brought to the straw walker (12) by guide drum (11). The mixture of grain and short straw are returned to step bed through bottom pan of straw walker. A baffle plate (13) is placed above straw walker to control the straw walker by allowing the straw to fall at front end of the straw walker and thereby making it to travel complete length of straw walker as such making the straw drop the out grains if any to the pan of the straw walker. The straw is thrown out from discharge hood; two guide plates are fixed at the hood to form a narrow swath on the field. The mixture of grain and straw dropped from the gates of the concave and also through the straw walker as explained above falls on step bed. (14) Due to vibrating action of the step bed grain is separated from the chaff and short straw and is carried to the chaffer rack to the cleaning sieves.

When the grains, chaff and short straw is being dropped from the chaff rack, air is directed from the blower which blows the chaff and the short straw out of combine. whereas the grain is separated on the hinged screen (15) and double strip screen. (16) un-threshed ears drop through chaffer rack (17) to the ear return pan (18) under the adjustable sieve is placed another fixed hole sieve. (19) inclination of the sieve can be adjusted. This fixed sieve can be replaceable one and can be changed to suit the type of crop.

Air from the variable speed blower (20) is arranged in such a way that it passes under chaffer rack as well as both the sieves. The air current blows out light weight dust particles, show straw, green trash and other impurities out of the combine.

A slide (21) is mounted at the end of the cleaning box to trap the grain if any being carried away by the air current. The slide is adjustable in height and can be locked in any position.

The grain is dropped from fixed hole sieve to the inclined lead (22) carried to the grain elevator (24) with the help of the screw conveyor (23). At the top end of the grain elevator is fixed another screw conveyor (bin feeder) to convey the clean grains to the grain tank (26) and discharge auger. (28)

The un threshed ears which had fallen at the rear end of the chaffer rack find their way on incline bed and carried by screw conveyor (30) into the threshing drum compartment for being re threshed again.

Feed the crop to the cutting machine. cut the crop. Feed the crop to the threshing unit. Thresh the crop. Separate the husk from the grain. clean the grains. Convey and store the grains.

Operation of reaper

This type of reaper has a cutting width varying between 1m to 1.6 m with a 3-10hp engine. The reaper has dividers of which the left one separates the crop to be cut from the uncut crop while the other row dividers guide the crop into the star wheel from where it is lifted by special lugged belts. A reciprocating cutter bar which consists of serrated knives and guards. provides the cutting action. After cutting, the star wheel passes the crop to the lat vertical belt conveyor with lugs, which transfer the crops to the right outlet and drive the star wheels. The pressure spring keeps the cut crop positioned vertically while it is transferred laterally. An outlet plate controls the evenness of the window when the cut crop is laid on the field. Power from the engine is transmitted by means of v belt and pulleys to the input shaft and through the set of bevel gears to the harvester unit.

Important guide lines for cutting the crop:

- 1 Drain the field 7-10 days before and the expected the harvest date, or when the upper grains is most of the tillers are in the hard dough stage turning from green to yellow.

- When the laying the crop in the field make sure that the panicles with the grains stay dry and are of the ground.

Operation of corn harvester

Acorn harvester receives the plants in rows removes the ears from the stalks. The picker removes the kernels from the cobs. The cutter serves the stalks from the ground

mounted on the frame. The chopper receives the stalks from the cutting edge and reduces the stalks after the ears have been removed. The conveyor (stover) conveys the chopped the material received from the chopper to the adjacent first container or to the ground. The grains the conveyor delivers the kernels after processing to the container to be mixed with chopped material from the chopper, or to an adjacent second container.

Cutter bar, feeder, thresher, straw walker, sieves, blowers and augers

Objectives: At the end of the lesson you shall be able to

- describe the check and repair the cutter bar and feeder
- explain the check and repair the thresher and straw walker
- state the check and repair the sieves, blower and auger.

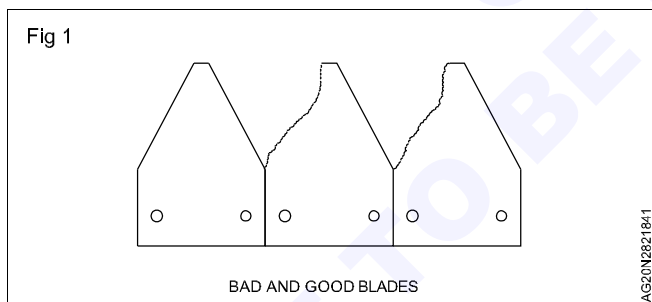
1 Check and repair the cutter bar

Knife

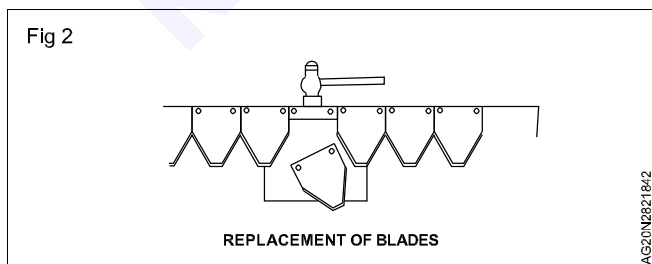
Cutter bar assembly is mounted on the machine with the feeder channel and can be lifted up or lowered down with the help of hydraulic jacks.

The knife guide and socket at the cutter head and at the lower ball end as well as the swash plate must be lubricated twice a day. Improper lubrication increases the rear of wear. Damaged finger plates and knife blades must be lubricated because they impair the cutting procedure.

The second of good combining lies in the knife and ledger plate being in good shape and properly adjusted. If not, it can amount to loss of power, loss of grain, missed plants and bunched feeding Fig 1 is shown for good and bad blades.



Blades now - a - days fitted to harvesting combine have teeth made on its cutting edges and are fluted as such with continuous running sharpen foreign matter. These can be replaced easily as shown in Fig 2



Reel

Care should be taken to see the reel runs parallel to the cutter bar.

The clamping jaws for fastening the reel on the reel tube must be properly tightened, especially at the right-hand side.

2 Check and repair the feeder

The feeder channel takes the crop from the cutter bar. It has three chains running on sets of sprockets fixed on two shafts. The upper shaft is a drive shaft. On the chains are fitted toothed angle irons called slats, these slats hold the crop and equally adjusted on both sides as unequal adjustment will accelerate wear on both sprocket and chain.

3 Check and repair the thresher

Material entrapped in the gap below the beater bars must be removed before starting working. If required reverse the beater bars so that the rear end points in the direction of rotation.

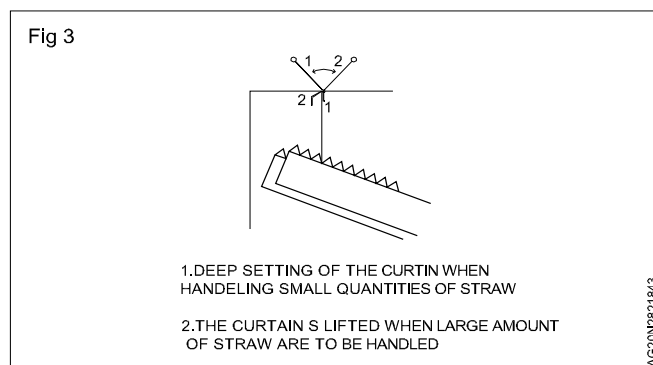
Before throwing the threshers drive into gear, the thresher clutch must be disengaged.

4 Check and repair the straw walker (Fig 3)

When bearded grain of high moisture content is handled, the lattice areas of the walkers must be cleaned from time to time, otherwise high losses will become inevitable.

The nuts on the bolts should be checked and tightened, if necessary, during any break. The screws of the connecting rods tend to work loose and will lead to worn bearings. Therefore, check the screws for proper fit several times a day.

The curtains at the end of the walkers must be checked for rents every day before commencing work.



5 Check and repair the sieves

The deposit on the sieves must be checked every two hours, this especially applies to bearded crops. Normally the deposit can be removed by vigorously actuating the adjusting louvers.

Before the beginning of the daily work, clean the sieves with round holes (by trapping) in order to remove trapped parts of straw.

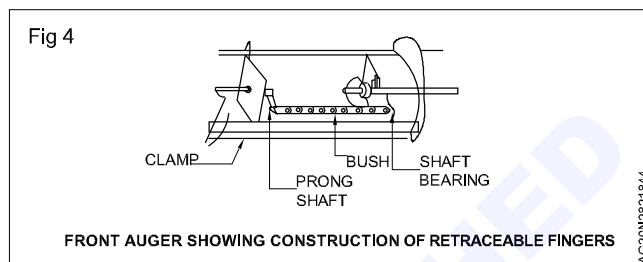
The radial blower (winnow) of the cleaning section must be checked for cracks before operation. Before the commencement of work, mount the sieves with that the hole diameter which is required for the crop to the thresher.

6 Check and repair the blower

Air from variable speed blower is arranged in such a way that it passes under chaffer rocks as well as under both the sieves. This air current blows out light weight dust particles, short straw, green trash and other impurities out to combine.

7 Check and repair the auger (Fig 4)

The crop cut by the knives and brought in by the take in sweep falls on the auger conveyor. Due to spiral movement, the crop is brought to the centre of the auger. In the centre of the auger retraceable fingers called prongs are arranged. These fingers come out of the housing at the front, take the crop and push it to the conveyor chain of the feeder assembly. When these fingers are in front of the feeder housing they retrace back in the housing thus making it easy for the feeder conveyor to take charge of the cut crop.



Faults and remedies of combine harvester and handling precautions

Objectives: At the end of this lesson you shall be able to

- state the faults and remedies of combine harvester
- describe the precautions while handling combine harvester in field.

Faults and Remedies

Breakages of grains

S.No	Causes	Remedies
1	More threshing drum speed	Reduce the threshing drum speed
2	Less clearance between threshing drum and the basket	Increase the clearance between threshing drum and the basket
3	Non uniform feed of crop in the machine	Check that uniform crop is fed in the threshing drum
4	Distorted and bent angular - pick -up	Angular pick-up rods should be straightened
5	Non uniform clearance of basket	The clearance should be 25 mm from front side and 7mm from rear side. see your operational manual.
6	Sharp edges of new beater bars used	Always chamfer the sharp edges before mounting beater bars.
7	Improper fitting of beater bars or damaged beater bars	Fit beater bars properly to replace in sets.
8	Basket choked	Clean basket
9	Damaged or dented pans of grain auger	Remove dents
10	Re-threshing of grain	Check sieve

Unsatisfactory Cleaning

Sl.No	Causes	Remedies
1	Blower speed is less	Increase blower speed to 2000rpm
2	Baffle plate closed	Lift the baffle plate
3	Wrong adjustment of the air guide plate of the blower	Adjust according to the requirement
4	Checked or distorted radial blower blades	Check for cracks and distorted radial blade of blower and replace
5	Straw walker troughs are not properly	Grain and chaff particles fall through the gap between the walker, increase in losses and foreign matter
6	Sieve clogged	Keep sieve always clean
7	Less engine speed	Increase speed to 2000rpm

Grains in chaff

Sl.No	Causes	Remedies
1	Straw walker clogged	Clean straw walker, check up speed and lift the baffle plate
2	More air current	Reduce blower speed
3	Less clearance of adjustment sieve louvers	Adjust clearance of the sieve louvers
4	Wrong inclination of the sieve	Adjust inclination of the sieve
5	Straw walker troughs are not properly aligned	Align the straw walker
6	Louvers of the adjustable sieve are distorted or louvers were broken	Replace or align the distorted louvers of the adjustable sieve
7	Improper fitting of beater bars or damaged beater bars	Adjust baffle plate
8	More cutting speed than threshing	Reduce the machine speed so that in take is less
9	Improper gap of threshing drum and basket	Adjust clearance
10	Green crop	Always harvest dry crop for better results

Unsatisfactory cutting

Sl.No	Causes	Remedies
1	Cutter bar blade worn out, damaged or broken	Repair it /replace worn out
2	bent fingers	Rodent or straighten bent fingers. Align all fingers
3	Stroke of knife blade not correctly set	Adjust it
4	Excessive vibration of cutter bar assembly	Reduce excessive play in knife and cutter bar drive

Choking of threshing drum

Sl.No	Causes	Remedies
1	Green crop	Always harvest dry crop
2	Excessively feed than threshing	Reduce machine speed.
3	Straw water clogged	Clean straw walker
4	Baffle plate not fully opened	Keep baffle plate open
5	Wrong clearance in threshing drum and basket	Adjust clearance of threshing drum and basket
6	Engine speed less	Increase engine speed up to 2000 rpm
7	Straw walkers drive belt slipping	Adjust tension

Chocking of elevators

Sl.No	Causes	Remedies
1	Grain bill full (beyond capacity)	Discharge grain earlier
2	Slipping of V-belt	Adjust tension of V-belts
3	Wrong and too large sieve	Fit proper/smaller sieves
4	Incorrect setting of conclave	Adjust clearance (in case of more clearance there will be much straw which will result in choking)
5	Elevator conveyor chain loose (this will result on friction and jamming of grains in the elevator)	Adjust conveyor chains
6	Less air current	Increase blower speed
7	Partition plate in the convey or housing loose and dislocated	Fix up properly the partition plate
8	Slipping of sprockets	
9	U- plate	

Cutter bar losses

Sl.No	Causes	Remedies
1	Overripe crop	Harvest crop at proper time
2	Heavy crop sweep in	Reduce the speed of the machine
3	Reel speed not corresponding with the machine speed	Reduce reel speed
4	Cutter bar too high	Lower cutter bar at proper height

Shatter of grains

Sl.No	Causes	Remedies
1	Over ripe crop	Reel speed is more
2	Reel too high	Harvest crop at proper time
3	Reduce reel speed	Reduce height of reel

Clutch slippage of cutter bar auger

Sl.No	Causes	Remedies
1	Drive chain jam	Set it right
2	Cutter bar working in lowest position (Sand struck up in between auger and bottom plate)	Raise cutter bar
3	Too high intake	Reduce machine speed
4	Damaged or dented bottom plate	Remove dent/damage in the bottom plate
5	Wet crop	

Precaution

General safety precautions

Frequently faults occur in a combine harvester which are considered to be so insignificant that the machine is not stopped for repairing in order to save time. For example, the operator tries to remove bunching material from the cutting mechanism by a means of a pusher. Further attempts are made to prevent accumulation of material at the straw discharge or chaff outlet by removing the material by means of a fork. Many accidents have been caused by such a careless situation.

The stopping of the combine removing any trouble is a fundamental safety rule

There are also many hazards involved in stationary combine operation. Combine harvesters are not equipped for stationary or shock threshing. If crops are to be harvested by this method, supplementary equipments such as feeder and hauling tarpaulins, feeding table attachments and the like must be used in order to prevent accidents.

Another source of hazards is combine operation on sloping ground. The combine on sloping ground. The combine is exposed to hazards especially when travelling along the contour line (across the slope) and when the grain tank is mounted on one side of the combine, the risk is smaller when travelling downhill; the smallest risk is given when travelling up hill.

Precautions to be taken before combine operation

Before putting a combine into operation, all safety devices and precautions must be checked for proper condition.

Hand and pedal brakes must be checked for proper performance. The brake hands and their linings, the brake

linkage and levers, and the toothed quadrant of the hand brake lever must be checked for cracks and breaks.

Defective parts must be replaced, brake parts must on no account be welded to restore them.

The V - belt of the travel drive must be checked for damage and wear with every care to ensure that the machine can be braked by the engine when driven downhill. A defective V - belt of the travel clutch must be checked for proper working order, defective components must be replaced by new ones, repairs by welding are not permitted. Main wheels and steering wheels must be checked for proper inflation pressure and inflated, if necessary.

Precaution to be taken during combine operation

The working of slopes with extreme gradients calls for a skill on the part of the operator which usually is only commanded by experienced combine operators.

Since the load on the steering axle is rather low when driving downhill, actuate the brake with every care. Do not brake jerkily (risk of tumbling forward)

Only if pedal brakes fails when operated on the move, the hand brake can be used on the move as emergency brake. When stopping on sloping ground, the combine harvester must in any case be placed in such a way that it stands with the major axis parallel to the contour line of the hill,

Safety precautions of combine harvester

- Combine harvesters operator should be well trained in all the area of use
- Take extra care while reversing the machine

- Keep in mind the hazards posted by straw choppers and spreaders - remember to allow the engine to run down before approaching the rear of the combine
- Before the plan and consider your move and movement to implement a safe transport of the machine and loading and unloading the header.
- Always follow the safe operating procedure and that have a copy of the owners manual on the machine.
- Use any grain sampling mechanism provided with machine.
- Be careful on slopes, avoid sudden changes in direction and always park on flat ground when possible.
- Do not operate the machine beyond its capability
- Do not overload the machine

Factor Affecting Combine Performance

The following factor influences the performance of a combine harvester:

i Machine parameters: This includes:

- a Speed of reel and its position with respect to crop and cutter bar

- b Cutter bar speed and its adjustment
- c Extent of vibration
- d Speed of threshing cylinder
- e Speed of straw rack, sieve and blower

ii Crop parameters : It includes

- a Crop moisture content and its condition at the time of harvest.
- b Density of the crop.
- c Variety of the crop and its maturity stage at the time of harvest.

iii Operational parameters: The following parameters are included in this

- a Forward speed of combine harvester
- b Heat of cut
- c Direction of harvesting with respect to plant orientation

iv Field parameters: It includes

- a Size and shape of the field.
- b Soil moisture content at the time of harvest.

Adjustment of cutter bar, feeder, thresher, straw walker, sieves, blower and auger

Objectives: At the end of this lesson you shall be able to

- describe the adjustments of cutter bar and feeder
- state the adjustments of threshers and straw walker
- explain the adjustment of sieves, blower and auger
- state the typed of grain losses
- describe the minimize the loss of grain.

Combine Harvester

Adjust machine speed

Check the machine speed to see that the combine is operating at the recommended revolutions per minute. The manufacturers operator manual will give the basic speed of machine. This may be given as beater shaft speed, engine speed at rated rpm blower speed, threshing cylinder speed etc.

Adjust cylinder concave clearance and cylinder speed

These adjustments have a great effect on the rack and shoe losses in the combine over threshing breaks up the straw and causes the rack and shoe to be over-loaded. Adjustments are provided for varying the speed of cylinder to suit the kind of crop being harvested. Too slow cylinder speed or too wide concave clearance may result into back feeding at cylinder. A compromise between cylinder speed and concave clearance should be maintained.

Type of crops	Drum speed (rpm)	Concave clearance	Sieves	Straw walker (rpm)
Wheat	900 - 1000	Front -15 mm	Upper - 16 -19 mm Lower - 6 to 8 mm	200
Paddy	600 - 800	Front - 17 mm Rear - 14 mm	Upper - 16 -19 mm Lower - 5 to 6 mm	180

Adjust cutter bar height

The height of cut should not be lower than required otherwise too much material will overload the rack and on too high heads or ear of grain will be left in the field

Reel adjustment

The reel may be adjusted for speed, height and position forward or rearward.

Reel speed = 1.25 x travel speed

Optimum value of reel index should be 1.1 to 1.25% for minimum cutter bar loss

Reel height for different crop condition

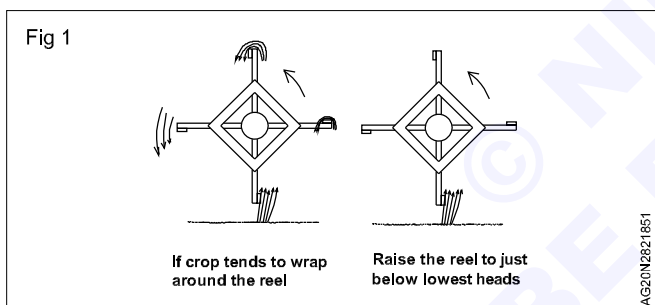
- For medium and short crops:** Adjust reel approximately 100mm above the cutter bar and for enough forward.
- For taller crops:** Set reel back and raised so the bats run close to the top of grain.
- For down crop:** adjust the reel to a lower and forward position.

The reel has the following adjustments

- Vertical adjustment
- Time angle adjustment
- Horizontal adjustment
- Speed adjustment

1 Vertical adjustment

The reel can be lifted up or down with the help of hydraulic jacks. In tractor driven combines it can be adjusted with the height adjusting bracket. The height of the reel should be so fixed to touch the plant just over the centre. If the crop tends to wrap around the reel, raise it slightly just below the ear head as shown in Fig 1.



2 Tine angle adjustment

Tine type of reels has an adjustment to change the angle or tines. The reel tines should be adjusted vertical to the ground as shown in Fig 2 and case of lodged crop tines should be adjusted, i.e., they may be pitched to a point slightly rearward as shown in Fig 3. This changing of angle will help lifting of lodged crop. Under such condition reel of course has to be lowered down.

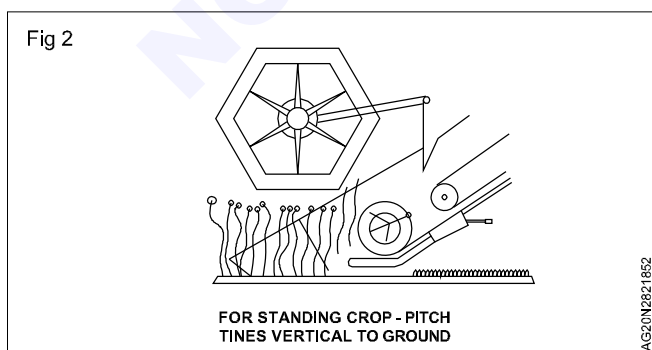
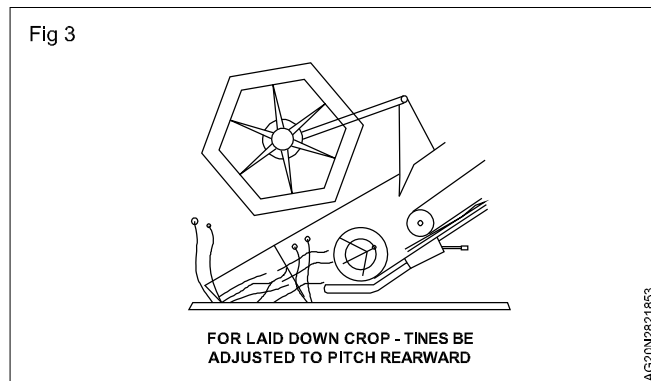


Fig 3



3 Horizontal adjustment

Reel is usually fixed slightly ahead of cutter knife, but for laid down crop it can be adjusted i.e., pulled forward and locked. While adjusting it should be noted if the reel is too much ahead of the cutter bar, the crop will not move on the platform and if it is too close straw may wrap around the reels and may increase losses.

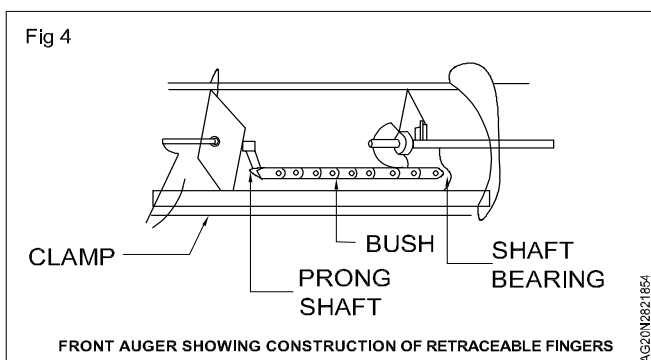
4 Reel speed

All the self - propelled combines are provided with variable changes for reel drive. The speed of the reel depends upon the condition of the crop, it should

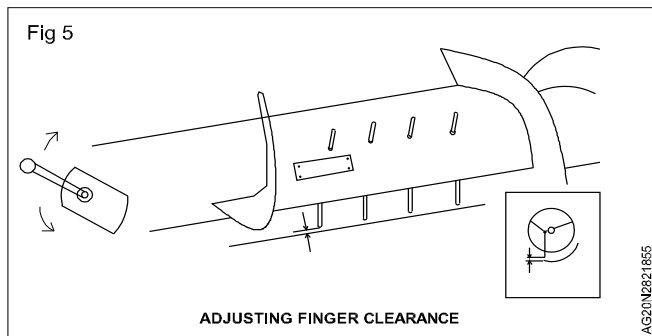
- Run fast without shattering the grain or throwing the cut plant out of the cutter bar.
- Move the crop smoothly over the entire length of the cutter bar.

Adjustment of auger

The crop cut by the knives and brought in by the take in sweep falls on the auger conveyor. Due to spiral movement (right and left hand flights fixed on the auger housing), the crop is brought to the centre of the auger. The fingers come out of the housing at the front, take the crop and push it to the conveyor chain of the feeder assembly. When fingers are in front of the feeder housing they retrace back in the housing thus making it easy for the feeder conveyor to take charge or cut crop (Fig 4).



The auger has up and down adjustment on both sides. While making adjustment it should be noted that equal adjustment is made on both sides. The auger flights are usually 20 mm from the pan of the cutter bar, but with crops with thin seeds it should be lowered down. Over the above moving up and down the height of fingers can also be adjusted from outside. The fingers should be around 30 mm when fully out of the housing and for gross seed 15 to 20 mm from the pan of cutter bar (Fig 5).



A part from the two main adjustments most of the combines are provided with scraper plate at the backside. This scraper plate can be brought close to the flights of the auger in case the crop tends to wrap around the auger. The drive for the auger is taken from the main cutter bar drive and has a safety clutch slips and the auger stops working. Special attention should be paid to the bushes of fingers. Incase found worn out these should be replaced with new ones failing which fingers will strike against the housing and tear it apart.

Adjust forward speed

Ground speed not be changed by using the throttle. The engine should be run at recommended speed. Forward travel speed should be adjusted by shifting gears and by variable pulleys. Driving too fast increases rack losses due to over loading the combine and also increases shattering and uneven height of cut.

Adjust the cleaning sieves and fan blast

Poor adjustment in the cleaning area of the combine will also cause grain loss. This adjustment and the operating loss or trouble they will cause are as below:

- a **Chaffer opening adjustment :** The lips may be raised or lowered to regulate the size of openings on the chaffer. The opening should be large enough to allow the grain to work through the chaffer before it passes over two third of its length.
- b **Chaffer height adjustment:** In some combines the rear of the chaffer can be raised to move the material uphill thus keeping it longer on the chaffer and increasing cleaning action. But when this is done the opening should be kept small.
- c **Chaffer extension height adjustment :** The chaffer extension openings should be large enough to allow the un - threshed portion of the heads to pass through into the tailing trough. At the same time coarse material should be carried out of the machine.
- d **Chaffer extension height adjustment :** The chaffer extension should be adjusted just high enough to prevent gains from being blown over and low enough to prevent clogging at the rear of the chaffer.
- e **The shoe sieve opening adjustment :** The shoe sieve openings should be small enough to allow only threshed grain to pass into the grain auger.
- f **Blower adjustment :** Correct speed adjustment of the blower is important to ensure a well balanced blast through the sieves. In general, the smaller the

seed, the air blast should be and the large the seed the greater the force of air blast should be.

- g **Tail board.** Can be raised and lowered as necessary to prevent un - threshed material from being carried out of the rear while still allowing the chaff to be blown out.

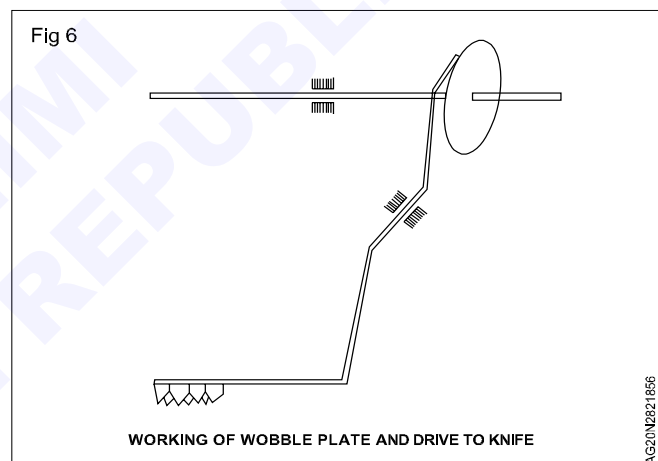
Cutter bar adjustment

- a Guard alignment
- b Knife clips
- c Wearing plates
- d Sickie register

If these parts become loose or worn, the knife will chew and tear the crop instead of cutting it. This will also cause more shattering of ripe crops.

Adjustment of knife and its drive

On the entire length of the cutter bar there are fixed fingers in which knife blades run. Knife blades are riveted on a knife strip and have a reciprocating motion given through wobble mechanism. Fig 6 is giving schematic view of the drive or crank mechanism.



The main adjustment to be checked in the knife and its drive are:

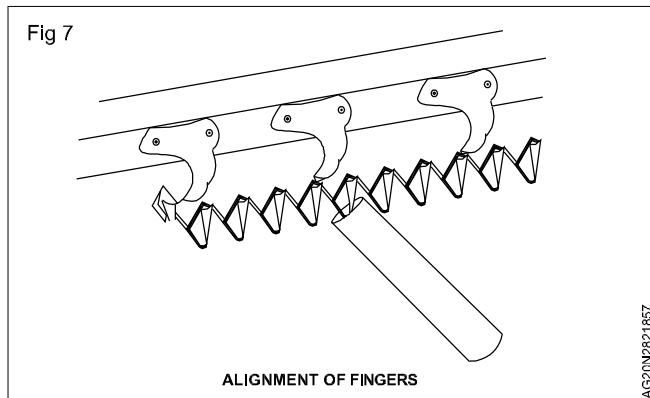
- 1 Stroke of knife
- 2 Blade up and down adjustment
- 3 Blade back play
- 4 Alignment of fingers

1 Stroke of knife: The knife travel is adjustable and it should be such that the blade travels out of adjoining finger equal distance.

2 Blade up and down adjustment: Most of the machines have pressure plate placed on the knife strip. Shims under the pressure plate can be placed or removed. The blade strip should have slight up and down movement.

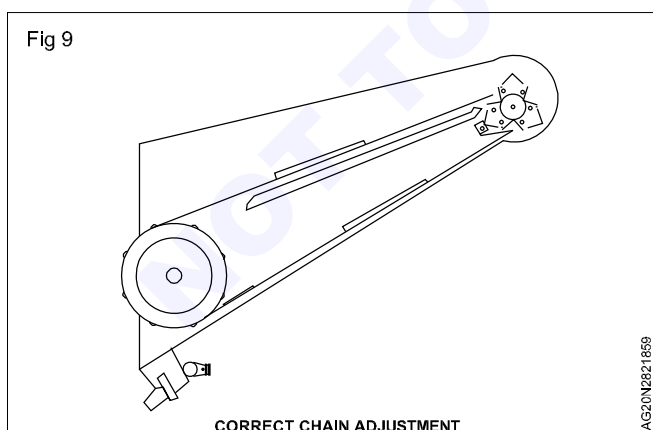
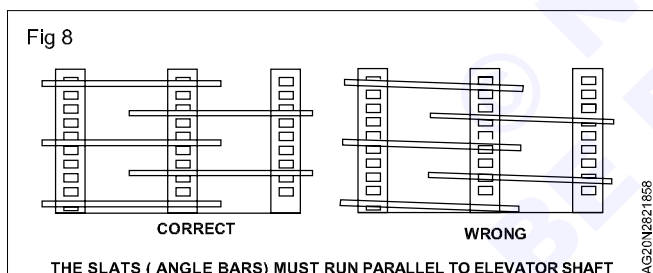
3 Blade back play: One thrust plate is fixed at the back of the knife strip and is held with pressure plate bolts. This strip should be positioned to touch the back of the knife strip.

- 4 Alignment of finger:** All the fingers must be positioned in one line. This can be checked by holding string from one end to another. The fingers can be lifted up or down by pipe as shown in Fig 7 and through in line with the string.



Adjustment of feeder

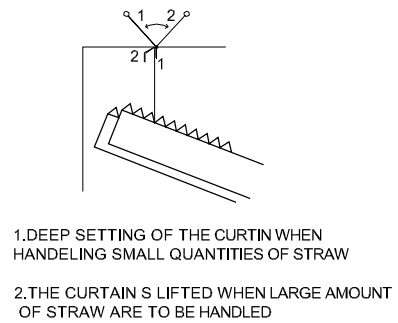
As the name implies it conveys the feed to the threshing system. One end of the housing is hinged to the main machine while the other open end is fixed to the cutter bar. It has three chains running on set of sprockets fixed on two shafts. The chain should be properly and equally adjusted on both sides as unequal adjustment will accelerate wear on both sprocket and chain. Wrong and right adjustment of chain is when the centre of chain just touches the bottom of the housing as shown in Fig 8 and Fig 9



Adjustment of straw walker

The curtains (Fig 10) at the end of the walkers must be checked for rents every day before commencing work. Tents in the curtains are primarily caused by un wieldy straw.

Fig 10

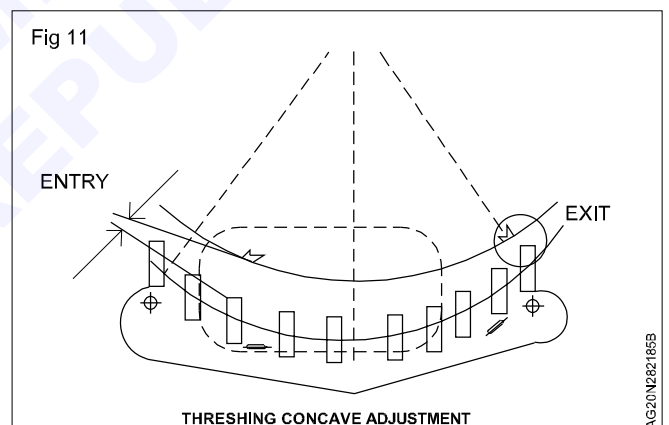


Threshing concave adjustment

The concave is suspended on a cradle with the help of a tubular shaft. This tubular shaft is moved with the help of a suitable leverage through basket quick adjusting handle.

When the lever is pressed down, the concave is lifted up and brought close to the drum, this is known as quick adjustment. Suspension lever on both sides of basket is adjustable and the clearance between the rasp bars and basket is adjusted through these.

In the front clearance of 14 to 15 mm is provided and at the back end clearance of 7 mm is provided as shown in Fig 11. This clearance should be kept equal on both sides in the front as well as on both side at rear.



Concave fine adjustment

Apart from quick adjustment which is put to use while starting the machine, or when the drum gets choked, the concave is lowered down giving enough room to the crop to clear out. There is a fine adjustment also provided to suit moisture-maturity of crop and type of crop. This is accomplished by bringing the basket close or apart from the threshing drum by the hand wheel.

Fine adjustment and setting

For different crops having different rates of maturity and moisture content, the clearance between basket and threshing drum can also be adjusted; over and above drum speed can be varied although it cannot be specified as setting depends upon the following factors:

- 1 Travelling speed
- 2 Maturity crop
- 3 Condition of crop

- 4 Moisture content of crop
- 5 Type of soil
- 6 Density of crop
- 7 Type of fields, i.e, big or small

It should be noted that while increasing threshing drum speed, the gap between concave and drum has to be reduced and while reducing the speed, gap increase.

Cylinder speed need to be higher and concave clearance lower in the morning or in the night time when the moisture content is higher or when the crop is slightly wet.

Concave and cylinder clearance and drum speed are very important factors for better threshing. Although losses due to cylinder are lower when checked but the basket clearance and cylinder speed has directed influence on rack and shoe losses. Poor adjustment in machine will result into

- 1 Less threshing: on - threshed heads
- 2 Too much threshing action:
 - a Excessive chewing of straw
 - b Overloading of sieves
 - c Excessive trailing
 - d Overloading of ear elevator

Type of losses and their remedies

In order to have good remedies from the harvester, it is necessary to reduce grain losses and therefore the operator must know about the following losses.

