

A. J. Mellor

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CONTRACT REPORT

C Pers. 97 TRAINER'S MANUAL
for training

BANTU FARM TRACTOR DRIVERS

SUBMITTED TO

Massey-Ferguson (South Africa), Limited

NATIONAL INSTITUTE FOR PERSONNEL RESEARCH
Council for Scientific and Industrial Research

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TRAINER'S MANUAL

FOR

TRAINING BANTU FARM TRACTOR DRIVERS

A. UMLAW

August 1964.

This Study was initiated under the direction of
Dr. D. J. Gouws, the Director of the National Institute for Personnel
Research.

R. F. Skawran supervised the project.

J. W. F. Böhr assisted in the initial planning of the project.

A. Umlaw carried out the field work and wrote the Manual.

P. J. Welch advised on the preparation of the job description.

L. Wepener assisted in revising the Manual and trying it out.

ACKNOWLEDGEMENTS

We wish to express our gratitude to Massey-Ferguson (South Africa) Limited who sponsored the study, provided technical information and arranged the farm visits of the field worker. The firm also provided all the necessary facilities as well as the trainees for the testing of the manual.

We appreciate the assistance and kind hospitality given to the field worker on his farm visits by:-

Messrs. A. Mendes and Sons of Modderfontein Estates,
Heidelberg, Transvaal,

Messrs. Datnow and Sons of Henley-on-Klip, Transvaal, and

Mr. J. Rhys Evans of Huntersvlei, Viljoenskroon, in the
Orange Free State.

We are grateful to Mr. B. N. Mokoatle who gave valuable advice during the initial stages of the project.

Messrs. Agricultural and Industrial Mechanisation (Pty.) Ltd., kindly allowed photographs of the tractor to be taken to illustrate some maintenance points which appear in this Manual.

Mrs. E. L. Murray and Mrs. S. Booyesen of N.I.P.R. are thanked for the typing and duplicating of this Manual.

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INTRODUCTION

This Manual is based on the Massey-Ferguson 65 Standard Tractor. Once the basic training principles involved in driving and maintaining this tractor are grasped, they can be readily applied to the other types of Massey-Ferguson tractors.

The Manual is divided into three main sections, viz. Driving, Maintenance, and Field Operations such as ploughing, planting and harvesting. Included in Driving is a lesson on traffic regulations. This lesson has been included because the tractor shares the roads with other vehicles, animals and pedestrians. It is essential, therefore, that the driver of a tractor should know the Road Safety rules and realize their importance.

The section on field operations has been dealt with in summary form. Ploughing alone could e.g. be a subject for a complete training manual since there are various methods of ploughing which depend for their choice on several factors, such as the terrain, the nature of the crop, etc. An attempt has been made nevertheless to provide some training guides with regard to these important farm activities.

The Manual does not claim to train the trainers. It must be seen as a guide which the trainer of Bantu tractor drivers may find useful. A full-time trainer is expected to be thoroughly familiar with a tractor and how it should be handled before he uses this guide for training purposes.

Bearing in mind present circumstances it is strongly suggested that trainers should be in possession of the Junior Certificate and be fully conversant with the language in which the manual is written.

Our experience has shown that, as a rule, the tractor drivers on farms have a low, if any, standard of education. They manage to carry out simple implement adjustments. It is questionable, however, whether a

totally /

totally illiterate tractor driver could carry out certain maintenance adjustments, such as adjusting the clutch, which require accurate and precise measurements. Nor would it be easy for such a driver to make use of the peg-board with its letters and figures. For this reason, we suggest that prospective trainees should either have a minimum qualification of Standard V or a comparable literacy level. Without this level of literacy it is doubtful whether they would benefit by training through this manual.

LAYOUT OF THE MANUAL

Lesson I - Introducing the Tractor:

The learner driver is shown the various parts of the tractor. Only those parts which are manipulated or referred to in driving are included. The learner driver is shown where these parts are located, and told what each one is used for.

Lesson II - Basic Maintenance Requirements:

Teaches the basic steps to be taken before the engine of a tractor is started. It teaches how to check and top up with engine oil, water and diesel fuel.

Lesson III - Familiarization with the Controls of a Tractor :

The learner driver learns to manipulate the tractor controls to move the tractor from one position to another, forwards and in reverse.

Lesson IV - Driving along Public Roads :

Teaches the learner driver the most important rules of the road and road signs. Knowledge of these is necessary, especially if the tractor is driven along public thoroughfares.

Lesson V - Tractor Maintenance:

Teaches the learner driver how to service the tractor, and how to record services on the pegboard.

Lesson VI - Operating in the Fields:

The most frequently used farm implements are introduced and the learner driver is taught how to work with these attached to the tractor.

Introductory talk given to the Learner Drivers

The trainer should begin the course with an introductory talk. This talk should not be too long as this may bore the pupils; at the same time it must include all the important points which should show the learners the rôle farming plays in our community. The importance of the rôle they will be expected to play as tractor driver must be emphasized. The driver's rôle is not simply to drive the tractor but also to see to its proper and economic handling.

The talk may run along these lines:-

"I welcome you to this very important course. I say 'important' because you are going to learn to handle a complicated and expensive machine, viz. the tractor. To appreciate the importance of a tractor, I want you to think of a large field of sugar-cane, or mealies, or potatoes. It may cover hundreds of morgen or acres. Imagine that there were no tractor to plough, harrow, plant and cultivate crops on this field. We would use oxen, or donkeys or mules. Men and women would also be employed to help these animals. Think of the number of ox teams, the number of men and women we would require, and the length of time it would take to plough just one field ! As a result, there would be no time to rest, our children would have to spend most of their time in the fields and not attend school.

"The tractor can plough, plant and cultivate most crops very fast. The driver of a tractor is the one man who does the thinking for the tractor. You must realize that farmers have to farm on a large scale because they do not think only of themselves and their families. They think of millions of men, women and children all over the country, even in other countries. They must provide food for millions of people who live in large cities and cannot provide their own crops because they have no fields. Think of anything you eat, and you will find that the farmer has contributed something, if not everything, towards its production.

"The tractor costs about two thousand rand to buy and a lot of money to keep it running. It can live for many years operating well, depending on how

the driver treats it. If he treats it well, it requires very little money to repair, because it does not have many breakdowns. What is more, the farmer trusts a driver who keeps his tractor well and this driver is in demand wherever he goes. He never runs out of a job. If, however, a tractor breaks down too often, the farmer will not hesitate to blame the driver. If the break-down is serious and is due to the driver's carelessness or ignorance, the driver may be fired and thus he and his children may suffer.

"Most of the breakdowns on tractors are due to the ignorance of the drivers who are not able to do the correct thing. You are here to learn the correct ways of handling a tractor. This course is aimed at teaching you not only how to drive the tractor but also how to service it correctly.

"Anything you will be taught here will be meaningless unless you practise it. You may have had wide experience with the tractor, but we believe you do not know everything. There is still much useful knowledge which you will be able to pick up.

"Before we start with the first lesson I would just briefly like to mention to you all the different things that a tractor driver has to do.

"A tractor driver does more than merely operate a tractor. He has to use it, together with farming implements, to carry out a variety of operations such as ploughing, cultivating, spraying crops with insecticides, operating a baler, etc. His job involves driving the tractor along roads or in the fields, adjusting speed and direction of travel by selectively (and sometimes simultaneously) manipulating gears, brakes, clutch and other controls. He also has to attach implements to the tractor by means of link connections and set or adjust implements (e. g. width of spaces between planter units) according to the particular operation to be performed. Then, he must also control and manoeuvre both tractor and attached implements to carry out farming operations, ensuring for instance that crop rows are evenly spaced and that the earth-working implements are at the correct depth, etc.

"In addition, he must keep the tractor clean, and service it at set intervals according to a standard maintenance procedure. Service requirements include, for instance, adjusting brakes, cleaning or changing oil filter element, adjusting fan belt tension, draining primary fuel filter, etc.

"While driving, he must constantly ensure that the tractor is functioning properly, e. g. by checking panel instrument readings and listening to engine sounds."

SECTION A : DRIVING

LESSON I

INTRODUCING THE TRACTOR

The object of this lesson is to let the learner driver become familiar with the tractor. He must know all the parts and controls which he will manipulate and to which he will refer when he drives it.

Equipment : Two tractors of the same type, and a long stick, about 3 feet, to be used for pointing.

Layout : The two tractors are parked in such a way that the front ends are nearly touching and facing away from the learners, while the rear ends are apart and facing towards the learners.

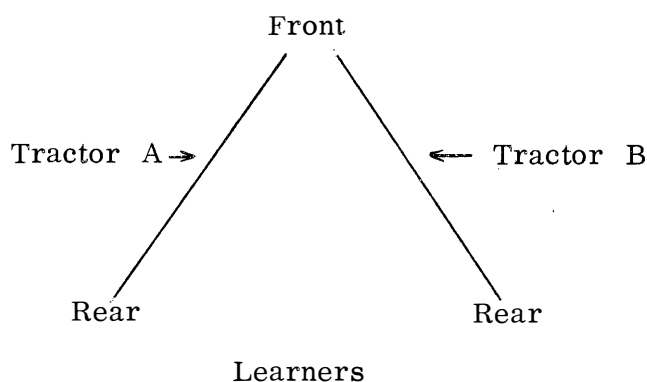


Diagram showing the position of the tractors in relation to the learners

This arrangement enables the learners to see the left and right sides of the tractor without moving from their position.

It is important that the learners know the names and location of the driving controls, instruments and other parts of the tractor before they begin to use these.

Conduct of the Lesson: The instructor names and points with a stick at the tractor as a whole. Then he points at the major divisions of the tractor, namely :

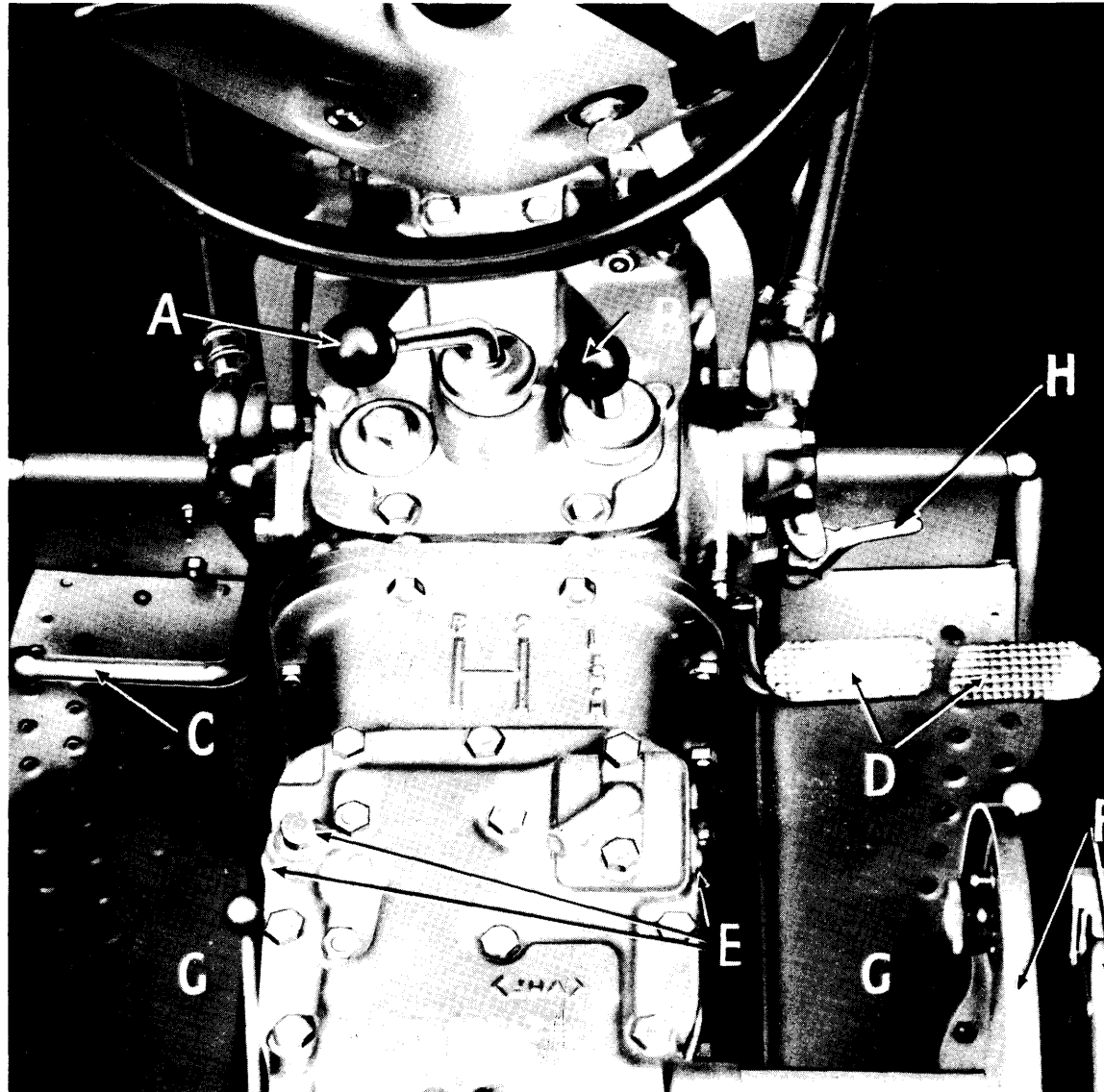


Fig. 1: Some tractor controls. A. Gear shift lever. B. Dual Range Selector lever. C. Clutch pedal. D. Brake pedals. E. Hydraulic Take-off points. F. Hydraulic control levers. G. Platforms. H. Inter-locking latch.
(from Massey-Ferguson)

1. Engine
2. Transmission
3. Wheels

Instructor then mentions those parts which are used when setting the tractor in motion, i.e. the driving controls. He explains what each control is used for. As he points at each control and mentions it by name, the learners repeat after him.

Driving controls and what they are used for:

- | | |
|------------------------------|--|
| a) Combined starter switch | - for starting the engine. |
| b) Fuel cut-off | - for stopping the engine. |
| c) Gear Shift lever | - for engaging forward and reverse gears. |
| d) Dual Range Selector lever | - for selecting the high or low range. |
| e) Clutch pedal | - for disengaging the transmission. |
| f) Brake pedals | - for stopping the tractor. |
| g) Parking latch | - for locking the brakes, i.e. keeping them on when tractor is stationary. |
| h) Seat | - for sitting on. |
| i) Foot rest | - for resting feet. |
| j) Steering Wheel | - for controlling direction of tractor. |
| k) Hand control lever | - for increasing or decreasing engine speed. |
| l) Interlocking latch | - for combining the two brake pedals. |

After he has pointed to and named each control about three times, the instructor asks every learner to identify each one of them.