- 1 Types of losses
- 2 Sources of losses

1 Types of losses

There are various type of losses, which may occur during harvesting as.

- Un - cut head of standing crop (one harvest)
- Falling down of the heads of cut crop
- Shattering of grains
- Un threshed grain
- Breakage of grain

2 Sources of losses

The following are the sources of losses.

- i **Cutter bar loss** : The cutter bar loss is caused due to
 - a Grain shattered out try reel
 - b Heads of grain thrown out by the reel
- ii **Cylinder loss** : Damage to the grain due to insufficient clearance between concave and cylinder. Cylinder loss above 1% is not desirable.

- iii **Rack loss** : Rack loss is the loose grain, which has not been separated from straw as it passes over the rack. This loss should remain between 0.2% to 0.4%.
- iv **Show loss**. Show loss is the grain that is carried over the rear of the sieves with chaff and blown out of the combine. Normally it is found between 0.2% to 0.4%
- v Any leakage of grains from covers.

In general, the accumulated loss from all the sources varies between 1% to 4%

Measurement of combine losses

- 1 **Pre - Harvest losses** : To measure pre - harvest losses first select level and sufficient field for combing. The area from where the sample is to be collected must be marked in 1m in the direction of travel and full or half with of cutter bar of machine. Pick up all loose grains, complete ear heads fallen in the marked area before run over of the machine and analyze for determining the pre-harvest losses in kg/ha
- 2 **Header loss** : Operated the combine on the marked area, where the pre - harvest losses were determined and pick up manually the loss grains complete or incomplete ear heads on the marked area. Care must be that no material falls down from the combine over marked areas.
- 3 **Straw walker and shoe loss** : To determine rack and shoe loss, collect straw and chaff leaving the machine separately on sheets or cloth for 20m run.

How to minimize losses

Before attempting to make adjustments it may be necessary to check up.

1 Machine speed

The machine is operated at the recommended revolutions per minute (rpm) at a constant speed any change in the engine speed will directly affect the speed of the threshing cylinders and other moving parts, similarly uneven travelling speed will also causes loss of grain, poor threshing sometimes complete clogging of the machine.

2 Adjusting the cylinder, concave, cylinder basket clearance and cylinder speed

The cylinder losses are usually the lowest, as already stated but any mis adjustment will have as advance effect on the rack and shoe losses.

If the basket is very close to the cylinder.

- It will chew up the straw
- It will give broken grains
- It will load the shoes excessively whereas too much clearance will give un - threshed ears/heads.

As a general rule, while increasing the cylinder speed, decrease the clearance between the basket and the cylinder and when the speed of the cylinder is decreased the clearance between the basket and the cylinder should be increased. For setting the drum speed, clearance between the basket and the drum, Operator's manual should be consulted. However, we give the following guidelines:

For high humidity in the air and high grain moisture increase the threshing drum speed and reduce the let out concave gap. However, if moisture content is medium than keep the medium drum speed and medium concave gap.

With low moisture content, slow down the drum speed and increase concave gap, similarly when running the combines in the field the following are the guidelines.

- i High driving speed - High drum speed and wide basket gap.
- ii Medium driving speed - Medium drum speed and medium concave gap.
- iii Slow driving speed - slow drum speed and narrow basket gap.

3 Adjusting the cutter bar

The cutter bar area has the highest losses as compared to all the areas in combine. The height of cutter bar should be adjusted so as to get all the heads of the grains in the cutter bar torque. At the same time it should not be too low as to draw the soil inside. If it is too high, heads of grains will be left in the field. If it is too low, the quality of material getting into the combine will be more and will eventually overload the rack, resulting in more losses. Similarly, the blades of the cutter bar should not be blunt as they are likely to leave the crop in the field.

4 Reel adjustment

In case the straw wraps around the reel, raise the reel height. As general rule, for standing crops the reel lines should be adjusted vertically to the ground and the working height should be such as to catch the crop a little above the centre of the crop. For different types of ensure conditions adjust the reel as under.

- For medium and short crops: adjust the reel approximately 10 cm (4 inches) above the cutter bar and quite forward enough to ensure that the reel does not leave the crop.
- For taller crops set the reel back and raise so that the back runs close to the top of the grain
- For laid down crops adjust the reel as low as a possible in a forward position and the tines should be pitched slightly rear-wards as that these lift the laid down crops easily and the reel bars are placed right in front of the cutting br. Take care to see that the reel tines do not come in between the cutter blades. As general practice, the reel speed is the same as the ground speed of the machine or $1\frac{1}{4}$ times more than the rate of ground speed.

5 Speed of the machine

To find out the optimum speed it is necessary to not the intake of the combine. In harvesting combines E - 521 the intake is 5 kg per second. Taking into consideration the amount of yield the exact speed has to be worked out. However, if the driving speed is too fast it will overload the combine and eventually cause a lot of losses and clogging the machine, similarly if the combine is run slow the output will be less. For wheat it is recommended the machine should be run in second gear and for rice it should run in first gear.

Problem	Remedy
Cutter bar damaged	It is absolutely necessary to stop the combine when working on or around the cutter bar, if necessary to work underneath, block the cutter bar up to avoid risk of accident.
Poor cutting action	1 Adjust knife registration 2 Reset knife keeps 3 Sharpen knife 4 Straighten finger bar 5 Replace damaged knife sections 6 Remove build-up of foreign material from cutter bar
Sudden knife blockage	1 Remove foreign objects 2 Replace misaligned cutter bar fingers 3 Adjust tension of drive belt
Dirt and material built-up on divider points	1 Set drives to higher position using the slide 2 Renew cutter bar skids if necessary 3 Adjust the reel further forward
Cutter bar lifts too slowly	1 Check hydraulic oil level and fill up if necessary 2 Have hydraulic oil pressure checked
Reel tending to stop	1 Adjust slip clutch tension a little bit
Feed rake and cutter bar tending to stop	1 Adjust jockey pulley of cutter bar V-belts clutch
Cutter bar dips at one end	1 Loosen the securing bolts on the feeder house and adjust cutter bar mountings to level cutter bar
Cutter bar clutch will not disengage	1 Check adjustment of cutter bar clutch belt guides 2 Clean V - belt pulleys of cutter bar clutch
Uneven crop feed	1 Adjust main table auger height to suit crop conditions 2 Adjust reel tine position and reel speed 3 Adjust feed rake chains to proper tension
Main table auger tending to stop or gets blocked	1 Turn the main table auger back by the flights and remove foreign matter
Crop wrapping round the reel shaft ends	1 Adjust inner deflectors closer to cutter bar centre and possibly higher
Crop wrapping round the reel finger tubes	1 Raise the reel 2 Set reel fingers more inclined to the front 3 Adjust reel speed to match ground speed
Reel fingers fouling knife in lowest position	1 Raise reel position by means of reel cylinder eye bolts
Reel dips at one end	1 Check for equal adjustment of reel cylinder's eye bolts
Too many stones being picked-up	1 Reduce number of grain lifters, if fitted 2 Do not cut unnecessarily low (lodged crops should be lifted with grain lifters)

Slugging of drum	1 Reduce drum - to - concave clearance 2 Increase drum speed in damp crops 3 Adjust basic settings of concave 4 Care for even feeding of crop to feed rake 5 Adjust main table auger further down 6 Check and have speed of main drive shaft adjusted 1140± rpm if necessary 7 Reduce ground speed as moisture level increases 8 Adjust spring-loaded cylinder for threshing mechanism drive power band belt stones and other foreign matter causing damage to threshing parts
Stones and other foreign matter causing damage to threshing parts	1 Clear stone trap frequently 2 Do not cut unnecessarily low and stony ground
Irregular speed variations	1 Correct the settings of the idler pulley as spring-loaded cylinder that controls the tension of power band belt. 2 Check engine (see engine problems)
Poor threshing action	1 Adjust concave closer to drum 2 Increase drum speed 3 Adjust basic setting of concave 4 Have worn or damaged threshing equipment repaired or replaced 5 Adjust relative position of concave entrance and concave exit to match crop condition 6 Use special threshing equipment if necessary
Unbalance	1 Clean dirty threshing drum 2 Remove dust accumulations from belt pulley 3 Have damaged rotor repaired
Grain cracking	1 Decrease drum speed 2 Increase drum-to-concave clearance 3 Adjust frogmouth sieves wider open 4 Adjust tension of elevator chains
Excessive belt wear	1 Engage combine drivers with engine as slow idling speed and then bring the engine to full speed 2 Adjust belt tensioners

Cleaning

Problem	Remedy
Uneven feed to sieves Knowing sieve pan	Clean preparation floor 1 Remove dirt accumulations from above cleaning fan housing 2 Retighten all bolts that secure sieve pan 3 Tighten the components securing the sieves 4 Have sieve pan bearings replaced
Excessive built up of material on frogmouth sieves	1 Reduce drum speed 2 Adjust concave to drum clearance wider open 3 Open concave clearance at the rear 4 Adjust frog mouth sieves to somewhat closer gaps 5 Increase wind blast
Dirty grain sample	1 Increase wind blast 2 Set air intake apertures to correct position 3 Decrease frogmouth sieves opening 4 Decrease main frogmouth sieve opening, respectively 5 Have basic speed of machine checked and corrected I-necessary (belt tension).

Returns

Problem	Remedy
Excessive amount of chaff and short straw in returns	1 Increase wind blast 2 Adjust frog mouth sieves to some what closer gaps 3 Reduce drum speed 4 Possibly change concave clearance at the rear. 5 Have basic speed of machine checked and correct if necessary
Excessive amount of grain in the returns	1 Adjust frog mouth sieves wider open 2 Adjust returns step floor
Excessive amount of green stuff in the returns	1 Lift cutter bar to highest possible position, the grain lifters should lift the crop out of the green stuff 2 Adjust rear end of frogmouth sieve to somewhat closer gaps

Elevators

Problems	Remedy
Elevator obstructed	1 Open elevator bottom flap to remove obstruction material. Open auger tough. Run combine with open flap until elevator and auger are clear. Tightly close elevator bottom flap chain. 2 Possibly improvement by re-tensioning elevator chain. 3 Avoid material build-up and excessive tailings. 4 Adjust tension of the belt driving the elevators.

Grain tank

Problem	Remedy
Grain tank recharge not functioning	1 Adjust tension of V - belt 2 Readjust the drive and belt guides for the grain tank unloading augers 3 Bend misaligned auger flights

Grain losses

Problem	Remedy
Grain Losses	Losses of grain may have different reasons. Therefore, always determine first where the losses occur. Checks combine for leakage losses. Check whether grain is lost where working parts join, especially check auger troughs, elevators etc. Extra care should be taken to check the working parts for good fitting when combining small seeds. Repair all leaks as necessary. Losses that are caused by overripe crops or poor weather condition must not be taken for combine losses. Grain losses that are due to combining usually have four main causes: - a Losses of grain over the cutter bar 1 Adjust reel tine angling to suit crop conditions 2 Adjust reel speed to match ground speed 3 In crops with hanging grain heads fit a grain lifter to every second cutter bar finger 4. Adjust dividers to avoid built up of material 5 Adjust main table auger position to match crop condition 6 Adjust reel forward or backward as necessary 7 Have slip clutches of reel reset to correct torque - b Losses caused by insufficient threshing 1 Have damaged or worn threshing during required 2 Adjust drum to crop condition 3 Adjust concave to drum clearance to crop conditions. 4 Correct basic adjustment to concave 5 Adjust relative position of concave entrance and concave exit to match crop conditions 6 Adjust cutter bar to ensure even crop feed 7 Reduce ground speed 8 Crop not ready for threshing - c Losses of grain caused by insufficient separation 1 Provide for even crop feed to the threshing parts 2 Try to pick up less green stuff 3 Severe straw conditions clog up the cage sieves. Clean it through the inspection doors

d Losses of grain over the sieves	1 Avoid heavy buildup of material 2 Increase air blast to meet crop conditions 3 Set cutter bar high enough to minimize green stuff entering the combine 4 Decrease drum speed when sort straw overloads the sieve pan, possible open concave at the rear 5 Adjust tension of sieve pan drive belts 6 Adjust rear end of upper frogmouth sieve wider open 7 Check and have speed of main drive shaft adjusted to 1140±5 rpm if necessary 8 Clean upper and lower sieves and preparing floor 9 Adjust frogmouth sieve gaps wider open and increase wind blast 10 Check fan speed pulleys for smooth operations 11 Avoid excessive amount of grain in the return. 12 Reduce ground speed
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Transmission system

Brake

A Path of brake pedal too long due to worn out or not properly adjusted brake linings	1 Replace the lining or adjust the brakes
B Brake pedal does not return effectively because tension spring has lost its tension or elongated	1 Replace the tension spring
C Insufficient breaking action due to	
1 Brake lining contaminated with grease or oil	1 Replace the brake lining
2 Water may have penetrated in the brake housing	2 To vaporize the water supply breaks several times
3 Brake assembly bolts are loose	3 Tighten the bolts
D Pulling towards one side due to brake adjustment of one side, either too tight or too loose. One side lining contaminated with grease or oil.	1 Read just the brakes equally

Hydraulic system: A hydraulic cylinder lifts the cutter bar too slow due to

Problem	Remedy
1 Hydraulic pump belt loose	1 Set to proper tension
2 Improper grade of oil	2 Use proper grade oil
3 Leakage in the system	3 Set it right
4 Blockage in the system	4 Correct it
5 Air in the system	5 Bleed it

General

A. Premature belt wearing belt flickering/jockey pulley support breaking due to

Problem	Remedy
1 Wrong alignment	1 Set right alignment
2 Fouling of belt	2 Correct fouling
3 Improper spring tension	3 Set the specified tension
4 Wrong pulleys fitted	4 Put right pulleys

B. Premature wearing of chains and sprocket's due to

Problem	Remedy
1 Alignment not OK	1 Set it right
2 Chain loose	2 Tighten the chain

Green harvesting equipment

Objectives: At the end of this lesson you shall be able to

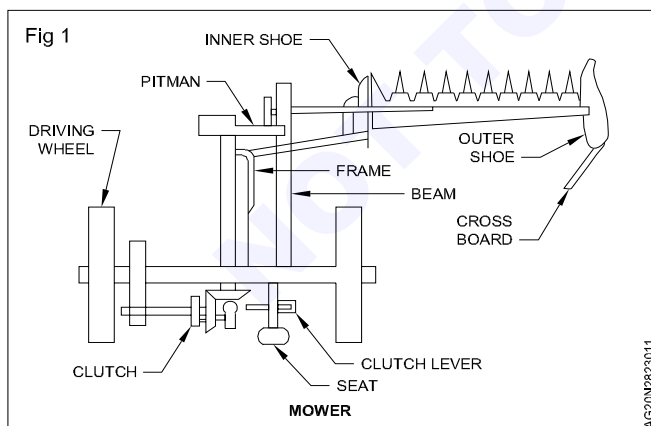
- state the need of green harvesting equipment
- describe the working principle and constructional details of mover and feeder
- describe the working principle and constructional details of power chaff cutter
- state the cause and remedies of power chaff cutter.

Need of green harvesting equipment: Green harvesting machinery is used for harvesting fodder crop. It depends upon the purpose, like meeting out the daily need of the cattle for food and storage purpose to be used during off season, when green fodder crop is not available. The farmers do get leafy material, various types of crops throughout the year used as green fodder for milch animals. During the off season the animals are fed with dried straw added with concentrates. Normally hay or silage is used during a particular period of year.

Mower: A number of machines are available for harvesting of standing forage crop and laying the whole crop in the form of swath or windrow. These machines do not convert the crop into the fodder to be fed to the animals. A mower is similar to reaper which is used for harvesting of cereal crops. The mower is simpler in design and has fewer components than a reaper. It cuts the forage crop and leaves the same in the field for sun drying. Depending upon the cutting unit of a mower, it can be of reciprocating knife type, rotary disc type, cylinder type or mower with flail knives. The size of the mower may vary between 2.40-2.42metre.

Mower

The important part of the machine is the cutter bar, which carries those parts concerned with the cutting action and lies on the ground whilst in work (Fig1).



The knife is carried in the cutter bar, and consists of a knife back to which triangular shaped sections are riveted.

Preparing a mower for work

The mower is attached to the top link adjusted until the main frame is vertical. The knife back should be straight

and all sections of the knife sharp and firmly riveted in place. The ledger plates should all be in line with those on inner and outer shoes. The knife is carefully slid into the cutter bar and the head attached to the pitman. When the knife is correctly registered, each section will travel from the centre of one finger to the centre of the next. This knife register should be checked and if necessary, adjust it, either by altering the length of the pitman or by moving the whole cutter bar toward or away from the crankshaft, depending on the design of the machine.

Operation of the mower

Start the cutting in a clockwise direction. The swath board and stick should be seen to be leaving a wide enough passage for the wheels and the P.T.O speed maintained at the standard 540 rev/ min. The forward speed is adjusted according to the condition of the crop. When moving, it is normal to make a reverse turn rather than loop turn, the cutter bar being raised and lowered in space cleared by the swath board.

After two or three rounds of the field, the knife edge and other parts of the machine should be checked to ensure that they are not running hot. the shape of the field produce the point, It will be found that laying the outer part of the cutting bar on a previously cut swath will cause the points to foul the swath. This can be overcome by cutting off by the tip of the point, two or three times, and then cutting normally until the point reforms, when the procedure is repeated. When the blockages occur, the mower is backed out of work and the P.T.O. disengaged clearing the knife. It is important to allow the knife to regain full working speed before re - entering the crop.

It takes a long time to dry and therefore should be cut fairly early. Against this is possible damage to knife and mower generally. Raking back the first swath own prevents the inner shoe becoming tangled. This practice often causes a high wear and tear, due to overheating of the knife, as a result of the lack of sap in the grass. This wear and tear can be reduced by lowering the P.T.O. speed and removing the swath board.

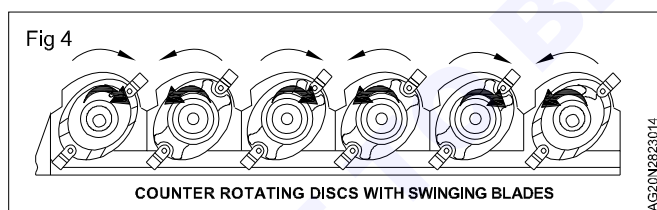
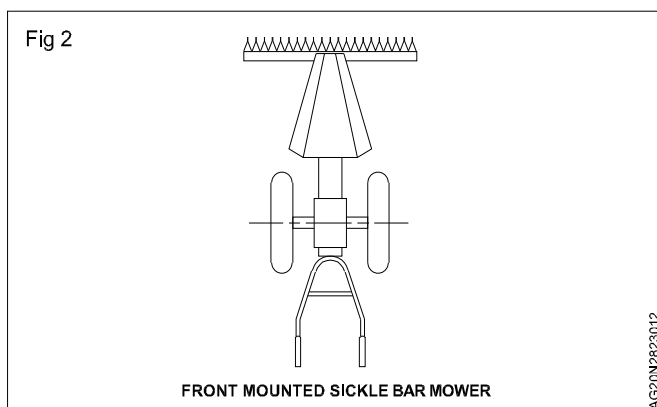
Adjustments

- 1 Adjust the knife blade for smooth cutting and minimum side draft.
- 2 Adjust the knife head guide by removing shims to prevent the stopping of the knife head.

- 3 Lift or lower the guards using pipe, if they are bent.
- 4 Keep the point of the guards aligned so that the ledger plate is at the same level.

Maintenance

- 1 Check the condition of knife sections and sharpen or replace after it has become dull due to constant use.
- 2 Do not lubricate the mowers when working under sandy soils.
- 3 Store the mower in the shed with its cutter bar lifted up when not in use.



Reciprocating knife type mower

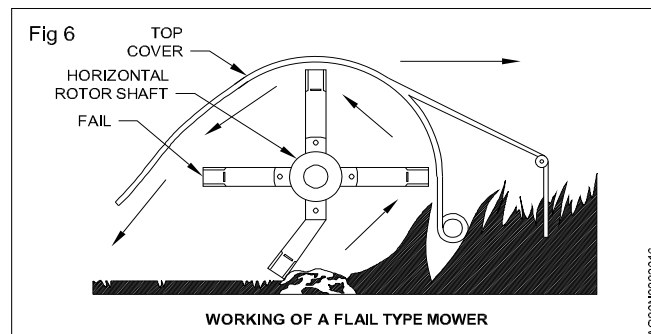
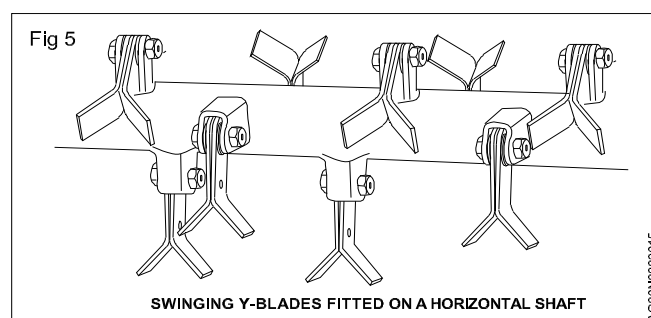
This type of mower is a traditional forage harvesting equipment. It cuts the forage crop by shearing action using number of reciprocating knives fitted on a cutter bar. It gets the reciprocating motion through crank wheel and pitman arrangement.

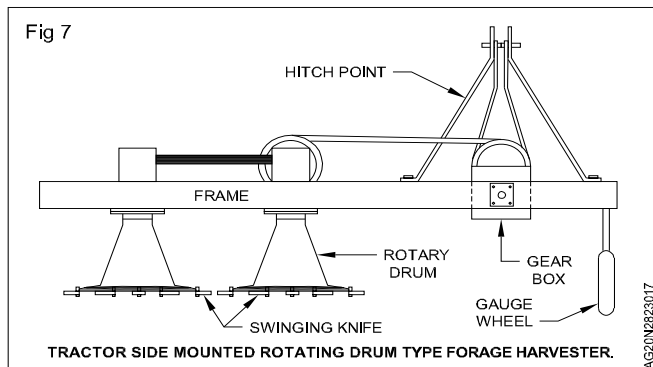
This type of mower do not perform well in high yielding fields as it tends to clog and are also inefficient for harvesting of all types of crops. The power requirement of a reciprocating mower is about 1.5 KW/ m - of width cut and forward speed of 3 to 8 km/h gives 0.20 - 0.60 ha/h for a 1.5 m wide cut depending on crop density.

Disc mower: Disc mower cuts the forage crop and leaves the same in swath of uniform thickness. It is better suited for land or heavy crop as it has less chance of blockage. The disc gets its drive from tractor P.T.O. through spur gear train, immersed in lubricating oil for its rotation. A tractor of 35 hp is required for a 4 disc mower. Disc mower can be operated up to a forward speed of 16 km/h speed, but 9 -13 km/h speed is more practical. Disc mowers require approximately four times more power for their operation compared to a reciprocating knife cutter bar type mower.

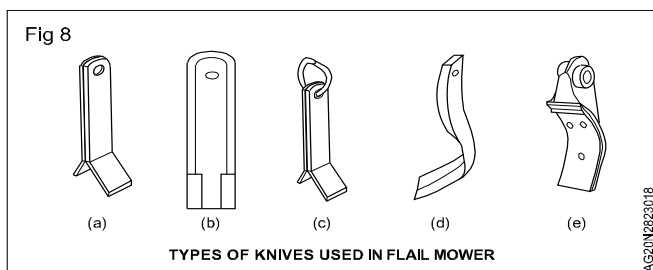
Flail mower: It is a P.T.O. driven implement and it is used to provide a rough cut to taller grasses. These machines are not suitable for harvesting very tall crops and do not chop fine enough for good silage. The machine has free swinging knives 59 - 150 mm wide or even chains attached to a horizontal or vertical rotor on 3 to 4 rows. (Fig 3). The rows are staggered to provide complete coverage (Fig 4). In other types blades are fitted in drum rotating in opposite directions to each other in vertical axis. The rotating drum is fitted (Fig. 5, 6, 7) perpendicular to the directions of motion. P.T.O. power is transferred to the rotating drum and finally to flails through a gear box. The flails are attached to the rotating drum with the help of nuts and bolts. As the drum rotates the flails are pushed outwards due to action of centrifugal force and cut the crop due to impact action. The cut crop is uniformly in windrow behind the machine. It works better than conventional mower in lugged crop. The machine cutting width is usually 1.20- 4.0 m and the peripheral speed ranges from 46- 56m/s. The power requirement is very high about 25 KW/m of cutting width Fig.5 Swinging Y-blades fitted on horizontal shaft.

Tractor side mount rotating drum windrow behind the machine. It works better than conventional mower in lugged crop. The machine cutting width is usually 1.20 - 4.0 m and the peripheral speed ranges from 46 - 56m/s. The power requirement is very high about 25 KW/m of cutting width





Types of knives for flail mowers (Fig 8) : various types of flail mower knives are used for cutting of forage crops. These are standard blades (Fig 8a) pin mounted blade (Fig 8b) pin mounted straight blade (Fig 8c), ring mounted blade (Fig 8d) and standard blade (Fig 8e) is generally 19mm wide and 127mm long and used for general purpose of mounting the grasses, weeds, and mulching leaves. It is used cleaner fields with stone. The following types of knives are used on flail mowers.



Fodder: The harvesting of forage crop and converting it into fodder involves various options and accordingly different types of machineries or their combinations could be used. They are as follows

- 1 Harvesting standing crop and converting into fodder:** The standing forage crop can be harvested by using sickles for small quantity. But for large quantity various types of mowers can be used. The harvester crop can be transported in a trailer for converting it into fodder with the help of a stationary cutter commonly known as chaff cutter.
- 2 Harvesting binding into bundles and converting into fodder:** A crop row binder is used to harvest the standing fodder crop and it binds the harvested crops simultaneously into bundles. Then the bundles of crops are transported for converting it into the cut fodder using a stationary chaff cutter.
- 3 Harvesting and converting into the fodder in the field:** In this method the crop is harvested and converted into fodder in the field, itself by a single machine known as field chopper. The basic operations performed by a field chopper is harvesting the fodder crop, chopping it into a smaller process and loading the same into wagon by blowing it.
- 4 Fodder harvester:** Fodder harvester consists of chute, rotor, shear plates and flails. It is operated by tractor. The discharge spout mounted to the harvester helps to discharge the cut fodder into the forage wagon.

Uses of forage harvester: It is used to harvest the forage crops. It cuts the forage crops into pieces and load them into forage wagon through the discharge chute.

Forage harvester

With the increase in emphasis on silage as a means of conservation, machines were needed to cut, lacerate and load crop at a high output rate. The flail type forage harvester met this demand.

The forage harvester consists of two basic parts (Fig.9)

A carefully balanced rotor, carrying two, three or four rows of flails, driven by the P.T.O. from a gear box and 'V' belt at 1200 to 1500 rev/min rotor turns against the direction of travel. The flails shear off the crop to prevent it falling the ground.

A chute, to collect and deliver the cut material, is propelled by the fan like action of flails. The top of the chute has a flap to control the delivery of the grass. It may also swivel side way delivery.

When choosing a forage harvester, the size of the machine must be related to the tractor power available. Generally, rotors 40 inch width are suitable for tractors of 35 to 40 bhp, and 60 in rotors for tractors of 50 - 60 bhp.

Types of harvester

In - line

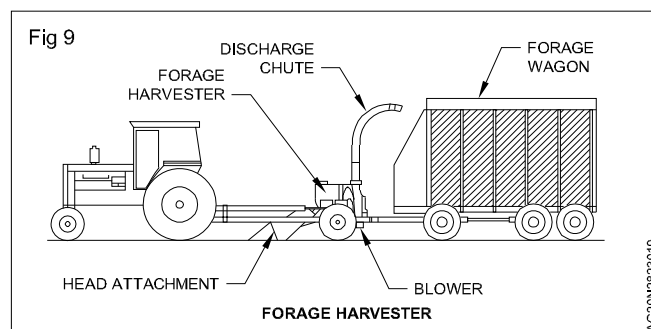
This type is the cheapest. It is used with the trailer hitched behind the harvester. It can be used as a one man system that is the harvester and trailer being taken over the clamp and back to the field as one unit.

Off - set

This type of harvester is more expensive but it does have greater versatility. It will operate efficiently in any type of crop. Trailers can be hitched behind the machine or drawn alongside by another tractor. It cannot be used as one man system, as it is too wide for gates and roads.

Side mounted

A considerable part of the harvester weight is carried by the tractor, in both cases. The trailer is hitched on the normal tractor draw bar to use it as a one - man outfit, the harvester is detached and left in the field.



Operation of forage harvester

- 1 Cutting the standing crop
- 2 Chopping it successfully

- 3 And lifting as well as throwing the chopped fodder in a trolley.

Care and maintenance of forage harvester

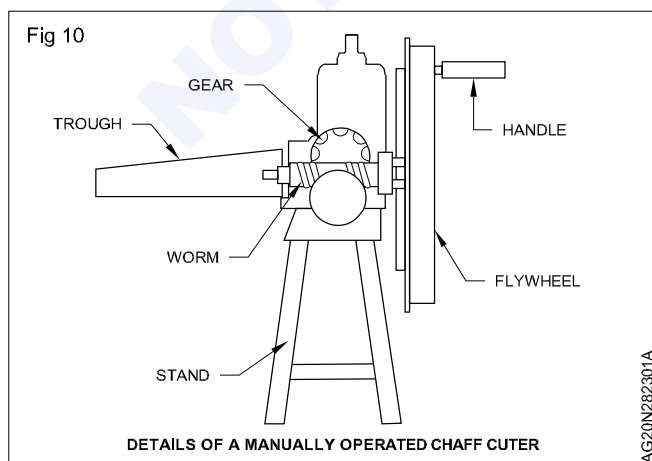
- 1 Check regularly the bolt and bushes for wear.
- 2 Replace or sharpen the blunted flails after use.
- 3 Lubricate the machines properly.
- 4 Worn out parts should be replaced.
- 5 Clean the fields of any debris that could damage the harvester.
- 6 Harvest the forage crop in the afternoon to optimize water soluble carbohydrates and nutritional quality.
- 7 The forage harvesting equipment must be operated at the optimum recommended settings and speeds to reduce loss of leaves.
- 8 The forage harvesting equipment must be clean before and after harvesting the crop.
- 9 Set shear plate to the proper theoretical cut for the crop being harvested.
- 10 Follow the proper storage method of forage harvester.
- 11 Ensure proper compaction to create anaerobic condition to minimize the bacterial growth.

Chaff cutter: Chaff cutter is a machine used for chopping the forage crops into smaller pieces, suitable for animal feeding. The chaff cutter is operated by manually or stationary engine/ electric motor or power operated.

Types of chaff cutter

Chaff cutter is classified on the basis of type of power source used for its operation. They are as follows:

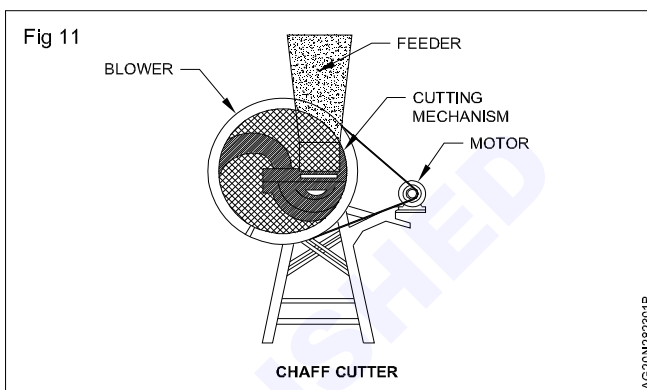
- 1 Manually operated hand chaff cutter
 - 2 Power operated chaff cutter
- i Manually operated chaff cutter (Fig 10) :** This type of cutter is very common with farmers and it is operated manually by one or two persons. Another person is required to feed the crop in the cutting machine. Generally the speed of the fly wheel having single blade and it rotates 50rpm whereas with two blades the speed is 35 rpm. This type of chaff cutters have curved blade and are used for cutting comparatively small quantity of the fodder.



- ii Power operated chaff cutter :** A Power chaff cutter may utilize comparatively a large size electric motor or stationary diesel engine for its operation. The speed of cutting head changes between 600 -1000 rpm. Generally, a power chaff cutter utilizes straight blades, fitted radially on a heavy fly wheel, instead of curved blades.

Chaff cutter is a machine used for chopping fodder(Fig11)

It is also called ensilage cutter. The ensilage power cutter can be of two types, cylinder type, fly wheel type.



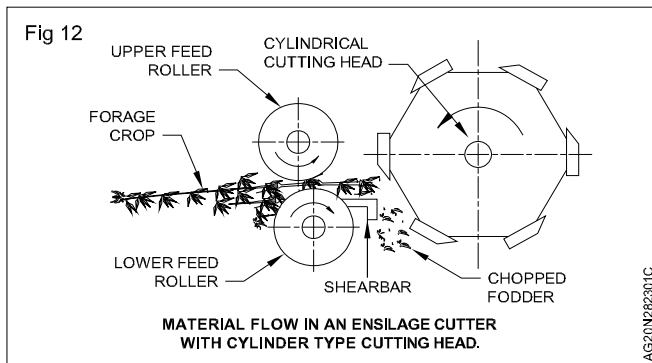
Working of power chaff cutter : A power operated chaff cutter usually consists of (i) cutting mechanism (ii) blower and fan conveyor. The straw is fed to the conveyor which runs along the bottom of a feed trough. At the throat of the conveyor, straw is gripped between two toothed rollers, which allow and pass it forward to a shear plate, where it is chopped into short lengths by rotating knives mounted on a fly wheel. The back portions of the knives are bolted to the fly wheel about 1/2" away from the shear plate. The cutting edges are adjusted such that so that they nearly touch the edge of the shear plate. The driver of the feed rolls and the conveyor is taken through bevel gears with two dog clutches, arranged to provide forward, neutral and reverse gears to a counter shaft running at right angles to the main shaft.

Care and maintenance

- 1 Lubricate all moving parts with grease and oil before use.
- 2 Sharpen the knives if they are bent.
- 3 Tighten the loosen nuts, bolts and screw to prevent accidents.
- 4 Check the power operated electric motor or engine periodically.

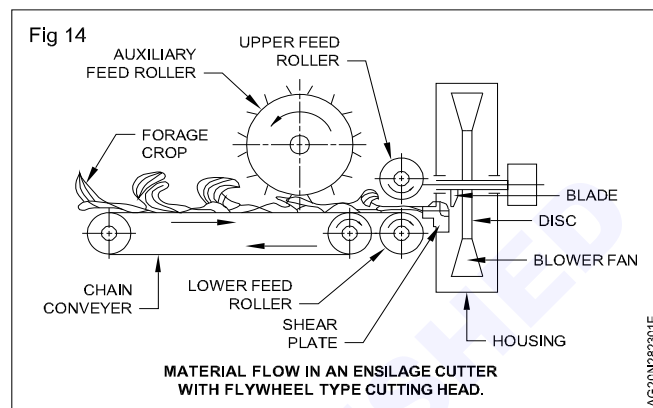
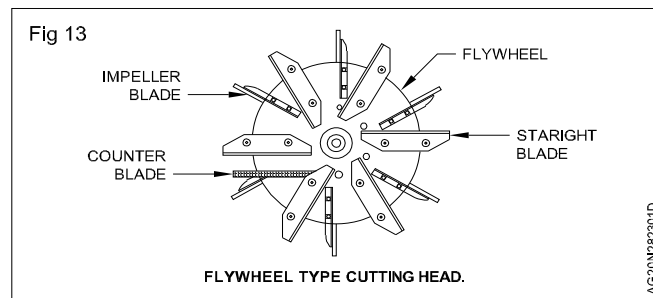
Cylinder type (Fig 12)

Cylinder type cutting head has 9-12 numbers of knives with each single blade arranged in spiral manner on a rotating cylinder. The cylinder is usually kept smaller to permit higher operating speed than fly wheel type cutting head. Fig 12 shows the working parts of cylinder type of chaff power cutter.



Fly wheel type

This type of cutting unit has got 6-8 number of straight blades. Sometimes the number of blades may exceed up to 10 in numbers. The knives have beveled edge with level angle ranging from 25°-27°. The knives are arranged radially on the side of a big wheel. Fig 13, 14 shows the fly wheel type enlarge cutter working parts.



Trouble shooting of power chaff/silage cutter

S. No	Defects	Remedies
1	Power chaff cutter worn out	Sharpen it
2	Electric motor not working	Repair/replace
3	Drive belt broken	Replace
4	Loose belt fitting	Adjust/tighten
5	Fly wheel jam	Check the fly wheel bearing
6	Conveyor not working	Repair
7	Fly wheel blade loose fitting	Tighten it
8	Upper and lower feed roller jam	Replace
9	Blower fan not work	Repair/replace the fan.

Precautions in working and transporting the power chaff cutter

- Clean the chaff cutter before and after use.
- Use the PPE while working on chaff cutter.
- Check the machine before starting it.
- Lubricate the moving parts.
- Check the blade sharpness if need sharpen the blades.
- Be Careful while operating and transporting power chaff cutter.
- Don't touch the blade using fingers while chaff cutter is rotating.
- Remove the power connection before transporting the chaff cutter.

Rotary combine harvester

Objectives: At the end of this lesson you shall be able to

- **state the function and working of rotary combine harvester**
 - **describe the working condition of adjustments of hay baler**
 - **state the method of field operation**
 - **state the hay baler transportation and common accidents and their prevention**
 - **state the care and maintenance and troubleshooting of hay baler.**
-

Rotary combine harvester

Rotary combine harvester uses centrifugal force to drive the grain through the straw. The faster the cylinder spins, the higher the centrifugal force. So it is easy to increase the capacity. The limit how fast the separator rotor can be turned is controlled by the operator. So it is easy to increase the capacity.

In a rotary combine the material passes over the concave two or three times before it leaves the threshing area. Setting the concave to cylinder clearance is not nearly as critical. Rotary combines are not as good in high moisture crops. The way mower material feeds into the rotor effects the rotor's ability to handle the high moisture material. Rotor run length wise on the machine, the crop feed against the end of it.

Crop material is harvested from the bottom of the front end of the rotor, So it moves to the side like a conventional but also around it. So the rotor easily feed the harvest material for further threshing process.

The weakness must be forced to go straight up. An aggressive beater is required to feed that cylinder evenly. But side way setting rotor solves the feeding problem because it is conventional machine. But there are limits on the rotor length, a combine can only be so wide. Rotary harvester rotor splits in three sections. The section in the centre front sits crossways to feed like conventional machine. The separation rotors then sit at right angles to this threshing rotor. A rotary combine harvester is much more sensitive to feeding than the conventional.

As for the rest of the rotary combine harvesting function and constructional settings are the same as combine harvester.

Functions of the hay baler

The hay baler gathers the cut hay from the windrow and compresses it into square or round shaped bales for easy transportation and storage. Most hay balers are stored as bales with small square bales weighing 18-32 kg and large round bale weighing 341- 908 kg.

A baler is used in for recycling application. It is generally hydraulic that press the components materials into dense package of specific size. The compacted materials are then held together with wire, twine, or stripping. Agricultural balers make bales that are easy to transport, handle and store.

The basic functional components or units. which make up a baler for rectangular bales are the pickup and clearing unit, feed conveyor, feeder, compression chamber and tying mechanism.

Types of balers

Balers are chosen depending upon the type of material to baled, material loading methods, required purity, dimensions for transport, milling and throughout. There are many types of balers available in market. They are as follows :

(1) vertical balers (2) Horizontal balers (3) Single ram balers (4) closed end balers (5) opened and extrusion balers (6) Two ram balers (7) Liquid extraction balers (8) Ferrous balers (9) Shear baler logger (10) Round baler.

Components of a baler

A simple baler consists of ram chamber, gate for material feeding and a machine to produce comprehensive force. Accessories and other machines, such as hoppers and wire tying mechanism also integrated to decimate manual labor. Below are common parts of a baling machine.

(1) Hydraulic cylinder (2) ram (3) hydraulic system (4) oil filter (5) motor and other electrical components (6) control system (7) proximity switch (8) bale chamber (9) hopper (10) conveyors (11) pressing lid (12) Tip pan (13) ejection ram or arms (14) automatic tying mechanism (15) bale ties (16) galvanized wire (17) black annealed wire.

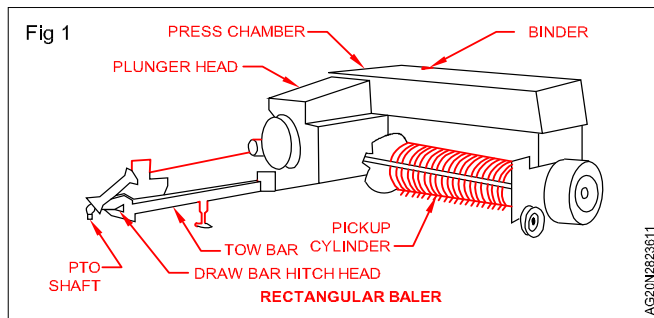
Balers are used to compress agricultural goods and recyclable materials to achieve better material handling and storage. The tractor balers eliminated manual raking bundling and wrapping of haystacks. The same concept of baling was then applied to industrial and domestic waste to save storage and transportation costs.

Bales can be classified according to the power source - PTO operated, auxiliary engine operated and self-propelled baler. They can also be classified according to the shape and size of the bale - rectangular bale and round bales . Rectangular bales varied from 14" x 18" to 16" x 18" and from 32"- 42' in length.

Rectangular baler

The pickup unit lifts the hay from the windrow carries it to the feed rake. The pickup tine rotates in the opposite

direction to the land wheel. Hay compressors on the pickup hold the hay down for uniform feeding and to prevent strong winds from blowing away the hay from pickup. The augur rotates continually and delivers the crop to the edge of the bale chamber where feeder teeth pull the hay into the bale chamber. Every charge of the intake material is sliced off between the knife and the knife on the plunger when moves forward. The plunger then compresses the hay in bale chamber. The process is repeated until the bale is formed. The density of the bale is determined by adjusting the spring loader upper and lower tension bars on the bale chamber.



Round baler

In this case, the pickup unit lifts the hay from the windrow and carries it between compression rollers. As the bale is rolled, the upper belt arm extend the tension spring and tension increases in the upper belts and to squeeze the ball. When the belts have completely extended a relative value, the hydraulic gear cylinder opens and triggers the gate bottom to move to the rear until the maximum bale diameter is reached. When full diameter of the bale is reached, twine is fed into the bale chamber with the hay. When the hay is twine wrapped, the twine is cut off. Hydraulic controlled gate is raised and bale is discharged.

Working method of hay baler

In the hay baler the hay enters the baler through the pickup and the teeth gentle rake the hay from ground to prevent the loss of leaves and ingestion of rocks of debris into the baler directly behind the pickup the compressor bar, which holds the hay in place. So the augur can feed it into the bale chamber.

Round bales are made by pulling the hay into the baler, which binds or rolls the hay until it reaches the size set by the set for bale. at which time twine or netting is wrapped around the bale to maintain its shape. The bale is then dropped from the rear of the baler to maintain its and it shape. The bale is then dropped from the rear of the baler can be moved by a tractor with a bale spear.

Workshop Adjustment of hay baler

- Hay baler machine needed several steps to complete the process. They are in order of process mowing tending, raking, baling and loading having and unloading.
- Visually asses the hay is cub when about 10% of the crop is flowering.

- Adjust the hay baler blades to cut above a point on the stem. Ensure the stems height must be perfect, because cutting too low will damage the crown and effect the plants ability to regenerate.
- Adjust the drying system of hay baler, warm days with low humidity, plenty of sunlight and wind are ideal for drying hay.
- Adjust the hay baler rakes into long heaps.
- Adjust the hydraulic pressure as required fluid pressure to pack the hay into tight bales.

Field Adjustment of hay baler

- Adjust the pick up height to ensure the entire crop is harvested.
- Adjust the pickup cylinder speed as per field crop tapes.
- Adjust the PTO shaft speed.
- Adjust the hydraulic pressure used for bale compress.
- Adjust the pick up unit lifts the hay from the windrow carries it to feed rake.
- Adjust the pick up lines location.
- Prevent the strong winds from blowing away the hay from the pick up.
- Adjust the auger location as you need.
- Adjust the hydraulic pressure for compress the hay in bale chamber.
- Adjust the spring loader upper and lower tension bars on the bale chamber.

Care and maintenance of hay baler

- Clean the baler before and after use.
- Keep the hay baler moving parts lubricated.
- Keep the machine under daily and periodical maintenance as per machine manufacturer. Refer the owner's manual for service maintenance.
- Always maintain the stem height while operating the machine in the fields.
- Check the nuts and bolts every day for damage or looseness of bolts.
- Lubricate the points of the machine.
- Check the power transmission of the machine for safe working.
- Replace the damaged parts of the machine.
- Take proper training to operate the hay baler machine.
- Use recommended wire for bundling the hay.

Common problems and their remedies of hay baler

Sl.No	Defects	Remedies
1	Dust formed on the baler	Clean the baler
2	Machine not performing optimally	Clean the dust on moving parts of the hay baler.
3	Low hydraulic pressure	Repair/ check hydraulic fluid flow
4	Improper baler operation	Check / replace the vulcan wire
5	Improper packing wire thickness	Replace the wire
6	Improper compressed bale	Adjust and set at proper hydraulic pressure.
7	Bale gets wedged	Replace the wear plate in the back door or check the bearing or moving parts of the hay baler.
8	Bale gets wrapped around rubber	Loosen the tensioner.
9	Does not tie the knot	Correct the twine disc rotation.
10	Broken knotter frame	Properly set the right shines to the gears.
11	Excessive noise while baling.	Check the moving parts and replace the damaged parts or tighten the loose fitting parts.
12	PTO shaft mounting noise.	Tighten mounting bolt.

Method of hay baler transportation from one place to another place

- Disconnect the PTO shaft connection with hay baler.
- Check the draw bar hitch head.
- Check the tow bar and ensure the draw bar is properly hitched to tractor or mower.
- Lift the pickup unit from the ground level to safe mode.
- Check the air pressure on land wheels.
- Disconnect the hydraulic connection of hay baler with tractor hydraulic line.
- Move the tractor with hay baler at specified speed limit.

Common accidents and their preventions

- Properly hitch the hay baler with tow bar with tractor to avoid accident.
- Properly connect PTO shaft with hay baler to avoid improper operations and accidents
- Set the proper hay baler stem ground clearance depend upon the crop and soil to avoid damage the tyne and cylinder.
- Use proper thickness of volume wire to avoid breakage of baler.

Diggers and their uses

Objectives: At the end of this lesson you shall be able to

- state the importance of root harvesting machine
 - state the working method of diggers
 - state the digger attachment and driving system
 - state the setting and adjustment of digger
 - describe the care and maintenance and safety precautions of digger.
-

Importance of root harvesting machine:

Digger is one of the agricultural root crops harvesting equipment. It is used for harvesting and exposing the underground crops. Digger machine will go a long way in reducing the dependence on labour for harvesting different root crops viz., onion, carrot, potato, garlic and turmeric. Digger performs following operations

- Digging.
- Separation of the soil
- Removal of vines and weeds.
- At least partial separation of tubers from similar sized stones and clods.

Classification of root harvesting equipment

The root harvester equipment can be classified in several different ways as described below.

According to the source of power

- Manual operated via hand tools and digging aids such as spade, khurpa, digging and picking fork.
- Animal drawn equipment such as potato plough, groundnut digger.
- Tractor operated equipment such as spinner, digger, elevated digger, groundnut digger-shaker windrower, sugar beet harvester, carrot harvester, radish harvester etc.
- Self propelled machine such as potato harvester, combine groundnut combine, sugar beet harvester etc.

According to the mode of hitching

- Trailed type
- Mounted type
- Semi mounted type
- Self propelled type

According to the unit operations performed

- Simple digger
- Digger shaker
- Digger elevator shaker

- Digger shaker conveyor/digger shaker conveyor windrower

According to the completion of operation

- Direct harvesting equipment
- Indirect harvesting equipment

Components of diggers: The major components of the machine requiring design include the blade, power transmission system, cleaning web, ridge roller, rear axle, frame, hopper and the linkage system.

Blade

A flat shaped blade is chosen for the machine to achieve low draught requirements and higher digging efficiency.

Cleaning web

The cleaning web is designed as a slatted conveyor according to the methods. Cleaning rod uses the continental web round rods fixed by rivets on a fabric band of webbing at the two ends. The conveyor rollers held in two shafts.

The ridge roller

The function of the ridge roller is to crush soil crumbs and assist to separation of the soil/cornels prior to lifting. Two steel vertical cutting discs are attached to the ridge rollers to cut along the edges of rows of ridges to minimize the lifting of roots and remains of vegetation.

Rear axle shaft

The rear axle shaft is designed taking into consideration the totality of the horizontal loads and vertical loads on the rear axle.

Compression spring

The ridge roller is to be held by two compression springs made from carbon steel that has been designed according to the procedure of the spring.

Frame

The digger frame is the component that holds all other parts together for efficient functioning. For this frame design, it is considered to be two rectangular steel beams using structural hollow section for structural stability and rigidity.

Three point linkage

Standard dimension of 3 point linkage for this category of implements are selected from dimensions available in Indian standard.

Hopper

The wooden hopper is conveniently placed under the tail end of the conveyor for collection of cornels.

Prime mower attachments and driving system of digger

- Clean the root crop harvesting digger.
- Lubricate the moving parts of the digger and prime mower.
- Attach the digger with tractor and connect all connections with tractor. Ensure all connections are properly connected.
- Move the equipment to the field test.
- Set the flat blade for required ground depth.
- Set the shaking speed of the digger for soil clings to pods, roots and stems.

Safety precautions

- It is extremely dangerous to carry out any work on a machine, while it is under work. The most important

safety measures is to be followed. These are the following steps:

- Don't touch the running and moving parts while machine is under operation.
- Always follow the machine manufacturers instruction to operate the root crop harvesting machine.
- Check the machine before and after use.
- Clean the equipment before storage off season.
- Periodical maintenance should be carried out in time as per the direction of the machine manufacturer.
- Tighten the loose nuts and bolts Of the machine
- Check and guard the drive mechanism.
- Always follow the safe stop procedure.
- Power takes off shaft should be fully enclosed in guard along its entire length from the tractor power take off to the other point input connection on the harvester. Other drive shaft should be guarded to the same standard.
- Machines with a picking/sorting platform require emergency stops accessible from the work position to stop the conveyor to the platform.
- Take care when reversing the equipment.

Components of potato, groundnut and onion diggers

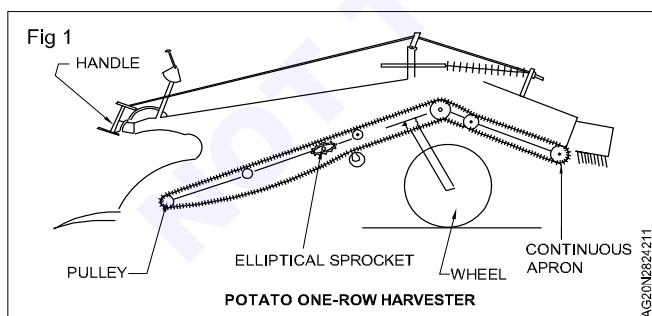
Objectives: At the end of the lesson you should be able to

- state the components and use of potato digger
- explain the components and uses of groundnut digger
- describe the components and uses of onion digger.

Potato Digger

One row potato harvester

The one row potato harvester is drawn behind the tractor, but the elevating and shaking apron is power- take off driven. A long power shaft extends from the power take-off to an enclosed gear box on the harvester. (Fig 1)



The blade is run deep enough to scoop up the buried potatoes. The complete mass of soil and potato is delivered to travelling elevator which is agitated up and down by elongated sprockets on each side of the chain, which are usually offset alternately, that is, one link is

set, while the next link is set low. The chain belt may be constructed as a continuous belt from front to rear, or it may be divided into sections.

Uses

Potato diggers are used for harvesting and exposing the potato tubers.

Two - row potato harvesters - tractor drawn

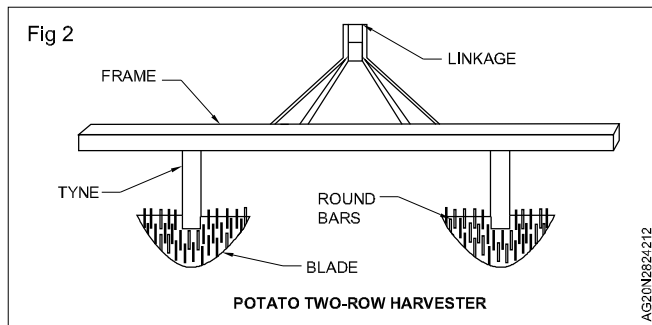
The two row potato digger has 2 blades fitted to the tynes. These are mounted on the cultivator frame having holes (Fig 2)

The mounting of the blades on the frame is made in such a way that 2 rows are left un dug between the blades.

At the time of harvesting, a system is adopted so that only one un dug ridge remains in between the blades. Digging alternate rows give sufficient time to the laborers for picking harvested tubers and clearing the strips for subsequent turn of the digger.

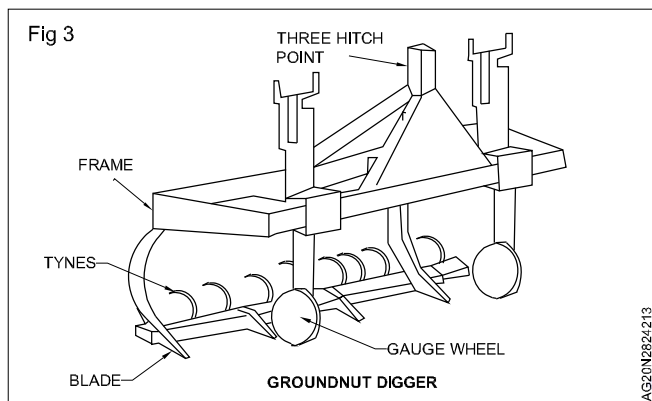
Uses

Used for harvesting and exposing the potato tubers.



Groundnut Digger

It is a tractor-mounted unit consisting of V-shaped blade and depth wheels mounted on mild steel frame made of angle iron or channel section. The blade is made from medium carbon steel or low alloy steel, hardened and tempered to suitable hardness (Fig 3)

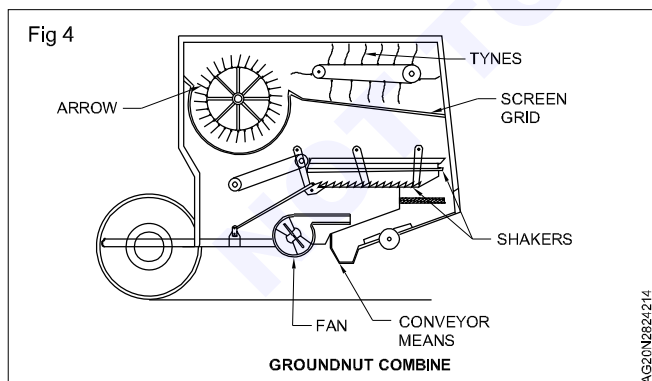


Uses

Suitable for digging out groundnut vines after softening of soil through irrigation.

Groundnut combine

Considering of tyne, fan, shakers and screen grid (Fig 4). In this case. Green groundnut combine must also possess the functionality of root crop harvester in addition to the threshing and separation functions of a grain combine.

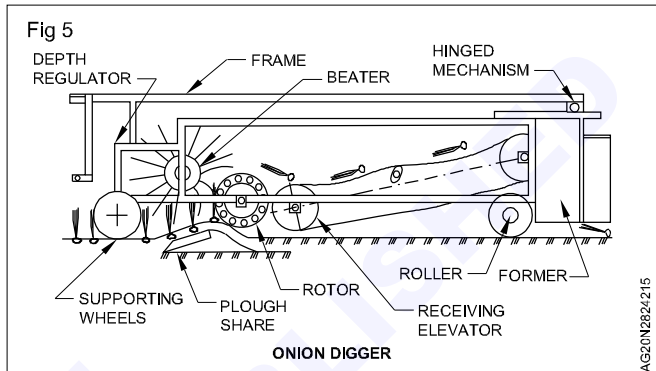


Uses

Used for pick-up the windrowed groundnut, removes soil, remove the halm, strip the pods and convey the stripped pods into the storage basket.

Onion Digger

It consists of share, crusher, rubber strip, brush type cleaner and wipe-off plate. Onions are generally harvested with a special onion harvester. The onions, which are grown in rows, are lifted by lifting wheels, picked up by an elevator or chain, then several rows are put together in windrows on the ground for drying (Fig.5)

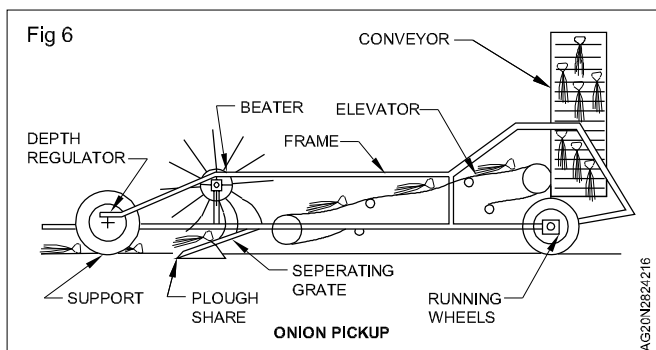


Uses

Used for digging, lifting, topping and sacking.

Onion pickup

After drying they are collected with a converted potato harvester, the lifting shares of which have been removed, or with a special pick up device (Fig 6). Consisting of plow share, separating grate, feed beater, mechanical digging depth regulator, running wheels, conveyor belt and longitudinal elevator.



Uses

Used for pick up the windrowed onion.

Construction details of potato, groundnut and onion diggers

Objectives: At the end of this lesson you shall be able to

- describe the construction details of potato digger
- state the construction details of groundnut digger
- explain the construction details of onion digger.

Potato Digger

Working principle

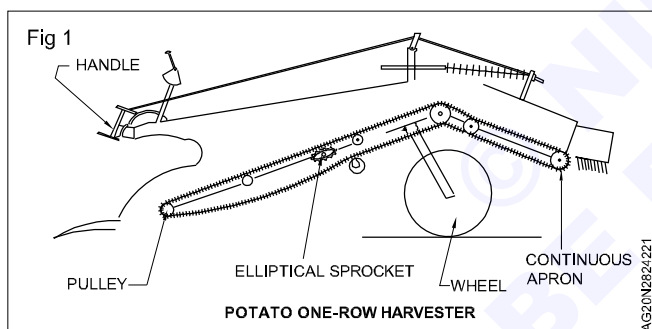
It performs the following operation

- 1 Digging
- 2 Separation of the soil
- 3 Removal of the vines and the weeds
- 4 At least partial separation of the tubers from similar-sized stones and clods.

i One row potato digger

Construction details

The one - row potato harvester is drawn behind the tractor, but elevating and shaking apron is power take - off driven. Along power shaft extends from the power take off to enclosed gearbox on the harvester. this gear box usually consists of a three - speed transmission which permits the elevator to be operated at speeds suited to the field condition. (Fig 1)

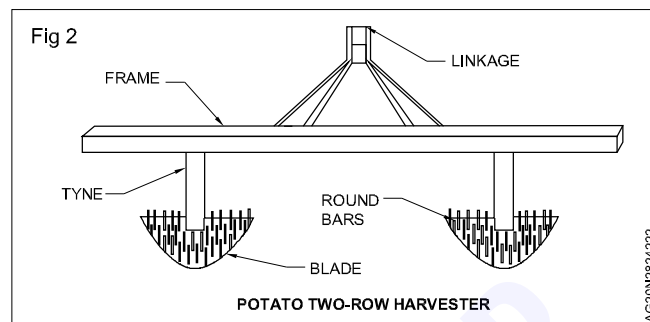


Several types of digging blades are available. The blade is run deep enough to scoop up the buried potatoes. complete mass of soil and potatoes is delivered to a travelling elevator chain which is agitated up and down by elongated sprockets on each side of the chain. This agitation shifts loose soil through the links of the chain, which are usually offset alternately, that is, one link is high, while next link is set low. The chain belt may be constructed as a continuous belt from front to rear, or it may be divided into two sections.

ii Two - row potato harvesters - tractor drawn

Constructions details

The two row potato digger consists of two units mounted on a long, heavy axle with a suitable frame supported on wheels. The power drive shaft is located between the units, each unit is driven by a cross shaft. Levers permit the adjustment for depth of each unit separately. The two row potato digger has two blades fitted on the tynes. These are mounted on the cultivator from having holes for adjustment of row - to - row spacing (Fig.2)



The angle of penetration of the blades is adjusted from the top link of the hydraulic system of the tractor.

After harvesting most of the tubers are exposed but some of them are covered by loose soil. The mounting of the blades on the frame is made in such a way that the 2 rows are left undug between the blades. At the time of harvesting, a system is adopted so that only one undug ridge remains in between the blades. Digging alternate rows give sufficient time to the laborers for picking harvested tubers and clearing the strips for subsequent turn of the digger.

Groundnut digger

Working principle

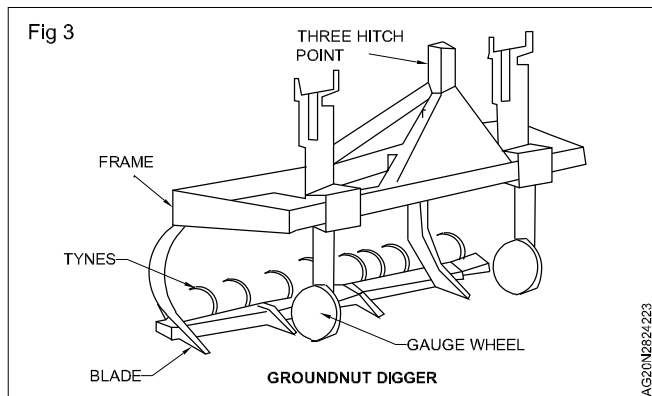
It will work in three stage operation :

- 1 The tap root is cut, and the soil loosened around groundnuts.
- 2 The vines and nuts are lifted from the soil, passed over the shaker or shake off loose soil, and collected in windrows; and
- 3 The windrows of groundnuts and vines are picked up and passed through a picker or thresher to separate the nuts from the vines.

Construction details

It is a tractor - mounted unit consisting of V-shaped blade and depth wheels mounted on mild steel frame made of angle iron or channel section. The blade is made from medium carbon steel or low alloy steel hardened and tempered to suitable hardness. The blade is mounted with fasteners and can be replaced upon wearing or becoming dull. Depending on the depth of pod zone the depth of operation is adjusted by lowering or raising of gauge wheels. The ground nut pods with vines are left on the ground and their soil mass and picking is carried out manually subsequent to digging operation (Fig.3)

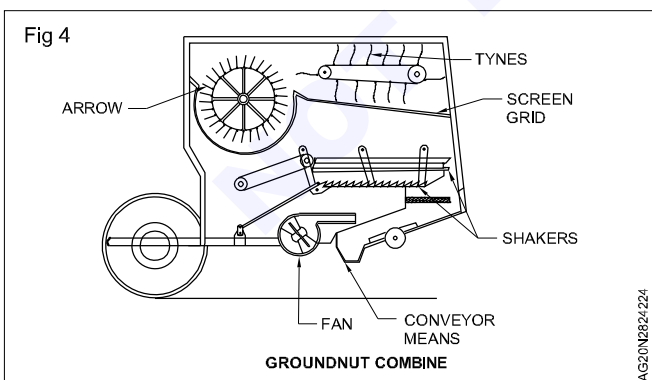
The initial function performed by the groundnut digger are the same as the bulk of potato harvester. A volume of soil, containing groundnuts attached above ground portions, is engaged by a series of disk coulters that are



strategically positioned. The final pair of opposing coulters is designed to provide an elevation and inversion of the groundnut plant while depositing the plant mass on windrowing and soil separating finger like elements at the rear end of the machine. In this machine, the PTO is used to vibrationally excite the separating elements to increase their separation effectiveness and assist in moving the plant material toward the central windrow position.

Groundnut combine

When the groundnut moisture has been sufficiently lowered, a groundnut combine, similar in function to a windrow grain combine, is used to move through the field and thresh (separate) the groundnut from the plant stem material. In this case, the green groundnut combine must also possess the functionality of a root crop harvester in addition to the threshing and separation functions of grain combine is shown in (Fig 4). This detailed view show how the dug plants with attached groundnuts are introduced at the arrow into the concave separation cylinder assembly that rotates about an axis. The tooth/tine arrangements of this threshing device is designed to remove the green groundnut containing pods from the plant peg material while minimizing damage to the pods. The entire mass of threshed material is moved across a stationary grid by the positive action of tines. Further separation is achieved with shakers, similar to straw walkers in grain combines, and a fan. Finally, the cleaned pods are collected in conveyor means where they are elevated to the storage and transport element of machine.



Onion digger

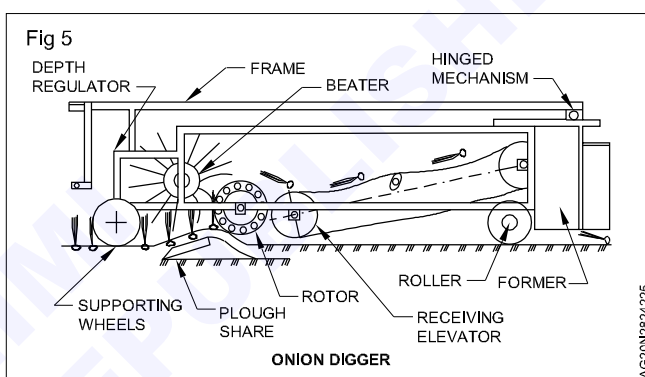
Working principle

The onions, which are grown in rows, are lifted by lifting wheels, picked up by an elevator or chain, and then several rows are put together in windrows on the ground for drying. After drying they are collected with a converted onion harvester, the lifting shares of which have been removed, or with a special pick-up device

Construction details

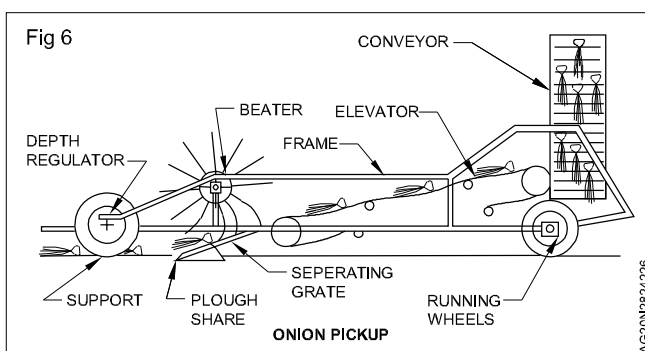
Onions are harvested in two stages. In the first stage the onions are lifted, and put into windrows for drying. Then they are picked up and transported to the store. Onions are generally harvested with a special onion harvester (Fig 5)

The onions, which are grown in rows, are lifted by lifting wheels, picked up by an elevator or chain, and then several rows are put together in windrows on the ground for drying.



Onion pickup

After drying they are collected with a converted onion harvester, the lifting shares of which have been removed, or with a special pick-up device (Fig 6). Drying is necessary, as the surplus water, especially in the tops, has to be removed, otherwise rot or discoloration may set in during storage. If they have to be brought in too early, part of the tops have to be removed. This can be done very well with a shredder. With this crop too, damage is a decisive factor in the final assessment of the quality and its prevention merits the greatest attention.



Repair and maintenance of the components of potato, groundnut and onion diggers

Objectives: At the end of this lesson you shall be able to

- describe the check, repair and replace the components of potato digger
 - state the check, repair and replace the components of groundnut digger
 - explain the check, repair and replace the components of onion digger.
-

Potato Digger

When elevator diggers are given an overhaul, dull shares should be taken out and sharpened on an emery wheels, care being taken that the original bevel is maintained. The shovel-lifting mechanism must be examined to see that it works freely and that all connections are secure. Badly worn parts should be replaced.

The elevator chain can best be inspected when it is removed from the digger. Worn rods should be replaced and bent ones straightened. In replacing the chain, care must be taken that the right tension is provided: if the chain is too tight, the draught of the digger is increased, and if too loose that upper, loaded section of the chain may drag against the lower section. Sprocket wheels with worn or broken teeth must be replaced, and the wheels must be in proper alignment on the shaft. Damaged or badly worn agitator sprockets may be kept in serviceable condition by welding new metal to worn surfaces. Any plain bearings should be washed out with paraffin and worn or broken ones should be renewed. Since shaker-hanger and pitman bearings must be frequently replaced, it is as well as to have some on hand as spares during the digging season. End play in the bearings of the main wheels can usually be taken up by inserting washers, or by adjustment.

Where power is transmitted from the main wheels, the wheel lugs must be secured and in good condition and the ratchets and paws must be adjusted correctly. Pneumatic tyres should be replaced or retreaded, if their tread is much worn. The drive-chain links should be adjusted, and any that are worn must be replaced. End play in the drive shaft is corrected in most makes of machines by inserting washers.

If the digger is operated by power take-off drive, all gears, bearings and shaft must be put into good condition. The universal joints and safety clutches must be in good working order. The oil from transmission on the rear cross-shaft be drained, and the container flushed and refilled with oil.

Agitators and rollers should be checked on every row to see that they are revolving. A sticking roller will quickly wear out and may jam the web once a groove has been worn in it. Power take-off guards must be replaced if they are removed when adjustments are made.

Groundnut Digger

Dull blades cause most digging losses because they fail to cleanly cut the tap-root and may drag roots or pods, dislodging the pods from the plant. The chain speed should be slightly faster than the forward speed of the digger inverter to avoid pod loss as the plant moves from the digger blade to the shaking mechanism. Check and replace the tynes, if worn. The gauge wheel is to be checked for damaged and replaced, if damaged.

Onion Digger

Most of the parts are working in the soil, especially wheels, plough share, beater, elevator and conveyor belt. The plough share is having direct contact with soil, cut the roots of the bulb and then lift them from the soil. Therefore, the plough share has to be checked thoroughly for worn out parts and damages. If they get damaged, they have to be sharpened. Similarly, if it is worn, replace with new one.

Check the beater and elevator for their damages and replace them. Sometimes, the soils are adhering to the parts and that may check and cleaned.

The damaged conveyor belt to be checked and if completely damaged that can be replaced. The pneumatic tyres should be replaced or retreaded, if their tread is worn.

Check the joints and clutches and keep them in good condition. Check the power take off drive, all gears, bearings and shaft for damages and replace them if worn or completely damaged.

Workshop and field adjustments of potato digger

Objectives: At the end of this lesson you shall be able to

- state the workshop adjustments of potato digger
 - state the field adjustments of potato digger.
-

Potato digger

Workshop adjustments

Though it is possible to make coarse setting of a spinner in the workshop before the machine enters the crop, some final adjustments must be made in the field if the spinner

is to give a good performance. The share pitch should be set to suit the hardness of the going, and it must be borne in mind that on some makes of machine the share moves without the tine mountings and so the clearance between the tines and the back of the share will have to be reset each time the pitch is altered. Share depth must be set

so that all the crop is taken without too much soil. If the planting has been shallow the tubers will be carried even higher.