He then turns to consider the second group of instruments, which indicate the way a tractor is functioning in other words, the danger signals. These are:

- | | |
|-----------------------|---|
| a) Tractormeter | - which is a combination of tachometer, speedometer and equivalent hourmeter. |
| b) Oil pressure gauge | - which indicates oil pressure. |
| c) Ammeter | - which shows the rate of battery charge. |

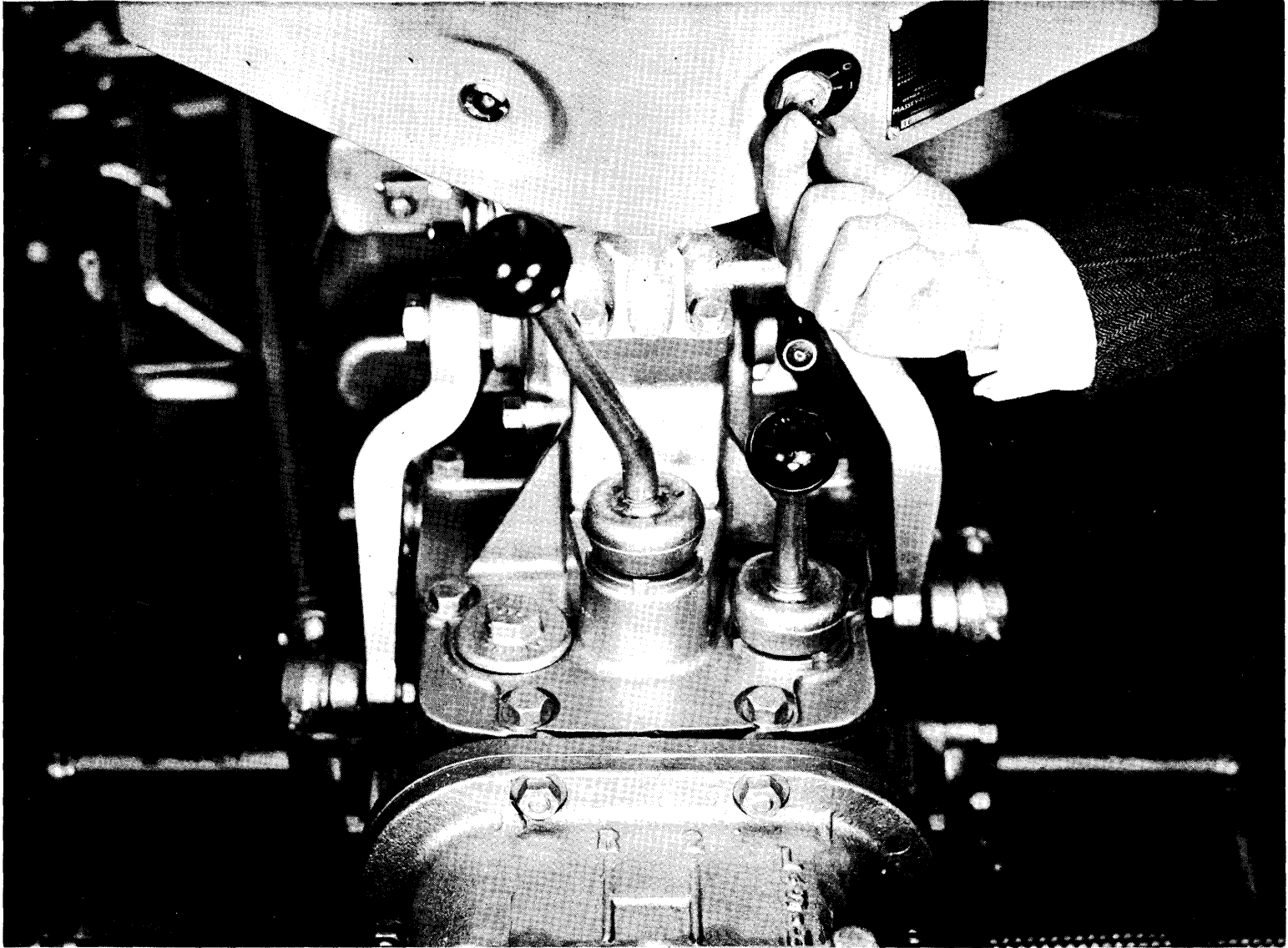


Fig. 2: Starter switch. (from Massey-Ferguson)

The third group of parts consists of those with which a tractor driver comes into contact daily, although they may not be directly involved in starting, steering or stopping the tractor. These parts are :

- | | | |
|---------------------------------|---|---|
| (i) Transmission filler cap | - | which closes the opening to the transmission. |
| (ii) Power Take-off (PTO) Lever | - | which engages the power take-off (PTO) shaft. |
| (iii) Transmission Oil dipstick | - | which is used for checking the level of oil in the transmission. |
| (iv) Hood | - | which covers the radiator, fuel tank and batteries. |
| (v) Grille | - | which acts as a screen for tractor radiator against chaff, insects, etc. |
| (vi) Fuel Tank | - | which stores fuel. |
| (vii) Battery | - | which provides electricity used by tractor. |
| (viii) Radiator | - | which stores water for cooling the engine. |
| (ix) Control levers | - | these levers connected to the hydraulic system are used for keeping the implements at required depth. |
| (x) Wheel valve | - | through which air is pumped into wheels. |

For the parts and for the instruments, instructor follows the pattern of pointing at each part, mentioning its name and its use. The learners repeat the words after him. Then he asks each learner to identify the various parts and to mention their uses, until the learners know all the parts.

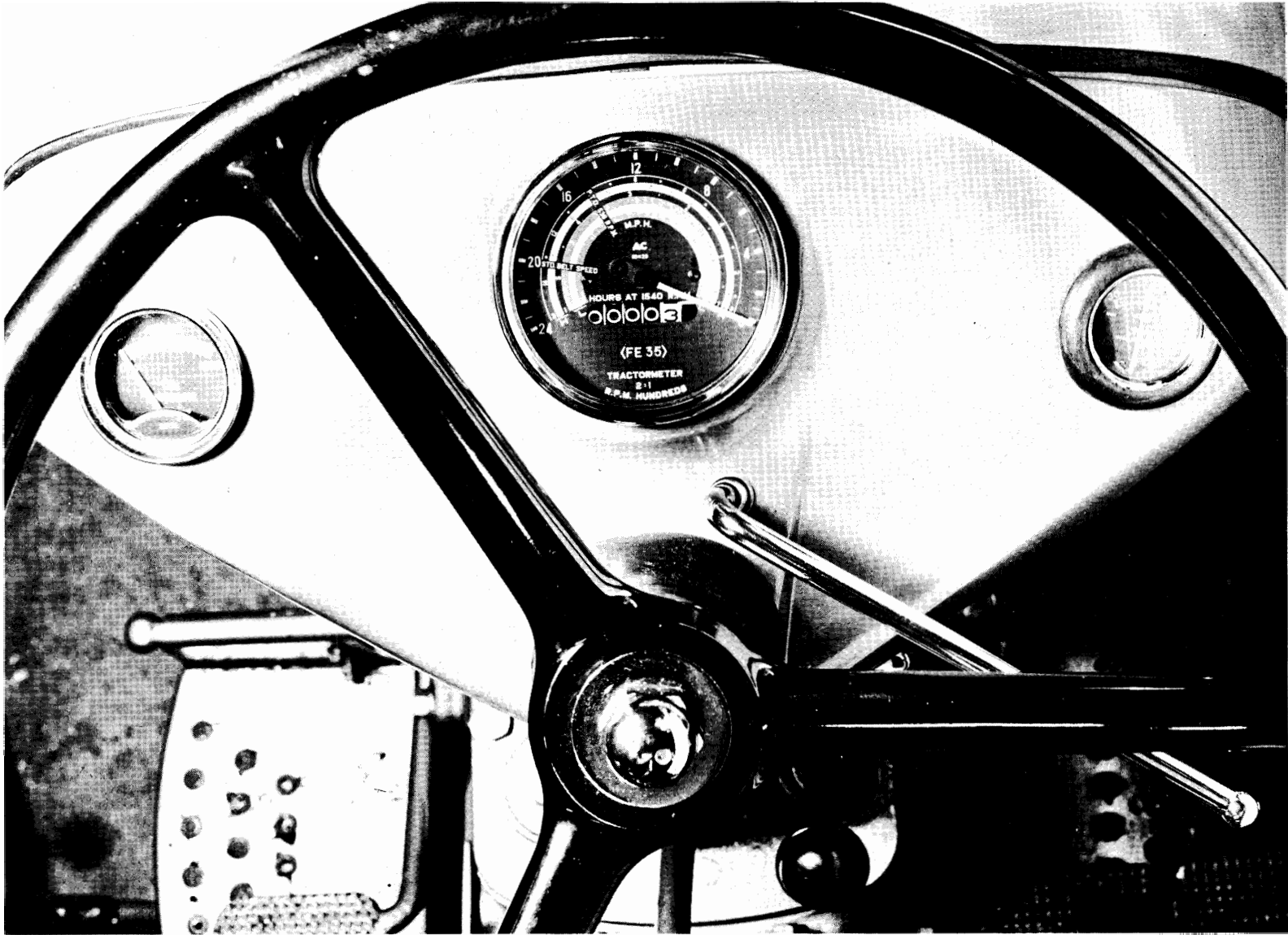


Fig. 3: Instrument panel of the M-F 35 Standard Tractor showing, from left to right:
Oil pressure gauge, Tractormeter, Ammeter. (from Massey-Ferguson)

LESSON II

BASIC MAINTENANCE REQUIREMENTS

The Object of this lesson is to teach the basic steps to be taken even before the engine of a tractor is started. It is important that the learners are made conscious of all the precautionary measures in the proper maintenance of a tractor as early in their training period as possible. These steps lead to the checking of engine oil, radiator water and diesel fuel.

Equipment : Clean mutton cloth, a stick about 3 ft. long, 2 pints of engine oil, funnel, 2 gallons diesel fuel, 1 gallon of water, one tractor.

Layout : A tractor with engine oil, radiator water and diesel fuel drained to levels just below the ones accepted as normal, is parked in front of the learners; a table or trolley, on which the rest of the equipment is placed, stands in front of the learners, between the tractor and the learners. It is important that the learners be able to see all the equipment and the tractor clearly.

Conduct of the Lesson: The Instructor revises Lesson I by asking each learner to identify and to mention the uses of the various parts of the tractor.

He then introduces the subject by explaining that a tractor, like a human being, has certain needs which are basic and must be met if that tractor has to function at all. The engine needs oil to lubricate it and water to cool it. For a tractor to move, diesel fuel is necessary. Elaborate on, and mention reasons for these needs, e.g. movement of engine parts causing friction, the fact that the engine becomes too hot when it is running and that water is therefore essential for those engines which are water cooled. A tractor will only run as long as it has fuel, but if it has too little or no water, it will not only stop, but great harm can be done, such as the cracking of the engine or parts of it, e.g. the pistons, and other parts burning out, e.g. bearings. To repair the damage caused by shortage of oil or water is very costly. It can ruin a new tractor completely.

A tractor has several other needs, but the minimum basic needs are oil, water and fuel. It must be impressed on the learners that before a

driver climbs on the seat, he must check to ensure that there is enough of each of these.

The following are exercises designed to help learners check oil, water and fuel, respectively. They are presented in descending order of importance, i. e. the first is the most important, followed by the second most important, and so on.

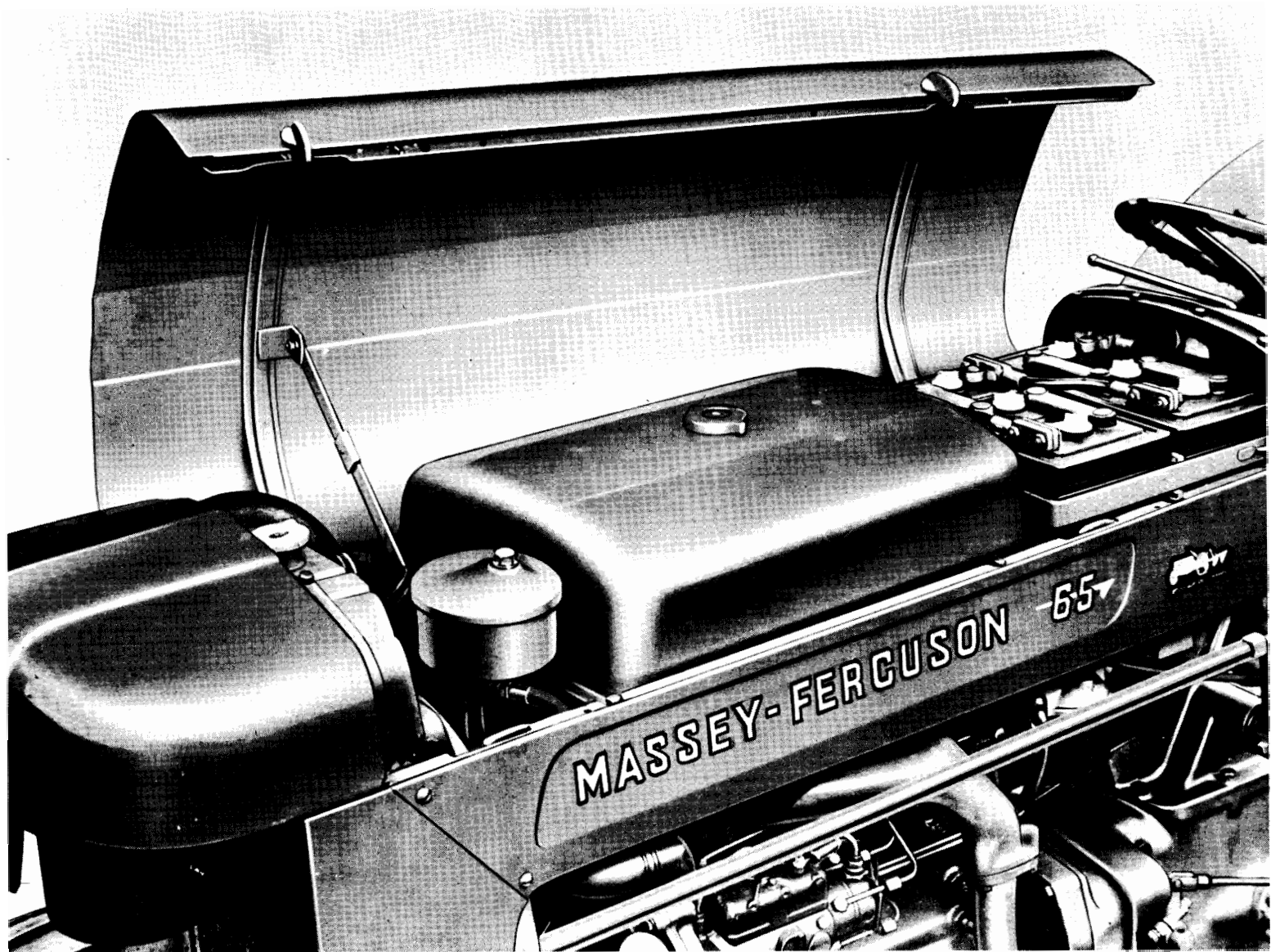


Fig. 4: Position of the radiator, fuel tank and batteries with the hood open. (from Massey-Ferguson)

Exercise 1.

Checking and topping engine oil

The object of this exercise is to train learners in the method of determining the level of oil in the engine and to add some, if this is necessary.

Check oil level when the tractor is standing level. Remember also that oil level reading must not be made immediately on switching off the engine. About ten minutes must be allowed to pass after switching off to allow oil to settle down in the sump. EMPHASIZE CLEANLINESS.

The whole process consists of pulling out the dipstick, wiping it, replacing it, pulling it out again, reading the level, wiping it and replacing it, then adding the required quantity of oil. Instructor demonstrates this process (without adding oil) three times, each time moving round with the dipstick for the learners to see for themselves the level marks and the actual oil level.

Instruct learners as follows:

Exercise 1.

Break-down Sheet

Subject: Checking and Topping-up Engine oil.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for the learner to master.	Anything in a stage which might:- Affect quality Cause injury or damage Make the work easier and any special information
1. Have tractor parked on level ground.	Before you check oil, the tractor must be level.
2. Wipe area surrounding dipstick hole.	Use a clean piece of mutton cloth to avoid any dirt dropping into engine when dipstick is removed.
3. Pull the dipstick out.	Push your forefinger into the hook and gently pull the dipstick out.

4. Wipe the dipstick.	Use a clean piece of mutton cloth. You wipe it to ensure that no splashed oil remains on the reading marks.
5. Replace the dipstick.	Make sure that you push it as far as it will go.
6. Pull the dipstick out.	Push your forefinger into the hook and gently pull the dipstick out. Keep the end of the dipstick furthest from your hand pointed downwards.
7. Read the oil level.	Note the point at which oil mark ends in relation to the "Max" and "Min" lines on the dipstick. If just below "Maximum" mark there is enough oil. If below "Min" line, oil must be topped up.
8. Replace the dipstick.	Make sure that you push it as far as it will go.
9. If oil level is low, wipe the area around filler cap.	Use a clean mutton cloth to avoid dirt entering engine.
10. Open the filler cap.	Pull one end open. If screwed on, turn the cap anti-clockwise.
11. Add oil.	Refer to colour code on the Maintenance Chart in selecting your oil. Make sure you use the right grade of oil. DO NOT USE GEAR BOX OIL. Add the oil little by little to avoid adding too much.
12. Replace cap.	Make sure that it does not introduce dirt into engine. Make sure that the cap fits well and is not askew. Tighten it up sufficiently so that it is firm.
13. Check the oil level again.	Keep on checking the oil level as you add oil. This will prevent the danger of adding too much oil.