If removal and replacement are difficult it may be possible to adapt the fittings in the workshop so that the guard is clipped on with over-centre clips or some other quick-release device

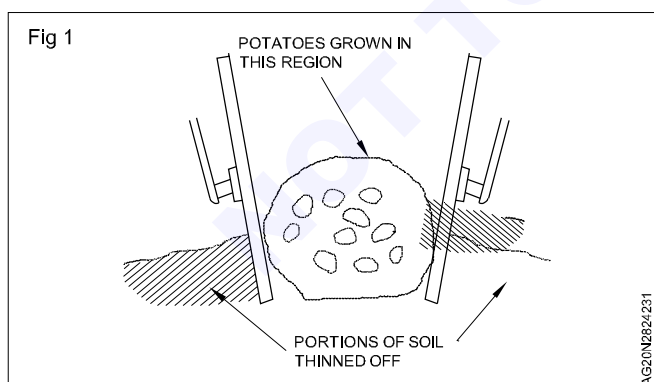
Field adjustments of potato digger

The very first setting to be made to a digger in the field is on the safety clutches which should slip as soon as a blockage occurs. The digger should be run a few yards into work, and when it has entered a normal stretch of going away from hard headlands, the safety clutches should be slackened off a little at a time so that they slip under ordinary loads. Once this stage has been reached the clutches should be tightened up slightly so that no slip occurs until the machine is overloaded.

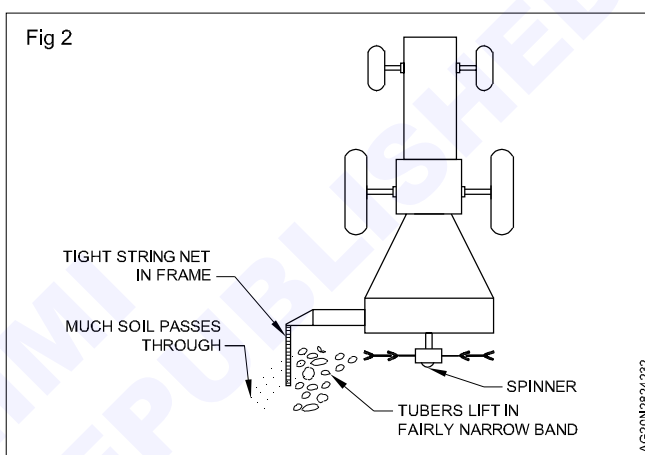
Soil should be worked as seed as can be managed, ridges should be shallow, so that the soles of the ridging bodies still have some inches of cultivated soil beneath them. When the ridges are split back to cover the potatoes, the bodies should be set so that they are well covered but are, nevertheless, placed high in the ridge; then at harvesting time the share of the spinner or digger can be set to run below the crop without running in the subsoil, and it will be possible to separate the tubers from the soil with less risk of damage to the potatoes. On fields, if they are grown higher in the ridge, the skins will be tougher and less prone to damage.

The tension of any driving chain on spinners should be adjusted to give it a little slack, it is important that it is not tight.

After the working parts have been set up and lubricated, the wheels of the spinner should be set for the particular row width of the crop to be harvested. There of the share must always run below the centre of the ridge to eliminate crabbing; the lateral distance from the share point to the wheel which runs between the ridges should therefore be set to half a row width (Fig 1).



Most spinners take in more soil they need, which makes picking up the potatoes more difficult. If the farm mechanic is able to fix up "trimmers", made of old disk coulters from a plough, in order to take off the lower side of the ridge as shown in figure 1, less soil will be put through the machine. Another aid to easy picking after a spinner is shown in (Fig 2). It consists of a steel frame carrying a tight string of about 1 1/2 in. mesh which is held rigid in the line the tines and about 1 1/2 to 2 ft. clear of the row being lifted. The width of scatter of tubers is reduced because any soil or potatoes not having dropped will strike the net; soil will work its way through the mesh but potatoes will strike the net and drop to the ground. The thick string net does not damage the tubers and has the advantage over the sacks or canvases, which are often trailed on spinners, that it allows soil to pass through and not cover the tubers (Fig 2).



On the opening round, speed should be kept down to prevent potatoes being scattered over the next ridge, and on machines with two separate sets of tines the second set may need to be removed to avoid fouling the adjacent row.

The shares of spinners should be set just deep enough to take all the crop without taking too much soil. Tines should be set not more than one inch behind the share and it is important that the tines should run as deeply as the share so that potatoes are not knocked by the ends of the tines.

Field operation of potato digger

Objectives: At the end of this lesson you shall be able to

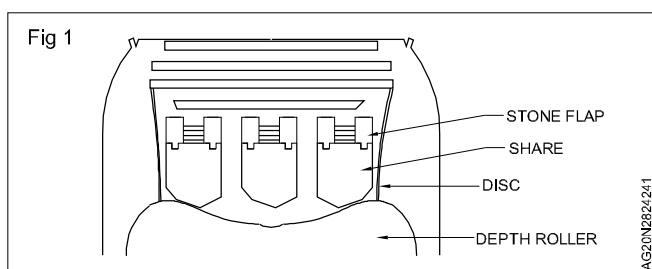
- describe the field operation of potato digger.

Potato digger

Field operation

The digging share, which lifts the ridges, must be well designed in order to avoid losses along the side of the share. Proper adjustment of the working depth is another important precondition for lifting all tubers. Most suitable for this purpose is a depth control unit consisting of a roller, running over the ridge just ahead of the share. A spade is the least prone to blockage.

Stone flaps are usually fitted between the share and elevator web to reduce breakage and wear of the elevator web (Fig 1).



The tubers are separated from the soil by the elevator web to reduce breakage the share or connected to it by an apron. Such an apron usually has a high speed, so that the ridge with tubers in it is broken up, and the elevator web can operate more effectively. The elevator web consists of rod links of a certain diameter and pitch. This pitch is the determining factor for the separating capacity of the open web elevator and may be adjusted covering the rods with rubber. Beneath the elevator web is an agitating attachment that impacts more or less vigorous movement to the elevator web. The degree of agitation of this open-web elevator is compromise between damage to the crop and separating efficiency.

The longer the tuber is enveloped by the soil, the less risk is there of damage. The elevator speed also plays a part: the higher the speed, the less soil is able to drop through the web. The spacing between the rods determines the sieving capacity, as well as the losses. With a wider pitch, not only the soil but also the tuber has a greater chance of dropping through the web. A tuber dropping back on to the field may develop into a new potato plant in the next crop, thus producing a weed plant difficult to control and possibly inhibiting crop protection measures for the following crop.

For separating haulm and weeds a haulm chain or haulm removing rollers are used. The linear speed of the chain, its angle of inclination and the number of agitator rollers determine the effectiveness. For the separation of fine haulm and stem pieces of stripped haulm the haulm rollers just behind the elevator chain are used. For the separation of stones and clogs some makes offer additional devices to be built in, operation of which, however, is in many cases unsatisfactory. Attachments like stone fingers are provided for this purpose. It is of utmost importance that damage is avoided as far as possible throughout harvesting. In this respect elevators which shake too vigorously, a lifting share set too shallowly, a haulm chain working improperly, excessive drop height in the harvester from the harvester into the bulk hop- per or trailer are all points worthy of attention. Stones and hard clods, too, may cause severe injuries.

Finally, it is advisable to transport the produce as soon as possible to a shady, cool place to improve the keeping properties.

Field operation of groundnut and onion diggers

Objectives: At the end of this lesson you shall be able to

- describe the field operation of groundnut digger
- describe the field operation of groundnut combine
- state the field operation of onion digger
- state the field operation of onion pick up.

Groundnut digger

Digging

The modern groundnut digger-inverter lifts groundnuts from the soil, separates pods from the soil, elevates the vine mass, and inverts and windrows the vines, exposing pods to the air for curing. Groundnut inverters can be classified into two types. One type uses a conventional rattler bar system for moving the groundnuts upward from the digger blades until the vines are inverted. The second type uses a tangent chain or chain rod combination to move the

groundnuts up to the inverter attachment. The first type of machine is the most common and is discussed in details.

With a conventional rattler bar system, the groundnut plant passes through three stages: digging, shaking or dirt removal, and inversion. Digging is accomplished by cutting the groundnut taproot with a horizontal blade just below the pods. This blade has a slight forward pitch to lift the plant onto a shaking conveyer just after the taproot is severed. The shaking conveyer is made up of horizontal bars that ride over small rubber wheels. These wheels cause the bars to vibrate, which helps remove soil from

the plants and pods. As vines exit the shaking conveyer, they engage the inversion wheels and rods that flip and windrow the plants.

Operations by combine

The groundnut combine removes groundnut pods from the vines, separates pods from vines and other material, and delivers pods to an overhead basket.

When the windrowed groundnuts have reached a moisture content of 18 to 24 percent, which usually occurs two or three days after digging, they can be combined with minimum mechanical damage. There is less combine damage when the plant has partially dried than when it is very green or very dry. Most groundnut prefer this time for combining when all quality and cost factors are considered.

An improperly set combine can result in reduced peanut yield and a product with excessive pod damage, loose-shelled kernels (LSKs) and foreign material.

Basic combine operations include

- 1 Picking up vines from the windrow by a header and conveying them to the threshing mechanism,
- 2 Threshing (removing groundnut pods from the vines)
- 3 Separating pods from vines and other material,
- 4 Detaching the stems from the pods, and
- 5 Conveying the pods to a storage basket.

The combine places the windrow into the feeder auger using a pickup head. The feeder auger delivers the material threshing mechanism. threshing mechanism consists of picking cylinders that operate over concaves. Stripper bars slow the movement of vines. Most of the peanut pods and small vine material fall through the concaves onto the shaker pan. The material that doesn't fall through is transferred rearward, either by straw walkers or some type of agitation device, where further separation takes place. The material that has fallen on the shaker pan is conveyed rearward onto an oscillating chaffer and sieve or other type of separation device. Openings in the chaffer or other mechanism allow the peanuts to fall through but retain

the trash As the material moves rearward, an air blast directed up-ward through the sieves helps separate pods from small vine material and other foreign material

The groundnut pods fall onto stemmer saws that remove the stems. Finally, the air delivery system conveys the pods to a storage basket.

Onion digger

Field operation

During travel of the machine, the support wheels, tracing the soil surface, provide the prescribed depth of travel of the plowshare, which is maintained by a mechanical regulator of its travel depth. The furrow slice of bulb containing soil cut by the plowshare is raised and drops to the underside, at the moment the slice descends from the plowshare the rods of the rotor and elastic beater blades seize the onion top, pull the bulbs from the furrow slice, and deliver them to the receiving conveyor, where transport and separation of the mass occur. The cleaned onions go to the windrow former, where their flow narrows and are placed on the soil surface for drying and after re-opening.

Onion pickup

After drying the windrows in the field for 3-7 days, the onions are collected by the pickup. During forward travel of the pickup along the windrows of onions preliminarily pulled up and placed on the soil surface, the plowshare, embedded to a small depth, raises the furrow slice consisting of soil and bulbs, which passes through the separating grate. For preventing its accumulation and reducing damage to the onions, a beater which acts on the pile is installed on the gathering implement. This promotes cleaning the pile by breaking up the soil admixtures and strewing them between the rods. The partially cleaned pile goes to the longitudinal elevator, which transfers it to the transverse loading conveyor and farther to a conveyor moving alongside.

Recommended speed

Speed for onion digger is 0.42-0.6 ha/h (ha-hectare)

Field adjustments of groundnut and onion digger

Objectives: At the end of this lesson you shall be able to

- describe the field adjustments of groundnut digger
- state the field adjustments of groundnut combine
- explain the field adjustments of onion digger.

Groundnut digger

Field adjustments of diggers

Operate digger-inverters from 3.5 to 5 mph at PTO speeds of 70 to 90 percent of rated PTO speed, depending on the type of machine.

Inspect the digger-inverter for broken, bent or missing parts before making adjustments. Many adjustments can be performed before actual field work starts. First, make sure the front tool bar is level with the tractor. Stand at the rear of the machine with the implement raised and sight

the top of the tool bar with the top of the rear axle. (For accuracy, first be sure the rear tractor tires are inflated to the same pressure.) If the tool bar is not parallel to the tractor axle, level the digger by adjusting the lift arm.

Next, inspect the blades. A well-adjusted digger will have sharp, flat-running blades set to clip tap-roots just below the pod zone where the taproot starts branching. Blades should run level, with a slight forward pitch to lift plants into the shaker. This adjustment can be accomplished best on a flat surface. Excessive pitch of the digger blades may result in soil and pods being carried forward by the

blade before being freed by the cutting edge. Such pods are usually lost. Dull blades cause most digging losses because they fail to cleanly cut the tap-root and may drag roots or pods, dislodging the pods from the plant.

After plants pass over the digger blades, they transferred onto the shaking conveyer. Check the conveyer chain speed and depth. The chain speed should be slightly faster than the forward speed of the digger-inverter to avoid pod loss as the plant moves from the digger blade to the shaking mechanism. This speed will avoid a pileup of vines ahead of the pickup point and allow a smooth flow of vines through the digger-inverter. The shaking conveyer should be set at a depth at which it picks up vines with its teeth just clearing the soil.

In the field, notice the shaking action. It should be enough to remove soil from the vines. More aggressive shaking is where soil clings to pods, roots stems. The amount of shaking can be changed by adjusting knocker wheels up or down.

As vines exit the shaking conveyer, they engage the inversion wheels and rods. These rods are factory set; however, they will change position with use. Adjust the inversion rods before going to the field by placing the digger on a level surface and setting them according to the operator's manual. Properly inverted groundnut plants will form a uniform, fluffy, well-aerated windrow with very few ground nut pods touching the soil.

Field adjustments of groundnut combines

Pickups

The pickup head consists of a cylinder-type unit with spring teeth bars. Combine cam-controlled on makers use many different arrangements to move the windrow from the pickup teeth to the threshing mechanism. Most combines have some type of auger, which uniformly feeds the groundnut vines into the threshing mechanism. Larger combines move the material laterally before it enters the threshing mechanism. The header height is controlled either by suspension from the tractor or with a hydraulic cylinder.

Check these points in the operation

- 1 The pickup head should run from 1 to 3 inches above the ground to avoid excessive wear on the springs and prevent more dirt from entering the combine.
- 2 The pickup head speed should match the forward speed. This allows the windrow to be lifted into the combine without separating or overrunning the vines, which pulls pods from plants before they enter the combine.

Threshing

Threshing is done by moving the groundnut vines through a cylinder or a series of cylinders operated over concaves. Stripper bars can be engaged to different degrees to slow the movement of the vines through the combine.

Once the vines and pods are inside the combine, they should be separated using the slowest possible threshing

cylinder speed and stripper bar engagement. The idea is to have the least aggressive threshing that gives good separation of the groundnut pods and vines. This will help prevent LSKs and pod damage. As windrow conditions change during the day, the threshing aggressiveness should be adjusted.

These adjustments will help eliminate LSKs:

- 1 Start with the manufacturer's recommended cylinder speeds. Depending on the make of the combine, the cylinder speed may be changed by adjusting a variable speed pulley or changing the cylinder drive sprocket.
- 2 Adjust the stripper bars for the least aggressive action that gives separation without excessive kernel bruising and hull breaking. Mechanical damage from fast-moving parts may leave peanuts susceptible to insect damage and undesirable molds.
- 3 Always use the lowest combine cylinder speed that gives good separation of pods from vines. This will keep mechanical damage to the lowest possible level.

Separation

Most of the groundnut pods and some small vine material fall through the concaves onto an oscillating shaker pan. The pan conveys the pods and other material to the rear of the machine for further cleaning. The remaining pods are transferred rearward, either by straw walkers or by some type of agitation device, where further separation takes place. The heavier peanuts fall through grates onto the shaker pan.

The material on the shaker pan is conveyed onto an oscillating chaffer and sieve or some other type of separation device (for example, a group of revolving disks). Air is blown upward through the separation device, which causes fine foreign material to be airborne until it is discharged from the rear of the combine.

The amount of cleaning air is adjustable, which allows for good separation as the moisture content of pods and other materials varies. Too much air will cause good peanuts to be discharged. Too little air will result in excess foreign material deposited in the bin. Slippage of the fan drive belt also influence the volume of air. This occurs when belts also influences the volume of air. This occurs when belts are loose or in poor condition.

Chaffer and sieve openings also influence the amount of separation, and should be adjusted according to the size and variety of peanuts. Although vine and field conditions influence final settings.

Conveying

After the peanuts are separated from vines and other materials, they fall onto a set of stemmer saws. The saws remove the stems from the pods and dispose of vine fragments. The pods are conveyed to one side of the combine and enter an air stream that moves them into the overhead storage basket.

The amount of air required to carry the pods upward varies with peanut yields. Adjust the amount to get the smallest airflow possible without the airlift duct clogging. Too much air damages the pods, which may crack and result in LSKs.

Onion Digger

Field adjustments

During travel of the machine, the support wheels, tracing the soil surface, provide the prescribed depth of travel of

plowshare, which is maintained by a mechanical regulator of its travel depth.

Care and maintenance of potato, groundnut and onion diggers

Objectives: At the end of this lesson you shall be able to

- state the care and maintenance of potato digger
- describe the care and maintenance of groundnut digger
- state the care and maintenance of onion digger

Potato digger

Care and maintenance

Potato-harvesting machines work in conditions very conducive to abrasive wear. When they are at work the main bearings should receive thorough lubrication two or three times a day. In very dusty conditions, however, any parts such as drive chains, which will pick up grit if lubricated, should be allowed to run dry. When routine lubrication is being carried out the whole machine should be checked for loose nuts, and bolts. In the case of a spinner this is particularly important for the share, digging tines and wheel spuds, all of which are likely to work loose.

Potato digger's work almost covered with soil, so thorough lubrication and day to day maintenance in the field is essential if the machine is to function.

When a spinner is left overnight, the digging share should be protected from rust by a coating of used lubricating oil. For longer periods it should be covered with thick grease. Before the spinner is put away at the end of the season it should be cleaned and examined for worn parts. Any necessary replacements should be ordered and fitted as soon as they arrive. The drive chain should be removed and washed in paraffin, dried and then greased. Finally, the whole machine should be lubricated thoroughly, and with all bright parts well covered with thick grease or anti-rust preparation it can be put away under cover.

Each night during the working season diggers and spinners should be put cover if this is possible, and at the end of the season they must be thoroughly cleaned. It is best to hose them down first. When the machine is dry the earth-working parts can be treated with rust preventer, and plenty of oil or grease forced into the bearings before the machine is put into store.

Some potato harvesters have V-belt drive, either endless rubber-cotton belting or V-link hide belting. Belts should be taken off and stored separately in the off-work season.

Groundnut digger

Care and maintenance

The soil moving parts of the digger are to be cleaned daily to prevent from rust. Lubrication of moving parts should be done daily, while the digger is in working operation. Clean the conveyor belt, straw fan, chaffer, sieve and

storage basket and keep them in good condition. During harvesting period, clean and cover the digger every day.

The earth moving parts should be cleaned, dried and greased and during off-season, stored under cover during off-season.

Onion digger

Care and maintenance

It is used in soil always and therefore lubrication should be done daily. The digging share should be lubricated daily to protect the rust. The drive chain should be washed, dried and then greased. For long term storage, the digging share is to be greased thickly. The whole digger should be washed thoroughly, cover with thick grease and store under cover during off-season storage.

Safety precautions for root harvesting equipments

- 1 Never, mount or dismount a harvester while it is in motion. Wait until the harvester stops. This means that both the belts and the forward motion have stopped. Many older model potato harvesters have the ladders in front of the wheel. This places the person mounting and dismounting in a precarious position. Know the harvester you are working on. The wheel sticks out much farther than the machine. Be clear of the harvester, wheel, truck and tractor while the harvester is traveling through the field. In addition.
- 2 Be in a stable position before the tractor starts to pull the harvester. This will reduce the possibility of falling down as the tractor jerks forward.
- 3 Do not place yourself, or allow yourself to be placed, in a dangerous position. No one should ever be between the tractor and the harvester while they are in motion or when they are started. The tractor operator or the workers riding the harvester should never be close enough to touch the PTO shaft while it is running or is started up. This is also a good rule to remember when repairing the machine.
- 4 Clean trash out of belts when they are stationary and the harvester operator knows where you are located. Never attempt to dislodge anything from the belts while they are in motion. Leave that little potato, rock or dirt clod in the belt. Picking rocks or small potatoes from between bars risks crushing or severing a finger, wrist or hand.

- 5 Keep the work area clear of debris. While the harvester is turning for another row, use that time to clear the area of rocks, soil clods or potatoes. This will encourage stable footing.
- 6 Concentrate harder during unfavorable conditions of rain and mud. Workers riding on the harvester, and the harvester operator, will have to concentrate harder as conditions worsen.
- 7 Do not lubricate, adjust or repair the harvester while it is running. Stop the harvester and do the necessary maintenance. A grease gun, oil can or wrench can become caught and possibly pull you into the machine or can be thrown back with great force.

Faults and remedies of potato digger

Objective: At the end of this lesson you shall be able to

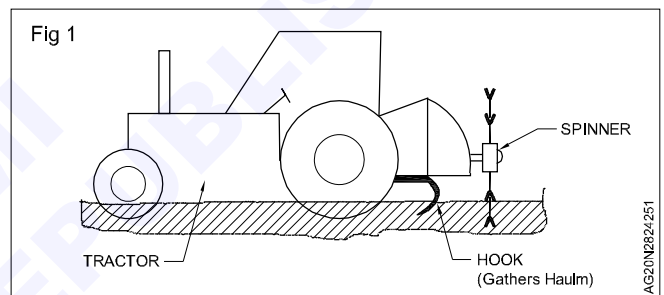
- state the faults and remedies of potato digger.

Faults and remedies of potato digger

While the spinner is at work it is as well to examine the harvested crop at times, and if there are signs of surface cuts or skinning, the tines should be adjusted. If the potatoes are lightly skinned or have shallow cuts, this means that the ends of the tines are striking them. The remedy is either to lower the tines in relation the share, or if there is more than about a one-inch gap between the back of the share and the tines, the gap should be closed little. If the potatoes have deep dents with crushed flesh, the tine speed is too high and must be reduced. With the advent of packaging for potatoes it is more than ever essential to minimize damage, and it is a good idea to cover the tines of spinners with soft rubber hose for cushioning. When they have outlived their original purpose, the long milk tubes of milking machines are ideal for this, as they are thick and pliable.

Where the soil and crop are not separating well, increasing the clearance between share and tines to approximately two inches will help to break up the ridge, but it is likely that some extra tubers will receive surface damage.

In a crop where the top growth is lush or has not died back some stoppages will occur because of accumulated rubbish round the shank of the share; mounting ridge trimmers will help to overcome this, as all rubbish will be cut by them. But a hook of half-inch round bar trailed from the frame of the machine, just in front of the share mounting, will stop the blockage completely and will work for long distances without needing cleaning (Fig 1).



Small stones tend to ride around inside the web and block up agitators and rollers, and on stony fields stone fingers attached to the rear of the share will help to keep stones out of the web.

Mechanic Agricultural Machinery - Winnower, cleaner, grade, huller, polisher, feed grinder cum mixer and their uses

Winnower, cleaner, grader and their uses

Objectives: At the end of this lesson you shall be able to

- state the importance of winnower and their uses
- state the types of winnower and its parts.

Introduction

Wind winnowing is an agricultural method developed by ancient cultures for separating from chaff it is also used to remove weevils or other pests from the stored grains. Winnowing the chaff is a common expression in its simplest form it involves throwing the mixture into the air so that the wind blows away the lighter chaff, while the heavier grains fall back down for recovery. This type of technique included using a winnower fan on a pile of harvested grain.

Importance of winnowing

Winnowing is the process of separating the quality grains from the chaff, it is a crucial process of cultivation of grain. The traditional way of winnowing is making the dried grains fall from a height using shovels and a sieve. During this operation the quality grains fall vertically while the weightless chaff and straw get down away by the wind. Thus winnowing is effective only there is wind. Farmers often have to wait for hours for wind to blow before they could start the process of winnowing. Now a days most of the farmers use the machine winnower to clean the grain.

Principle of winnowing

Winnowing is based on the any difference in mass between the components, if a grain mixture contains two components, one is lighter in weight compared to the other one then it can be separated by winnowing process. The mixture is allowed to fall down from a height. While the wind is blowing through it the lighter components will blow off by the wind and heavier grains will fall down.

Applications of winnowing

- The husk of grain can be removed.
- Straw from grain can be removed.
- Impurities in the grain can be removed.

Types of winnower

Manual winnower and power operated winnower

Manual operated winnower (Fig 1)

The process of separating the heavier and lighter components of a mixture with a grader by natural blowing air. This method is used by farmers to separate lighter husk particles from heavier seeds of grains. Now a days winnowing fans, both manually operated and tractor PTO driven or electrical operated fan is used for separation and cleaning of grain from the chaff.

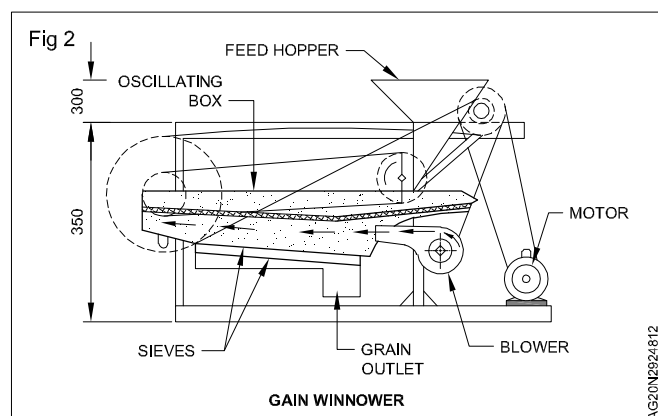
Fig 1



Machine winnowers

The machine winnowers the grain already threshed by a grain thresher. It has a feeding hopper at the top to receive the threshed grain with other impurities. It discharges the threshed grain over a scalper and removes bigger of size impurities. A blower provided at the bottom sends a stream of air against falling through the scalper. which separates the straw, chaff and other impurities. The dust, chaff and straw are collected separately and cleaned grain is taken out through another outlet near the bottom of the unit. The unit varies from machine to machine. The machine is operated by electric motor. (Fig 2)

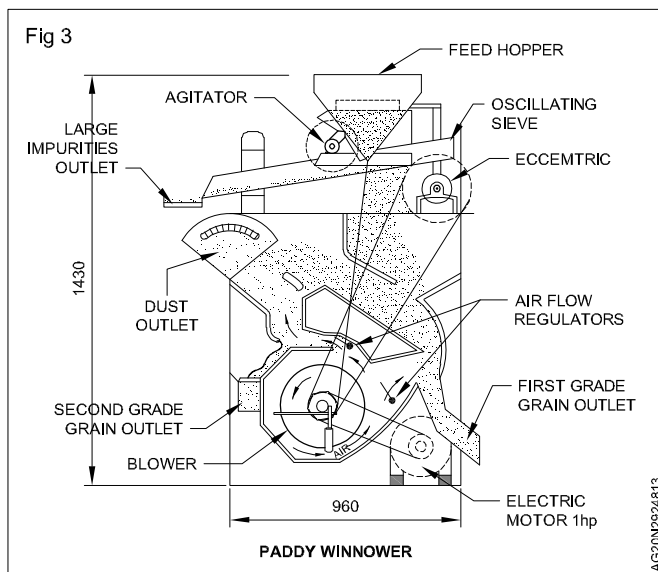
Fig 2



Paddy winnower (Fig 3)

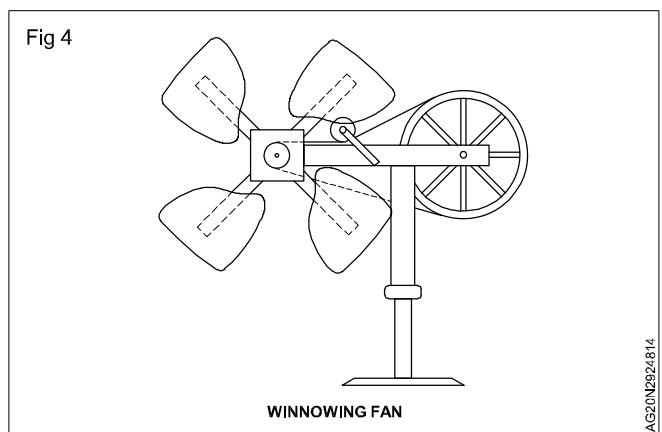
The machine winnows paddy threshed by the paddy thresher or by other means. It has a feed hopper at the top to receive the threshed paddy. chaff and straw bit. A blower provided at the bottom sends a stream of air which separates straw, chaff and other impurities. The dust, chaff

and straw come out through an opening and cleaned paddy is taken out through another spout. The unit is continuous type and operated by one hp electric motor.



Winnowing Fan (Fig 4)

The manually operated winnowing fan consists of a frame, cranking lever, gear or chain sprocket drive and 3-4 fan blades made of mild steel sheet for creating air blast. The blade is operated in speed range of 210-320 rpm. The mixture of grain in front of the fan where air blast helps in separating the grains is poured at a distance between 1.20 - 1.80 meter away from the winnowing fan. It requires two persons to perform winnowing operation fan can be carried to any desired location.



Importance of grain cleaning and grading

Grain cleaning will improve the drying and storability of grain, reduce dockage at the time of milling and improve milling output quality. Seed cleaning will reduce damage by diseases and improve yields.

Grain cleaning and grading result in reduced bulk of the material, high value products, safe and longer storage more turnout of better quality milled products.

Cleaning and grading are first and the most important post harvest operations undertaken to remove foreign and undesirable materials from the threshed crops and grains and also to separate the grains into various functions.

Grain grading of grains depends upon four main properties (1) Bushel crest (2) moisture content (3) broken foreign materials (4) damaged kernels. Grain grading system determines the quality of grains, grain graders examine represented samples of all grains deliveries and grade them as machine manufacturer specified size of the grain.

Uses of cleaner and grader

Objectives: At the end of the lesson you shall be able to

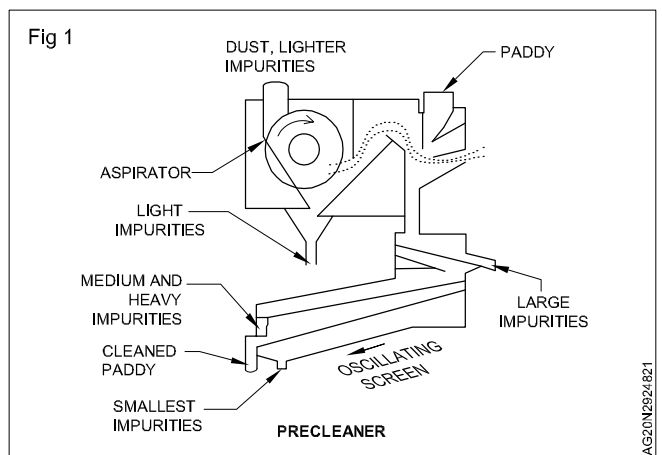
- explain about the different components of cleaner and its operation
- explain about the adjustments of cleaner cum grader.

Cleaning/grading/separation

Harvested grain (threshed/ shelled / dried) needs further processing to get rid of various types of contaminations or undesirable matter viz., inert material, common and seeds of noxious weeds, other crop/variety seed, decorticated seed, damaged seed and or off sized seed. Cleaning and grade result in reduced bulk of the material, high value products, safe and longer storage. more out-turn of better quality milled products.

Pre-cleaner (Fig 1)

The pre-cleaner is used in modern grain handling and storage systems for preliminary cleaning of all kinds of grains which under goes further processing in rice, flour, and dal mills. The equipments consists of a sturdy frame, body, centrifugal fan, expansion chambers, magnetic separator and sieving assembly. The magnetic separator removes ferrous impurities like nails, pins, screws etc. from the grains before it enters the cleaning system. The centrifugal fan removes the dust, chaff, immature grains

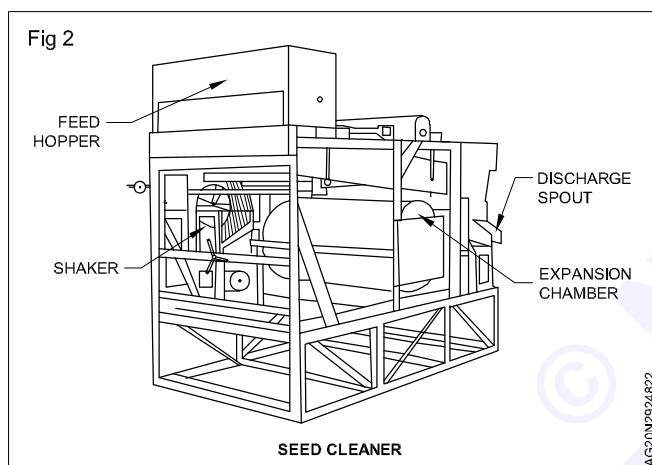


and all other impurities from the grain. an aspiration box collects the immature grains and delivers them through the seal gate flap for bagging. The unit has dual aspiration at and exit, which ensures thorough cleaning and also creates a dust free atmosphere in the working area. The

triple sieving mechanism removes stones, clay lumps, straw, leaves, sand and other impurities from grain. A beater type cleaning device prevents sieve clogging and maintains a high sieving efficiency. These sieves are replaceable and can be selected according to grain. It is used for cleaning of wheat, paddy and other grains, which undergo further processing in the mills.

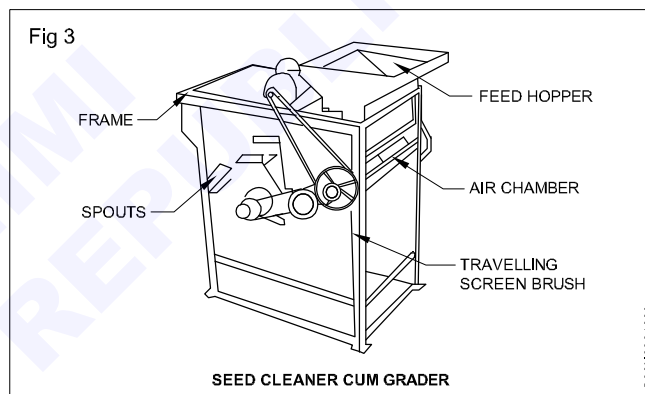
Seed cleaner (Fig 2)

The seed cleaner consists of a hopper below which oscillating trays are provided for cleaning. A separate blower is used to drive away light and fine dust particles. The serving trays are arranged one over the other for separating materials having different materials having different sizes. The unit is operated with electric motor and v belt pulleys. The frame is made up of mild steel angle sections. The trays are made of perforated mild steel sheets fitted on frames. A dust collector is also provided for pollution free operation. It is used in cleaning of wheat, paddy and other grains, which undergo further processing in the mills.



Seed cleaner cum grader

The seed grader is similar to the seed cleaner cum grader 2 - screen type attached with two indented cylinders. It consists of feed hopper with feed roller and feed control gate, set of sieves, dynamically balanced aspirator fan, step less variable air controls, air chamber, sieve deck assembly, spouts and indented cylinder grader. All these are mounted on a sturdy steel frame. Seeds/grains are fed into a feed hopper where they are evenly distributed by a feed roller and drop through controlled gate on the top of the sieve. Before falling on top screen, grains are subjected to primary aspiration, which drains off chaff, straw, dust, diseased grain etc. Material is then passed through two sieve layers for separation according to the width and thickness. After passing through screens, cleaned/graded material again passes through air sifter and aspiration where remaining light particles are sucked off by a strong upward draught of air. After size grading, material passes through indented cylinder grader for removing impurities based on length. Final product and impurities are collected separately through discharge chutes. Used for cleaning and grading of seeds of all crops such as wheat, paddy, maize and millets.



Construction details of pre- cleaner, cleaner cum grader, groundnut grader, decorticator and driers

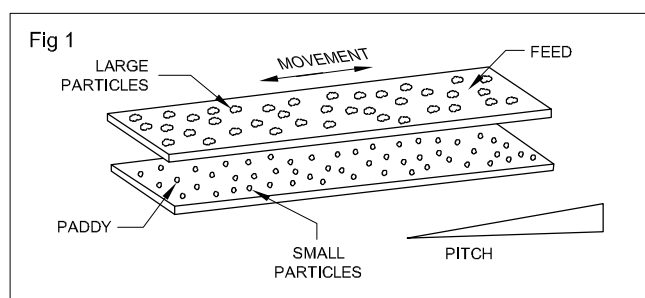
Objectives: At the end of this lesson you shall be able to

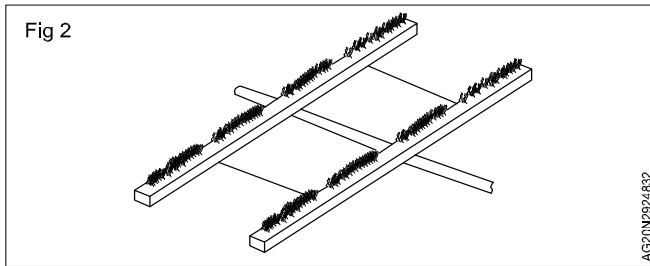
- describe the construction details for precleaner, cleaner and cleaner cum grader
- describe the construction details for groundnut grader decorticator
- describe the construction details for driers
- state the setting and adjustment of cleaner/grader.

Precleaner

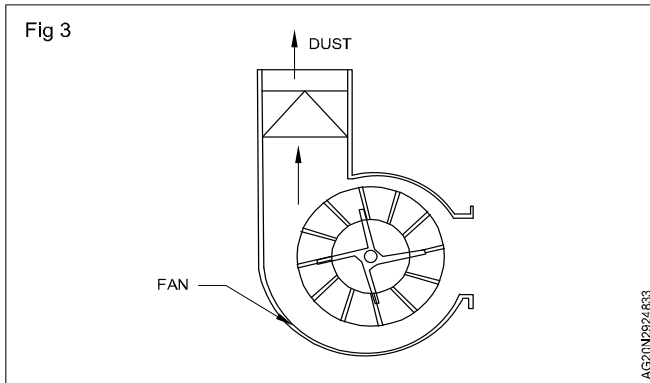
The equipment consists of sturdy frame, body, centrifugal fan, expansion chambers, magnetic separator and sieving assembly. A beater type cleaning device prevents sieve clogging and maintains a high sieving efficiency. These sieves are replaceable can be selected according to the type of grain. This sieves can be made of wire mesh or perforated sheet metal sieves. (Fig 1)

The screen brushes are used for cleaning the openings, which clogs usually. (Fig 2)





Mostly the aspirators are air blowers which remove the lighter particles. (Fig 3)

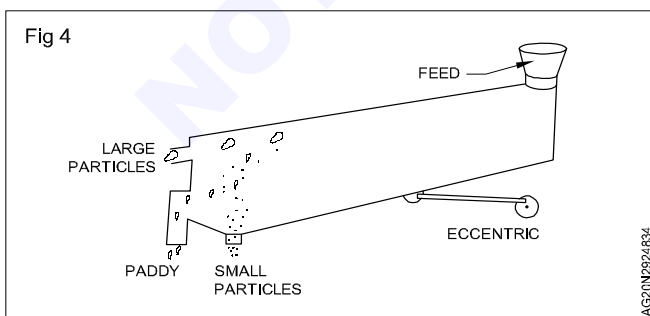


Cleaner

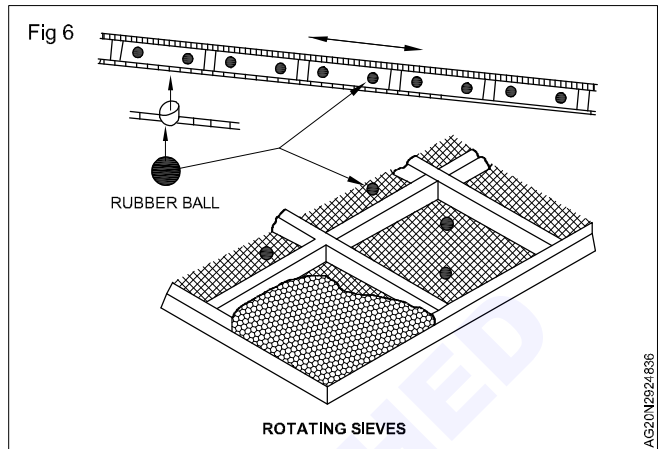
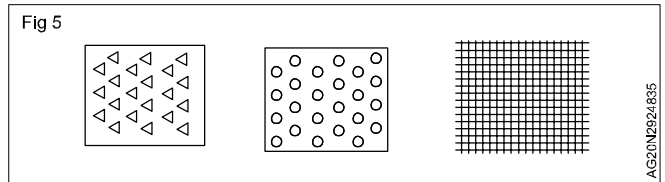
The seed cleaner consists of a hopper below which oscillating trays are provided for cleaning. The sieving trays are arranged over the other for separating materials having different sizes. The unit is operated with electric motor and v belt pulleys. The frame is made up of mild steel angle sections. The trays are made of perforated mild steel sheets fitted on wooden frames. A dust collector is also provided for free pollution free operation.

Cleaner cum grader

The cleaner cum grader 2 screen type attached with two indented cylinders. It consists of feed hopper with feed roller and feed control gate, set of sieves, dynamically balanced aspiration fan, step less variable air controls, air controls, air chamber, sieve deck assembly, spouts and indented cylinder. All these are mounted on a sturdy steel frame. The top screen hole sizes are bigger than the size of the grains, which allows the grains to remove bigger particles. The bottom screen hole sizes are smaller than the grain size so it retains the grains and allow the small particles to pass through. (Fig 4)



Screens are constructed of perforated sheet metal and the openings may be round, oblong and triangular. (Fig.5) Sometimes, they are also made up of woven wire mesh. In this cleaner cum grader either brushes or rubber balls are provided to clean the holes which are clogged (Fig.6)



Drier

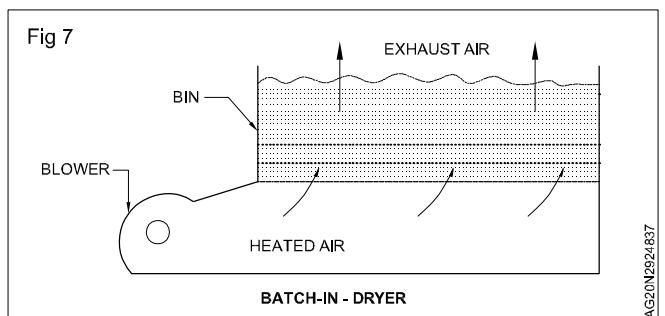
The driers are constructed with the simplest inexpensive materials. The hot air chamber is attached to the blower. Above the hot chamber, there is a rectangular bin to hold the grains which is separated by a wire screen or perforated sheet.

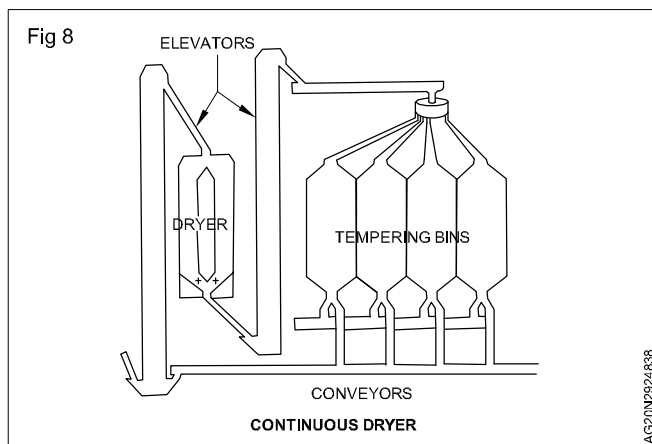
Batch driers

Batch driers are bins with an inner air chamber (plenum) surrounded by two parallel-perforated steel walls to contain a designed thickness of grain. Batch driers generally are rectangular or cylindrical, are usually described by the volume in bushels that a drier will hold per fill. The size of the drier depends upon the area supporting perforated screen on which the grain is placed. The holding capacity of these driers from 0.25 to 1 tons/ batch only. The horse power of the motor for the blower ranges from 1/4 to 1. For convenience an oil burner can be used but for economy a husk furnace should be used for the supply of heat. (Fig 7)

Continuous driers

The construction is very simple. It has a garner or holding bin on top, followed by a tall drying section. Below that is a flow control section that controls the flow through the dryer and discharges the grains. In the drying section, these are also attached with conveying equipment. (Fig 8)

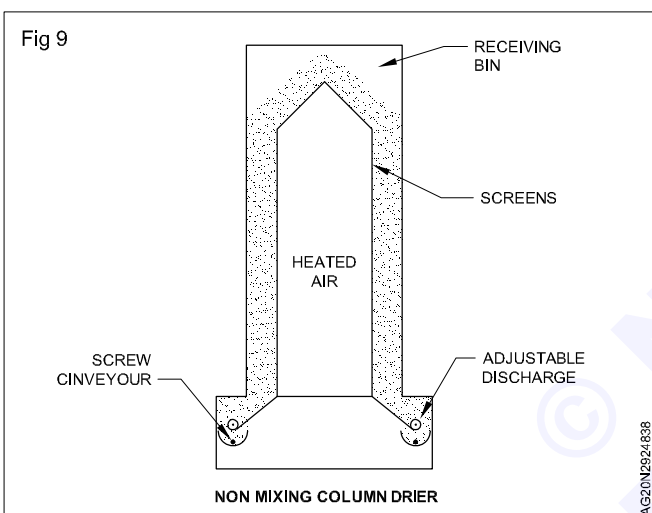




Continuous type dryer is of two types

Non- mixing columnar dryer

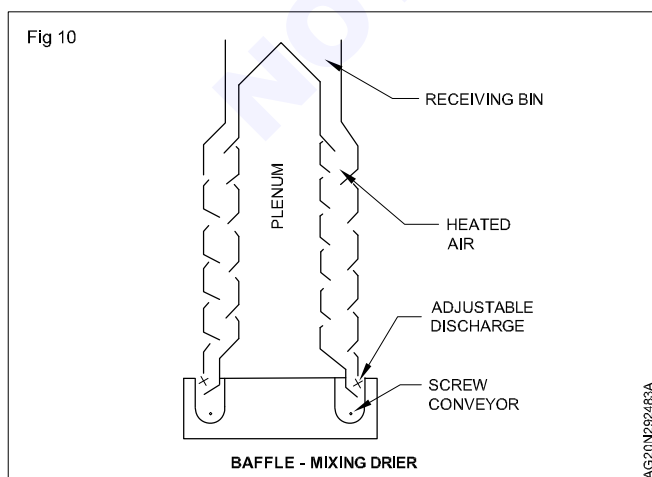
Two parallel screens are usually set about 15 cm apart while heated air blows through the screen. No appreciable mixing occurs during the process. (Fig 9)



Mixing dryer

Baffle type

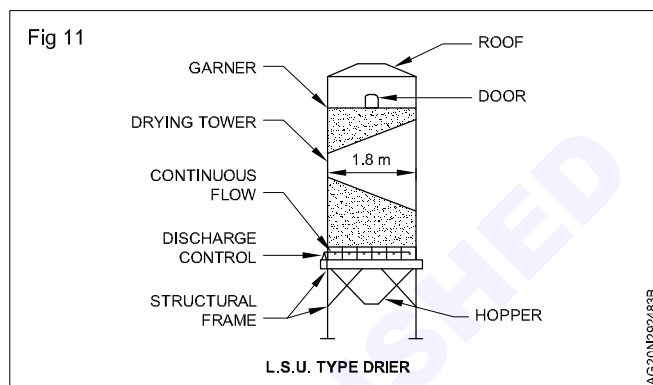
The vertical compartments are with rows of air channels shaped like inverted V (Fig 10). The baffle dryer consists of grain receiving bin, drying chambers fitted with baffles, plenum fitted with hot air inlet, grain discharge control device and hopper bottom. A number of baffles are fitted with the drying chamber to divert the flow and effect certain



degree of mixing of grains. The two baffle plates with the outer and inner sides are set 20 cm apart for the passage of the grain in the drying chamber. The dryer is made up of mild steel sheet.

Louisiana state university (LSU) type

This dryer consists of a bin in which layers of “^” shaped air channels are provided. Each layer of the channel is set off from one above the other so that the top of the “^” shaped channel split the stream of paddy causing through mixing (Fig 11)



It consists of a rectangular drying chamber fitted with airports and the holding bin, an air blower with duct, grain discharging the mechanism with a hopper bottom and an air heating system.

The rectangular bin

The following top square sections of the bins are used for the designs of LSU dryers.

- 1 1.2m x 1.2m
- 2 1.5m x 1.5m
- 3 1.8m x 1.8m
- 4 2.2m x 2.1m

The rectangular bin can be divided into two sections, namely, top holding and bottom drying chamber.

Air distribution system

Layers of inverted V shaped channels (called inverted v ports) are installed in the drying chamber. Heater air is introduced at many points through the descending grain bulk through these channels. One end of each air channel has an opening and the other end is sealed. Alternate layers are air inlet and air outlet channels. In the inlet channels, the channel openings face the air inlet plenum chamber but they are sealed at the opposite wall, where as in outlet layers, the channel opening face exhaust fan but are sealed outside. The outlet and inlet ports are arranged one below the other in an offset pattern. Thus air is forced through the descending grain while moving from the feed end to the discharge end. The inlet ports consist of a few full size ports and two half-size ports at two sides. All these ports of the same size are arranged in equal spacing between them. The number of ports in dryer varies widely depending on the size of the dryer.

Each layer is set off so that the top of the inverted v ports helps in splitting the stream of grain and flowing grains between these ports taking a zigzag path

In most models, a blower supplies the heated air.

Grain discharging mechanism

Three more ribbed rollers are provided at the bottom of the drying chamber, which can be rotated at different low speeds for different discharge rates of grains. The grain is discharged through the hopper fixed at the bottom of the drying chamber.

Causing some mixing of grain and air discharge system at the base of the dryer also regulates at the rate of fall of the grain.

Air heating system

The air is heated by burning gaseous fuels such as natural gas, butane gas, etc., or liquid fuels such as kerosene, furnace oil, fuel oil, etc., or solid fuels like coal, husk etc., Heat can be supplied directly by the use of gas burner or oil burner or husk fire furnace and indirectly by the use of heat exchangers. Indirect heating is always less efficient than direct firing system. However, oil fired burner or gas burners should be immediately replaced by husk-fired furnace for economy of grain drying.

The heated air is introduced at many points in the dryer so as to be distributed uniformly through the inlet ports and the descending grain bulk. It escapes through the out let ports.

This type of dryer is sometimes equipped with a special fan to blow ambient air from the bottom cooling section in which the dried or partially dried warm grain comes in contact with the ambient air.

In general, the capacity of the dryer varies from 2-12 tones of grain, but sometimes dryers are of higher capacities are also installed. Accordingly power requirement varies widely.

Recommended airflow rate is 60-70 m³/min/ tone of par boiled paddy and optimum air temperatures are 600c and 850c for raw and par boiled paddy respectively. A series of dryers can also be installed.

Prime mower attachments and driving system

Grain cleaner/grader is working under the power source of electric power motor or tractor PTO power drive systems.

Setting and adjustments of precleaner

- 1 Adjust bolt meters onto Setting and adjustments the scalp screen using spanner.
- 2 Adjust the brush to tighten enough against the screen using spanners to obtain maximum cleaning of the screen.
- 3 Make sure there is no build up on the back screen rack when adjusting either screen hold - downs or brushes.

- 4 Adjust the screen hold down before adjusting the brushes by loosening the bolts using spanners.
- 5 Use the adjuster wrenches from the front and turn the adjuster eccentric just enough to squeeze the brush against the screen.

Adjustments of the cleaner

- 1 Adjust bolt meters on to the scalp using spanner.
- 2 Adjust the grain plate the desired aspiration using spanner.
- 3 Adjust the bolt on the spreader hopper clock wise using the spanner to increase the flow.
- 4 Adjust the shaking speed of the screen for uniform rate movement.
- 5 Range of slope adjustment is 4 to 12 degrees.

Adjustments of cleaner cum grader

- 1 Adjust the feed flow control gate for uniform falling of grains onto the screen using spanner.
- 2 Adjust the settings such as scalper drums speed and indent cylinder through position.
- 3 Adjust the speed rate to provide an even supply and uniform covering of the deck all the time.
- 4 Adjust the airflow through the deck to allow heavy seeds to stay in contact with the deck.
- 5 Adjust the tilt of the deck.
- 6 Adjust the oscillation rate of the table as fast enough so that heavy seeds in contact with the deck will move to the upper end.
- 7 Remove or add the vanes attached to the disc spokes.
- 8 Adjust the height of the discharge gate for control the seed level in the machine and the rate of discharge.
- 9 Cylinder speed is adjusted therefore to lift grains nearly to the top of the arc.

Adjustments of batch type, continuous flow and LSU driers

Batch type driers

- 1 Adjust the air flow rate from 20 to 40 m³ min per 1000 kg of the grain
- 2 Adjust air flow rate or quantity according to the depth of the grain in the bin.
- 3 Adjust the static pressure of the air flow based on the depth of the grain in the bin.

LSU drier

- 1 Adjust the air flow rate from 60 to 70 m³/min/ ton
- 2 Adjust the heating unit to provide good distribution of heat.

Trouble shooting in winnower machine

Sl. No.	Defects	Remedies
1	Winnower motor not work	Check power supply Check motor wire connection
2	Winnower fan not work	If motor is defective repair it. Check fan drive system.
3	Grain does not properly flowing from hopper	Check grain flow regulator
4	Sieves does not vibrate	Check/repair

Trouble shooting in cleaner/grader

Sl. No.	Defects	Remedies
1	Broken grains	Improper adjustment/ adjust the speed
2	Grain dust not removed	Check the centrifugal fan speed
3	Light impurities not removed	Check the shaker and fan speed
4	Seed gate cap not open	Repair
5	Immature grains not separated	Check the fan speed
6	Heavy dust come out from the machine	Check dual aspiration at entry and exit
7	Grain not graded by size wise.	Check the oscillating screw

Care and maintenance of grain cleaner / grader

- Clean the machine before and after the use.
- Lubricate all moving parts of the machine.
- Follow the daily, weekly, monthly, hours, and periodical maintenance as directed by machine manufacturers.
- Tighten the loose nuts and bolts of the machine.
- Don't touch the machine while running the machine.
- Set the machine for cleaning/grading as specified limit for particular type of grains (If it is a multiple cleaner/ grader).
- Check brushes and spring tension on the brush drive mechanism, adjust or replace if necessary.
- Be sure that feed hopper is located to capacity to ensure uniform flow of grain on to the entire width of the screws.
- Check fan and eccentric bearings for adjustments as wear, excessive vibration, replace when necessary.
- Check the air chest to be sure that it is not ploughed with straw and trash.
- Check air exhaust vents to be sure that grains/ seeds is not being blown by the air blast and discharged through the dust collectors.
- Inspect the cleaner frequently during operation to detect visually or by air or any mal function.
- Check all screens daily to see that surfaces are flat and true.

- At the end of the processing season, check for worn and damaged parts and replace immediately.

Safety precautions of grain cleaner/ grader

- Check the machine before start for grain cleaning / grading.
- Follow the machine manufacturers machine safety procedure.
- Wear the personal protective equipment while operating the machine.
- Minimize ignition source by controlling hot work operations.
- Follow the house keeping program on ledges, equipments, floors and other exposed surface.
- Workers must wear appropriate respirators while operating the cleaner / grader.
- Operate the machine in open/ well ventilated area.
- Take training before operate the particular type of grain cleaner/grader.
- If found any defects in machine, stop the machine and inspect it.
- Rectify the defects before you start the machine.
- Disconnect the power from the machine, when the machine is not in use.
- Clean the machine before storage during off season.

Rice huller, rice polisher and their care and maintenance

Objectives: At the end of this lesson you shall be able to

- state the importance of rice huller and polisher
- state the function and construction of cleaner, destoner, dehusker, husk separator, bran remover and grader
- state the feed grinder cum mixer
- state the hammer mill, oil extractor and sugarcane crusher
- state the common faults and remedies
- state the care and maintenance and safety precautions

Importance of rice huller and polisher: The rice huller is an agriculture machine used to automatic process of removing the outer husks of grains of rice. Modern rice mills are used to hull and polish the rice. A rice polisher is a machine for buffing kernels of rice to change their appearance taste and texture or for transforming brown rice into white rice. Rice polisher are used after the rice has gone through the whitening process. They are abrasive machines that use talcum or some other very fine dust to buff the outer surface of the rice kernels.

Different function of rice mill: The modern rice mill constructed with different type of component to improve the quality of rice by various systematic operation of rice mill. The following operations are carried over by the rice mill.

- 1 Cleaner
- 2 Destoner
- 3 Dehusker
- 4 Husk separators
- 5 Bran remover
- 6 Rice polisher
- 7 Rice grader
- 8 Flour mill

1 Cleaner

Cleaning is a material separation process. The objective is to separate undesirable foreign materials from the paddy. The paddy is cleaned to reduce requirements for drying and drying cost, remove materials that could cause paddy deterioration during storage, remove materials that could damage the conveying and milling machinery, remove materials that cause a reduction in the grade.

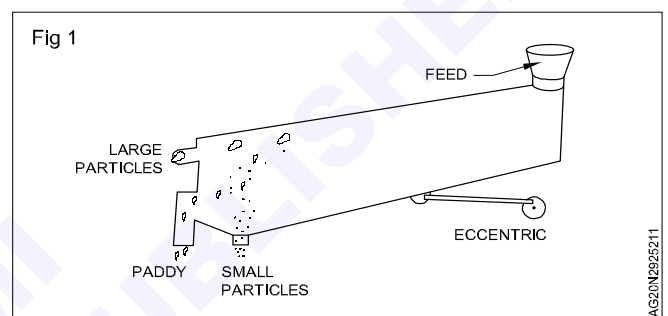
Vibration sieves

The sieve can be made of wire mesh or perforated sheet metal. Moving the sieve back - forth direction moves the materials, permitting smaller particles to through the openings and larger particles to remain on top. Without movement little separation would occur.

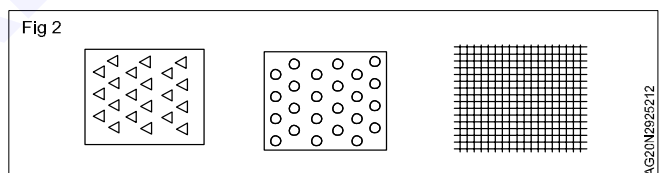
The pitch or slope of the screens also effects the rate of grain movement over the screens.

Cylinder type cleaners use one or two horizontal rotating cylinders, each covered with perforated sheet or wire mesh. Screens are constructed of perforated sheet metal or woven wire mesh. Opening the perforated metal screens

may be round, oblong or triangular. The size of the round hole screen is designated as the diameter of the perforations. (Fig 1)



A more common arrangement is to have an aspirator built in as part of a cleaner. The screens remove the heavier foreign matter and the aspirator removes the particles. (Fig 2)



Used to separate the undesirable foreign materials from seed mass.

Construction details of cleaner:

Basically it consists of horizontal rotating scalper drum, an aspirator and vibrating sieves.

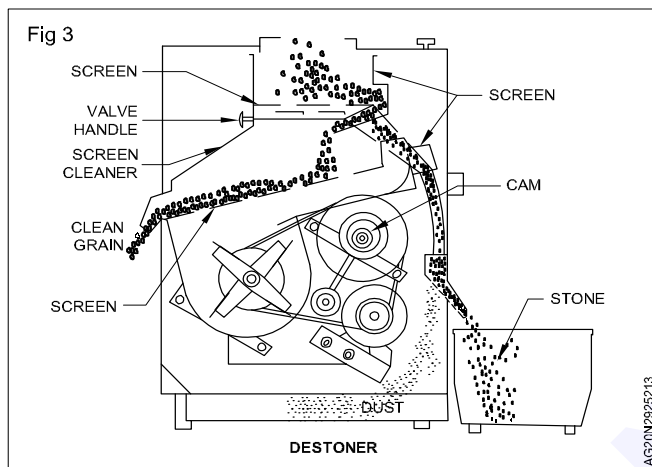
The dispersing plate disperses the paddy evenly on the whole width of the vibrating screen. A feed roll and a valve control the paddy input. An inclined vibrating screen helps the paddy grain in getting them fed to the rotating scalper drum. The scalper drum, covered with hexagonal slotted screens, removes the large impurities such as straw, ear chaff, big stones, etc. The paddy with small impurities first enters through the hexagonal slots of the scalper drum and is then discharged from the drum uniformly with the help of the device. An inclined plate equalizes the speed of the falling grains. When they fall from the inclined plate as a film, an air stream is sucked through the grain film by a suction fan to aspirate the lighter impurities like dust, etc., from the grains. The paddy with remaining impurities is fed through hopper to the reciprocating sieve. The reciprocating sieve is a double layer type. The top sieve of large mesh removes large impurities through the

outlet while the bottom sieve of small mesh separates heavier and smaller impurities like sand. The clean paddy overflows and is discharged from the outlet. The scalper drum is continuously cleaned by cleaners (made of rubber) and a special moving scraping device cleans the wide vibrating screen. These two devices prevent them from clogging.

2 Destoner

It is used to separate the stones larger or smaller than the rice grains, which is often a part of the cleaner. The destoner consists of a perforated deck mounted at an angle and operated by a reciprocating motion. A blower is arranged to push air through the deck.

Heavy products are discharged from the high end of the deck, entirely separate from the light particles, which are discharged from the low end. (Fig 3)



Construction details of destoner

The grain with impurities is distributed over the whole width of the machine by a dispersing plate. A feed control valve controls the flow of the mixture. With the help of a device the speed of the flow is reduced and equalized. Light and small impurities in the grain are aspirated by an aspirator. The immature grain is separated /settled in the expansion chamber and discharged by a screw conveyer. The airflow rates controlled by the air-controlling device. Then the grains are delivered to the separating tray in which stones and a few grains move upward while almost all grains move downward. The paddy grains are discharged through the grain outlet. While stones are discharged through the stone outlet as described earlier. (Fig 2)

3 Dehusker

Dehusking, often referred to as huskers, dehuskers, hullers and shellers - removes the paddy husk from the paddy grain.

There are two types of dehusker.

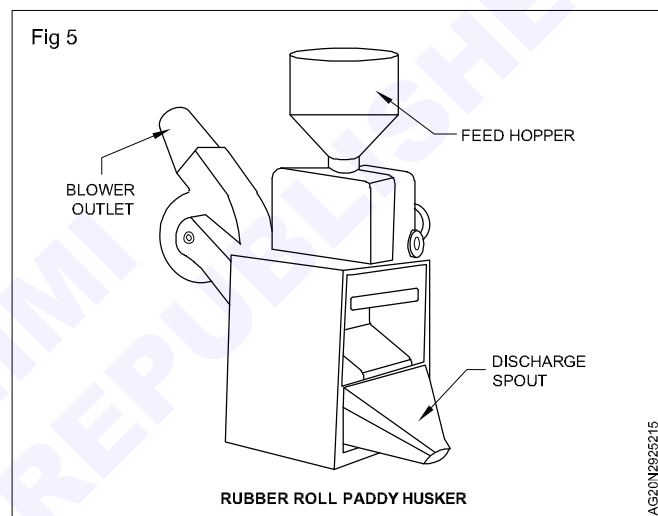
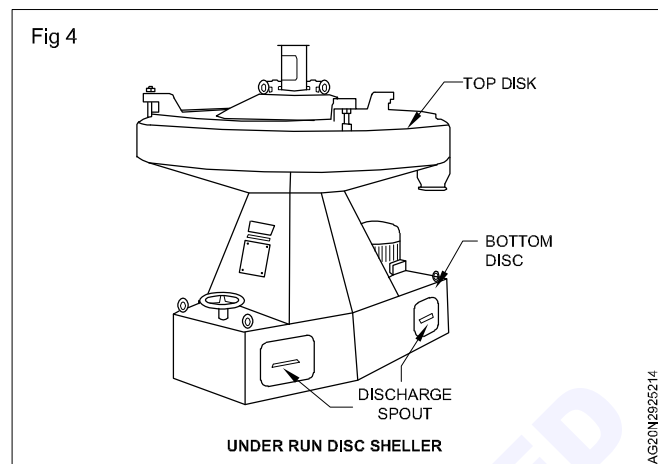
Under run disc sheller:

Consists of horizontal iron discs partly coated with an abrasive layer. The top disc is fixed to the frame housing and the bottom disc rotates. (Fig 4)

Rubber roll paddy husker

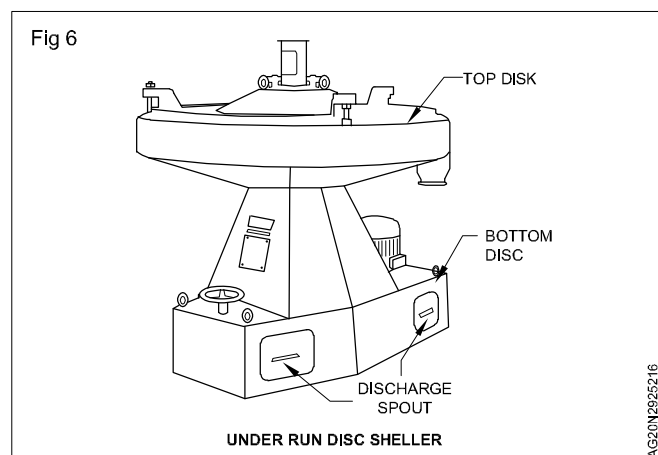
This machine is also referred as huller or sheller. It consists of two rubber rolls rotating in opposite directions at different speeds. One removes about 25% faster than the other

(Fig 5) Compared to disc sheller, the rubber roller offers many advantages. It reduces grain breakage and loss of small broken.



Under run disc sheller

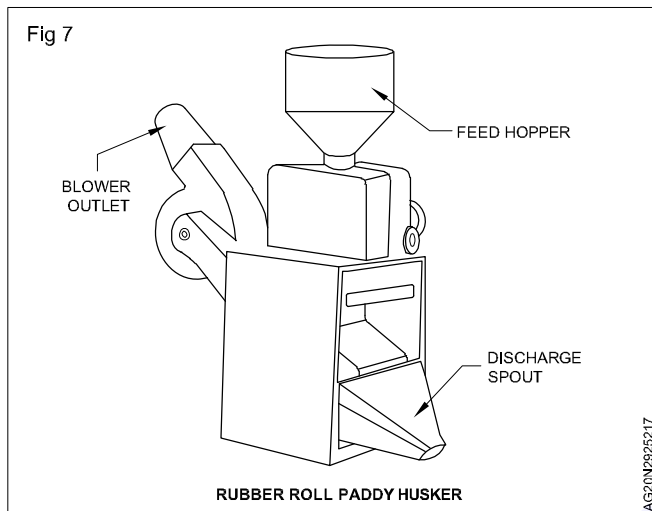
The main parts of this machine are the feed control device, the upper stationary disc, the lower rotating disc fitted to the shaft, and the pulley mounted on shaft. The shaft can be moved up and down (Fig 6)



Rubber roll husker

It consists of two major parts, the upper part is the husking section and the lower part is the husking aspirating section. Clean paddy is delivered through a shutter and a feeding roll, fixed below the shutter. Feed rate is controlled

by a feed regulating valve. The paddy is then passed through the gap between a fixed roll and an adjustable roll and husked. After reducing the grain speed with the help of resistance plate, the mixture is allowed to pass through aspiration to the aspirate husk. Mature grain being heavy is collected in the husked rice outlet. Immature grain being light is collected and discharged by a screw conveyor. The husk is aspirated and thrown out of the mill building by a fan. Both rolls have the same diameter. Diameter of the rubber rolls varies from 150 to 250 mm depending on the capacity of the husker). (Fig 7)



4 Husk separator

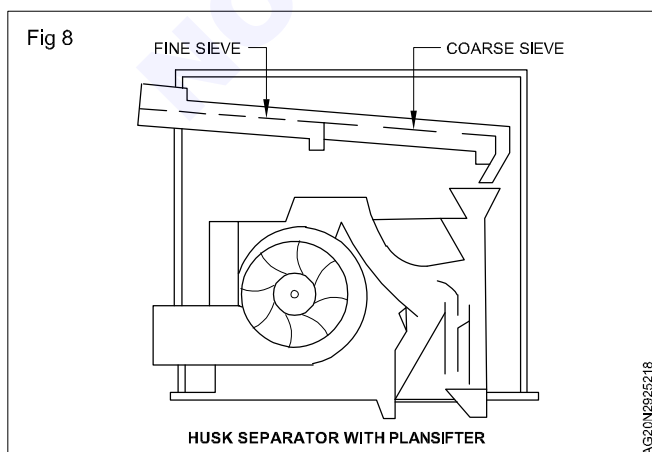
The dehusked and unhusked paddy is separated in a husk separator. The broken grains and stone brain can be separated through an oscillating sieve with fine perforations and discharged separately.

Husk separator

It consists of one oscillating sieve with the perforations and discharged through the discharge spouts. An aspirator is also attached to the machine. The feed hopper is mounted on the top and the discharge spout is at the bottom of the machine.

Husk separator with plansifter

Plan sifter is equipped with two self-cleaning sieves. Sieve 1 has fine perforations for separating bran and dust. Sieve 2 has larger perforations for separating broken grains. The sieve overflow is a mixture of husk, paddy and brown rice. (Fig 8)

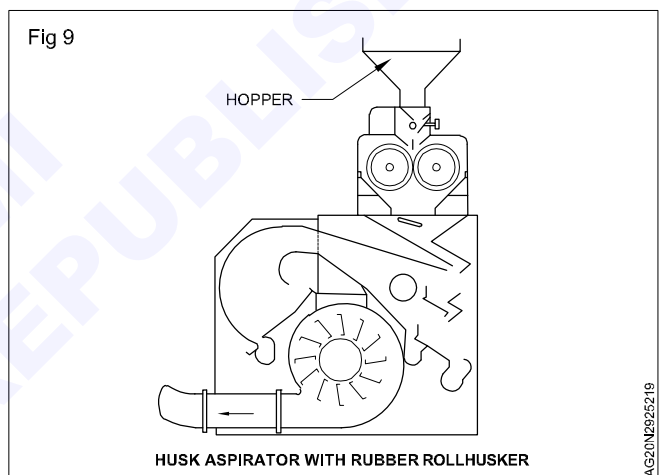


The lower part of this machine, the husk aspirator, pulls air through the mixture and lifts the husks to be discharged through the blower. The immature grains are lifted by the airstream and dropped into the V-shaped compartment for automatic discharge through the double air valves. The brown rice and the paddy are discharged.

Husk aspirator with rubber roll husker

About 90% of the paddy from the rubber rolls is dehusked in the first pass and the combination is fed immediately into the husk aspirator. An airstream is pulled through the grain to separate the husks and immature grains. The immature grains drop into a separate hopper for discharge. The paddy and brown rice are discharged separately. Efficiency is generally high with this type of husk aspirator (Fig 9)

An airstream is pulled through the grain to separate the husks and immature grains. The immature grains drop into a separate hopper for discharge. The paddy and brown rice are discharged separately. Efficiency is generally high with this type of husk aspirator). (Fig 9)



5 Bran remover (Whitener)

The process of removing the outer and sometimes inner bran layer is most commonly referred to as 'whitening'. Sometimes it is termed polishing or milling. Polishing however, refers to the process of removing bran particles that are stuck to the rice surface after whitening and gives the rice grain a shiny appearance.