Exercise 2.

Checking and topping-up radiator

The object of this exercise is to teach the learners the method of determining the level of water in the radiator and how to add water if there is not the required amount.

The process consists of unscrewing the filler cap, looking through the opening for level of water, adding water and replacing the filler cap. Instructor demonstrates this to learners, who should stand close by.

It is important to warn learners that they should never pour cold water into a hot engine as this may crack it. They should also be told that excessive loss of water might be an indication of a leak somewhere, and this should be checked.

If the tractor runs out of water away from a tap or another source of water it is very important that the driver of the tractor should stop the tractor immediately, switch off the engine, and walk to fetch water. HE MUST NOT DRIVE THE TRACTOR TO WHERE WATER IS.

Instruct learners as follows:

Exercise 2.

Break-down Sheet

Subject : Checking and Topping-up Radiator

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject Select suitable portions for the learner to master.	Anything in a Stage which might:- Affect quality Cause injury or damage Make the work easier and any special information
1. Wipe area surrounding filler cap.	Use clean mutton cloth to avoid dirt entering radiator.
2. Remove the filler cap.	Unscrew slowly in an anti-clockwise direction. If the engine has been running, cap may be hot, in which case it is advisable to hold it with a cloth. Keep your head away to avoid steam and hot water splashing in the face.

3. Check water level.	Look into the opening. If there is enough water, it will show at the top, inside.
4. If there is not enough water, add some.	Use clean water, in fact so clean that you too can drink it. Do not pour water if the engine is still very hot. Add water to a point where it shows at the top.
5. Replace the cap.	Screw the cap on securely.
6. Check hoses and clamps.	Open grille to inspect all the clamps and hoses leading from radiator to engine. If necessary tighten the screws on clamps with a screw driver.
7. Remove the trash from front of radiator.	Use your hand. Anything else, e.g. metal or wood, may damage the radiator. Too much trash interferes with the cooling function of the radiator.

Exercise 3.Checking and Filling up Fuel Tank

The object of this exercise is to teach learners how to check fuel in the tank and, if it is too low, how to fill it up. The process consists of unscrewing the filler cap, checking the level of fuel it contains, adding fuel and replacing the cap. As in all other operations, CLEANLINESS must be emphasized. In addition, open fires such as burning matches, must be kept away from the open tank. For this reason, it is important not to smoke when filling up with fuel.

To emphasize the danger of having open fire near fuel, instructor pours a little fuel into a receptacle. He puts this away from the tractors and other objects, strikes a match stick and then throws it into the fuel containing receptacle.

It is advisable to fill up when the engine is still hot, because it helps to prevent the formation of water droplets in the tank, caused by condensation of vapour in an empty tank. There is a chance that these water droplets could accumulate, get into the fuel system and damage the injectors.

Instruct as follows:-

Exercise 3.Break-down Sheet

Subject : Checking and Filling up Fuel Tank

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for the learner to master	Anything in a Stage which might:- Affect quality Cause injury or damage Make the work easier and any special information
1. Wipe top of the tank and filler cap.	Use a clean mutton cloth so that no dirt gets into the fuel tank.
2. Remove filler cap.	Unscrew cap in an anti-clockwise direction.

3. Check amount of fuel in the tank.	Look into the tank to see level of fuel inside.
4. Wipe funnel, nozzle of hose or suction pump.	The inside as well as the spout of the funnel or anything used for pouring fuel into tank must be spotlessly clean and dry before they are used.
5. Put funnel spout into mouth of the tank.	Ensure that the funnel rests firmly as it may easily be upset and cause fuel to spill.
6. Pour fuel into tank.	Be careful not to over-fill the tank but leave about 1 inch space from the top.
7. Replace filler cap.	When the funnel has been removed, replace the filler cap and screw it on tightly, making sure that it is straight and gripping well.
8. Wipe around filler cap and top of tank.	Some diesel fuel may have spilled over. If left there unwiped, it may attract dust to the tank.

Conclusion

Throughout this lesson, emphasis has been placed on cleanliness. The idea is to impress upon learner drivers that dirt is likely to affect the performance of a tractor if it is allowed to enter the engine. It may even block fuel pipes and thus interfere with the free flow of fuel in the tractor.

Learners must be able to see every phase of the operation. They must also practise every operation until they have mastered it. A single practice is therefore inadequate.

When the learners have mastered the exercises in this lesson, they are ready for the next, which familiarizes them with the controls of the tractor and introduces them gradually into the actual manipulation of these controls, resulting in the movement of a tractor.

LESSON III

FAMILIARIZATION WITH THE CONTROLS OF A TRACTOR

The object of this lesson is to guide learners through all the steps necessary to move a tractor from one point to another, in a forward or reverse direction. It consists of exercises which teach the learners how to correctly climb on to a tractor seat, through starting a tractor engine, up to moving a tractor in reverse into an indicated position. This of necessity requires the proper and orderly manipulation of all the tractor controls.

Equipment : A tractor, a stick about 3 feet long to be used for pointing, 4 poles about 6 ft. long and 5 inches in diameter, a jack and wooden blocks to be used as stilts.

Layout : The lesson is conducted in an open space which must have a fairly even surface. The ground must be flat. An area of 70 ft. by 70 ft. would be ideal. Nothing likely to obstruct the tractor must be allowed in the training area.

Conduct of the Lesson : Instructor revises Lesson II by asking learners to describe how the basic maintenance check-ups are carried out. Then he briefly asks the learners to identify the controls of the tractor and to mention their uses.

Instructor next tells the learners the object of the Lesson. He tells them that before they can drive a tractor, they must realize that safety is very important, whether driving during field operations or on public roads.

The Lesson is divided into several exercises. Instructor drills the learners on one exercise at a time ensuring they have mastered it before passing on to the next. He demonstrates to the learners as he explains verbally what he is doing and why he is doing it.



Fig. 5: Sitting position on tractor. Note the position of the foot. (Photograph by Graphic Arts, CSIR)

Exercise 1.Preliminary checking and sitting in Driver's position

The object of this exercise is to teach the driver the preliminary precautionary measures which must be taken before a tractor is started. These measures include checks made on oil, water and fuel, treated in some detail in Lesson II, as well as the position in which certain controls must be when a tractor is parked.

The Instructor demonstrates by checking oil, water and fuel. He mounts the driver's seat and checks that the latch on the brakes is on, the Power Take-Off lever (P. T. O. lever) is in the neutral position and that the fuel cut-off is in the stopping position.

Exercise 1.Break-down Sheet

Subject : Preliminary checking and sitting in Driver's position

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject Select suitable portions for the learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Check engine oil.	See that the level of oil as shown on dipstick is not below the minimum level mark. If there is not enough, add some.
2. Check water in radiator.	If there is not enough, add clean water.
3. Check diesel fuel.	Fill up if there is not enough.
4. Mount the driver's seat.	Mount on the left hand side of the tractor, grip the steering wheel with your left hand; place your left foot on the platform; grip the mudguard with your right hand; heave yourself up and pass your right foot near the gear levers to the right platform. Sit on the seat. Make sure the seat is firm.

<p>5. Check that the brake is engaged firmly.</p>	<p>The brake is on your right. See that it remains depressed and held in that position by the latch which should be engaged. Feel the firmness of the latch with your right hand.</p>
<p>6. Ensure that the P. T. O. lever is in the neutral position.</p>	<p>There are three possible positions marked for P. T. O. lever : "Engine P. T. O." at top, "neutral" in the middle, and "Ground P. T. O." at bottom. See that the P. T. O. lever is in the middle position - i.e. against "neutral".</p>
<p>7. Ensure that the fuel cut-off control is in the stopping position.</p>	<p>This control on the left side can either be pushed forward or pulled backwards. If the tractor is off and parked overnight, it must remain in a pulled position, i.e. position nearest the driver. This minimises the risk of the tractor engine being tampered with by children who may turn the starter key.</p>

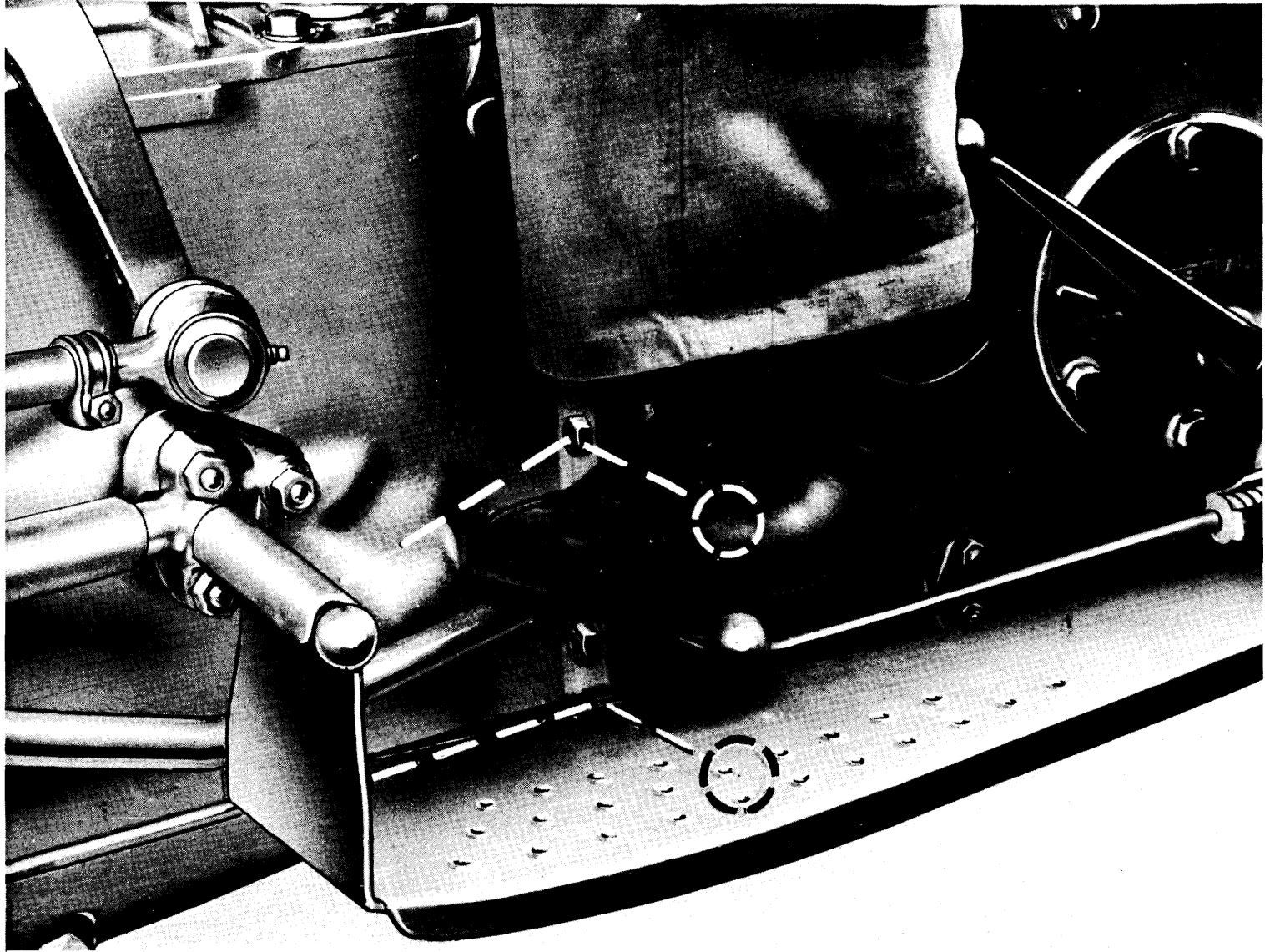


Fig. 6: Clutch pedal, showing the resting (top), First (middle) and Second (lower) foot positions.
(from Massey-Ferguson)

Exercise 2.Manipulating controls on a stationary Tractor

The object of this exercise is to teach the learners to use all the controls which are manipulated when the tractor is in motion. The learner must not only know what these controls are used for, but he must have practical experience of how they respond when manipulated. He must have the "feel" of shifting them with the tractor standing still and its engine dead.

The learner mounts the stationary tractor and then receives the following instructions:-

Exercise 2.Break-down Sheet

Subject : Manipulating Tractor controls on a stationary Tractor

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for the learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information.
1. Depress clutch pedal through 1st and 2nd positions.	Using the left foot, depress the clutch pedal. The 1st position disengages transmission and can be used in gear change without interfering with P. T. O. or hydraulics. The 2nd position disengages P. T. O. and Hydraulics as well as the transmission.
2. Shift the dual range selector to "High" position, then to neutral position and lastly, to "low" position.	With the left foot keeping clutch pedal depressed to Position 1, use your right hand to shift the dual range selector lever. The left hand holds the steering wheel. Pause at each position which the dual range selector lever engages.
3. Shift the gear lever into the various gear positions, including neutral.	With the left foot keeping the clutch pedal in the First position, use your left hand to shift the gear lever. The right hand holds the steering wheel. Start by engaging the 1st gear, then neutral position, then 2nd gear, neutral and then 3rd gear. Then reverse the positions, from 3rd gear backwards to reverse position, pausing at neutral position each time it is passed.

4. Release clutch.	Lift your left foot from the clutch pedal slowly. Lift it gradually, not abruptly.
5. Depress the foot brake.	Using your right foot, depress the brake pedal nearest the engine. It will cause the other brake pedal away from the engine to move down (the interlocking latch is engaged). Depress first gradually and then abruptly.
6. Release the brake.	Lift your foot from the brake pedal after you have depressed it a few times fast and slowly.
7. Move the fuel cut-off control to starting and then to stopping positions.	With your left hand, push the fuel cut-off control forwards to starting position. It may be necessary for you to unlatch it if it is in a latched position before you release it forwards. Pull it and latch it.
8. Set the hand throttle lever fully open and then close it.	With your right hand, turn the hand throttle lever in a clockwise direction, towards you until it cannot move any further. Then push it up to close it until it cannot go any further.

Exercise 3.Starting the tractor engine

The object of this Exercise is to proceed from mounting the stationary tractor to manipulating certain controls in such a manner that the tractor, still motionless, comes to life. In other words, the engine of the tractor is started. The exercise continues from where Exercise 1 ends, with one or two changes in control positions, e. g. the fuel cut-off control is move from the stopping to the starting position. In addition more controls are manipulated.

Exercise 3.Break-down Sheet

Subject : Starting the tractor engine

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for the learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage make the work easier and any special information
1. Check engine oil, water and diesel fuel.	Top up where necessary. Always use clean cloth, containers and water.
2. Mount driver's seat.	Mounting on the left hand side of the tractor, grip the steering wheel with your left hand, place your left foot on the platform; grip the mudguard with your right hand; heave yourself up and pass your right foot near the gear levers to the platform on the right. Sit on the seat. Make sure the seat is firm.
3. Check that the brake is engaged firmly.	The brake is on your right. See that it remains depressed, and held in that position by the latch which should be engaged. Feel the firmness of the latch with your right hand.
4. Ensure that the P. T. O. lever is in the neutral position.	There are three possible positions marked for P. T. O. lever: "Engine P. T. O." at the top, "Neutral" in the middle, and "Ground P. T. O." at the bottom. See that the P. T. O. lever is in the middle position - i. e. against "neutral".
5. Depress clutch pedal.	Use your left foot. It may require hard pressing as it offers some resistance. Let it go down to the first position.