Bran remover (Whitener)

The process of removing the outer and sometimes-inner bran layer is most commonly referred to as "whitening". Sometimes it is termed polishing or milling.

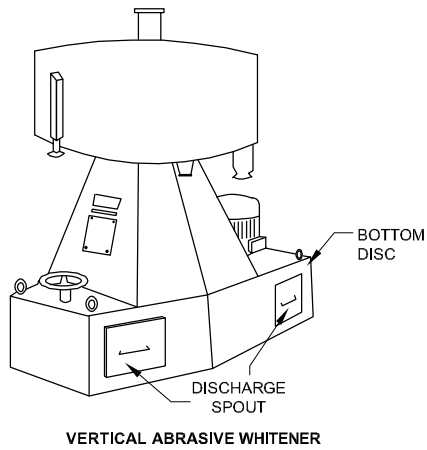
Abrasive whitener

The two processes used to remove the bran layer from the grain are abrasion and friction. Three kinds of whitening machines used are a vertical abrasive whitening cone, a horizontal abrasive whitener and horizontal friction wherever.

Vertical abrasive whitener

It is available with cone directed either up or down, but with no difference in performance or capacity. The cone has an abrasive surface and turns inside a cylinder covered with a wide screen. (Fig 10)

Fig 10



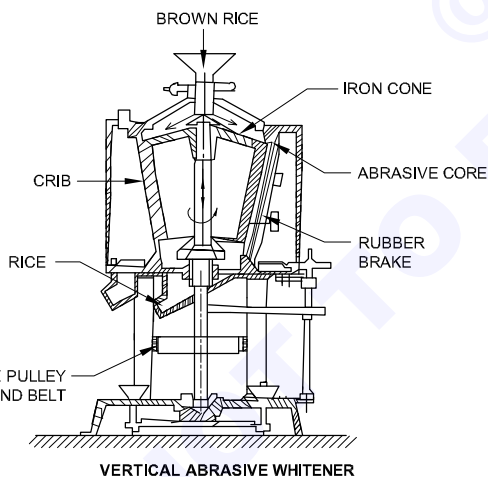
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Abrasive whitener

Vertical abrasive whitener

The machine consists of a rotating vertical conical cast iron cylinder with an abrasive material. The entire rotating cone is encased within a fixed perforated metal sheet known as crib. The gap between the abrasive surface and the crib is about 10 mm, it is provided with rubber brakes, placed vertically and spaced equally, which protrude into the gap between the abrasive cone and the crib. The clearance between the rubber brake and crib is about 2-3 mm, the pressure inside the whitening chamber can be adjusted by pushing in or pulling out the rubber brakes. The whole abrasive cone can be lifted up or down to adjust the clearance between the cone and the rubber brake as when rubber brakes are worn out a little. (Fig 11)

Fig11

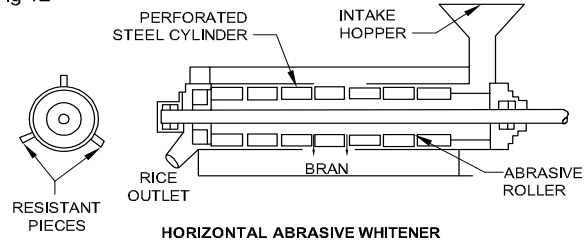


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Horizontal abrasive whitener

It is more compact than vertical type. The machine consists of an abrasive roll (emery stone attached to a steel shaft) operating in a cylinder metal perforated screen mounted horizontally. (Fig 12)

Fig 12



AG20N292521C

Horizontal abrasive whitener

The horizontal abrasive roll type whitening machine consists of an abrasive roll fitted with steel screw and cap cover clamped on a horizontal hollow shaft rotating at a high speed (1000 rpm) in a slotted steel cylinder. An inlet hopper, shutter and feed control gate are provided above the feeding screw. An adjustable steel plate with weights is fitted in the rice outlet spout. This plate with weight acts as a valve. The counter pressure of this valve that is adjusted by the weight, controls grain flow rate mainly and milling pressure partially.

The outer cylinder, i.e. housing, can be separated into two halves. The bottom half is slotted with rectangular slots. The slots are inclined at an angle of 80° to the rotating direction of the roll so that grains move slightly towards the outlet. Over the full length of the cylindrical housing two to three rows of adjustable steel resistance pieces are protruded into the angular space between the roll and the cylindrical housing. The resistance pieces can be turned from 0° (axial) to 90° (radial).

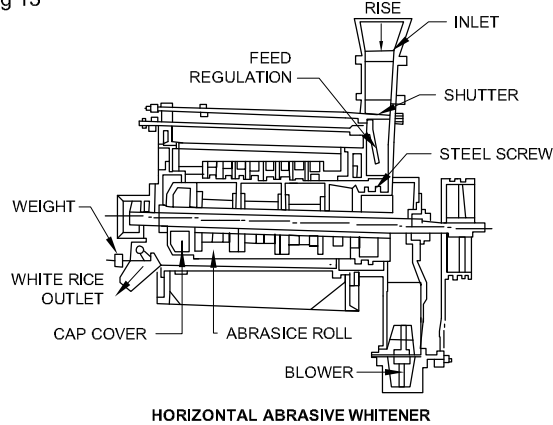
After feeding through the steel screw, the grain passes through the space (10) between the rotating roll and the slotted steel cylinder. The bran layer of the grain is shaved, cut and ground into small particles by the fine and sharp edges of the abrasive roll. The bran passes out through the slots of the steel cylinder. An air current from the hollow shaft flowing through the gaps of the abrasive roll accelerates the separation of bran and rolls the grain. The whitened rice is discharged through the outlet.

The abrasive roll is made of carborundum (SiC) particles bound by some ceramic substances. (Fig 13)

Horizontal friction whitener

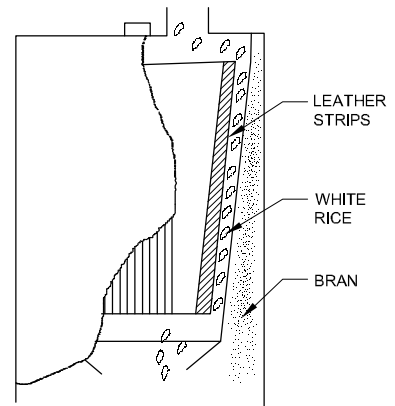
The machine consists of a rotating steel cylinder having two friction ridges, feeding screw and a lock nut mounted on a horizontal, partly hollow, perforated shaft, engaged in a hexagonal chamber. There are two lengthwise openings behind the ridges for the passage of air. The hexagonal chamber is made of slotted screen and has small projections on the inner-surface. The inlet is located above the feeding screw. An adjustable steel plate with weights is fitted at the rice outlet spout to adjust the variable pressure. The pressure can be varied by adjustment of the counter weight. Strong air stream is blown by a centrifugal blower through the long slots of the cylinder and holes of the shaft to help in separating the bran and dissipating the heat generated by the friction between rice and rice (Fig 14)

Fig 13



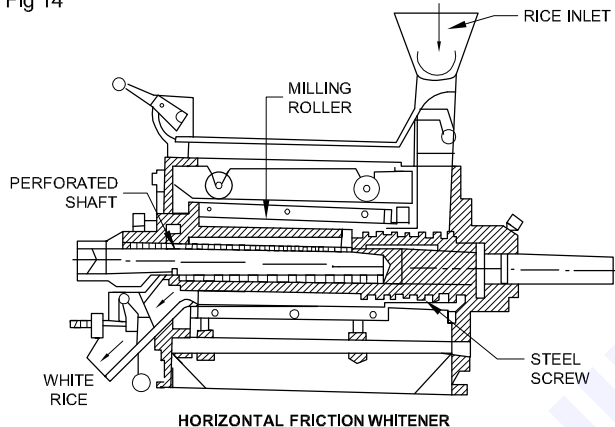
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Fig 16



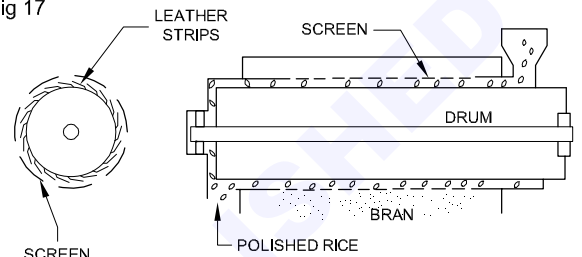
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Fig 14



AG20N292521E

Fig 17

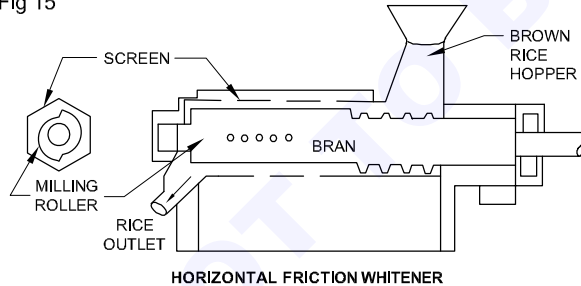


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Horizontal friction whitener

These are often called as jet or pneumatic peelers. By friction process, the bran is peeled off from grains. The major components of the friction whitener are the metal roller and the metal perforated screen. (Fig 15)

Fig 15



AG20N292521F

6 Rice polishers

Some rice markets require a glossy, highly polished rice. In this case, rice polishers (sometimes called pearlers or refiners) are used after the whiteners. Vertical horizontal polishers are available (Fig 16 & 17)

In these machines, the cones (vertical or horizontal) are covered with leather strips, the screens are perforated and operated at a lower rpm. The leather strips roll the whitened rice over and over against the screen.

Rice polishers

Rice polishers are used after the whiteners to give glossy and polished appearance. Vertical and horizontal polishers are available.

In the vertical types, the cones are mounted vertically which is covered with leather strips and perforated screens. The feed hopper and the discharge spouts are also mounted.

In the horizontal types, the cones are mounted horizontally which is covered with leather strips and perforated screens. This machine also contains the feed hopper and discharge spouts.

7 Grader

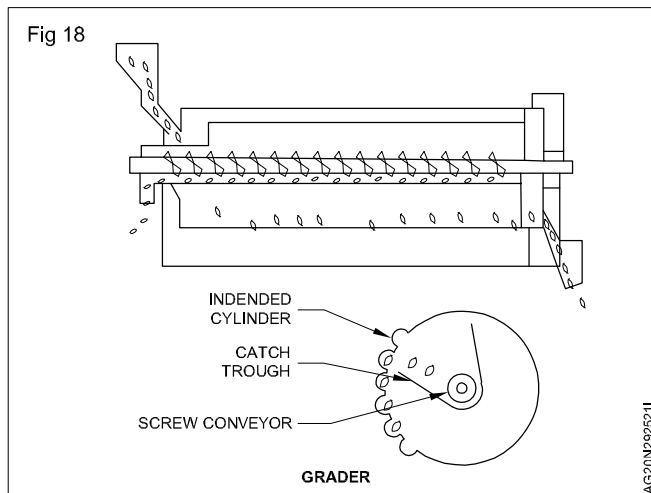
Separation of broken rice, bran and dust after whitening is termed "grading". An indented cylinder is installed at a slight incline. The inside of the cylinder has a catch trough and screw conveyor to catch and remove the broken. (Fig 18)

An indented cylinder is installed at a slight incline. The inside of the cylinder has a catch through and screw conveyor to catch and remove the broken.

8 Flourmill

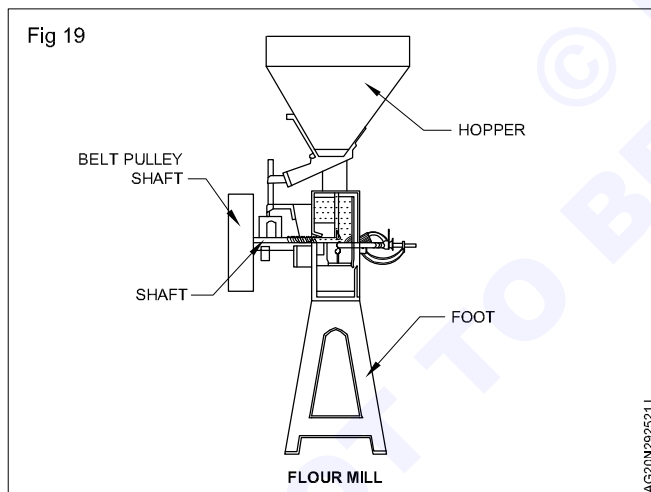
Flourmill is used to grind the grains into flour. It consists of a hopper, two rollers, round separator, bran vent and flour vent (Fig 19). Used to grind the grains into flour. After being cleaned and tempered (moisture content should be controlled within 13 -15%, the wheat is lifted to the hopper, then the wheat is fed evenly into between the fast roller and slow roller, the grinded grain flows into the round separator to sieve flour, the bran flows out through the bran vent. Flour flows out through the flour vent. And then the bran is fed into the hopper by manual or wind power

to grind once more. Generally, 5 times will be all right for the processing of wheat milling.



Flourmill

It is constructed with a hopper, two rollers, round separator, bran vent and flour vent (Fig 19). Used to grind the grains into flour. After being cleaned and tempered (moisture content should be controlled within 13-15%, the wheat is lifted to the hopper, then the wheat are fed evenly into between the fast roller and slow roller, the grinded grain flows into the ground separator to sieve flour, bran flows out through the bran vent. Flour flows out through the flour vent. And then the bran is fed into hopper by manual or wind power to grind once more. Generally, 5 times will be all right for the processing of wheat milling.



Feed grinder cum mixer: Agricultural used grinder cum feed mixer machine is used for grinding the animal feed materials and mixing them properly to provide the material to eat by animals. This agricultural grind mixer materials are getting better and more quantity and quality. This type of machine is available in 200 kgs -1000 kgs mix per power 5.5 kw. This type of machine products with efficient grinding performance and particles size granulation from coarse to fine application.

The crushing process is an important part of the animal feed processing in feed mills and forms. The crushing degree is directly related to the subsequent animal feed processing procedures and the quality of feed products.

The hammer type feed grinder for animals is a kind of impact feed crushing equipment it has high versatility small footprint, good crushing quality, quick start without load, flexible transmission connection mode and week temperature sensitivity to feed. High productivity and convenient use and maintenance.

Construction details of animal feed grinding machine

- The animal feed grinding machine can be equipped with bearing vibration temperature remote detection system, alarm and stop automatically when out of order.
- This type of machine have crush room is designed as water drop system.
- This machine's bottom of the crushing chamber to greatly improve the production.
- Animal feed grinding machine rotor pass an accurate dynamic balancing test resulting in low noise and smooth running.
- The particles made by animal feed grinder machine are uniform use x 1.2 mm below and large aperture screen to produce thick medium, thin or supper powder materials, higher efficiency and sticking screen phenomenon.

Working principle of the animal feed grinding machine

The raw material falls into the inlet of the animal feed grinding machine by gravity from the top of the crusher and the falling speed is about 1.64 - 3.28 m/s. The raw material is hit by hammer for the first time on the top of the rotor. The initial crushing zone due to the raw material. The speed at the end of the hammer is very different and most of the material flow is crushed. The speed of the material layer closer to the screen surface is lower and the speed of the material layer closer to the end of the hammer is higher. The area is narrow and is called the acceleration zone.

The crushed material is to be discharged through the sieve holes and its speed should reach a discharge speed perpendicular to the screen surface. The crushed material close to the screen surface are affected by the friction of the animal feed grinding machine screen surface to reduce its circulation velocity and are subjected to centrifugal force, pressure and airflow perpendicular to the screen surface to allow it to be discharged out of the animal feed grinding machine screen (Fig 20).



Double cylinder cattle vertical feed grinder cum mixer (Fig 21)

This type of feed grinder cum mixer machine is having a very high accuracy gear box and high output. It is widely used in large middle small scale aquatic, food and feed processing factory, like stick form poultry farm, individual raisers middle and small farm houses.



Model 1000 feed unit

Size 210*150*360cm

Installed Capacity, Crushing B352: 2 grade: 7.5 KW: mixer ordinary 4 grade: 2.2KW

Bearing: 1 set 7208: 1 Set UCF208:2 set 205

Oil seal: 2 sets 50*72*12: 4 sets 25*25*10

Triangle belt: 2 pieces A1700: 2 pieces A650

Mixer type: Vertical

Suction device form: double simple suction nozzle

Production: 500-100kg/h

Power consumption: 4-9KW/h per ton

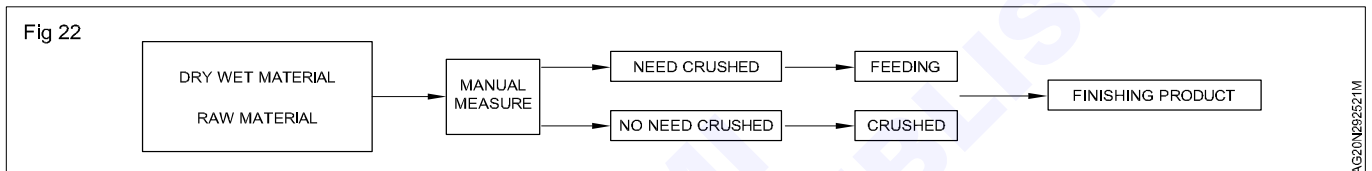
Finished material type: powdery dry material

Operators: 1-2 people

Mixing uniformly: coefficient of variations d" 13%

1 Structure: The unit consists of four groups of hammer mills, vertical mixers, iron removal devices-double cylinder nozzles, bag dust removal devices, etc. (as shown in below).

2 Process flows (Fig 22)

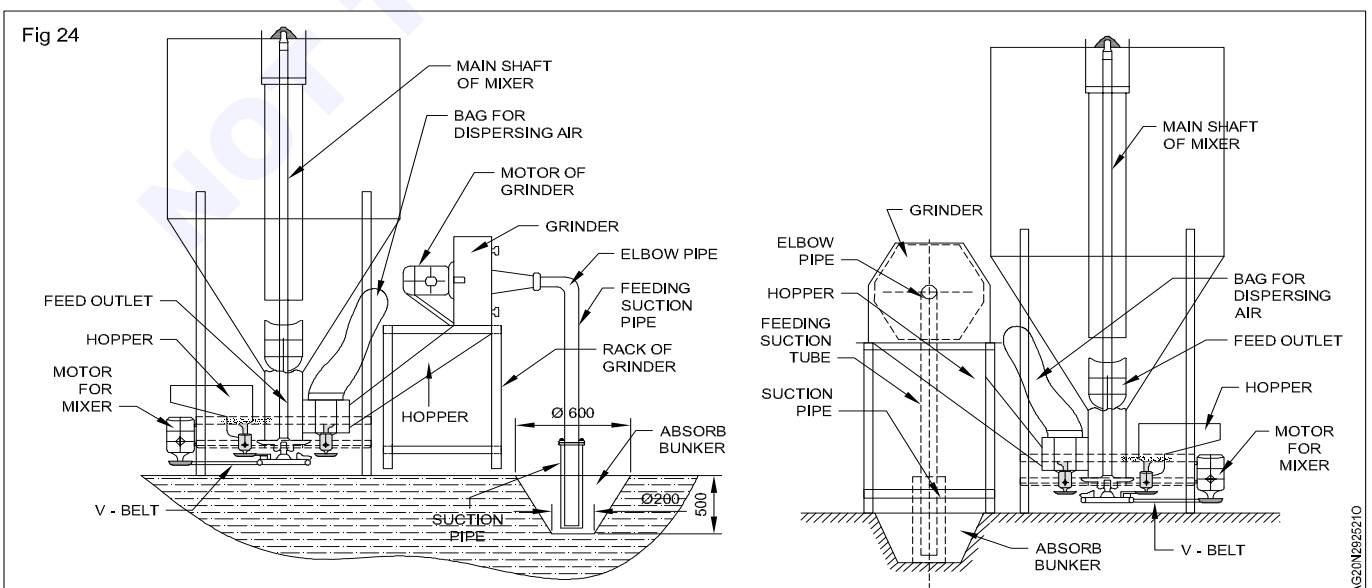


Device installation

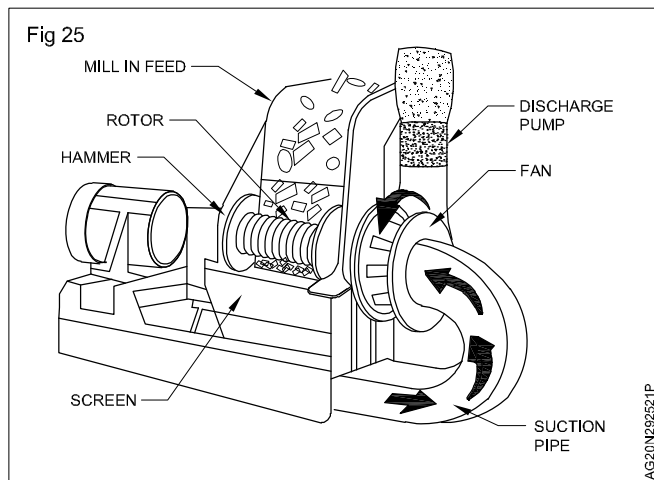
- 1 First choose the appropriate place to stabilize the machine and dig the pit.
- 2 Install the motor of the mixer.
- 3 Install the suction tube, and place the return air tube on the suction tube. The lower side of the return air tube is 1 cm lower than the suction tube. If the button of the crusher is less 4 mm, the bottom of the return air duct should be 3 cm smaller than the bottom of the pit.
- 4 Install a dust bag and fasten the bag.

Single cylinder feed grinder cum mixer (Fig 23)

Construction details of single cylinder feed vertical grinder cum mixer (Fig 24)

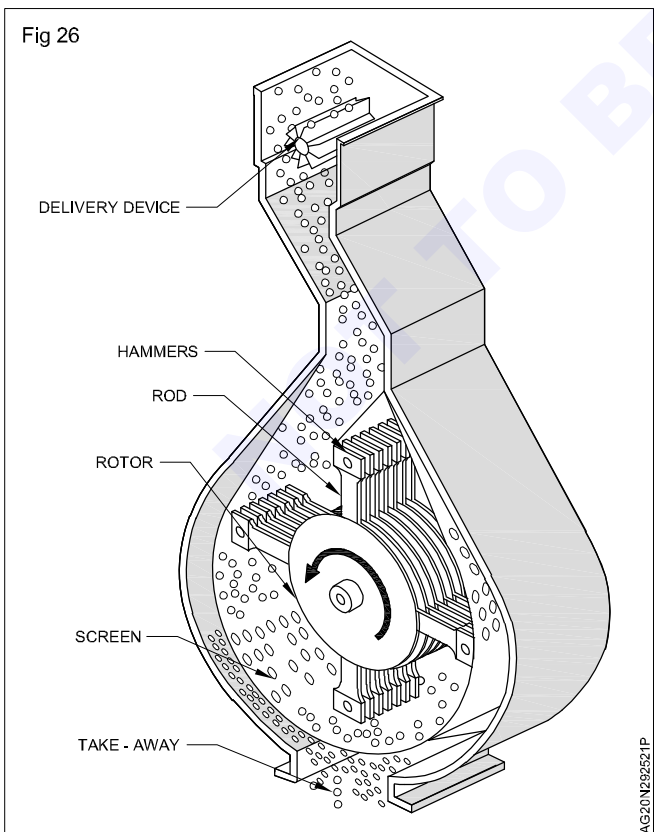


Hammer mills: A hammer mill is used for the purpose of feed material is to shred or crush aggregate material into smaller pieces by the repeated blows of little hammers. Hammer mill is used numerous industrial applications including a farm machine, which mills grain into course flour to be feed to livestock (Fig 25).



Hammer milling is a high energy process of reducing particle size by impact with rapidly moving hammers. Hammer mills are operating on the principle that most materials will grind or crush upon impact with the hammers. Raw material impact rapidly moving hammer mounted on a rotor and powder.

Construction of hammer mill: The hammer mill consist essentially of a high speed rotor turning inside a cylindrical casing. The rotor is mounted on a shaft, which is usually horizontal. The swing hammers are pinned to a rotor disk. The hammers are rectangular bars of metal with plain or enlarged ends (Fig 26)



Materials used for hammer mill: Hammer mills consist of a series of hammers hinged on a central shaft and enclosed with a rigid metal case. It produces size reduction by impact. The materials to be milled are struck by these rectangular pieces of hardened steel, which rotation at high speed inside the chamber. These radically swinging hammers at a high angular velocity causing brittle fracture of the feed material. Hammer mills crush materials into two stages. 1. Size reduction which occurs by dynamic impact 2. Sizing which occurs by attrition and shear in second zone, where small clearance exists between the hammer and the screen bar producing a particle range for 15-50 μm . The targeted particle size can be controlled by factors such as feed rate, rotor speed, clearance between the hammers and grinding plates, hit resistance, the size of screen opening.

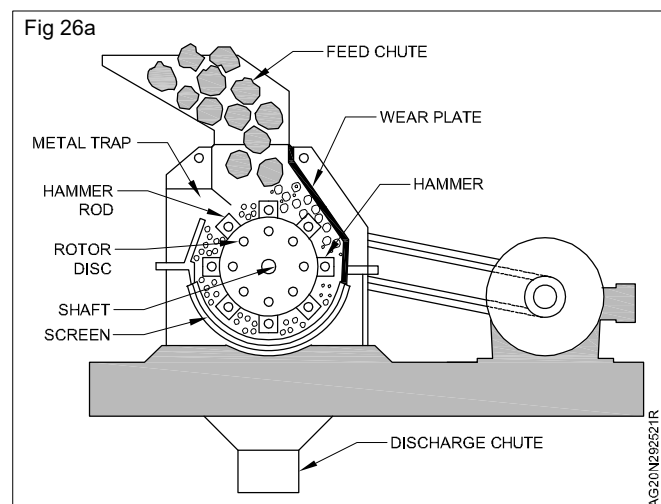
Classification of hammer mills: Hammer mills are classified into following types

- 1 Reversible type of hammer mill.
- 2 Non reversible type of hammer mill.

The above sub type is based on the direction of the rotor working and grinding action remain similar despite the fact that their construction differs in many respects.

Hammer mill parts (Fig 26a)

- feed chute
- discharge chute
- hammer
- rotor disc
- shaft
- hammer rod
- screen



Oil Extractor: An oil extracting machine is used for high pressure on the feed materials and putting heat friction and pressure to work as they squeeze the oils out of different type of plant product. Those products including seeds, nuts, vegetables, fruits and leafy plants, oil extractor machine release their oils through machines mechanical process, which is often done without adding any chemical (Fig 27, Fig 28).

Working method of oil extractor

Oil extraction machines typically use a screw press. Some products, the groundnuts, need to be shelled or peeled before moving through the screw press. The peeling process might use powerful centrifugal forces or airflow from a fan to separate lighter shells from the heavier nut.

After peeling, the product is fed into the screw system, which comprises a screw inside a high-pressure cylindrical chamber. The material moves through the screw, generating friction and heat. While the high pressure squeezes out much of the oil, the heat contributes, too. It can denature some of the proteins in the product and increase the viscosity of the oil to easier movement.

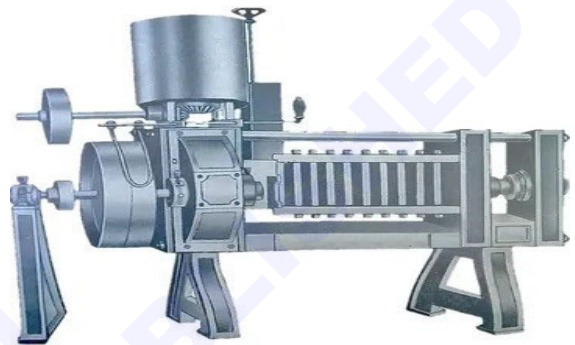
As the oil pressed out, it seeps through a screen or filter to ensure that no solids or fibers move with it. This creates a clean, smooth product. The leftover pressed seeds form a hard cake that is removed from the machine, and the oil flows out into a separate container.

The heat generated in this process can affect some materials in undesirable ways, and harder products like nuts generate more heat than softer products like fruits. To combat the extra heat, some users choose to cold-press certain materials by controlling the temperature in some way. They might use some additional chemicals or a centrifugal system to help draw the oils out without adding more pressure.

Fig 27



Filter press



Steel body oil - Expeller



Oil expeller



Muller mixer

Fig 28



Home made edible oil making machine



Parts of an Oil Extraction Machine

Oil extraction machines can come in several configurations, but here are some of the main components you'll typically find.

Hopper: The hopper is a metal structure that funnels the raw material into the screw press.

Screw press: The screw press is the power house of the oil expeller. The screw shaft rotates within a cylindrical cage, pushing the material forward in a high pressure chamber. Friction is generated between the material, the screw shaft, the feedstock and the press chamber itself.

Gear reduction unit: The gear reduction unit, or gearbox, converts the speed and torque of the electric motor to the right settings for the machine.

Slots or screens: A screening surface allows oils to seep out while keeping the leftover materials moving through the screw. Where they press into a "cake" for removal.

Frame: The metal frame provides the support for and connects these components. You'll find various other parts in an oil extraction machine like lock nuts, rings, seats

and gaskets that make up these larger components and link them together. These parts might be made of metal and electro plate materials, both of which offer long lasting durability in the tough, messy conditions of oil pressing.

Operating principle of screw oil press

Oil bearing materials are fed from the hopper to pressing chamber, when the screw expeller pressing is running screw shaft rotates in the cage, which pushes the oil material into the machine for pressing on the one hand, the raw material keeps moving all the time is great friction drag between raw press chamber. Thus the friction and relative movement emerge on the other hand the circle diameter of screw shaft distance is reducing little by little. When the screw shaft is rotating, it pushes raw material strongly and rolls over outward at the same time. Thus there is a relative movement among friction drag satisfies technology in the pressing, which will contribute to thermal denaturation of protein in the material, and improve the oil extracting rate meantime, the screw oil expellers of big scale or small scale have similar theories during the pressing process.

Fig 29



Sugarcane crusher machine

Sugarcane crusher machines: There are two types of sugar cane juice extraction machine power source is used. There is petrol engine, power drive system and electric motor drive system is used to operate the sugar cane crusher (Fig 29)

Sugarcane crusher machine parts: 1. Sugar mill roller 2. Tail to bar coupling 3. Scraper plate 4. Trash plate. 5. Juice tray 6. Motor 7. Machine frame.

Sugarcane crusher: Sugarcane juice extraction machine is simple crushing mechanism consists of sets of machine start motor spins spur gears rolls spins for sugarcane crushing 7 gears and rolls. The gears and rolls are powered by the AC alternating current electric motor spur gears are attached to the motor. Voltage supplied causing the motor to spin, the motion is then transferred to the rolls through sets of spur gears. Sugarcane will be fed between rolls than diameter of sugar cane. The compression occurs through the whole stalk causing the juice to be extracted. The load of compressing the sugarcane is reduced by

spur gears. The load is distributed and reduced for less power of consumption.

Working method of sugar cane juice extraction method

Sugarcane flow process of extracting sugarcane juice is quite messy by using existing sugarcane juice extraction machine. First the skin of sugarcane is peeled using knives or machine. After the peeling of sugarcane skin start the juice extractor machine insert sugar cane into machine rolls crush sugar cane juice filter manually sugar cane is inserted again into machine for few times bagasse is piled up for dump an outer skin is peeled, if it is fed into the operating extraction machine. The crushed sugarcane will be strained and came out from behind of the machine it is then inserted again into the machine to extract more juice. The juice extracted and then filtered from the fiber. The small fiber is filtered because, it may cause discomfort to throat, when consuming, after juice extraction occurred the bagasse is piled up for dumping.

Solar powered sugarcane crusher

Solar powered sugarcane crusher DC motor is coupled with a traditional sugarcane machine powered by solar module and battery mounted on a four wheel push cart or on a fixed table. It can run for 6 hours on battery power produce approximately 35.40 liters of juice per hour from 50kg sugarcane. This machine can run continuously for about 12.15 hours on combined solar and battery power, it has a facility to run DC fan, mobile charger and run juice grinder which can make other fruit juice sustained the business beyond the sugarcane season.

Components of solar powered sugar cane crusher

Solar module - 50 wp 24V	- 1 No.
Solar battery - 50Ah, 12V	- 1 No.
Module mounting structure	- 1 No.
Sugarcane crushing machine - 40W12V	
Machine operating voltage - 24V	
Dimension - 57 x 29 x 50 cm	- 1 No.
Cables and consumables	- As req.

Common faults and remedies of rice huller and polisher

Sl.No	Defects	Remedies
1	Bearing temperature rise to high	Lubricate the bearing before start the machine Avoid the long time machine operation
2	Incorrect installation of the grinding wheel	Install properly
3	Loose buckle nut	Tighten the nut
4	Loosening of anchor bolts	Tighten/replace
5	Transmission belt loose fitting	Tighten the belt
6	Transmission belt serious skidding	Replace the belt
7	Raw material is cannot flow into the studio	Open the entry panel to certain width
8	The gap between the rubber knife and grinding wheel is too large	Adjust the vertical gap between the cutter and grinding wheel
9	Rolling mill pressure not enough	Raw materials need to be dried for efficiency of the milling be effectively improved

Common problems and remedies of feed grinder cum mixer

Sl.No	Defects	Remedies
1	Strainer damaged	Replace
2	'V' belt loose fitting	Tighten the belt
3	Bearing noise	Replace/lubricate
4	Cylinder blade broken	Replace
5	Worn in the feeder cylinder is worn out	Replace
6	Side cover nut and bolts loose	Tighten it
7	Hopper feed unit damaged	Replace
8	Machine ON/OFF switch defective	Replace
9	Discharge pipe blocked	Replace/clean
10	Blower not work	Repair/replace
11	Electric motor defective	Repair

Common fault and remedies of hammer mill

Sl.No	Defects	Remedies
1	Wear plate worn out	Replace
2	'V' belt worn out	Replace
3	'V' loose fitting	Tighten the 'V' belt
4	Electric motor defective	Replace/repair
5	Hammer red bent	Replace
6	Screen damaged	Replace
7	Discharge valve defective	Replace
8	Suction pipe damaged	Replace
9	Rotor mounting loose	Tighten
10	Rotor disc and hammers worn out	Replace
11	Raw material delivery device not work	Repair or Replace
12	Shaft bearing noise	Replace

Common faults of oil extractor

Sl.No	Defects	Remedies
1	Expeller is not getting sufficient feed	Increase the flow of raw material.
2	Abnormal discharge of foots from the cage	Set proper pressure of the meal or increase the inter space between the cage bars.
3	Expeller refuses to feed	Provide spaces between cage bars of the feed section by inserting suitable spacers between them.
4	Material entering pressure cone	Cone should be remove and clean at least once in 24 hours
5	Expeller worms get heaviest wear or tear	Replace
6	Oil drips continuously for the discharge end along cake	Propeller set the worms and collars on the shaft Put the thick brown paper rings in between the worms and collars

Common Faults and remedies of sugarcane crusher

Sl.No	Defects	Remedies
1	Flywheel of crusher rotates but sugarcane juice not extract	Adjust the reduction gear
2	Chain/belt loose fitting	Adjust
3	Reduction gear worn out	Replace
4	Motor mounting loose fitting	Tighten it
5	Motor not work	Repair/Replace
6	Juice discharge tray damaged	Replace
7	Motor wire loose connection	Tighten it
8	Roller damaged/noise	Replace
9	Cutting blade worn out	Replace

Care and maintenance of rice huller and polisher

- Check the rice mill parts before and after operating the machine (rice sieve, rice knife and cylinder core).
- Check the machine mounting nut and bolts, regularly.
- Check the regular moisture testing (broken rice grain, rice quality and power consumption).
- Carried out the daily maintenance task.
- Follow machine manufacturers maintenance instruction.
- After each use turn off the power first and then clean the grinding cavity and grinding wheel.
- Every 2 days of work, clean the dust in the machine screen, surface and the electrical appliance.
- Frequently check the flexibility of the pressure door to ensure the smooth flow of the rice outlet.
- Frequently check the belt tension.
- Add lubricant to each bearing every 3 months to ensure lubrication.
- The chaff powder collected by the cloth bag exceeds 2/5 of cloth bag and the machine needs to be shutdown to discard the chaff powder to prevent the fan of the rice mill from clogging and affecting the rice quality.

Safety precautions while operating the machine

- Use the PPE while operating the machine.
- Switch off the power when machine not in use.
- Fix the guard on moving parts of machine.
- Clean the machine before and after use.
- Don't run the defective machine.
- Don't touch the moving parts of the machine, while machine is in operation.
- Don't give over load on the machine.
- Study the machine operating guide to get more information about machine operation.
- Lubricate the moving parts before start the machine.

Care and maintenance of feed grinder cum mixer

- Lubricate the moving parts.
- Carry out the daily and periodical maintenance as per the instruction of the machine manufacturer.
- Clean the machine before and after use.
- Replace the worn out and damaged parts of the machine.
- Tighten the nuts and bolts.
- Use the cleaning solution, water and air for servicing them before storage in off seasons.

Care and maintenance of the hammer mill

- Clean the hammer mill machine daily.

- Check the machine operation, if found any defects carried out the defects before start the machine.
- Carried out the daily and periodical maintenance as per the instructions of the machine manufacturers.
- Remove and clean the screen after every use.
- Clean the suction and discharge pipe.
- Periodically replace the rotor and hammer.
- Replace the damaged belt.
- Properly adjust the belt tension.
- Tighten the mountings of the hammer mill.
- Check the electrical motor connections and blower functions while operating the hammer mill.
- Check the hammer mill ON/OFF switch if need replace it.
- Lubricate the all moving parts before start the machine.

Care and maintenance of oil extractor

- Check the lubrication situation every 50 working hours of the machine.
- Fill the butter with screw holes no dry grinding.
- Provide dust and other impurities invading into every lubricating parts of oil press machine.
- Check the motor oil quality of reducer crossing every year if need replace the oil.
- Replace the worn out/damaged parts of the oil extractor.
- After working, clean the oil cake inside oil press machine and dust and oil dirt in the machine surface.
- Overhaul the whole oil expeller every six months.
- After the production season, oil press machine is stored for a long time and do maintenance for it.
- Paint the motor and oil to the pressing shaft, cage bar and outlet devices and then, put them in dry place.

Safety tips for oil extractor and oil industry workers

- Collaborate effectively with the local emergency response community.
- Study and follow the safety operating instructions given by machine manufacturers.
- Carefully watch the machine performance while operating the machine.
- If found any defects carried out the defects before use the machine.
- Implements a 5s system.
- Maintain consistent house keeping.
- Use tools and machines properly.
- Be aware of your surroundings before start the machine.
- Wear your protective gear.

- Follow the machine operating procedure as directed by the machine manufacturers.

Care and maintenance of sugarcane crusher

- Clean the machine before and after use.
- Lubricate the bearings and oil the drive and driven gears.
- Properly adjust gap between the rotters.
- Replace the damaged parts of the sugar cane crusher.
- Carried out the daily and periodical maintenance as directed by machine manufacturer.
- Adjust the motor drive belt tension.
- Never put thick sugarcane stalk inside the unit because it can damage the motor and gear box inside the machine.

- Every four months you need to grease to the chains and sprockets inside the machine.
- Apply grease on the chain which is highly recommended for the chain and gears.
- Learn about sugarcane machine and how to works.

Safety precautions of sugarcane crusher

- Wear safety gears (personal protective equipments).
- Don't run machine without guards.
- Avoid working near pits.
- Never try to stand or work on feeder conveyor.
- Concentrate on machine crystallization.
- Clean the juice filter every operation.

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Seed treating and grain drying equipment working method

Objectives: At the end of this lesson you shall be able to

- state the function of grain dryer fan or blower
- describe the purpose of grain auger and bucket elevator
- state the construction details of grain dryer
- state the grain storage structure.

Introduction to grain drying process

Grain or seed drying is the process for conditioning the grains for safe storage. Grain is a living organism and during the drying process. Correct drying method preserves the seed/grain quality, nutritive value and visibility of grain.

Basically seed/grain drying can be done by two method viz. natural drying and mechanical dehydration or artificial drying based on source of energy. Natural drying takes place under the influence of sunlight and wind drying is of three types viz. sunlight, solar and shade drying.

The principal parameter of drying the grain/seeds: The following method is used to govern the condition of drying grains.

- Maximum temperature to which the grain is heated.
- The duration for which the grain is maintained in the heated state.
- Temperature of the drying agent supplied to the drier.
- Velocity of the drying agent
- Relative humidity of air
- Food grains are valued according to the quality of their gluten content.

Process of grain drying: As per we set them temperature and relative humidity, dryer air has the capacity to hold a specific amount of moisture. As the air moves through grains/seeds there is team for moisture from one to another grain unless moisture equilibrium exists between the grain and the air.

In forced air drying method, the moisture moves from the grain to the air. The air is used a medium to supply heat, needed for evaporation of moisture from grains and as a carrier to remove the evaporated moisture from the grain. Thus the process of drying is heat and mass transfer process.

Principle of grain drying: Grain drying is based on two principles, they are as follows:

- This layer drying
- Deep bed drying

Thin layer drying:

This layer drying refers to the drying of grains, which are entirely exposed to the air moving through the grain.

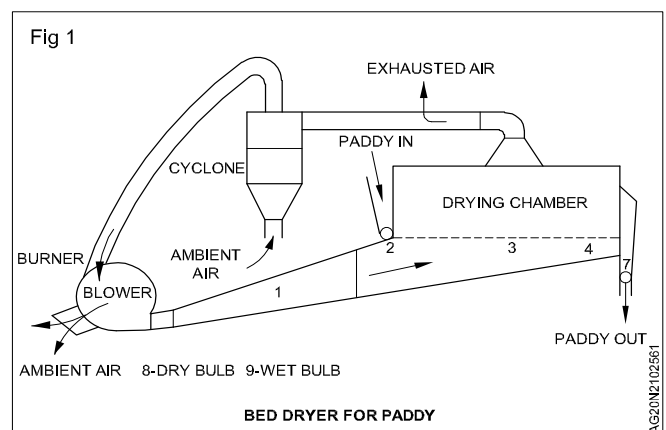
Special features of thin layer drying

1. Grain depth is not more than 20cm
2. At a grain relative humidity, the drying rate is proportional to the difference between grain moisture content and equilibrium moisture content (dry basis)
3. Rate of drying is proportional to the difference between vapour pressure of grain and vapour pressure of drying air.
4. At a given moisture content, the drying rate is proportional to the difference between the dry bulb temperatures of air in equilibrium with the grain. The dryer which uses the principle of thin layer drying is known as continuous flow driver.

Continues flow drier is of two types

- a Non mixing columnar drier
- b Mix in drier - mixing drier and mixing are available in several designs.

Deep bed drying process (Fig 1): Deep bed drying process includes bin or batch type driers, when the drying air has to pass through a layer of more than 20 cm thickness of grain, it is called deep bed drying process (Fig 1)



In this process grain does not move, grain is contained in a bin. The natural air or heated air is forced through the bottom of the bin upward through the wet grain. The temperature, humidity saturated vapour pressure and specific volume of drying air change as the air passes through the grains. Consequently, the drying potential of air decrease as it moves upward, the temperature and humidity of air entering and leaving each layer vary with time depending upon the stage of drying deep drying system consist of the following.

- Structure for holding grain
- Suitable fan or blower for supplying air
- Air distribution system
- Heating unit (if heated air is to be passed) circular bins made of plain or corrugated steel sheets are commonly used in this system. The main consideration is to provide a tight structure. Which prevents leakage of air and moisture through floors and walls.

Two types of air distribution system may be used for this drier

- 1 Perforated or bottom open ducts placed on a solid floor.
- 2 Perforated false floor with air introduced below it.

This type of system distributes air more uniformly and offers less resistance to air flow than the first one. The net area of perforation is about 15% of the gross floor area. The air flow rate is approximately 0.40 to 0.60 cubic meter/min/100 kg of wet grain, depending upon weather conditions and initial moisture content of grain. The air flow rate, limits the depth of grain to a maximum of about 2.40 meters for grain having 20% moisture. Maximum safe temperature of drying air is considered to be about 44°C for paddy.

Method of Grain Drying

There are three general methods of drying grains:

- 1 Unheated air drying.
- 2 Unheated air drying with some additional heat source drying.
- 3 Heated air drying.

1 Unheated air drying system

In this type of drying atmosphere air is forced through the grains, it is an economical and slow process. This process is connected with a method called batch or bin drying. The seeds are kept in a bin. The drier consists of a structure for storing the seed, a blower, a motor and an air distribution system.

A false floor with small perforations is used to hold the seed. The area beneath this floor consists of a chamber containing air called plenum chamber or Air chamber. The air is blown through a blower driven by a motor. This is a simple method with low investment requiring very less supervision. The main drawback is that if the weather condition is not favorable, this method becomes ineffective. The rate of drying is very slow and there are chances of damage of grains by mold growth due to prolonged drying.

2 Unheated Air Drying with Additional Heat Source drying

The method engaged additional equipment for heating purpose. This process of drying does not depend much upon weather conditions. The drying time is also reduced to a great extent. The equipments required are same as that of unheated air drying with an addition of heating

unit. It is recommended that this method be employed during humid and cold weathers, or during prolonged period of high humidity (above 75%)

3 Heated Air Drying

Heated air drying is the process of drying grain by heated air, forced through the grains. It is quick and efficient process of drying. It is independent of weather conditions but the initial cost is high.

4 Depending upon the methods of construction, a few common driers are:

- a Sack drier
- b Revolving drum drier
- c Closed circuit drier with dehumidifier

a Sack Drier:

Sack drier is useful when small quantity of grains is to be handled. In sack drying, it is desirable to use maximum air temperature of 110°F only. The bags should be turned once during the drying operation. There is a blower connected to the air chamber beneath the floor to supply air. Suitable building with perforated floor should be used for this purpose.

b Revolving drum type driver

This method consists of a large drum 1 to 2 m in diameter. 3 to 6m in length placed on a slight inclined position. At the higher and the grain is fed and as the unit rotates the grain is dropped through the air, following in the opposite direction to grain flow, in this process, continuous mixing of the seed with the drying air takes place.

c Closed Circuit Drier with Dehumidifier

A dehumidifier is used to dry the air before it passes through the seed. In this process the seed does not move during drying period. A closed circuit is needed in this process.

Grain drying fundamentals: Grain drying starts at the bottom of the bin, which is the first place air contacts. The dry air is brought up by the fan through a layer of wet grain, drying happens in a layer of 1 to 2 feet thick which is called the drying zone. The drying zone moves from the bottom of the bin to the top and when it reaches the highest layer, the grain is dry. The grain below drying zone is in equilibrium moisture content with drying air which means, it is safe for storage, while the grain above still needs drying. The air is then forced out the bin through exhaust vent.

Allowable storage time is an estimate of how long the grain needs to be dried before spoilage and maintain grain needs to be dried before spoilage and maintain grain quality during storage. In grains storage process fungi or molds are the primary concern. Many other factors such as insects, rodents and bacteria also affects the condition of storage. The lower the grain temperature is the longer the allowable storage time will be proper moisture levels for safe storage.

Purpose of grain auger (Fig 2) : A grain auger is used to put grain bin for storage or to transport the grain out of the bin to a truck or grain wagon to take to market.

This grain auger is portable and can be moved from bin to bin by using the wheels attached with it.

Types of augers: There are many types of auger are used as follows :

- Earth auger
- Hand auger

- Garden auger
- Ice auger (Fig 2)
- Grain auger

Only grain auger is used for transport the grain from the grain storage.

Fig 2



Purpose of grain bucket elevator (Fig 3): Bucket elevators are used for moving grain and other bulk materials vertically on an machine. A bucket elevator can be elevate

a variety of bulk materials from light to heavy and from fine to large lumps.

Fig 3



Early bucket elevators used a flat chain with small steel buckets attached every few inches. Most current bucket elevators use a rubber belt with plastic buckets. Pulleys several feet in diameter are used at the top and bottom. The top pulley is driven by an electric motor. The grain bucket elevators is diverter at the top of the elevator allows the grain to be sent to chosen bin.

Method of measure the grain moisture content: There are various methods to choose from when measuring moisture content in grains. These methods are grouped into primary and secondary method. The grain mate

moisture meter offers a simple and fast way to measure grains moisture content. The grain moisture come different forms. Follow the following method to measure the moisture content in grains.

- First insert a battery into the device in preparation for use and then connect the metal probe to the hand hold device by connecting to male connect or of the probe's cable into the female port on top of the device.
- Now press and hold the power button for two seconds until the LCD turns on.

Fig 4



- Now select the appropriate grain type you want to measure.
- Ensure that grains to be measured have been stored in the bag for at least two hour period to measure grains while they are still being dried, heap to a height of 50cm.
- Now insert the connected probe into the bag or heap of grains.
- The grain mate will measure the moisture content of the grains in less than 5 minutes and take away and rate the measured reading.

Grain moisture measuring primary method: Primary methods include weight measurements where grain is weighted for its initial weight. The water in the grain is then evaporated using heated air, while the weight is being monitored for changes until no change is observed. The new weight is the subtracted from the initial weight to get the moisture content. It is often called the microwave or oven method.

Secondary methods: This method is used to measure the electrical properties of the grain, which is that grain is a conductor of electricity, since it contains water. This method is often used in moisture meters. The secondary methods of how moisture is measured in grains using grain moisture meter device. The moisture meter help to measure the moisture content in different grains before and after harvest.

Measuring the moisture content of grains are dry enough, knowing the moisture content of grain is important because the high moisture content in grains leads to mold growth and aflatoxin contamination which destroy the grains.

Types of grain moisture meters: There are different types of moisture meters are used. They are as follows

- Probe type moisture meter
- Grain mate moisture meter
- Cup type meter
- Grand portable grain moisture meter

Grain storage structure: Storing of seeds and grain require a combination of different temperature and conditions, so accordingly their relative storage environment is modified to enhance a longer shelf life of the products. The storage of grains or crop kept relatively in an isolated conditions artificially created by man.

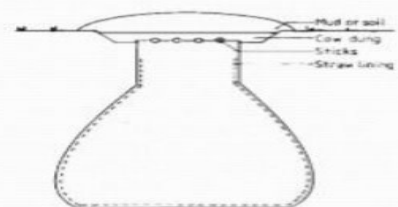
The grain or crop storage should be providing adequate protection from rodents, birds and insects and provide aeration and fumigation when it is required. The storage should be preventing losses due to moisture and temperature and capable to protect the grains from weather, fire and theft.

Types of grain storage structure Fig 5,6,7,8

Fig 5



Straw bin



Underground storage



bamboo baskets

Fig 6



(Earthen bin)



Earthen pot-pile



(Bamboo bin),



Mud house



Wooden bin



Fig 7



Gunny bags



Paper bags



Gunny bags



Metal bin storage



Fig 8



Super grain Bags



Plastic containers



Cocoon storage



Silo bags

Grain is generally stored either in bags or in bulk. In villages the bulk storage system is more common than the storage which is considered to be a practicable method of storing grain in the government godown as well as in trade. There are four types of storage structures for storage of grains.

- Traditional storage structures
- Improved storage structures
- Modern storage structures
- Farm silos

Traditional storage structures: In this type of storage the grain is generally stored in bulk, This types of storage structures having capacitors between 1 to 50 tones. The storage of grain is generally done in one of the following storage structures in the different rural and urban regions of India in bulk as well as in bag storage.

- Morai type storage structures
- Bukhari type storage structures
- Kother type storage structures
- Muda type storage structures

- Mud koltin type storage structures.
- Kanji type storage structures
- Kuthla type storage structures
- Metal steel bin type storage structure
- Bag storage structures
- Underground storage
- Straw storage
- Bamboo storage
- Wooden storage
- Metal or plastic drums

Bukari storage structure: It is cylindrical in shape it's capacity ranges from 3.5 to 18 tones and it is elevated on a wood or masonry platform. This structure is held with timber posts, which are fixed in the ground, extending up to full height of the wall, it's floor is either made of timber plants or bamboo plants plastered with mud mixed with cow dung and paddy straw, its roof is cone type generally made of bamboo or timber frame work to protect the grains from sun light and rain.

This type of structures are used for storage of paddy, wheat, maize and sorghum.

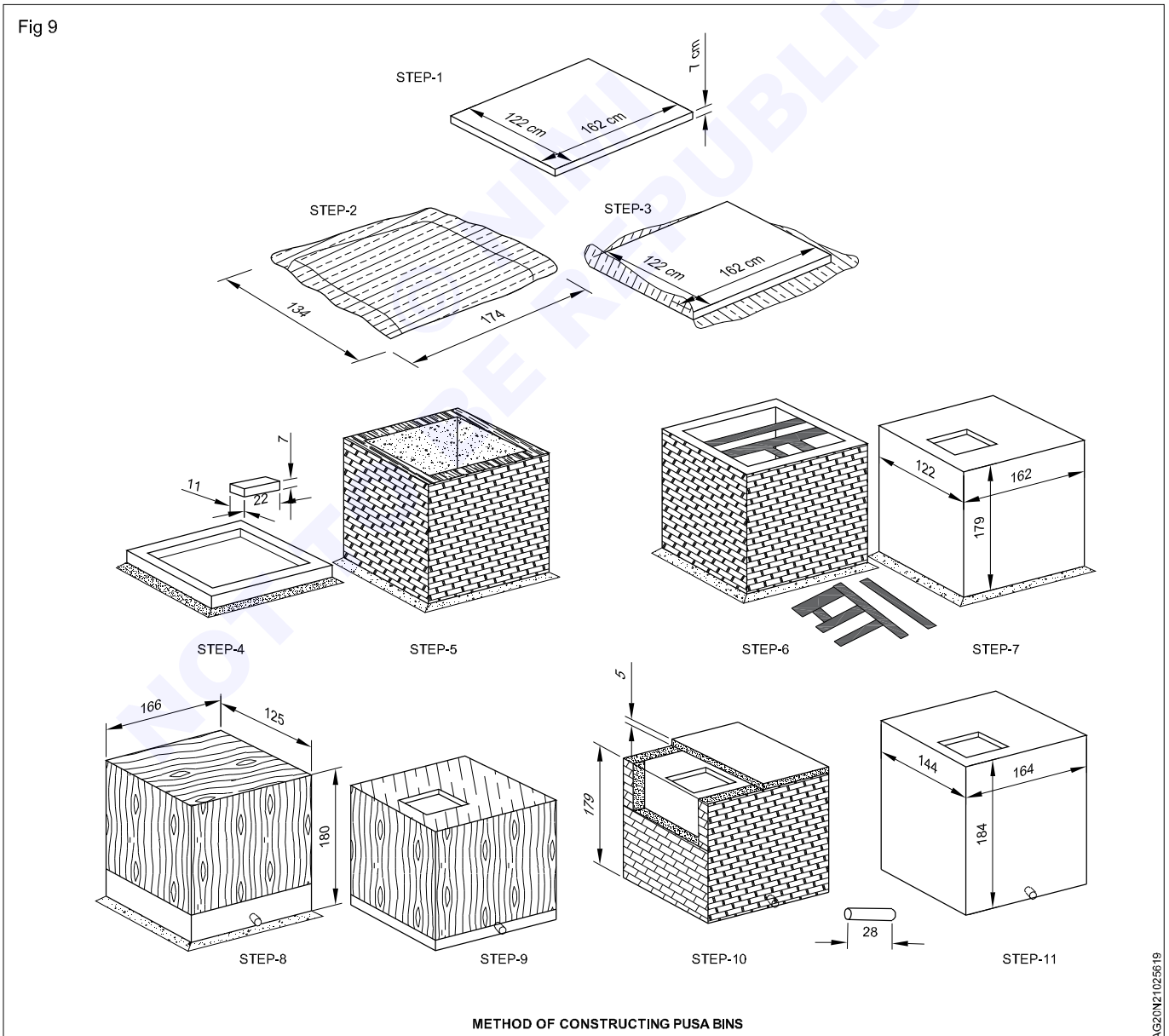
Morai storage: This structure is widely used in eastern and southern parts of India. Paddy, maize and sorghum are generally stored. The shape of the structure is like an inverted truncated cone elevated by wooden or masonry pillars. The floor is made by wooden planks and surrounded by 22 gauge corrugate metal cylinder of 90 cm height with nailing on floor timber. The edge of the cylinder is flushed with the bottom end of the floor. Rat proofing cones are also provided 1.5m above on all the four pillars to avoid damage by rats.

Kothar storage: It is used to store paddy, maize sorghum, wheat and barley. It is wooden box type structure elevated from the ground by pillars. The roof is tilted and can be made of planks or corrugated metal sheets with sufficient overhang on all sides of the structures is raised on timber pillars 1.5 cm above ground level with rat proofing cones.

Improved storage structures: There are different type of improved storage structures are used as follows.

- Pusa bin
- Metal silos
- Cover and plinth storage
- Pucca kothi
- Hollow brick storage structure
- Reinforced brick masonry bin
- Partly under ground and partly above ground bin

Pusha bin storage (Fig 9): It is rectangular in shape and has a capacity of 1 to 3 tones. The bin is constructed on a hard surface to prevent rodent attack. If the surface is not hard a platform of burn bricks is built. The surface of the wall is plastered with mud. A wooden frame with two poles is prepared and is placed at the top of the inner wall to support the roof. A small hole, 90mm in diameter is cut at the bottom in the middle of the front wall of delivery of the grain.



Metal silos storage: It's capacity to storage the grains is over 25 tones. Such silos are made of smooth or corrugated galvanized metal cylindrical in shape with flat top. It is placed on platform or plinths to a facilitate emptying. This type of structure is cement mortar layer is plastered to prevent penetration by water and pests.

Cover and plinth storage (Fig -10,11): This type of grain storage is an improvised arrangement for storing food grains in the open, generally on a plinth, which is damp and rat-proof. The grain bags are stacked in a standard size on wooden dunnage. The stacks are covered with 250 micron level developed polythene economic sheets from the top and all four sides. Food grains are generally stored in covered and plinth storage for 6-12 months periods.

Fig 10



Fig 11



It has been developed by the food corporation of India. It involves the construction of bricks pillar to a height of 14" from the ground with grooves into which wooden creates are fixed and embedded with a polythene sheet. This method is an economical way of storage on a large scale.

Hollow brick and cement bin: This type of storage structures are very strong and effect of seasons on this is minimum.

Bunker storage: These types of storage structure are used for long term storage and larger volume of grain storage.

Re-inforced bricks masonry bins: Modern grain storage bins are designed and constructed by re in forced bricks and plastered by cement concrete mixer. This type of modern permanent storage system should be selected for the safe keeping of storage grains and other products.

Modern storage structure: In India for larger volume of food grains are to be stored in bulk is silo and conventional godowns designed for bagged storage. The godown side wall are of stones or bricks masonry and sloped roofing in asbestos. The modern storage structures are as following types.

- Silo type of storage structures
- Shed type of storage structures

Silo type of storage structures: This type of storage structures are classified into two groups depending upon the relative dimensions of the container. They are classified as deep bins and shallow bins.

Deep bins: Vertical silos are comes under this type of storage structures. There are two types of vertical silos (a) flat bottom vertical silo and hopper bottom vertical silo.

Shallow bins: Squat silos are comes under shallow bins.

Shed: A horizontal sheds have been used to provide low cost, large volume, storage.

Farm silos: Farm silos are a farm structure used to store and protect the animal fodder, so that it is preserved in an ideal condition for farm animals. Animal fodder is cut and packed in the air tight silo to allow a atrial fermentation to occur. There are two type of farm silos (1) Tower silos (2) Horizontal silos

(1) Tower silos: This type of silos is a cylindrical shape and made of wood or metal. It is not suitable for Indian climate condition.

(2) Horizontal type silos: This type of silo is a pit type, bunker type and trench or state storage structures used for storage of animal fodder. There is surface as well as below ground (underground) types of storage structures used on most of dairy farms as temporary and permanent storage structures for silage.

Seeds treating and fumigation methods: Fumigation is the process to kill grain/seeds pests at all stages of their life cycle (egg, lava, pupa, adult). Chemicals are used for grain/seeds fumigation process.

Grain fumigation can be effected by types and condition of the grain size, shape and permeability of the kernels and the amount of dockage in the grain. Phosphine gas is an extremely effective fumigant for grain and other commodities either in bulk or packaged, when fumigating grain/seeds the phosphine gas dosage rate depends on the type of storage. The pest to be controlled and commodity temperature as with all fumigations seal the structure as tight as possible. Some cases you need to cover entire structure with polyethylene or gas. Proof tarpaulin.

Simply apply the fumigant directly into the grain mass or the stream of grain as it is conveyed into the silo if the bulk commodity is already stored in a silo bulk bin flat storage etc, insert the fumigant tablets or pellets into the mass with a probe.

The recirculation method gives the best results when using phosphine in a grain bin or elevator. This method requires blowers, which are usually located outside at the bottom of the silo or storage building. Ducts connected to the blowers go from the inside bottom to the top of the bin. So the air will go down through the grain and re-circulate to the top. Recirculation allows gas to penetrate areas that are resistant to natural gravity movement of the gas, this providing better insect control.

Seal the grain/seeds storage facility as air tight as possible before fumigating and ensure that the recirculation system is operating properly. After establishing airflow throughout the grain mass, turn the fans and place the phosphine on top of the grain. Recirculate air until the fumigant is thoroughly distributed. Then turn off the recirculation system and allow at least four days exposure time.

Aerate the grain by disconnecting the return air duct and operating the ventilation system until exhaust air is free of fumigant traces, as indicated by gas detector tube or audible alarm. Phosphine can be left in the grain for long periods without adverse effects and this will improve the control however aeration is needed if grain is moved soon after fumigation.

Note: The fumigant label will state the exposure time and aeration procedures read the fumigant label instruction before use it.

There is a fundamental difference between phosphine fumigation of bulk product. How ever neither tablets, pellets, bags or plates nor their residues come in direct contact with the goods in packaged commodities.

Chamber Fumigation: A fumigation chamber is an example of a tight seal. Little gas escapes from a well-constructed chamber. (Fig 12)

Compare that to placing a gas - tight tarp over commodities or structures. Tarps can provide a poor - to - excellent seal depending on:

- The condition of the trap
- The tightness of the seams
- The type of ground seal

Fig 12



Vacuum Chambers

The penetration rate of gas into the material to be fumigated is often an important factor, and is related to the material's sportive capacity. The product's penetration rate is greatly increased if fumigation is done in an airtight chamber from which the air has been removed. This is vacuum fumigation. You can remove the fumigant quite completely from by drawing a second vacuum after the proper period of exposure to the gas and then breaking this vacuum with air. This process is known as 'air washing'. Do NOT use phosphine for vacuum fumigation.

Personal protective equipment (PPE): PPE is clothing and devices used during fumigation of grain/seeds that minimize your exposure to a pesticide. The label lists the minimum required PPE. Federal and state law require pesticide users to follow the all instructions on the protect label including wearing the appropriate PPE like overall cloth, goggles, cum boot, respirators (atmosphere-supplying respirator) and air purifying respirators.

Operation of transporting and handling of farm equipments

Objectives: At the end of this lesson you shall be able to

- handling of tractor, tractor trailer
- handling of power tiller
- handling of combine harvesters.

Introduction

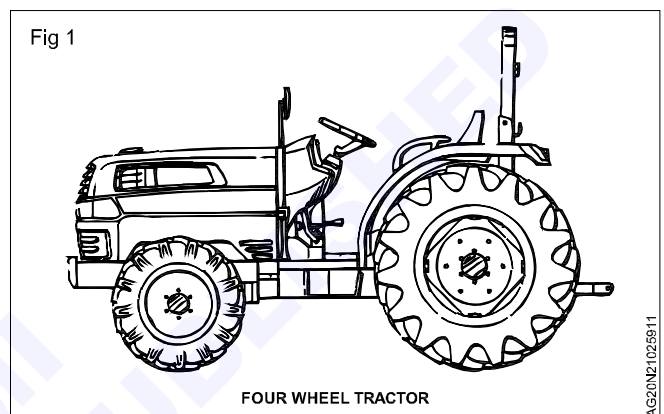
Various type of farm equipments are used for agriculture field operations for increasing the crops production and productivity of land. Farm power is used for operating different types of machinery like power tiller, tractor, tractor trailer and combine harvester cum threshing machinery and other equip like operating irrigation equipments, threshers/sellers/cleaner/grader/Transporting machineries etc.

Farm equipments like tractor, tractor trailer, power tiller and combine harvester helps for proper cultivation, harvesting, and transporting the agriculture products, from one place to another place for storing/selling the seeds/grains as farmer need. With the support of machines farmer can do his job better and quicker. Farmer will get more lessure and devote his time to other work.

Tractor: Tractor is a self propelled power unit having wheels or tracks for operating agricultural implements and machines including trailers. Tractor engine is used as a prime mover for active foods and stationary from machinery through power take off (PTO) or belt pulling.

Classification of tractor: Tractor can be classified into three classes on the basis of constructional design.

a Wheel tractor (Fig 1)



b Crawler tractor (Fig 2)

c Walking tractor (Fig 3)

Wheel tractor (Fig 1): Tractor having four pneumatic wheels four wheel tractor are popular and used everywhere.

Fig 2



crawler tractor

Crawler tractor (Fig 2): Crawler tractor also called track type or chain type tractor. In such tractors fitted with endless chain or track in place of pneumatic wheels.

Walking tractor (Fig 3): Walking type tractor is known as power tiller. This type of tractor is usually fitted with two wheels. The direction of travel and its controls for field operation is performed by the operator walking behind the tractor or power tiller.

Fig 3



Wheel tractors: Wheel tractors are fitted with various following components (Fig 1).

- 1 I.C Engine
- 2 Clutch
- 3 Transmission gears
- 4 Differential unit
- 5 Final drive
- 6 Rear wheel
- 7 Front wheel
- 8 Steering mechanism
- 9 Hydraulic control and hitch system
- 10 Brakes
- 11 Power takeoff unit
- 12 Tractor pulley
- 13 Draw bar
- 14 Control panel

This internal combustion of suitable horse power engine is used as a prime mover in a tractor. Tractor engines ranging from 8 to 200 horse power are used for agricultural tractors power tiller is fitted with 8 -12 hours power.

Operation of the tractor: The above mentioned tractor components are functioning by operator operate the tractor for the purpose of farm work.

Clutch: Tractor clutch is used to connect and disconnect the tractor engine power from the transmission gears and drive wheels, clutch transmits engine power between driving members and driven members. The power transmission system consists of clutch, differential transmission gears PTO drive final drive rear axle, rear wheel

Gear box: Tractor gear box is fitted between engine and rear axle wheels for variable speed and torque.

Differential unit: Differential unit is a special arrangements of gears to permit one of the rear wheels of the tractor to rotate slower or faster than the other, while turning the tractor on a curved partly the inner wheel has to travel lesser distance than outer wheel.

Differential lock: It is a device to join both half axles of the tractor, so that even if one wheel less resistance, the tractor comes out of the round, as both wheels move with the same speed and apply equal traction.

Final drive: Final drive is a gear reduction unit in the power train between differential and drive wheels final drive device used for final speed reduction, suitable for tractor rear wheels, it is known as final drive mechanism.

Starting mechanism: Tractor steering system governing the angular movement of front wheels of a tractor. This system minimizes the tractor operator's manual efforts in turning the front wheels with the application of leverages. The steering mechanism contains the different components like, steering wheel, steering shaft, steering gear steering gear, drag link, steering arm, tie rod, king pin etc. When the operator turns the steering wheel, the motion of steering components effects the movement of front wheel.

Tractor hydraulic control system: All tractors are equipped with hydraulic control system for operating three point hitch of the tractor. Hydraulic system works on pascal's law.

Hydraulic control system components are as follow:

- 1 Hydraulic pump
- 2 Hydraulic cylinder and piston
- 3 Hydraulic tank

- 4 Control valve
- 5 Safety valve
- 6 Hose pipe and fittings
- 7 Lifting arms

When the operator operates the hydraulic control lever the hydraulic pump draws up oil from the hydraulic oil reservoir and sends it to the control valve under high pressure. From the control valve, the oil goes to the hydraulic cylinder to operate the piston which in turn, raises the arms. The implements attached with the arms are lifted up.

Brakes: Tractor brake is used to stop or slow down the motion of the tractor, It is mounted on the driving axle and operated by two independent pedals. Each pedal can be operated independently to assist the turning of tractor during field work. In tractor two types of brake is used mechanical brake used for parking vehicle and hydraulic brake is used for field operation of tractor's movement.

Power take off unit: PTO unit is a part of the tractor transmission system. It consists of a shaft and shield cover. PTO shaft is externally splined to transmit torsional power to another machine. A rigid guard is fitted on a tractor to cover the power take off shaft as a safety device.

PTO drive belt pulley: All tractors are provided with a belt pulley. The function of the pulley is to transmit power from the tractor to stationery machinery through belt. The pulley is located either on the left right or rear side of the tractor. Pulley drive is engaged or disengaged from the engine by means of a clutch.

Tractor control board: The control board of the tractor is consists of

- 1 Main switches
- 2 Throttle
- 3 Decompression lever
- 4 Hours meter
- 5 Light switches
- 6 Horn button
- 7 Battery charging indicator
- 8 Oil pressure indicator
- 9 Water temperature gauge

When the operator operates the tractor ensure the function of dash board gauges and indicator light.

Function of dash board controls:

Main switch: When main switch is on, the current flows in the electric circuit of tractor.

Throttle lever: This lever is for increasing or decreasing the speed of the engine

Hour meter: Hours meter indicates the engine running hours as well as engine revolution per minute

Light switches: Light switch is for light points only

Horn button: It is used for operate the horn

Battery charger indicator: It indicates the charge and discharge of the battery

Oil pressure indicator: During tractor engine operation oil pressure indicator indicate the oil pressure.

Temperature gauge: This gauge indicates the temperature of water of the cooling system

Crawler tractor: Crawler tractor is a vehicle that runs on continuous tracks instead of wheels. In agriculture they are used for land cleaning and land leveling works. This type of tractor makes them suitable for use on soft, low friction and uneven ground such as mud ice and snow. It provides large area of contact with the ground. Crawler tractor is most suitable for heavy work, specially earth moving work and reclamation work and it is used for all types of agricultural works with heavy implements.

Tractor trailer: Tractor trailer construction design is suitable for attach with tractor and transport the agricultural product from one place to another place. Tractor trailer constructed with two wheels and parking stand. Tail light and brake system also provided with trailer. When the trailer is attached with tractor, need to connect the brake system and electrical system with tractor (brake electrical) connection. Tractor operator's need to learn and practice proper procedures for hitching and operating a tractor trailer in all situations.

Hawking up the trailer: Special attention to care when trailer hitch with tractor is essential safety step. The driver should be the primary person hooking up the trailer and double check that a trailer proper hook-up was made and spot for backing. Each trailer will have nuances to consider in order to hook it up correctly generally following process includes.