6. Shift the Dual Range Selector Lever into "S" position.	With your left foot keeping the clutch pedal fully depressed, use your right hand to grip the knob of the Dual Range Selector Lever firmly and pull it or move it forwards towards the "S" position, depending on where it is when you grip it.
7. Shift the gear lever into the neutral position.	With your left foot keeping the clutch pedal fully depressed, use your left hand to grip the knob of the Gear lever firmly and pull it or move it forwards towards the middle position, depending on where it is when you grip it. To ensure that it is in neutral position, move it from side to side. If it moves without resistance, you can be sure it is in neutral position.
8. Release clutch pedal.	Lift your left foot from the depressed clutch pedal. Lift it gradually, not abruptly.
9. Move Fuel cut-off control to Starting position.	With your left hand, push the fuel cut-off control forward to the starting position. It may be necessary to unlatch it if it is in a latched position before you release it forwards.
10. Set the hand throttle lever half-way open.	Using your right hand, turn the hand throttle lever in a clockwise direction, half-way towards you, and leave it in that position.
11. Start the engine.	Using your right hand, turn the starter switch key clockwise to operate the starter. This should result in a spluttering sound as the engine comes to life. The engine will not start if the tractor is in gear.
12. Close hand throttle lever.	As soon as the engine starts, turn the hand throttle lever away from you in an anti-clockwise direction. This will reduce the noise of the engine to a steady rhythmic sound.

To stop the engine, you pull the fuel cut-off control towards you.

It is important that learners master the proper sequence of the stages involved. They must therefore practise this as often as necessary. One actual performance per each learner should suffice. Afterwards each learner can watch others perform and thereafter mention the various operational stages verbally. Subsequent exercises also involve the starting of a tractor. These should serve to give learners practice.

Exercise 4.Manipulating controls - on a stationary tractor with its engine running.

It is advisable that learners become thoroughly familiar with the controls of the tractor and learn to pick up various cues of its performance before they are allowed to move the tractor from one point to another. This minimises the risk of the tractor running out of control. It also helps to develop confidence in the learner driver.

The aim of this exercise is to give each learner an opportunity of manipulating the controls of a tractor whose engine is running, without moving the tractor.

Equipment consists of a jack and wooden stilts.

The layout : The rear wheels are jacked up and the wooden blocks are used as stilts to keep the rear wheels in a raised position - about 3 inches from the ground. A piece of rock is placed in front of each of the front wheels to stop the front wheels from moving forwards.

Conduct of the exercise : Learner mounts the tractor and is directed by the instructor on what to do. Learner is instructed to start the tractor, change gears, increase speed, etc, following the sequence used in actually operating the tractor.

Instructor gives the following orders:-

Exercise 4. Break-down Sheet.

Subject : Manipulating control levers on a stationary tractor with its engine running.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for the learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Start the engine.	Using your right hand, turn the Starter switch key clockwise to operate the Starter. This should result in a spluttering sound as the engine fires.

2. Close hand throttle lever.	As soon as the engine starts, turn the hand throttle lever away from you in an anti-clockwise direction. This will reduce the noise of the engine to a steady rhythmic sound.
3. Depress clutch pedal.	Use your left foot. It may require hard pressing as it offers some resistance. Push it to Position 1.
4. Shift the dual range selector lever into Low range position.	With the clutch pedal depressed, use your right hand to grip the knob of the dual range selector lever firmly, and then shift it into Low range position indicated by the letter "L". In this range, the tractor is powerful but not as fast as when the High range is engaged.
5. Engage First gear.	With the clutch pedal depressed, use your left hand to grip the knob of the gear lever firmly. Move the lever along neutral line to the left, then press it towards you into first gear position as indicated by the number 1.
6. Grip the Steering Wheel.	With both hands, hold the steering wheel firmly at 1.50 o'clock position. Keep your head up and look straight ahead.
7. Release brakes.	With the back of your right foot, disengage the latch by giving it a slight kick backwards.
8. Release clutch.	Lift your foot gradually from the clutch pedal. As you do so, the clutch pedal also comes up and the rear wheels start turning.
9. Place both feet on their respective foot rests.	You do not need the use of your feet as soon as the tractor is moving, except when you are stopping it. It is unwise to keep the feet on the platforms because when you want to use them in an emergency they may be blocked by the various pedals.
10. Open the hand throttle gradually.	Pull the lever towards you and watch the tractor meter. On the M-F 65 Standard Tractor, the pointer moves in a clock-wise direction, indicating the increase in engine revs. There is a gradual rise in the pitch of the engine sound. The wheels also rotate faster. The Rev. meter in tractor meter must be between 1750 and 1800 when the tractor is operating.

11. Close the hand throttle lever.	Move the lever away from you and watch the tractormeter. The pointer moves in an anti-clockwise direction, indicating reduction in engine revs. There is a gradual lowering of the sound pitch of the engine. The wheels rotate more slowly.
12. Depress the clutch pedal.	With your left foot, depress the clutch pedal gently but firmly to the first position. The wheels turn more slowly until they stop.
13. Apply the brakes.	Depress the brake pedal gradually. Then engage latch to lock the brakes.
14. Shift gear lever to the neutral position.	With the clutch pedal fully depressed, shift the gear lever into the neutral position. To make sure that it is in the correct position, move the lever sideways. Remove foot from the clutch pedal.
15. Stop the engine.	Pull the fuel cut-off control and this will stop the engine.

Exercise . 5.Setting tractor into forward motion and stopping.

By manipulating some controls in Exercise 2, the learner was able to start the engine of the tractor. By manipulating more controls, he should be able to move the tractor forwards or backwards. This exercise shows the learner what further controls to manipulate and how to manipulate these so that the tractor moves forward. The tractor will move forward for some distance, about 3 feet, and then stop. The learner will be shown how to stop the tractor.

After the tractor engine has been started the following controls are manipulated so as to set the tractor in motion.

Dual Range Selector lever

Gear lever

Brakes

Steering wheel

Instructor demonstrates to the learners and then gives learners a chance to practise.

Exercise 5.Break-down Sheet

Subject : Setting tractor into forward motion and stopping

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Start the engine.	Using your right hand, turn the starter switch key clockwise to operate starter. This should result in a spluttering sound as the engine starts.
2. Close hand throttle lever.	As soon as the engine starts, turn the hand throttle lever away from you in an anti-clockwise direction. This will reduce the noise of the engine to a steady rhythmic sound.

3. Depress clutch pedal.	Use your left foot. It may require hard pressing as it offers some resistance. Push it down to the first position.
4. Shift the Dual Range Selector Lever into Low range position.	With the clutch pedal depressed, use your right hand to grip the knob of the Dual Range Selector lever firmly, and then shift it into Low range position, indicated by a letter "L".
5. Engage the First gear.	With the clutch pedal depressed, use your left hand to grip the knob of the gear lever firmly. Move the lever along the neutral line towards your left, then press it towards you into 1st gear position as indicated by the number 1.
6. Grip the steering wheel.	With both hands, hold the steering wheel firmly at 1.50 o'clock position. Keep your head up and look straight ahead.
7. Release brakes.	With your right foot, kick the parking latch backwards with the heel. This disengages brakes.
8. Let the tractor move.	Lift your foot gradually from the clutch pedal. As you do so the clutch pedal also comes up and the tractor moves forward. If you lift your foot too abruptly, it causes a sudden jerk of the tractor forwards. At first move the tractor for a short distance, about one yard.
9. Steer the tractor straight.	Do not turn the steering wheel. Place your feet on the foot rests and let them rest there.
10. Stop the tractor.	With your left foot, depress the clutch pedal gently. Apply brakes. Release clutch. Lock brakes. Place Dual Range Selector lever into neutral.

After each trial, instructor reverses the tractor to the starting position. This should be at a point which leaves sufficient space for forward movement of the tractor.

At this stage, nothing has been said about increasing tractor speed. The slower the tractor the less risk of it getting out of control. It is advisable that the instructor climb onto the back of the tractor and accompany the learner drivers on their first attempts.

The first attempts should be over very short distances .
As the learner becomes familiar with the controls, the distance should be gradually increased. As the learner becomes accustomed to working the controls, he is told to keep an eye on the instruments and to rely on the sound made by the working tractor and thus to detect any abnormalities which may occur.

Exercise 6.Setting tractor into reverse motion and stopping.

The stages of setting a tractor into reverse are the same as those followed when moving forwards, with this difference that instead of selecting the 1st gear, or any of the forward gears, the driver engages the reverse gear. Instead of looking forward, the driver turns his head and faces backwards. This means that the sitting posture alters and the way the steering wheel is handled is slightly affected. During the first few trails, the tractor moves a short distance at a time. The distance increases gradually.

Starting at a point when the engine is running, the instructor makes sure that there is enough room behind the tractor and gives the following instructions:-

Exercise 6.Break-down Sheet.

Subject : Setting tractor into reverse motion and stopping.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Depress clutch pedal.	Use your left foot. It may require hard pressing as it offers some resistance. Push it down to position 1.
2. Shift the dual range selector lever into Low range position.	With the clutch pedal depressed, use your right hand to grip the knob of the dual range selector lever firmly, and then shift it into Low range position, indicated by letter "L".
3. Engage Reverse gear.	With the clutch pedal depressed, use your left hand to grip the knob of the gear lever firmly. Move the lever along the neutral line towards your left, then push it away from you into reverse gear position as indicated by the letter "R".
4. Grip the Steering Wheel.	Using your left hand, hold the steering wheel firmly.

5. Release brakes.	With the back of your right foot, disengage the parking latch by giving it a slight kick.
6. Face backwards.	Turn your head first to the left to see if there is anything likely to block the way, and then to the right and keep it there, looking backwards a few yards from the tractor. Your right hand should help balance your twisted body by holding on to the back of the seat.
7. Let the tractor move.	Lift your left foot gradually from the clutch pedal. As you do so, the clutch pedal also comes up and the tractor moves in reverse. If you lift your foot too abruptly, it causes a sudden jerk of the tractor backwards.
8. Steer the tractor straight.	Do not turn the steering wheel. Place your feet on the foot rests and let them remain there. Let the tractor move for a short distance and then stop it.
9. Stop the tractor.	With your left foot, depress the clutch pedal gently. Apply brakes by depressing brake pedal. Engage neutral gear. Release clutch. Lock brakes by engaging latch.

N. B. The side to which the head is turned to look backwards depends on the individual's choice. Some find it easier to turn to the left. Others prefer the right hand side.

Exercise 7.Making right and left turns forward.

At this stage, the learner should be familiar with moving a tractor straight, both forwards and in reverse. The present exercise introduces turns to the right and to the left while the tractor is moving forwards.

The first thing to demonstrate is turning the steering wheel to the right, i.e. clockwise, while the tractor is in motion. The turn must be very slight so that the tractor moves in a wide curve to the right. Then turn the steering wheel slowly to the left, i.e. anti-clockwise, while the tractor is in motion. This will cause the tractor to make a wide curve towards the left. The instructor drives the tractor round, in a clockwise direction, in this way forming a wide circle. Then he brings the tractor sharply to the centre, from where he starts steering it anti-clockwise so that it again turns in a wide circle.

He lets each learner practise these wide circular turns.

Next, the instructor demonstrates sharp turns to the right followed by sharp turns to the left, with emphasis on safety precautions, e.g. reducing speed considerably before making a turn. He gives learners practice runs on these turns.

The third turns are sharp U-turns to the right and to the left, necessitating the corresponding use of right and left brakes.

Exercise 7.Break-down Sheet

Subject : Making right and left turns forward.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Move the tractor forward.	Grip the steering wheel firmly with both hands, and let the tractor move straight.
2. Make a turn to the right.	With both hands, turn the steering wheel slightly and gently in a clockwise direction. Keep the steering wheel at that position. Steering is lighter if the tractor is in motion.

3. Make a turn to the left.	With both hands, turn the steering wheel slightly and gently in an anti-clockwise direction. The first few turns will straighten up the tractor. The next few turns will gradually turn the tractor to the left.
4. Keep the tractor straight.	Swing the steering wheel slightly to the right. As the steering turns, the front of the tractor also gradually assumes a straight position. Look at the right front wheel. When the tractor is straight, it will also be straight.
5. Make a sharp right-angle turn to the right (and bring tractor straight again).	REDUCE SPEED. Turn the steering wheel in a clockwise direction, but make more turns than before. As soon as the front of the tractor faces your right, swing the steering wheel slowly to the left in an anti-clockwise direction. Watch your right front wheel. When it is parallel to the tractor, stop turning the steering wheel.
6. Make a sharp right-angle turn to the left (and straighten tractor again).	REDUCE SPEED. Turn the steering wheel in an anti-clockwise direction, making a few such turns until the front of the tractor faces your left. Then swing the steering wheel in a clock-wise fashion until the right front wheel is parallel with the tractor, then stop turning the steering wheel.
7. Make a sharp U-turn to the right.	Do not reduce speed. Turn the steering wheel in a clockwise direction. As you do so, depress the brake pedal on the right (i.e. the one away from the tractor). This will cause the right rear wheel to stop moving but it will turn on one spot, while only the left rear wheel moves in a circle, thus causing the tractor to turn very sharply. As soon as the tractor faces the direction from whence it came, release the brake and straighten the steering wheel.
8. Make a sharp U-turn to the left.	Do not reduce speed. Turn the steering wheel in an anti-clockwise direction. As you do so, depress the brake pedal on the left (i.e. the one nearest the tractor engine) with your right foot. This will cause the left rear wheel to stop moving but it will turn on one spot, while only the right rear wheel moves in a circle thus causing the tractor to turn very sharply. As soon as the tractor faces the direction from whence it came release the brake and straighten the steering wheel.

A point to remember.

In ordinary turning, either to the right or to the left, it is important to reduce speed considerably. If you make a fast turn you run the risk of over turning the tractor.

When you make a sharp U-turn which necessitates the use of one or the other foot brake, do not reduce speed to the same extent as when you make an ordinary turn. If you reduce it too much, the engine stalls and the tractor stops.

Exercise 8.Making right and left turns in reverse.

The previous exercises should give learners enough training in controlling the direction of a tractor while moving forwards. The present exercise introduces the control of a tractor's direction in reverse.

The first turns are very simple, involving a slight turn of the steering wheel while the tractor slowly moves backwards. The tractor, therefore, does not make sharp turns, but moves in wide circles. First, it moves to one direction and then to another. The idea is to make the learner familiar with the way he should turn the steering wheel in order to control the direction of the tractor. It is only after the learner can easily control the direction of the tractor that more complex movements, requiring precise controls of the steering wheel such as those involved in parking, can be introduced.

Starting at a point when the tractor engine is already running and the reverse gear has been engaged, the instructor gives the following instructions to the learner:-

Exercise 8.Break-down Sheet

Subject : Making right and left turns in reverse.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Grip the steering wheel firmly.	Using your left hand, grip the steering wheel at a position where you have 10 on a clock.
2. Face backwards.	Turn your head first to the left to see if there is anything to block the way, and then to the right and keep it there. Your right hand should help balance your twisted body by holding on to the right mudguard.

3. Let the tractor move.	Gradually lift your left foot from the clutch pedal. As you do so, the clutch pedal also comes up and the tractor moves in reverse. If you lift your foot too abruptly, it causes a sudden backwards jerk of the tractor.
4. Turn the steering wheel.	With your left hand, turn the steering wheel slowly and gently to the right in a clockwise manner. Keep the steering in that position whilst the tractor moves in a wide circle towards the direction you are facing.
5. Stop the tractor.	At the point where the tractor started depress the clutch pedal and the brake pedal to stop the tractor.
6. Let the tractor move.	Turn your head to the left. Lift your left foot gradually from the clutch pedal. As you do so, the clutch pedal also comes up and the tractor moves in reverse. If you lift your foot too abruptly, it causes a sudden backwards jerk of the tractor.
7. Turn the steering wheel.	With your left hand turn the steering wheel slowly and gently to the left in an anti-clockwise manner. Keep the steering in that position whilst the tractor moves in a wide circle towards the direction you are facing.
8. Stop the tractor.	After making a few circular turns, depress the clutch pedal, and the brake pedal and when the tractor has become stationary, shift gear lever into neutral position.

Exercise 9.Reversing along a predetermined course.

The previous exercises should have given learners enough training in controlling the direction of a tractor while moving forwards. The present exercise introduces the control of a tractor's direction in reverse.

Experience has shown that controlling the tractor's direction while reversing is more difficult than controlling it while moving forwards. It is therefore necessary to spend some time coaching learners and giving them practice in reversing.

The aim of this exercise is to train learners in making right and left turns along a predetermined course while reversing.

Instructor first draws a wavering line on the ground like this



He stops the tractor at Point A, with the rest of the line behind the tractor. The right rear wheel stops on top of the line. He then sets the tractor into backward motion, trying to keep the right rear wheel running along the line, following it to the right and to the left.

The sitting position is similar to that for Exercise 8. Whereas in the previous exercise, the learner turned to face the left and right sides respectively, the learner now, to begin with, only faces the right side. When, however, it is the left wheel which runs along the line, the learner faces the left side.

To be able to steer along the line, without making wide swerves the turning of the steering wheel must be gentle and gradual. In following the direction, you turn the steering wheel to the right (clockwise) if you want the tractor to move to the right, and to the left (anti-clockwise) if you want it to move to the left. Keep your eyes some distance from the tractor so as to have the whole line in view and not just a small portion of it.

Exercise 10.Reversing straight into a limited parking space.

This exercise is based on the skill acquired in Exercise 6. An important point to remember and emphasise to the learners is the change in the direction of turning in reverse.

Whereas in forward driving turning a steering wheel clockwise will cause the tractor to turn to a clockwise direction, in reverse the direction of the tractor will be the opposite of the direction of the steering wheel. In other words, in reverse, when you swing the steering wheel clockwise, the tractor turns in an anti-clockwise direction, and when the steering wheel is swung in an anti-clockwise direction, the tractor moves in a clockwise manner.

The next important point to mention is that the more turns you make in swinging your steering wheel, the sharper the turn of the tractor. If you turn the steering wheel only slightly, the tractor will turn so slightly that it will describe a wide curve.

The third point to mention is that it is very important to slow down a great deal if you want to make a very sharp turn, whether moving forwards or in reverse.

In reversing in to a limited parking space the three points mentioned above should be kept in mind all the time.

Equipment includes poles which can be supported to stand upright.

The lay-out : Tractor is parked. A pole is placed at each corner outside the tractor. The two poles near the rear wheels of the tractor are placed first, allowing about eighteen inches distances between each rear wheel and the pole, and about 2 feet behind the wheels. The front poles are placed directly in line with each rear pole and about 2 feet in front of the line where the front wheels end.

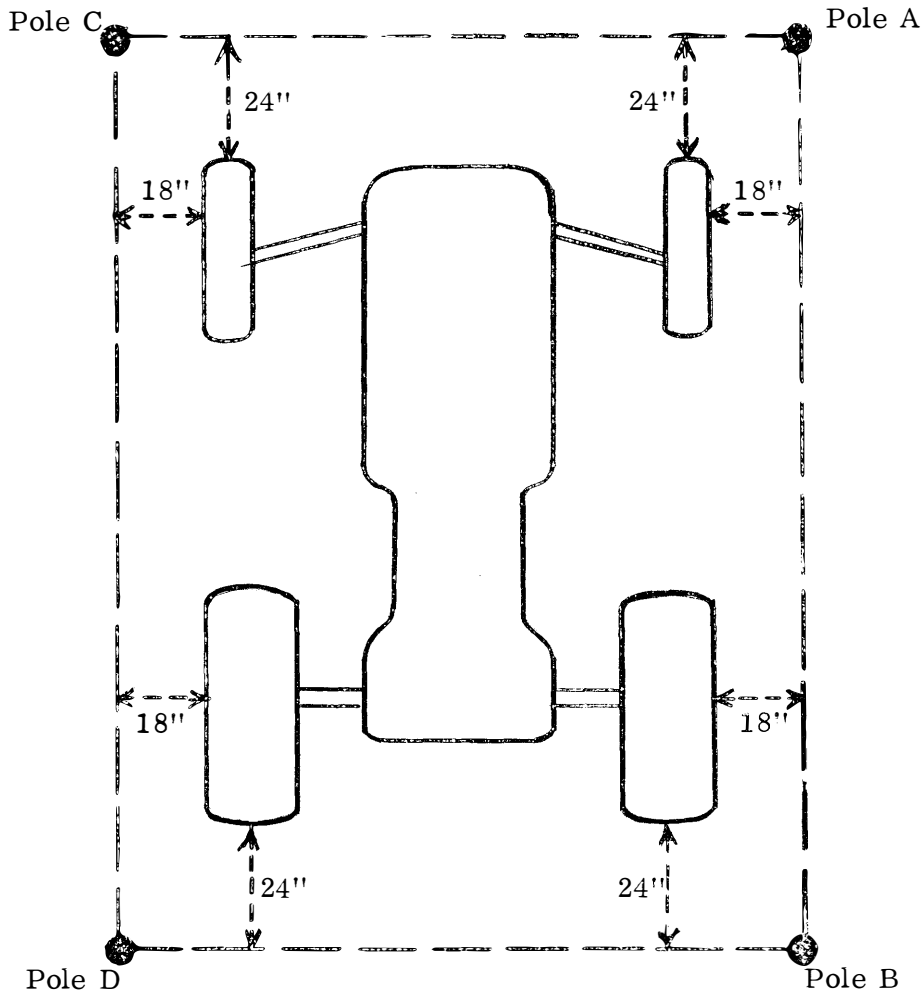


Diagram showing position of the 4 poles in relation to a tractor

The space between the tractor wheels and the poles is initially made deliberately wide, and gradually reduced after the learners have mastered the technique of reversing into the space between them.

Conduct of the exercise : Instructor drives tractor forwards out of the parking position bounded by the four poles. The idea is to avoid knocking any of the poles down. Then he backs into the space slowly and stops the tractor when there is enough space between the wheels and the poles. He drives out forwards and turns the tractor to the right at some distance from the space. Then he backs into the parking space. He moves the tractor forwards and turns to the left and then backs into the space as before. These are demonstration runs.

Instructor then gives the learners practice in making these runs. He instructs them on how to park the tractor coming from the side of the parking space.

Instructor gives the following instructions :-

Exercise 11.

Break-down Sheet

Subject : Reversing into a limited parking space, e.g. a garage, from the right.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Face backwards.	Turn head and body to the right and look back at the whole parking space.
2. Move tractor in a curve to point just in front of Pole "A".	At this point, the front wheels are turned. Watch the right rear wheel and make sure that it is heading towards a point a little inside Pole "A".
3. Turn the steering wheel more to the right.	Turn the steering wheel in a clockwise direction and let it pass close to Pole "A". Look at left wheel and make sure it is clear of pole "C".
4. When the right rear wheel is parallel with Pole "A", straighten up the steering wheel.	Turn the steering wheel in an anti-clockwise direction until the right front wheel is parallel with the tractor. Look at the right front wheel and let it run on the inside of Pole "A". Look at Pole "B". If the tractor is straight, the right rear wheel will run towards a position on the inside of, and close to Pole "B".
5. Stop the tractor.	Depress the clutch pedal firmly but gently. Depress the brake pedal and shift the gear lever to neutral position.

Break-down Sheet

Subject : Reversing into a limited parking space, e. g. a garage from the left.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Face backwards.	Turn head and body to the left and look at the position of all the poles. Visualise the whole of the parking space.
2. Move tractor backwards in a curve to a point just in front of Pole "C".	At this point the front wheels are turned. Watch the left rear wheel and make sure that it is heading towards a point a little inside Pole "C".
3. Turn the steering wheel more towards the left.	Turn the steering wheel in an anti-clockwise direction and let it pass a little inside Pole "C". Look at right rear wheel and make sure it is clear of Pole "A".
4. When the left rear wheel is parallel with Pole "C" straighten up the steering wheel.	Turn the steering wheel in a clockwise manner until the right front wheel is parallel with the tractor. Look at left front wheel and let it run on the inside of Pole "C". Look at Pole "D". If the tractor is straight, the left rear wheel will run towards a position on the inside of, and close to, pole "D".
5. Stop the tractor.	Depress the clutch pedal firmly but gently. Depress the brake pedal and shift the gear lever to neutral position.

Exercise 12: Break-down SheetSubject : Parking the tractor from the Right.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might:- Affect quality Cause injury or damage Make the work easier and any special information
1. Move the tractor to the right of the parking space.	The left rear wheel must stand opposite Pole "A", about 3 feet from it.
2. Back into parking space.	As you back with face turned to the left, swing the steering wheel hard anti-clockwise into the space between poles "A" and "B" until the right rear wheel is at a position just beyond line AB.
3. Turn steering wheel to the right.	Steer hard in a clockwise manner until the front right wheel is parallel with the tractor. As you straighten up, watch out that the right rear wheel does not run on to Pole "B" and that left front wheel does not catch pole "A".
4. Move forward and Stop.	As you move forward, swing steering wheel slightly anti-clockwise and straighten up. Move for a short distance and be careful to keep the tractor within the poles. Depress clutch pedal gently and firmly and then the brake pedal. Engage parking latch. Shift gear lever to neutral position.

Break-down SheetSubject : Parking the tractor from the Left.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might:- Affect quality Cause injury or damage Make the work easier and any special information
1. Move the tractor to the left of the parking space.	The left rear wheel must stand opposite Pole "C", about 3 feet from it.
2. Back into parking space.	As you back with your face turned to the right, swing the steering wheel hard to the right (clockwise) into the space between poles "C" and "D", until the left rear wheel is at a position just beyond Line CD.
3. Turn steering wheel to the left.	With your face turned to the left, steer hard to the left (anti-clockwise) until the front left wheel is parallel with the tractor. As you straighten up, watch out that the left rear wheel does not run on to pole "D", and that the right front wheel does not catch pole "C".
4. Move forward and Stop.	As you move forward, swing the steering wheel slightly to the right (clockwise) and straighten up. Move for a short distance and be careful to keep the tractor within the poles. Depress clutch pedal gently and firmly and then the brake pedal. Engage parking latch. Shift gear lever to neutral position.

Conclusion: In Lesson III, an attempt has been made at presenting exercises designed to teach the learners how to drive a tractor and how to manoeuvre it into given spaces, forwards as well as in reverse. Smooth operation of the tractor will be acquired with more practice.

It is important that the skill in manipulating a tractor be developed to the maximum until it becomes the driver's second nature. The reason is clear : the most important operations involving the use of a tractor, e.g. ploughing, harrowing, planting, harvesting and other farming operations require that the driver be thoroughly familiar with the tractor controls.

The tractor, like motor cars and lorries, runs on public highways and even in towns where there is much traffic. For this reason, the tractor driver should be familiar with the rules of the road and the road signs which endeavour to ensure the safety of all road users. The next lesson introduces the learner driver to the public road by way of road signs and rules of the road.

LESSON IV.

DRIVING ALONG PUBLIC ROADS

This lesson aims at teaching learner drivers the rules of the road and the meaning of road signs. Emphasis is placed on the importance of these rules and road signs in maintaining safety of the driver, his vehicle, other road users: pedestrians, animals, drivers, vehicles, and other property. It would be preferable if each learner were to have a pamphlet outlining all the main road signs.

The Road Signs.

Road signs may be divided into three groups:

- (a) Danger signs that warn road users. They are normally used to convey advance information and are erected, where possible, about 500 feet from danger. They can be recognised by the characteristic red triangle. The legend or symbol depicting the type of hazard is usually in black on a yellow background.
- (b) (i) Prohibitive signs that must be obeyed, such as STOP, NO ENTRY, SPEED LIMIT;
- (ii) Mandatory or permissive signs, such as derestriction notices.
These signs are circular in shape. The colours used are red and yellow, with black lettering and symbols.
- (c) Informative signs, which give information about pedestrian cross-walks, filling stations, first-aid posts, bridges, routes, etc. They are rectangular in shape and usually show a black legend or symbol on a yellow background.

To summarise : Red Triangle means Danger
Red Circle means Do or Don't
Yellow Rectangle Informs you.

RULES OF THE ROAD

1. Keep Left.

The main rule of the road is to keep to the left-hand side of the road as far as practicable. The slower the vehicle, the closer to the edge of the road it should travel. Encroaching on the right-hand side of the road, e.g. when overtaking, is permissible only when it can be done without obstructing or endangering other traffic, such as causing oncoming vehicles to swerve or reduce speed.

2. Traffic Lanes

A driver should not change from one lane to another unless he has made certain that it is safe to do so and has given an appropriate signal. In a one-way street the same procedure is followed.

3. Turning Movements

If you intend turning left at an intersection, get over to the left-hand edge of the road well before you arrive at the intersection and maintain this position until you have completed the turn.

If you want to turn right, move to the right-hand lane some distance from the next intersection so that when you make your turn you will be in the right-hand lane.

4. Signalling

Always give a correct signal every time you intend to turn, stop or slow down, change your lane, or when you are ready to be overtaken. Signal in good time and keep your arm out for a reasonable while, so that others will have every opportunity of seeing your signal. Signals help not only drivers following you, but also oncoming drivers, traffic waiting in side streets, pedal cyclists and pedestrians.

Hand signs for:

- a) Stopping Extend the right arm sideward from the shoulder with the forearm held in a vertical and upward position and the palm of the hand turned to the front.
- b) Turning to the Right Extend the right arm and hand sideward and fully horizontal to the road with the palm of the hand turned to the front.

- c) Turning to the Left. Extend the right arm sideward from the shoulder with the hand pointing downward. Move the fore-arm with a circular anti-clockwise motion.
- d) Slowing down. Extend the right arm sideward with the palm of the hand downward, and move the arm slowly up and down.

5. Robot Lights

When the red light is against you, bring your tractor to a smooth halt and do not encroach on the pedestrian line. Look only at the signals ahead of you. Move off when you see the green light, not before.

The purpose of the amber light is to clear the intersection for the next cross-stream of traffic. You must therefore stop on amber if you can't clear the intersection before the light turns to red. It is illegal to enter an intersection against the amber light when you are in a position to stop before reaching the intersection.

When traffic is congested it sometimes happens that intersections are not cleared between changes of light. Even if the green light is in your favour, it is an offence against the traffic law for you to drive into the intersection when you can see that there is insufficient space on the opposite side to permit you to get clear across.

6. Turning traffic must yield

Vehicle drivers and cyclists who turn right or left must always give way to through traffic, including pedestrians.

7. Pedestrian Crossings

Always approach a marked pedestrian crossing at a speed which will enable you to stop, if necessary, before reaching the crossing. When stopping at a pedestrian crossing - and this includes scholar patrol crossings - make a habit of giving the "stop" signal to warn traffic behind you. Apply your brakes in good time so that your vehicle will stop a reasonable distance from the stop line, giving pedestrians plenty of room to pass.

The law requires that when a pedestrian on a crossing is within your half of the roadway, or just about to enter it from the opposite half, you must yield the right of way to the pedestrian by slowing down, or if necessary stopping.

8. Overtaking

The rule is to overtake on the right. You may, however, if you have satisfied yourself that it is safe to do so, overtake a vehicle on the left if the driver has signalled his intention of turning to the right or is in the act of doing so. The strict rule of overtaking only on the right may be relaxed in

- (a) A one-way street in an urban area, or
- (b) Where the roadway is divided into traffic lanes to accommodate two or more lines of vehicles moving in the same direction.

Overtake on the straight and never

- (a) when approaching the top of a rise;
- (b) at a corner or curve in the road;
- (c) at an intersection; and
- (d) at any time when there is not a clear view ahead.

When overtaking a stationary bus, have due regard to the safety of passengers boarding or alighting.

When a vehicle is following you closely on the highway, and you intend overtaking the car in front, signal your intention. By giving a hand signal (the same as for a right-hand turn) you show the following driver that he should not overtake you at that point.

Where a continuous white line divides the road down the centre you must keep to the left of it. You may cross a broken line when overtaking another vehicle provided you do not do so in the face of oncoming traffic. Where there is a broken line and a solid line running parallel, do not overtake on the stretches where the solid line is on your side of the road.

9. Following Distance

Never follow another vehicle too closely as the other vehicle may have to stop suddenly. Keep at least the distance of the tractor (plus any additional trailer) away from vehicles in front of you.

10. When to reduce speed.

- a) When approaching a school or school bus with children alighting or boarding.
- b) In heavy traffic and when entering a built-up area.