- Place the wheel chocks.
- Align the ball under the raised coupler.
- Lower the coupler onto the hitch and ball assembly.
- Engage the locking mechanism around the ball.
- Attach release cable around the ball onto a fixed point on the tow vehicle.
- Hook the safety chains in a crisscrossed fashion under the ball assembly.
- Connect the electrical connection.
- Lock the trailer to the hitch ball assembly.
- Ensure the trailer jack stand is retracted and secured.
- Remove wheel chocks.
- Ensure the trailer properly hitched with tractor.

After completing the trailer hitching procedure the driver should drive the trailer approximately 10 - 20 feet to ensure the trailer is seated properly, there brakes are working, the light is functioning, and the vehicle is ready to be moved.

Transportation of tractor

Agricultural tractor is a non - transport vehicle, but tractor with trailer is a transport vehicle as per Indian case law. Agricultural tractors allowed to drive on road with attaching implements. Perfectly legal to drive tractors on roads.

Though rules and regulations differ among states some are common. Almost every state requires a slow moving vehicle sign or orange triangle at right to alert other motorists. Several countries do not allow farm equipments to drive on public roads at night. That's because no matter how many flashing lights tractor have, judging the speed of an oncoming vehicle at night is difficult.

Safety tips for tractor transporting on roads

Tractor drive should be practice safe driving

- Drive the tractor slower, while two additional equipment.
- Only skilled operators should drive tractors on public roads.
- Before driving you should make sure tractor tyres are properly inflated, the wheels are bolted tightly and vehicle is balanced properly.
- Slow down around sharp curves and when going down hill.
- Never allow extra people or pets riding on the tractor.

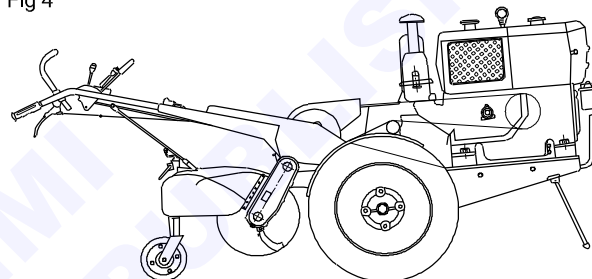
Power tiller: Power tiller is a prime mover in which the direction of travel and its control for field operation are performed by the operator walking behind it also known as walking type tractor.

Power tiller is a two wheeled agricultural implement fitted with rotary tillers, which gives a smooth resistance to all farm activities. In fact, it has multiple uses and advantages of power tiller helps in preparing the soil, sowing seeds, planting seeds, adding and spraying the fertilizers, herbicides water in addition to it also helps in pumping water, harvesting threshing & transporting crop. It is a farm machine that is mainly used to cultivate the land, it works effectively as it can reverse or cut soil simultaneously. In terms of maintenance, it is cheaper & economical to use and also requires less space for storage it.

Types of agriculture power tiller (Fig 4 & 5): On the basis of farm work, the power tillers are divided into three categories.

- 1 Mini Tillers - which best suited for gardeners with limited strength.
- 2 Mid Sized Front line tillers - Used for home gardens & moderate tilling work with great ease.

Fig 4



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Fig 5



- 3 Large Sized Rear line tillers - which are useful where one has large areas to till.

Power tiller is easy to use, it needs to be balanced and it drives automatically. It has made possible the harvesting of every kind of crop. It is the most wanted machine for puddling operation in rice cultivation.

Components of power tiller: There are many components are fitted with power tiller. Each component has different functions. The following components are used in power tiller.

- 1 Engine
- 2 Transmission gears
- 3 Clutch
- 4 Brakes
- 5 Rotary unit

All type of power tillers are fitted with I.C Engine. Power tiller manufacturers used diesel engine and other some manufacturers used kerosene engine.

Operation of a power tiller (power transmission in a power tiller)

For operation of power tiller, the power is obtained from the I.C. Engine, fitted on the power tiller. The engine power goes to the main clutch with the help of belt or chain. From main clutch power is divided in two routes, one goes to transmission gears, steering clutch and the two wheels. The other component goes to the tilling clutch and then to tilling attachment. V-belt pulley is usually used to transmit power from the engine to the main clutch.

Main clutch: Power goes from engine to main clutch through V-belt-pulley arrangement

Transmission gears: Transmission gears consist of gear, shafts and bearings. Transmission gears reduce speed of the engine and increase the torque at the wheels.

Brakes: All power tillers have braking arrangement for stopping the movement of power tiller.

Wheels: Usually two to four ply pneumatic tyre and used in power tillers for the wheels, inflation pressure ranges from 1.1 to 1.4 kg / cm².

Rotary unit: Power tillers have a rotary unit for field operation. Rotary tines are used in rotary unit for soil cutting and pulverizing purposes. Rotary tines are of three types

- a Straight tines
- b Curved tines
- c L shape blades

Uses of power tiller: Power tiller is used for the following purposes

- 1 Puddling operation in paddy fields-using rotary tines.
- 2 Cutting and pulverizing the soil in dry lands and in garden lands.
- 3 Cutting and pulverizing the stubbles of sugarcane, maize and cotton.
- 4 Sowing and inter-cultivation works.
- 5 Spraying of orchard trees.
- 6 Transporting purposes.
- 7 Agricultural cultivation, sowing, weeding and tillage.

Power tiller transportation

As defined in the central government motor vehicle rules 1989, power tiller means agricultural machinery used for soil preparation having a single axle in which the direction of travel and its control for field operation is performed by the operator walking behind it. The equipment may or may not have a riding attachment and when coupled to a trailer can be used for the transportation of goods. Further the CMVR also mandates fitment of certain electrical (parts like signaling devices, direction indicators, refactors, bulk sets on power tiller.

The power can travel on the public road with small trailer attached with power tiller manufacturers shall declare a particular model in for the purpose of its intended usage and registration.

Category A- For exclusive use in agricultural field.

Category B- Power tillers playing on the road with trailer.

At the time of purpose, the perspective owner shall specify the model and the intends to buy and give a specific declaration to the effect.

Power tillers to be registered in category. A shall bear a warning sticker at a prominent location on the power tiller "Not for Road Use" to be fixed by the dealer. Such power tillers shall be exempted from fitment of electrical appliances. Since these power tillers are agricultural equipments and not adopted for use upon the road, they need not be registered. These power tillers shall not be allowed to ply on the road. Power tiller to be registered in category B shall comply with all the requirement of central motor vehicle rule (CMVR) - 1989, including the fitment of electrical devices as specified in the type approval certificate issued by the testing agencies under rule 126 of CMVR. All such fitments shall be done only by an authorized dealer on permanent basis, prior to its registration. The concerned manufacturer shall ensure the fitments and compliance. On verification of fitment of all mandatory electrical parts, the registering authority shall register such power tillers.

Combine Harvester (Fig 6): The combine harvester is used to cut thresh winnowing and clean the grain/seeds it consists of header unit threshing unit, separation unit, cleaning unit and grain collection unit. The function of the header is to cut and gather the crops and delivery it to the threshing cylinder. The reel pushes the straw back on to the platform. While the cutter bar cuts it. The crops are thresh between cylinder and concave due to impact and rubbing action. The threshed material is shaken and tossed back by the straw rack so that the grain moves and falls through the operating the rack onto the cleaning shoe, while the straw is discharged at the rear. The cleaning mechanism consists of two sieves and a fan. The grain is covered with a conveyer and collected in grain tank.

6 Maintenance of harvesting equipment

a Maintenance of combine harvester

Maintenance at proper time and with proper techniques increases the workability, quality of work and life of machine. Hence during the operation, the maintenance should be undertaken as per maintenance schedule given below in order to cut-down break downs.

Before starting operation

Preparation of the combine harvester before starting the harvesting season should be done as follows.

- 1 Clean the diesel tank and top up with clean diesel
- 2 Change all diesel filter elements.
- 3 Change the engine oil and oil filter.
- 4 Check and reset tappet clearance.
- 5 Check the injection pressure and spray of the injectors.
- 6 Change air cleaner oil, clean air cleaner bowl and refill it with recommended grade of oil.

Fig 6



- 7 Change hydraulic oil and top-up with the recommended grade of oil.
- 8 Change sieves and straw walker.
- 9 Check batteries for its voltage, electrolyte level and gravity. If required add only distilled water to make up the electrolyte level.
- 10 Check batteries for its voltage, electrolyte level and gravity. If required add only distilled water to make up the electrolyte level.
- 11 Check oil in transmission and hydraulic system.
- 12 Check flat belts, V-belts and roller chains for proper tension
- 13 Check water level in the radiator. Use only fresh and clean water
- 14 Check tyre pressure and reset the tyre inflation (front tyre: 0.18 to 0.19) and rear tyre (0.25 to 0.28 M Pa)
- 15 Check-all nuts and bolts for their proper torque and locking
- 16 Check clearance between feeder bottom and feeder angle
- 17 Check clearance between 'cutter bar pan and conveyor worm.
- 18 Check the clearance between threshing drum and concave at front and rear
- 19 Check all electrical components for their proper functioning
- 20 Start the engine and check the following
 - a Leakages' from diesel, hydraulic, engine oil connections and
 - b Engine oil pressure, battery charging, and RPM rate system running

- 21 Check all ball ad taper roller, thrust and needle roller bearings
- 22 Check the chain for broken links
- 23 Check welding joints and broken components for replacement. Check all for any crack, bend or undersize/ loose bearing surface.

8 Hours Maintenance

Following jobs should be completed after every eight hours run of combine harvest

- 1 Grease as per greasing schedule.
- 2 Clean pre cleaner of air cleaner.
- 3 Check air cleaner oil, if it is contaminated, clean the bowl and oil of the cleaner.
- 4 Check water in the radiator.
- 5 Check for leakage and rectify if any defect.

Daily Maintenance

- 1 Clean the machine and engine from dust and straw particles.
- 2 Complete 8 hrs. maintenance and it is essential to clean the air cleaner bowl to change the oil.
- 3 Check engine oil and top up if required.
- 4 Check proper tension of V-belts, flat belts and roller chains, adjust if required.
- 5 Check tire pressure and reset if required.
- 6 Top up diesel in the diesel tank, always use clean and pure diesel.
- 7 Check the condition of knife blades and replace the damaged ones.

- 8 Check and tighten loose nuts and bolts.
- 9 Clean sieves, stone trap and straw walkers.
- 10 Grease as per greasing schedule.
- 11 Check and rectify welded joints and cracks.
- 12 Check oil level in the hydraulic tank and top up, if required.
- 13 Start the engine, run the machine for a few minutes, then check for any leakage, battery charging, engine oil pressure, engine rpm, system running, any abnormal sound from the system.

After 50 Hours maintenance

- 1 Repeat 8hrs and daily maintenance.
- 2 Open drain plug of fuel filter and drain dirty fuel.
- 3 Check fuel filter and replace if clogged.
- 4 Check water separator.
- 5 Check oil level in the F.I. Pump and top up.
- 6 Check oil level in the gear box and reduction, top up, if required.
- 7 Check battery electrolyte level and top up, if required.
- 8 Checks vent plugs of the battery and clean.
- 9 Bleed the fuel system and run the engine.
- 10 Check engine and chassis mounting bolts.

After 150 hours maintenance

- 1 Perform daily and 50 hrs maintenance.

- 2 Start the engine for a few minutes and drain engine oil and refill with recommended grade of oil.
- 3 Change oil and fuel filters.
- 4 Change the water in the radiator.
- 5 Check and reset tappet clearance, if required.

After 300 hours maintenance

- 1 Perform daily 0 hrs and 150 hrs maintenance.
- 2 Check oil in the gear box, reduction, steering column and hydraulic tank.
- 3 Check injector for correct opening pressure and spray.
- 4 Tighten engine head bolts and nuts.

Transportation of combine harvester:

Combine harvester are used to cut crops quickly and consistently, without damaging the product and clearing your fields quickly at harvest times. The tractor mounted harvester can travel on the road easily. But over size combine harvester need a truck flatbed trailer to transport it from one place to another place. Commonly truck and standard flatbed trailer is used for transport the heavy combine harvesters. The combine harvester is load on the trailer surface is designed to be loaded with stability by balancing and securing cargo on the outside edges of the trailer.

The following types of truck and trailers are used to transport the combine harvester (Fig 7) (Fig 8).

Fig 7

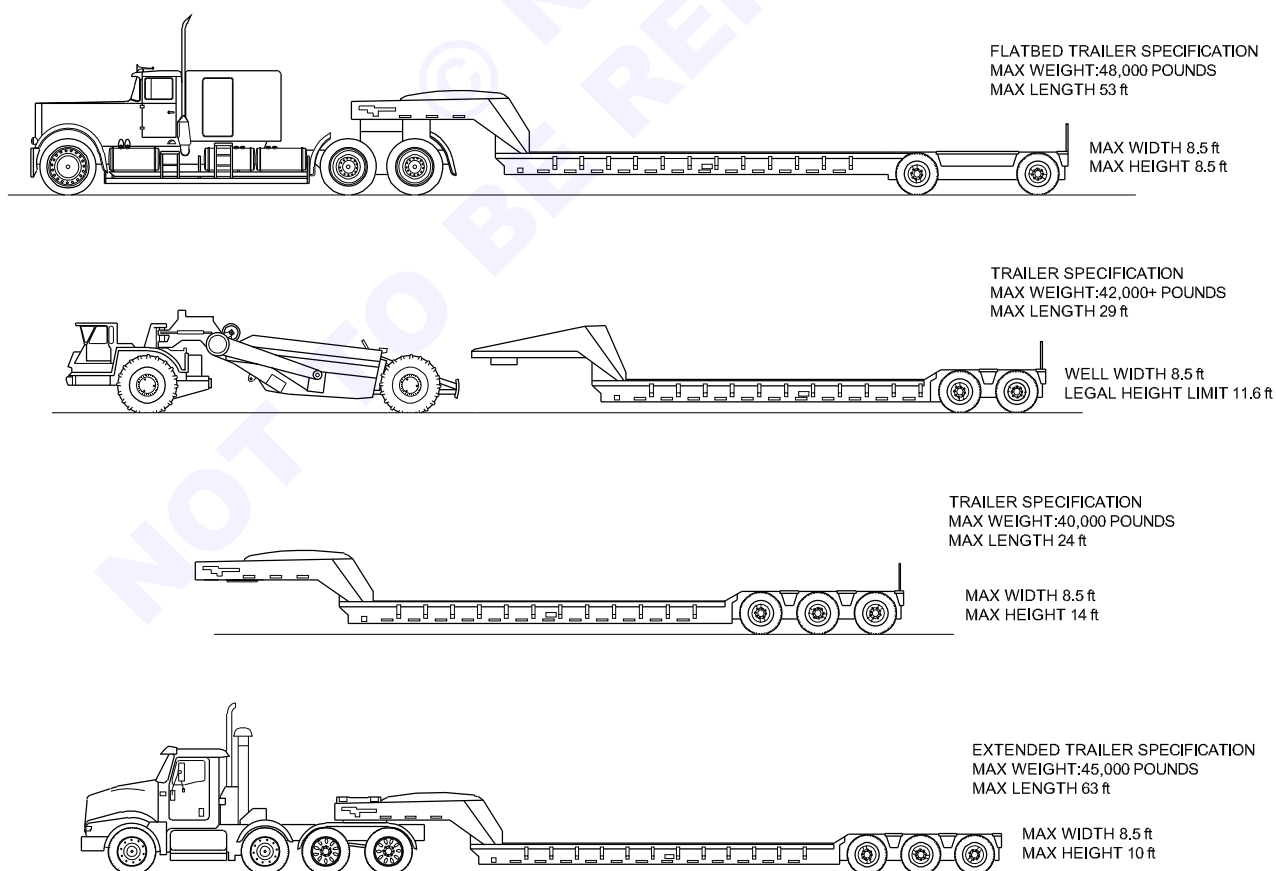


Fig 8



Procedure and Principle for farm efficient management

Objectives: At the end of this lesson you shall be able to

- state the management system
 - state the function of management system
 - state the types of management system
 - state the farm management system
 - state the process of farm management
 - state the farm management principles
 - state the structure of organization agricultural farm
 - state agricultural farm layout
 - state the layout of farm shop.
-

Introduction to management system

A management system is a set of policies processes and procedures used by an organization to ensure that. It can fulfill the tasks required to achieve its objectives. These objectives cover many aspects of the organizations operations including financial success, safe operation, product quality client relationships, legislative and regulatory conformance and worker management.

Function of management: Management main function is to plan, do, check, act approach. A complete management system covers every aspect of management and focuses on supporting the performance management to achieve the organization's goal (objectives). The management system should be subject to continuous improvement as the organization learns.

Types of management system: There are different type of management systems are used in the organization. The management system may be vary from organization to organization. Even through some common types of management system is as follows

- Process control
- Management reporting system

Concept of management system: A system is an arrangement of components designed to achieve a particular objective according to plan. The components may be either physical or conceptual or both, but they all share a unique relationship with each other and with the overall objection of the system.

Elements of management system

The important elements of a management systems are as follows.

- Output and input
- Processor
- Control
- Feedback
- Environment
- Boundaries and interface

Need of farm management system

Majority of the Indian population depends on agriculture. The agriculture sector contributes only about 18 percent of the total gross domestic product, with more than 60% population dependence, resulting in low per capita income in the farm sector. Consequently, there is a large disparity between the per capita income in the farm sector and the non-farm sector. Therefore, it is essential to deal with those issues which improve income levels of farmers. The income levels are determined by the overall production supported by proper procedure and following the appropriate principle for efficient management of organization of a farm.

Indian government takes several steps in the fast strengthen agriculture procedure. The government monitor the inputs such as seeds, fertilizer and electricity. The government make the policy and practice sustainable agriculture aims to balance the economic environmental and social aspects of farming, creating a resilient farming system in the long term.

The farm management system guide to the famous use of traditional and modern methods to increase productivity but limit environment impact agricultural management is a key force affecting soil process and functions. Triggered by biophysical constraints as well as rapid structural and technological developments, new management practices are emerging with largely unknown impacts on soils process and functions.

Process of farm management

Farm management making and implementing of the decision involved in organizing and operating a farm of maximum production and profit. Farm management draws on agricultural economics for information on prices, markets, agricultural policies and economic institutions such as leasing and credit.

Step in agricultural process: The main steps for agriculture practice including preparation of soil, sowing adding manure and fertilizers, irrigation, harvesting and storage.

- 1 Seeding
- 2 Seedling
- 3 Pollination
- 4 Irrigation

Agriculture process involved as follows

- 1 Ploughing
- 2 Sowing
- 3 Adding nutrient
- 4 Irrigation
- 5 Protecting plants
- 6 Harvesting
- 7 Storage

Steps required in the preparation of land involve

- 1 Cleaning and weeding the field
- 2 Pre - irrigation
- 3 First ploughing or tilling
- 4 Harrowing
- 5 Flooding
- 6 Leveling

Strategic design of production system for period of 1 - 5 years specially the labour, machinery system in connection with selected types of crops.

Importance of farm management in agriculture: Farm management is essential for farmland owners to maximize annual revenue of irrigation and long term capital appreciation. The farm management system follows the farmers farm land increase in value and produce annual income to land owners. But with progressive farm management, land owners can expect much higher profit.

Type of Farm management system: There are many types of farm management systems are followed in agriculture. They are as follows.

- Management practice in agricultural process.
- Soil tillage (tillage practice influence soil no emission and mainly through changes in soil aeration status and microbial activity.
- Farm land development and preparation.
- Biodiversity.
- Fertilizer.
- Proper irrigation session.
- Pesticide.
- Soil organic carbon. (Agricultural management practice influence the amount of organic matter in soil and cause changes in the rate of soil organic matter turnover.)

- Environmental system dynamic (decision-making supported by bio geochemical knowledge environmental quality management decisions are often made among competing intersects and perspectives. here in - values tradeoffs.

Agricultural management (AM) practices can have various degrees of effect on individual AM fungi as well as on the community of AM fungi as a whole. Some agricultural practices (e.g. tillage, compaction plant rotation, irrigation, soil amendments such as lime, gypsum compost) after the soil physical fertility and lead to changes in chemical fertility.

Types of agriculture: Mainly four types of agriculture followed in India. They are as follows:

- Shifting cultivation
- Subsistence farming
- Pastoralism
- Intensive farming

Agriculture is the most widespread activity in spite of its variable nature.

Basic function of agricultural management:

Management is the most fundamental level management it is a discipline that consist of a set of five general functions. They are as planning, organizing, staffing, leading and controlling the activity. These five agricultural management functions are part of a body of practices and theories on how to be a successful farm management.

Five principles of great agriculture management systems

According to principle of management, simple can be harder than complex, you have to work hard to get your thinking clean to make it simple, by learn and understanding to apply these universal principles you are more likely to excel as a manager in any farm organization.

Five principles of great management system is as follows:

The functions of management: Planning, organizing, leading, staffing and controlling.

Types and roles of managers within the organization:

The agricultural organization structure is important in successful functions. All of the farm organizations contain front line, middle and top managers. All of these management roles have specific task and duties. The managers play three main types of roles, they are decisional, interpersonal and informational.

Effective management of organizational resources:

An essential component of operationalizing the organization's strategic plan is allocating resources where they will make the most impact operational planning and budget planning process and in doing so, actively determine what resources are appropriate to be successful in achieving the plan.

Understanding and applying the four dimensions of Emotional intelligence in maximizing (labour) human potential

Effective agriculture farm managers understand the context and culture in leadership situations. Those four dimensions are a high self awareness, social awareness self-management and good social skills. These are lead to stronger and more effective managerial performance in farm activities.

Know the agricultural farm functions: The qualified agricultural farms managers can manage the farm activities. The managers bring to their work in leading crows departments divisions and farm agricultural activities is both a solid knowledge of the farm production and solid knowledge of the principles of great management. The farm managers aspirants, must first learn the characteristics of the agricultural activities and business by doing, working in the trenches and discovering how the various pieces of the organization work together to become a universal. Managers role is important in the agriculture farm work and business and capitalize on it to advance the business and improve performance.

Use of agricultural management plan: Agricultural management plan is an analysis of current farm infrastructure and management with recommendations about how to reduce energy and cost consumption.

Agricultural management process: Before cropping commences the farmer has to make important decisions which profoundly affect the subsequent operational management. Farmer choose the crop and then the operational requirements at farm level include

- Water management in relation to moisture requirement
- Tillage and land preparation
- Acidity control
- Fertilizer use
- Crop protection

Crop choice: The crop choice is dependent upon many factors of which suitability of soil is but one. However also serious limitations to cropping

- Water logged conditions, requiring drainage.
- Very low chemical fertility requiring large application of fertilizers.
- High acidity requiring limiting.
- Low traffic ability preventing intensive mechanized farming.

The above mentioned factors play an important role in crop choice, they are specific to a locality and should be studies and evaluated for site.

Choice of crops should be suited to such conditions are sage, raffia rice, wetland taro. Most crops including those mentioned above require a plentiful supply of oxygen in the water and relatively entrophic condtions for good growth In many countries organic soils are highly regarded for vegetable growing because of their excellent physical properties as a medium for plant growth. The choice of which vegetables to grow is dedicated by many factors

some of which cannot be influenced by management. The choice of which vegetables to grow is dedicated by many factors some of which cannot be influenced by management. The minimum depth of water table required for maximum yield and quality also limits the crops choice.

Choice of crops assuming deep drainage is defined as greater than 60 cm depth but some crops require a depth greater than 90 cm.

Fruit trees and horticulture initial investments are higher than other soils and banana cultivation on peats is difficult and demands good management. In general many fruit crops, though performing well are plagued by bird damage, insects pests, nematode and disease problems, therefore these crops need a high level of crop protection for success.

Miscellaneous field crops are difficult to place in the categories mentioned in above of these principle has good potential because it both flourishness in the acid conditions prevent in peal soils and it is relatively low growing and not susceptible to being up rooted at maturity. Sugarcane.

Is grown successfully on the everglade peats in northern and south India the later for maize and rice production good management and assured markets are pre request to economic feasibility of sugarcane growing.

Water management: The aim of water control system is both to provide adequate drainage for optimum crop yield and to maintain the water table at an optimum depth to prolong the life of the organic soil. Initially stagrant surplus water must be drained away thereafter the water table should be lowered to and maintained at a depth where crop growly becomes possible an adequate source of irrigation water must therefore the available.

Water management at farm level: The provision and maintenance of adequate water control systems in peat swamp as a whole. The aim of water control systems is both to provide adequate drainage for optimum crop yield and to maintain the water table at an optimum depth to prolong the life of the organic soil. Initially stagnant surplus water must be drained away, thereafter the water table should be lowered to maintained at a depth when crop growth becomes possible.

Tillage and cultivation methods: Good tillage on peat avoids breaking down the peat particles to dust. Too much tillage seeds to wind erosion of the fine particles and rapid desiccation in dry spells.

Farm management principles

Farm management principles guide the farmer or farm manager to take decisions, detail on fix principle involved in making rational farm management decisions are presented as following topic,

- a Principle of variable proportions or laws of return
- b Cost of principle
- c Principle of Substitution between inputs
- d Equi - Marginal Returns principle
- e Principle of substitution between products
- f Principle underlying decisions involving time and uncertainly

a Principle of variable proportions or laws of return:

This principle helps in deciding the optimum amount of an input that needs to be applied for cultivation of a particular crop. In agriculture law of diminishing returns will operate.

Diminishing returns: If increasing amounts of one input is added to production process, while all other inputs are held constant, the amount of output added per unit of variable input will eventually start decreasing.

b Cost principle: Cost principle is importance to the cost of production while taking production decisions.

Accounting periods

There can be two accounting or planning periods, short-run and long run. Short run is a period of time wherein at least some factors (such as land building) used in crop cultivation is fixed while others are variable and could be altered to increase the yield. The long run is generally considered to be the period wherein all the factors used for crop cultivation could be varied.

Application of the Fixed and Variable Cost Principle

In the short run, gross return must cover the variable costs. The maximum net revenue is obtained when marginal cost (MC) equals the price of the product (MR).

If gross returns are less than total costs (variable + fixed costs) but are still larger than variable costs, guiding principle should be to keep increasing production as long as added returns (MR) are greater than added costs (MC).

In the long run, gross return should be more than variable plus fixed costs (total costs).

c Principle of Factor - Substitution (Least-cost combination)

In agriculture, various inputs or practices can be substituted in varying degrees for producing a given output. A farmer can meet the nutrient requirement of the crop by applying, farm yard manure, vermicompost, neem coated urea, and other inorganic fertilizers. The inputs should be substitutable. The choice before the farmer is to either use only one particular source (organic / inorganic) to meet the entire nutrient prudent for the farmer to choose a particular combination of inputs which would be of least cost to produce a given level of output. Cost minimization will not depend only upon the cost of inputs and prices of products but also on the rate of substitution.

d `Law of Equi - Marginal Returns

The farmer has only limited capital (including own and borrowed) at his disposal and he has to use this money among cultivation of crops and other enterprises that are technically feasible in his farm. The farmer has to make a choice of the crops to be cultivated and the allied enterprises to be undertaken and also the area under the selected crop and size of enterprise, such that it would maximize the net revenue from the farm as a whole. This principle, thus, states that resources should be used in crops or enterprises where they bring not the greatest average returns. But the greatest marginal returns.

f Principle of combining enterprises

To combine the products, it is better to know their relationship.

Structures of agriculture farm: Agricultural farm structures are designated as principal of buildings. Principal structures are essential to create environmental that protect animals and crops from the elements and to minimize productivity. Most accessory building are typically used for storage or equipment working areas. Mechanization covers a wide variety of equipment from labour saving factors to sophisticated electronic sensors and robotics.

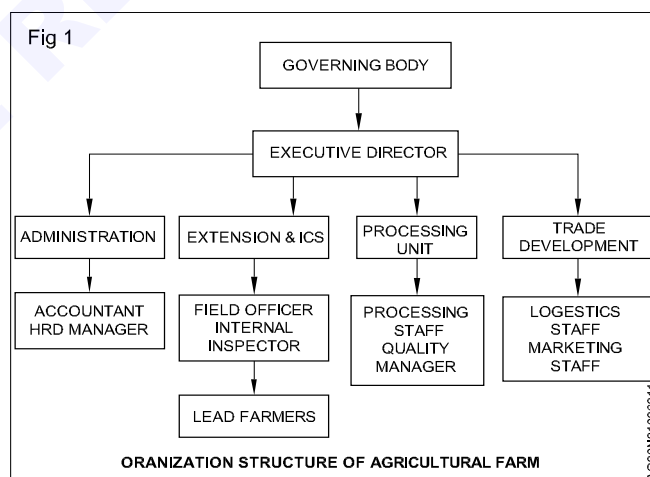
Importance farm structures

Farm structure provides the efficiency of farmers and improves the living conditions of livestock and poultry.

- Provides better efficient housing
- Reduce the post harvest loss
- Improves animal houses and storage facilities
- Regulators living environment (humidity, temperature)
- Ensure maximum comfort
- Provide better production
- Improve transportation facilities

Farm structure play a significant role in developing the agricultural sector in india. They provide better housing improve transport and storage facilities , provide modern amenities, a good level of working conditions for farmers and better living conditions for poultry and animals agricultural structures include produce storage and packing facilities livestock and poultry housing milking centres , manure storage facilities grain this silos feed preparation centres and horse riding exercise and training facilities.

Organiztion structure of agricultural farm



Agricultural farm layout: Farm layout involves the location of the fields with respect to the farmstead and public highways, the size, shape and number of fields and the location of hog, lots, feed yards etc

Example arranging or rearranging a farm layout the most important considerations are convenience and economy of agricultural products.

Types of farm layout: There are many types of farm layouts are structural even though four main farm layouts are defined as large crop farms, large stock far, farms in under developed areas, and small to medium mixed farms.

Basic steps of agricultural farm planning

- Resource list when we are going for starting a agricultural farm we must do a list of present resource.
- Identifying enterprises.
- Estimation of co - efficient to assess the size or resource for each enterprise.
- Estimating gross margins.
- Over laping the whole farm plan.

Basic steps of agricultural farm planning

- 1 Resource list- land, building, labour, machinery capital, management.
- 2 Identify enterprises - Farmer must decide to make a farm of crops or livestock or others so that he can get maximum utility from his resources.
- 3 **Estimate of co-efficient to assess the size for each enterprises:** Enterprises must be well defined on small unit as for example one acre or hectare for crops and one head for livestock, must estimate the resource needed for each enterprise (Per unit).

4 Estimating gross margin: Estimate the gross margin for a single unit of each enterprise it is required for the farmer to estimate the yield for each enterprise and expected yield.

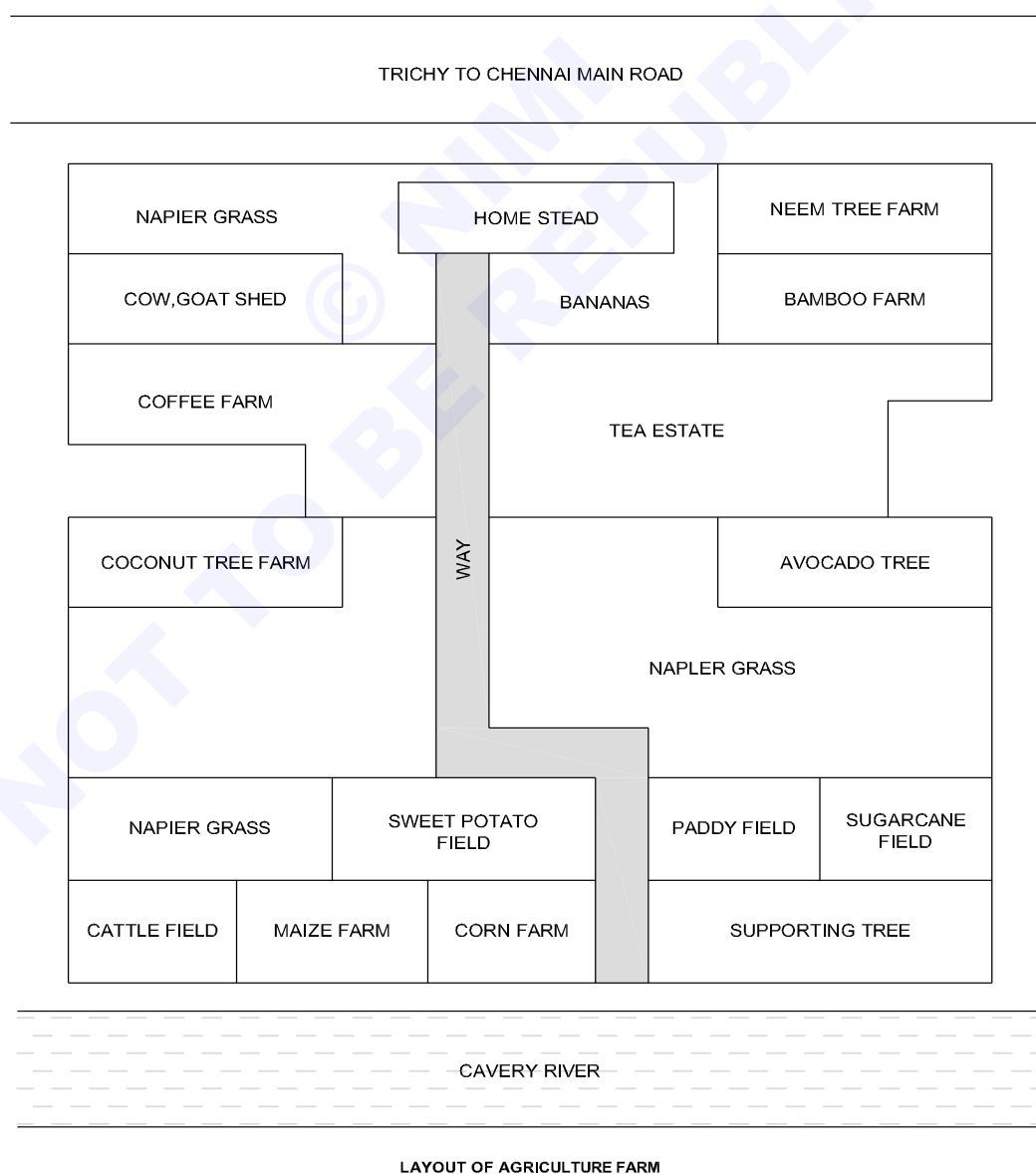
5 Developing the whole farm plan: Identifying the most and important limiting resource and identifying those enterprises with greatest gross margin per unit of resource, identify the systemic procedure to whole farm planning.

6 Planning of farm layout: Farm planning is the sketching, outliving and drawing of the farm steed as well as arrangement of the land for proper usage without the risk of land degradation.

Feature of farm layout

- Principles and features of farm layout.
- Farm layout, a farm layout refers to the compiling of physical structures such as homesteads out building waterways, contours, water supply, road and the layout of orchard, vineyards.

Fig 2



Farm shop layout: Farm shop layout is involves in nature of farm business like store the agriculture product, transport the product, sell the product or dispose the storage agriculture products. These type of shop are located near the public place, where the people can reach or identify the shop easily. The farm shop sizes are different as per need of quantity of product store in the shop.

Layout of farm workshop: Farm equipment repair shop layout include work bays, service bays, spare parts store body shop, minor and major repair bays, welding shop, painting shop, electrical work bay, inspection area, farm equipment in and out inspection area and security guard gate etc. Farm workshop is used for repair and warranty collection of farm equipments.

Layout of farm equipment workshop

- 1 In and out gate
- 2 Customer reception courage
- 3 Tractor park area
- 4 PD1 bays
- 5 Warranty bays
- 6 Fire service bays
- 7 Major repair bays
- 8 Accident repair bays
- 9 Implement repair bays

- 10 Tool room
- 11 Store room
- 12 Service bay
- 13 Paint booth
- 14 Managers room
- 15 Workers rest room

Layout of agriculture farm equipment's workshop