- c) On narrow, winding roads, and on stretches where the surface is bad (e. g. loose or gravel).
- d) When approaching a level crossing or bridge.
- e) When approaching an intersection.
- f) When approaching a bend, crest or other feature that limits the sight distance.
- g) When approaching children, or when a ball or toy is seen in the road.
- h) When approaching animals on or alongside the road.
- i) In rain, dust, twilight, dark, and when driving into the rising or setting sun - whenever visibility is poor.

11. When to stop the Vehicle

- a) On the approach and passing of any emergency vehicle which is sounding a bell, siren, or exhaust whistle.
- b) In compliance with any direction conveyed by a road traffic sign or given by a Police or Traffic Officer in uniform.
- c) On the request of or signal of any person with a restive animal.
- d) At a Zebra crossing when any pedestrian is within the crosswalk.

A driver must stop if by so doing he will avoid an accident or even the risk of an accident.

12. Parking and Stopping

Never leave your vehicle on the roadway:

- a) Near the brow of a hill.
- b) At or close to a bend or junction.
- c) Next to an intersection, a fire hydrant, or across a driveway.
- d) Within 30 feet of the approach side of a pedestrian crossing, or where it could obscure a traffic sign, such as a stop-sign.
- e) Within 20 feet of a tunnel, subway or bridge.
- f) Next to an excavation or in fact at any place where an obstruction to other traffic or to a sidewalk or footpath would be caused.

If you have to stop on the road, park if possible right off the roadway. In a town area, park within 18 inches of the kerb on the left side of the road.

ACCIDENTS

The driver of a vehicle which has been involved in an accident resulting in death, injury or damage must:

- a) Stop immediately.
- b) Give his name and address (and that of the owner of the vehicle) to anyone who asks for it.
- c) Give all possible help.
- d) Report the accident to the nearest policeman, police station or traffic office as soon as possible.
- e) Report the accident to the company from which the Third Party Insurance disc was obtained.

Conduct of the lesson : The instructor gives a short introductory talk in which the value of the tractor in Rands is mentioned and the fact that such an expensive piece of machinery can be worth its cost if properly maintained. Mention is made of the unfavourable conditions under which the tractor works: rainy, windy, dusty, hot; the strain the engine experiences, becoming extremely hot, and the engine parts constantly moving, some at very fast rates; the wearing out of parts and the necessity for timely replacements. The tractor manufacturer understands his product better than anyone else. He has tested it thoroughly before selling it. He has drawn up specific instructions on how a tractor should be handled and used and recommendations on the materials suitable for each particular type of tractor. These instructions have to be followed precisely. That is why learners are being trained on the correct operation and maintenance of these tractors.

After this introductory talk, the instructor then briefly revises Lesson I by pointing at the various parts, controls and instruments of the tractor. He mentions that the learners are now familiar with most of the controls. There are a few additional parts of the tractor with which the learner must become familiar because they are important in the maintenance of the machine.

He mentions these parts, one at a time, pointing at each, calling it by name, and describing its function. The parts are:-

- fuel sediment bowl - through which all fuel passes and in which all sediment or water collects;
- grease points - into which grease is pumped by means of a grease gun,
- air cleaner - which protects the engine from dust and other abrasives by filtering the air entering the combustion chambers;
- Fuel filters - there are two of these : the primary and the secondary.
As the name implies, fuel filters through them so that any dirt and other foreign matter, including water, remains behind;
- oil filter - this serves to stop any dirt and foreign matter in the lubricating oil from reaching working and bearing surfaces;
- fan belt - which connects the fan pulley, the dynamo and the crank shaft.
- Engine oil sump - which carries engine oil.

Instructor asks each learner to indicate the various parts until all learners know them and where they are located on the tractor. He then starts the first exercise.

Exercise 1.

Daily Maintenance

This exercise aims at teaching the learners the daily maintenance routine of the tractor. The exercise should be illustrated through use of the maintenance chart which is spread on the board, placed in such a manner that all learners can see it clearly.

The instructor explains the maintenance guide to the learners. The hour numbers on the left of the chart from top to bottom, indicate periodic service intervals. Across the chart, the pictures refer to those parts on the tractor which are to be serviced after the tractor has run the number of hours indicated on the left of each series of such pictures. In addition, there are two pictures showing the M-F 35 and the M-F 65 type of tractors. At each period service interval, there is a shaded or unshaded symbol, namely, a circle, square or triangle with letters A, B, C, up to F inside them. These symbols, together with letters and numbers, are shown on the tractor pictures, indicating at a glance what service must be done to which part of the tractor at each service interval.

The instructor points at the first picture against the 10 hourly service unit on the chart. He names the part of the tractor involved and then points at the actual part on the tractor. He explains what is done to it and demonstrates by actually doing the service. He then asks learners to perform the same service, and to explain what they are doing. It is very important that learners actually participate in what the instructor teaches them.

It is important to maintain the order of service as it appears on the Chart. This will help learners to know the order by heart, so that they become more systematic in carrying out the services.

Instructor instructs as follows:-



Fig. 7: Checking engine oil level. Pulling the dipstick out. (Photograph by Graphic Arts, CSIR)

Exercise 1.Break-down Sheet.Subject : Checking Engine oil level.

<u>Stages</u> Go through the job or Subject. Select suitable portions for learner to master.	<u>Key Points</u> Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Wipe area surrounding dipstick.	Use a clean piece of mutton cloth to avoid any dirt dropping into engine when dipstick is removed.
2. Pull the dipstick out.	Push your forefinger into the hook and gently pull the dipstick out.
3. Wipe the dipstick.	Use a clean piece of mutton cloth. You wipe it to ensure that no splashed oil remains on the reading marks.
4. Replace the dipstick.	Make sure that you push it as far as it will go.
5. Pull the dipstick out.	Push your forefinger into the hook and gently pull the dipstick out. Keep the end of the dipstick furthest from your hand pointed downwards.
6. Read the oil level.	Note the point at which oil mark ends in relation to the "Max" and "Min" lines on the dipstick. If between these two marks, there is enough oil. If below "Min" line, there is not enough oil.
7. Replace the dipstick.	Make sure that you push it as far as it will go.
8. If the oil level is too low, wipe the area around filler cap.	Use a clean mutton cloth to avoid dirt entering engine.
9. Open the oil cap.	If screwed on, turn cap anti-clockwise to open.
10. Add oil.	Add a little at a time to avoid adding too much. Make sure you use the right grade of oil. Refer to the colour code on Maintenance Chart.

11. Replace cap.	Make sure that it does not introduce dirt into the engine. Tighten up sufficiently so that it is firm.
12. Check the oil level again.	Keep on checking the oil level as you add oil. This guards against the danger of adding too much oil.

- Note.
1. Engine oil level must be checked with the tractor standing on level ground.
 2. Some time, about 10 minutes, must elapse after switching the engine off, before a check is made. This allows oil in the engine enough time to settle down in the sump.

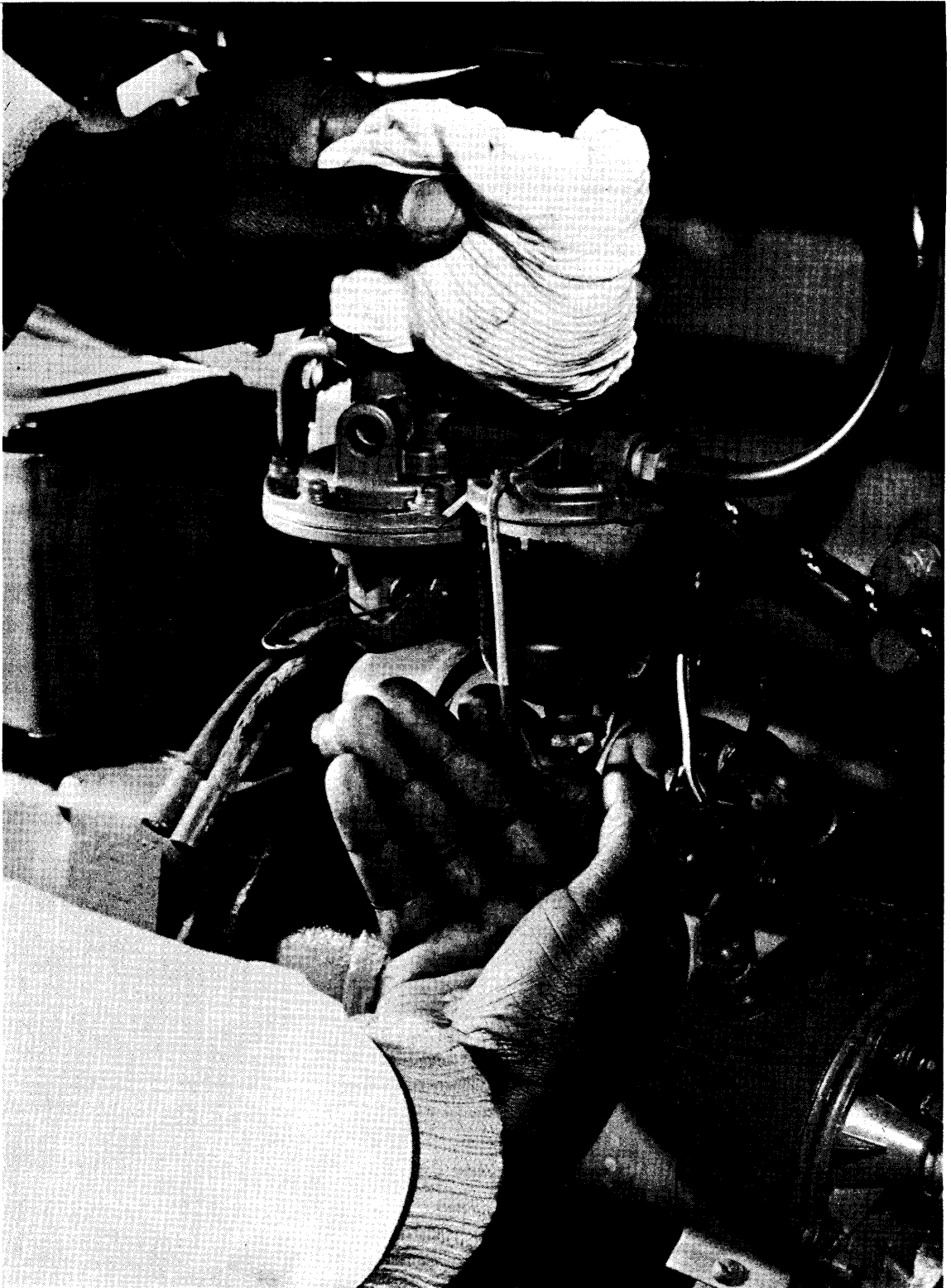


Fig. 8: Cleaning fuel sediment bowl. Unscrewing the bottom nut.

(Photograph by Graphic Arts, CSIR)

Break-down Sheet.Subject : Cleaning Fuel Sediment Bowl.

<u>Stages</u> Go through the job or Subject. Select suitable portions for learner to master.	<u>Key Points</u> Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information.
1. Close tap from fuel cut-off.	Turn the tap firmly. Doing this stops fuel from flowing into the fuel sediment bowl.
2. Clean outside of glass.	Use a clean mutton cloth. The outside of the glass is usually covered in dust.
3. Unscrew the bottom nut.	The nut beneath the glass bowl keeps the bowl in position.
4. Pull glass bowl out.	Grasp it carefully so that it does not slip out of your hand and fall.
5. Empty it.	Empty the contents which may include water and dirt into a receptacle.
6. Rinse it with fuel.	Empty the cleaning fuel into the receptacle.
7. Clean gauze filter.	Remove the gauze filter at top of the glass when in position, and clean it with fuel and a small brush. Replace it.
8. Replace glass bowl.	Ensure that the rubber gasket is placed correctly. Be careful not to over-tighten the screw at the bottom as it will crack when engine becomes warm.
9. Open tap from fuel cut-off.	Fuel will flow into the glass bowl. If the glass bowl is properly placed and tightened, it will not fill up until tractor engine is started. If it fills up, this is a sign that there is a leak somewhere.

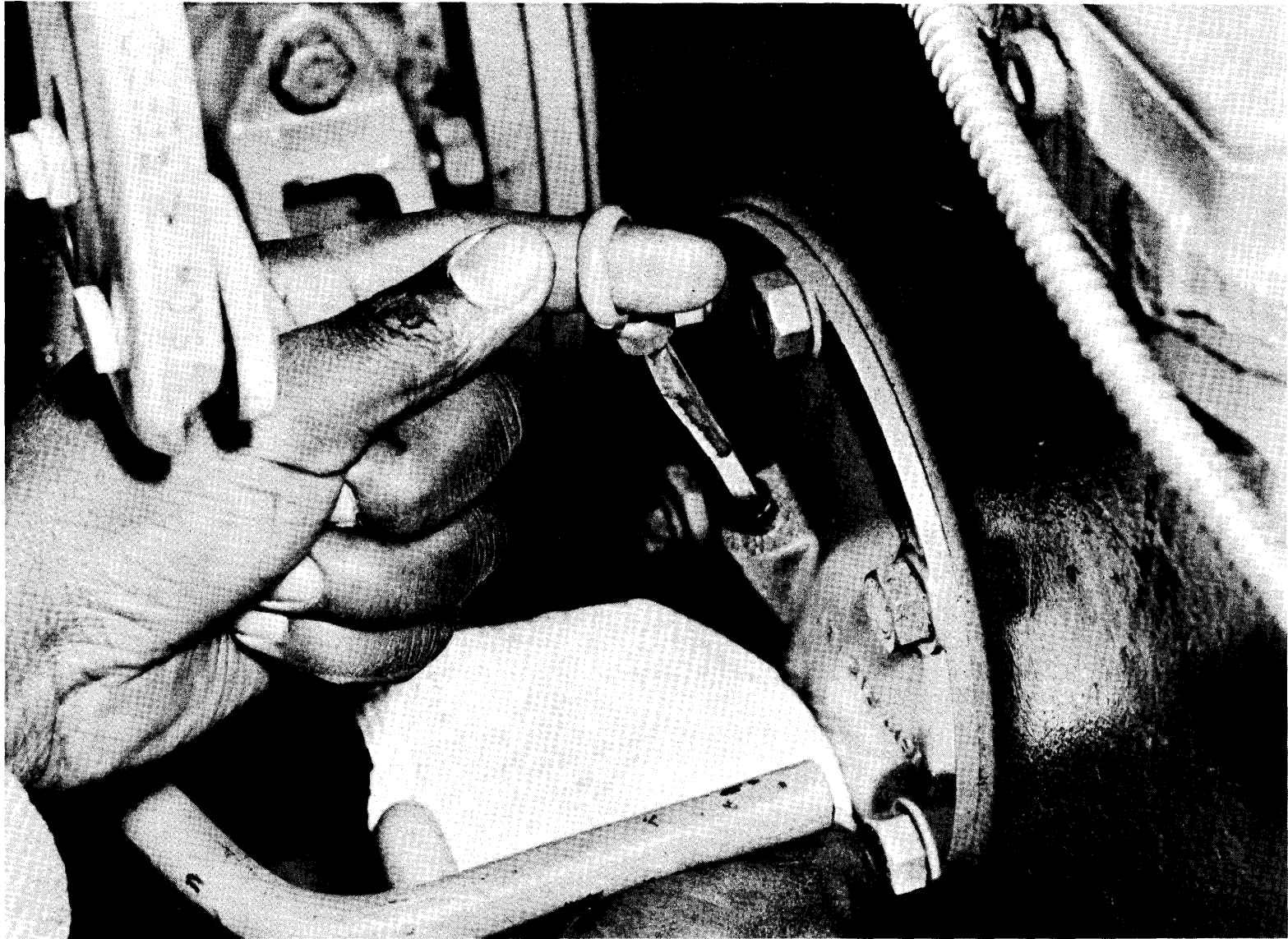


Fig. 9: Checking gear box oil level. Pulling the dipstick out. (Photograph by Graphic Arts, CSIR)

Break-down SheetSubject : Checking gear box oil level

<u>Stages</u> Go through the job or Subject. Select suitable portions for learner to master.	<u>Key Points</u> Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information.
1. Wipe area surrounding dipstick.	Use a clean piece of mutton cloth to avoid any dirt dropping into engine when dipstick is removed.
2. Pull the dipstick out.	Push your forefinger into the hook and gently pull the dipstick out.
3. Wipe the dipstick.	Use a clean piece of mutton cloth. You wipe it to ensure that no splashed oil remains on the marks to give false readings.
4. Replace the dipstick.	Make sure that you push it as far as it will go.
5. Pull the dipstick out.	Push your forefinger into the hook and gently pull the dipstick out. Keep the end of the dipstick furthest from your hand pointed downwards.
6. Read the oil level.	Note the point at which oil mark ends in relation to the "Max" and "Min" lines on the dipstick. If between these two marks, there is enough oil. If below "Min" line, there is not enough oil.
7. Replace the dipstick.	Make sure that you push it as far as it will go.
8. If the oil level is too low, wipe the area around filler cap.	Use a clean mutton cloth to avoid dirt entering the gear box.
9. Open the oil cap.	Turn the cap anti-clockwise to open.
10. Add oil.	Use correct grade of oil as is shown on the maintenance chart. As you add a little oil at a time, check the level. Don't over-fill.
11. Replace cap.	Make sure that it does not introduce dirt into the gear box. Tighten up sufficiently so that it is firm.
12. Check the breather cap for tightness.	If too tight, the breather cap must be loosened. It must also be clean. It must be loose enough to be turned by hand.

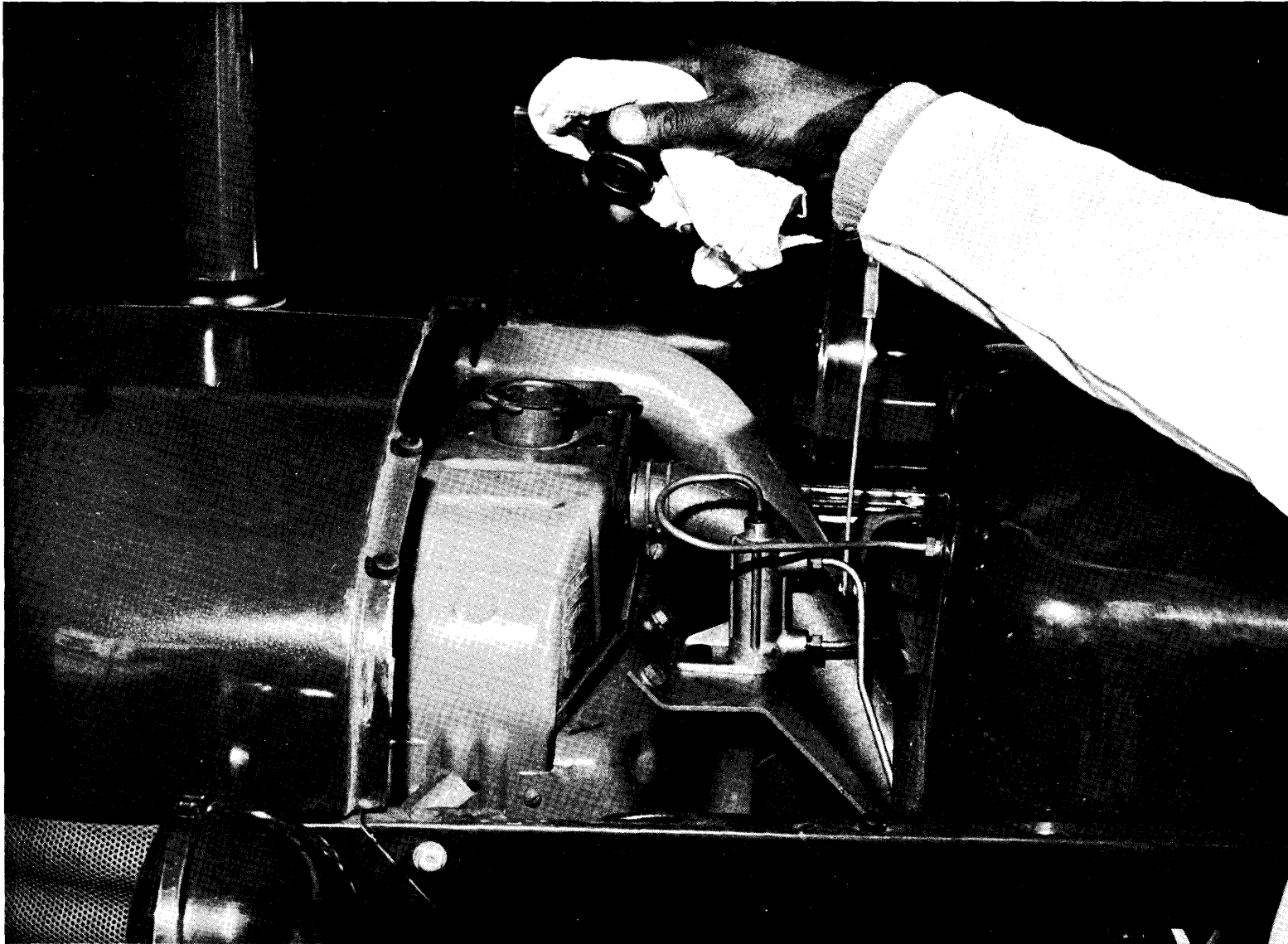


Fig. 10: Checking and topping up radiator. (Photograph by Graphic Arts, CSIR)

Break-down SheetSubject : Checking and Topping up Radiator.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Wipe area surrounding filler cap.	Use clean mutton cloth to keep away dirt which may enter the radiator.
2. Remove the filler cap.	Unscrew slowly in an anti-clockwise direction. If the engine has been running, cap may be hot, in which case it is advisable to hold it with a cloth. Keep your head away to avoid steam and hot water splashing you in the face.
3. Check water level.	Look into the opening. If there is enough water, it will show inside at the top.
4. If there is not enough water, add some.	Use clean water, in fact so clean that you too can drink it. Do not pour water if the engine is still very hot. Add water to a point where it shows at the top. An excess of water will escape through over-flow pipe at the side.
5. Replace the cap.	Screw the cap on securely.
6. Check hoses and clamps.	Open grille to see all the clamps and hoses leading from radiator to engine. Feel hoses with your finger by pressing them. If necessary, tighten screws on clamps with a screw driver.
7. Remove trash from front of radiator.	Use your hand. Anything else, metal or wooden, may damage the radiator. Too much trash interferes with the cooling function of radiator. Replace the grille securely.

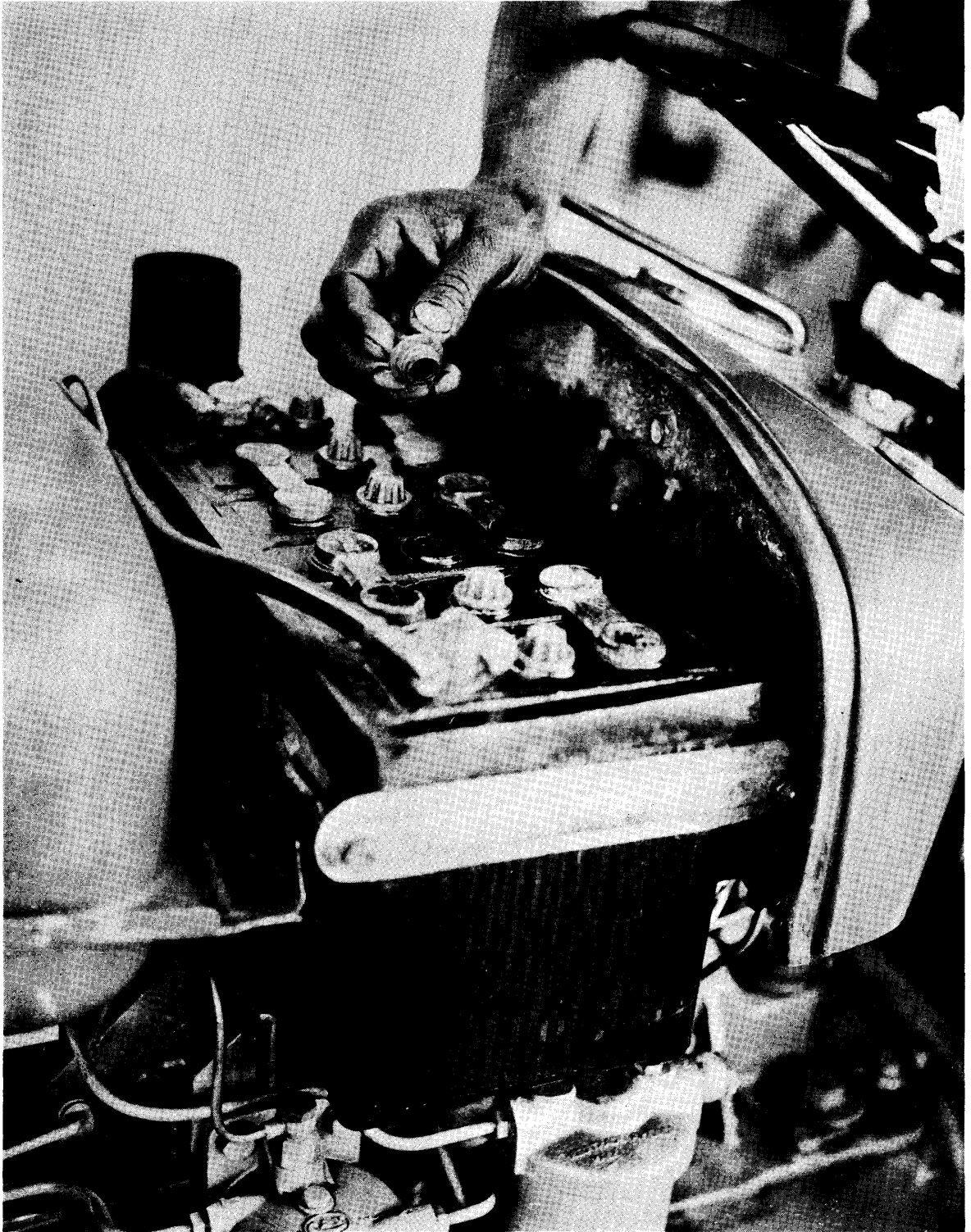


Fig. 11: Topping up batteries. Unscrewing vent plugs. (From Massey-Ferguson)

Break-down SheetSubject : Topping up the batteries.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Screw out vent plugs.	The vents open into the cells. To open them, turn the plugs in an anti-clockwise direction. Use your fingers. Do not place any metal object, e.g. spanner, on top of battery.
2. Check level of the liquid.	See if the level of the water just covers the separators inside.
3. Top up.	If the level of the fluid inside is too low, that is, the separators are exposed, pour in some distilled water in those cells where it is too low. Never over-fill.
4. Close the vent plugs.	Replace vent plugs by screwing them on by hand.
5. Clean the batteries.	Remove the terminals, one at a time. Avoid knocking the battery as this will break the plates inside. Wipe terminals using a clean damp cloth. Smear them with petroleum jelly, e.g. "Vaseline", to avoid corrosion. Avoid dropping dirt from terminals anywhere. Be careful that the liquid from inside the battery does not touch your clothes or skin because acid will damage them.
6. Make sure batteries are secure in position.	Check the screws keeping batteries in position and make sure they are tight.
7. Check earth connections.	Make sure the earth connections are still in position and firm.



Fig. 12: Checking fuel. (Photograph by Graphic Arts, CSIR)

Break-down SheetSubject : Checking and Filling up Fuel Tank.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject . Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Wipe top of the tank and filler cap.	Use a clean mutton cloth so that no dirt gets into the fuel tank.
2. Remove filler cap.	Unscrew cap in an anti-clockwise direction.
3. Check amount of fuel in the tank.	Look into the tank to see level of fuel inside.
4. Wipe funnel	The inside as well as spout of the funnel used for pouring fuel into the tank must be dry and scrupulously clean.
5. Put funnel spout into mouth of the tank.	Ensure that the funnel rests firmly as it may be easily upset and cause fuel to spill.
6. Pour fuel into tank.	Be careful not to over-fill the tank, but leave about 1 inch space from the top.
7. Replace filler cap.	When the funnel has been removed, replace the filler cap and screw it on tightly.
8. Wipe clean around cap and top.	Some fuel may have spilled over. If left there unwiped, it will attract dust to the tank.

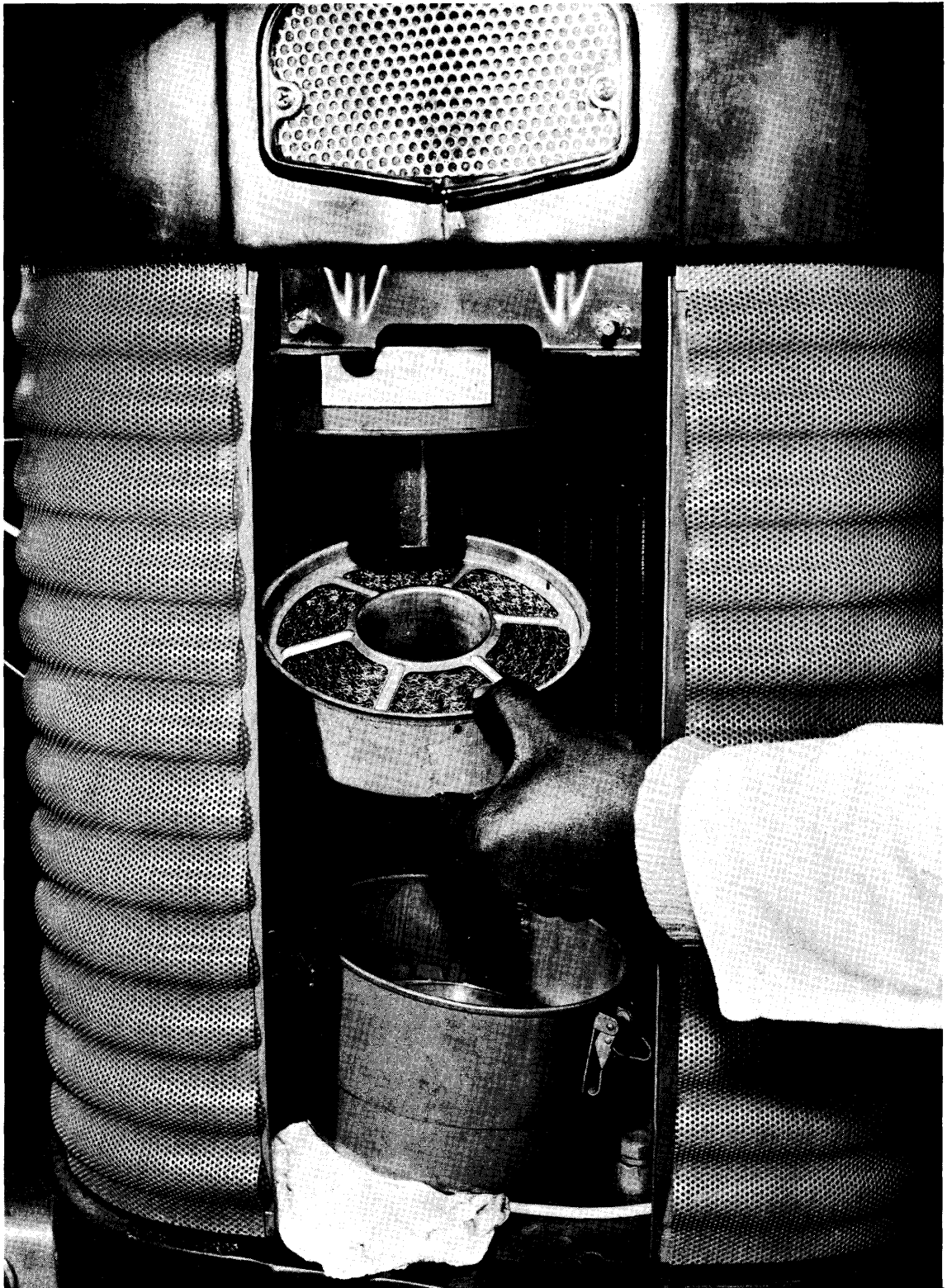


Fig. 13: Cleaning and refilling air cleaner. Removing the screen element and bowl.
(Photograph by Graphic Arts, CSIR)

Break-down SheetSubject : Cleaning and refilling Air cleaner.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Pull the vertical air cleaner out.	This protrudes through the top of the hood. It can be detached by pulling upwards.
2. Open the radiator grille.	The centre panel made of perforated sheet steel is removed by unscrewing the two chrome-plated thumb nuts.
3. Remove the detachable element and bowl.	With your left hand, hold the bowl, while your right hand removes the detachable element. Watch out that the contents of these do not drip on to your clothes.
4. Check the oil in bowl.	Use forefinger to scrape bottom of the bowl. If oil is dirty, empty the contents into another container. Don't throw old oil away.
5. Clean bowl and the screen element.	Dip the two in diesel fuel and then wipe them inside and outside with a clean cloth.
6. Clean Vertical air cleaner and downpipe.	Use the cloth and push it inside the pipe.
7. Check hose connections.	Check for possible air leaks. Use screw driver to tighten screws on clips.
8. Refill air-cleaner bowl.	Use proper oil grade. Refill bowl up to level mark.
9. Replace detachable element.	Place it on top of the bowl. Make sure that it fits flush into it.
10. Replace air cleaner into the tractor.	Ensure that the two rubber sealing rings on air-cleaner bowl are correctly placed, thus sealing off all air.
11. Close the grille.	Replace the centre panel and fasten it firmly with screws.

N. B. After cleaning the air-cleaner, start the tractor and then place the hand on top of the inlet pipe to block it. The engine will stall. If it does not stall, there is a leak somewhere.

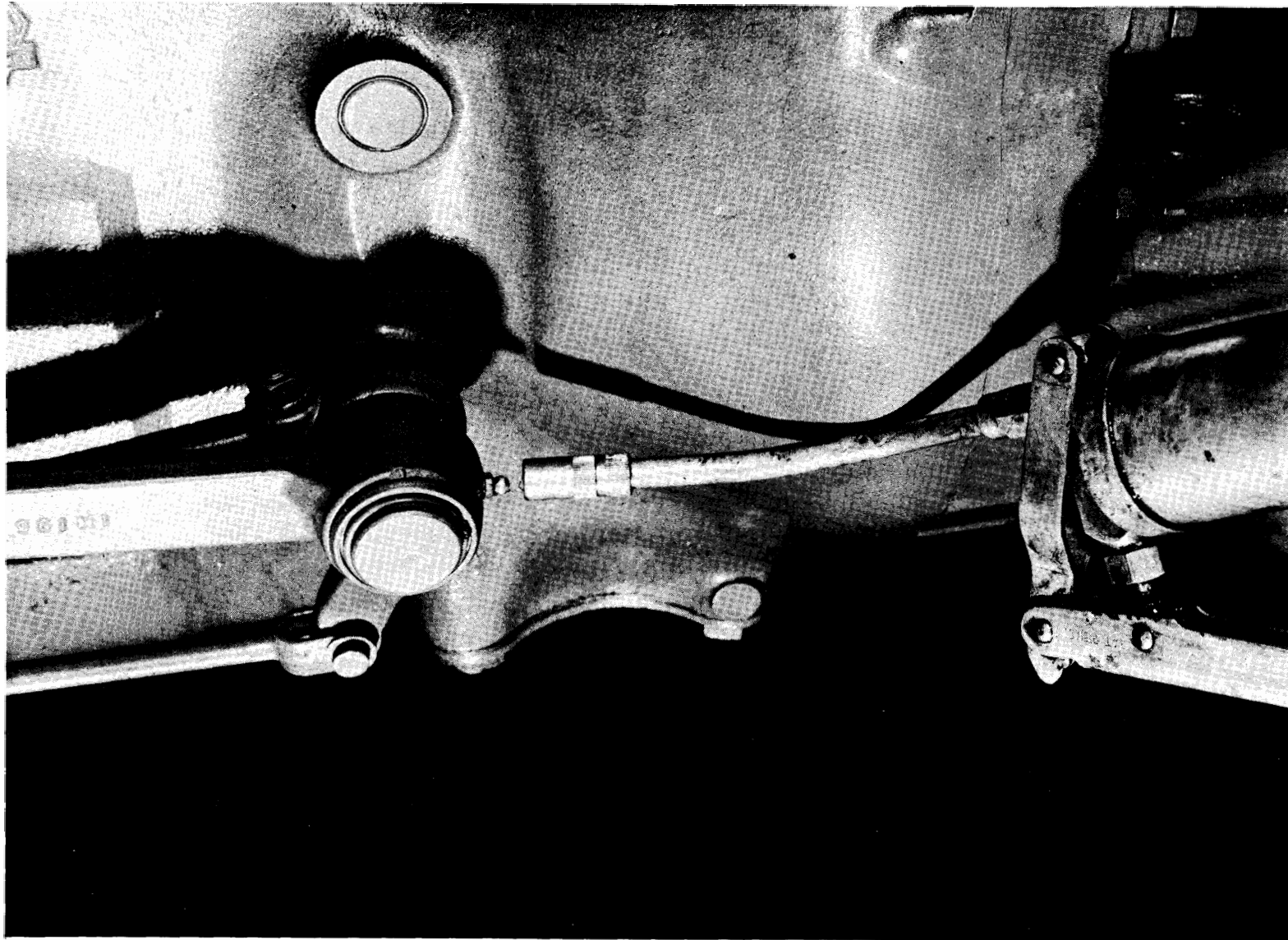


Fig. 14: Greasing nipples. Note cleanliness of the grease gun nozzle and the grease nipple.
(Photograph by Graphic Arts, CSIR)

Break-down Sheet.

Subject : Greasing all the points.

<u>Stages.</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information.
1. Wipe the grease nipples and the grease gun nozzle.	Before greasing, use a rag to clean all the nipples. These are usually covered in dust, and this dust can easily be pumped into the bearings.
2. Grease through the nipples.	Grease sufficiently to push out the dirt. Two pumps are usually enough to replace the old dirty grease.
3. Wipe the grease nipples.	After greasing, use a rag to clean all the nipples.

Checking tyre pressure. In checking tyre pressure of the rear wheels, it is important to keep the valve at 12 o'clock position in order to avoid letting water out. Pressure is usually between 12 and 16 lbs. Use water gauge. Check tyre cuts and remove anything sticking on the tyres.

Tightening nuts and bolts. Use the correct size spanner. Pay particular notice to the nuts holding the rear wheels to the hub, and nuts on top of the hydraulic mechanism.

N. B. It is more dangerous to over-tighten a nut than to under-tighten. Tighten as fully as they can go but use only the appropriate spanners - the ones supplied with the tractor.

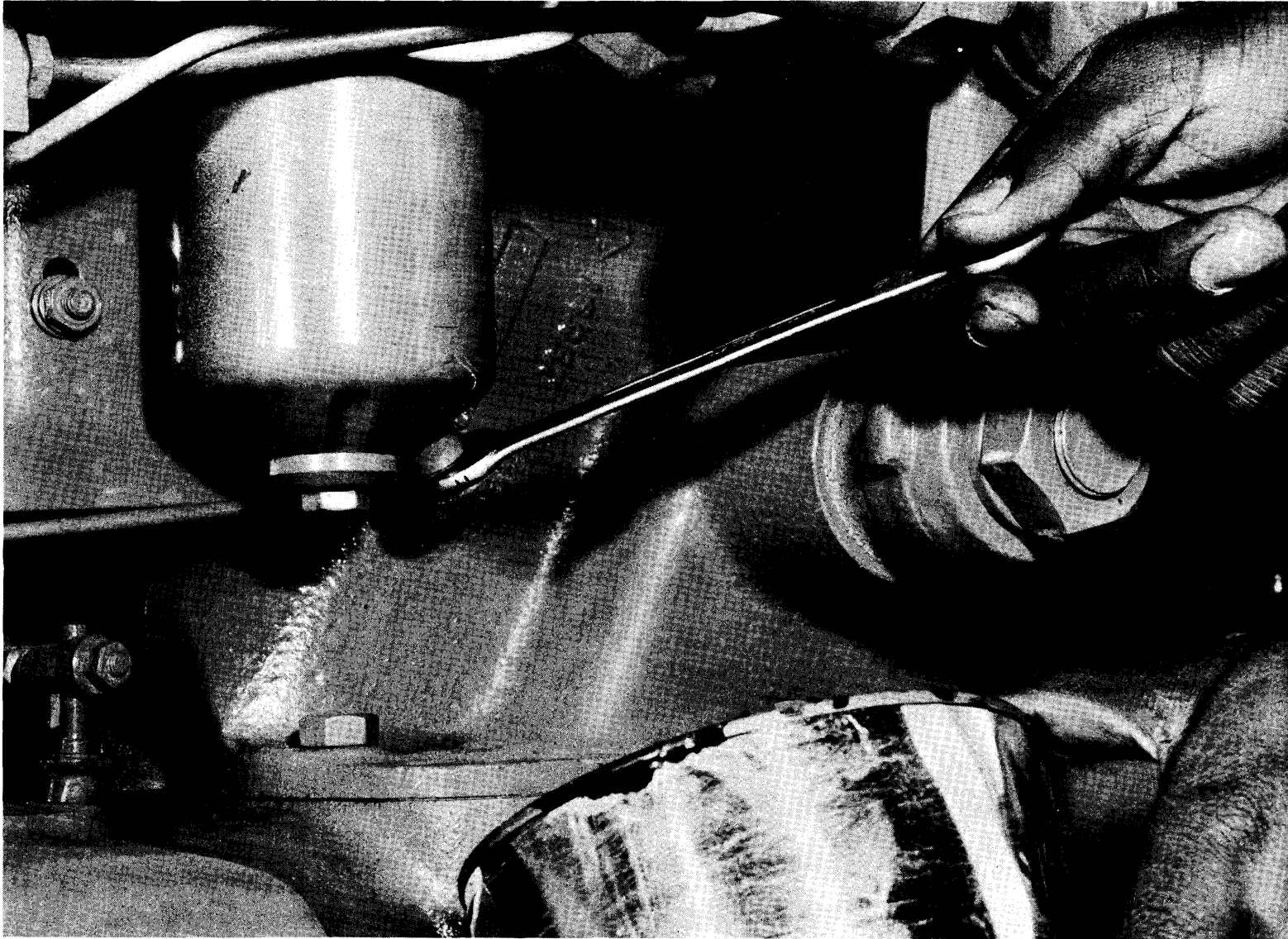


Fig. 15: Draining primary fuel filter. Note the small receptacle held below the drain plug.
(Photograph by Graphic Arts, CSIR)

Exercise 2.50-Hour Maintenance.

A fifty-hour period corresponds roughly to one week for tractors which work only during the day.

The procedure for demonstrating 50-hour maintenance is the same as that for daily maintenance. Again emphasis should be on allowing learners to actually perform the services themselves.

Exercise 2. Break-down Sheet.

Subject : Draining Fuel Filter.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information.
1. Loosen the vent plug of the primary filter.	This plug is at the top of the primary filter.
2. Open the drain tap.	The drain tap is at the bottom of the fuel filter. Fuel will run out together with water which may have accumulated.
3. Close the drain tap.	Close when clean fuel begins to flow out. Make sure that the threads are straight by turning the drain plug with your hand before using a spanner.
4. Tighten the vent plug.	Check for leaks on the bowl.

N. B. Hold a small receptacle below the vent plug to collect the out-flowing water and fuel.

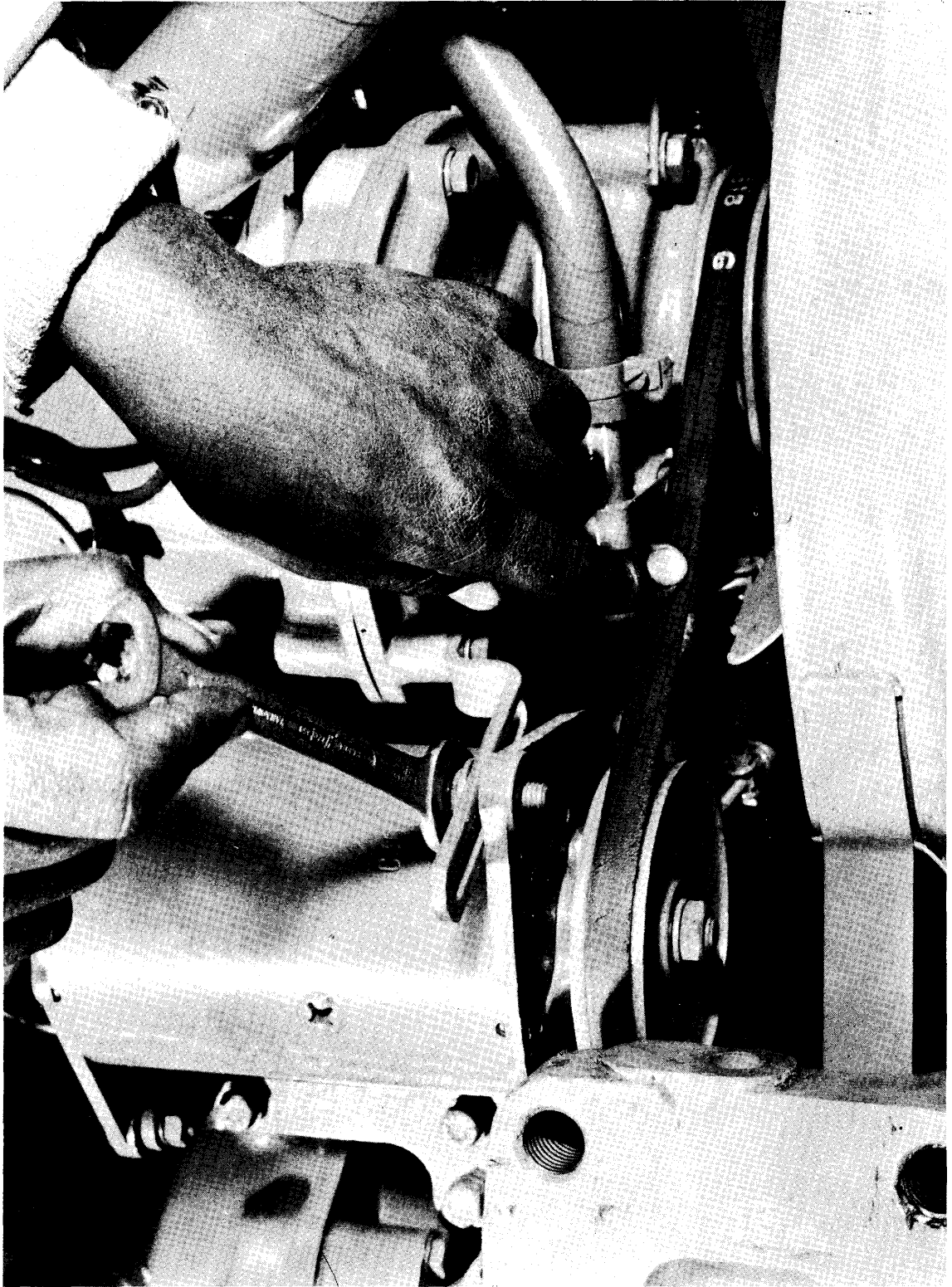


Fig. 16: Checking fan belt tension. (Photograph by Graphic Arts, CSIR)

Break-down Sheet.Subject : Checking Fan belt Tension.

<u>Stages</u> Go through the job or Subject. Select suitable portions for learner to master.	<u>Key Points</u> Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information.
1. Depress the fan belt with your forefinger.	Pick the point midway between the fan pulley and the dynamo, and depress it with your forefinger.
2. Note amount of deflection.	Normal belt tension should allow deflection of the belt of between $\frac{1}{2}$ " and $\frac{3}{4}$ ". Check new belt after one hour service.
3. If too loose, adjust.	Slacken off the two retaining nuts holding generator and the one adjusting nut. Pull generator with hand to a point producing required belt tension. Do not use a tyre lever or anything similar to pull the generator. Re-tighten nuts securely.
4. Check fan belt wear.	See if the fan belt is wearing out. If worn out, it will be frayed or thinner than it should be.

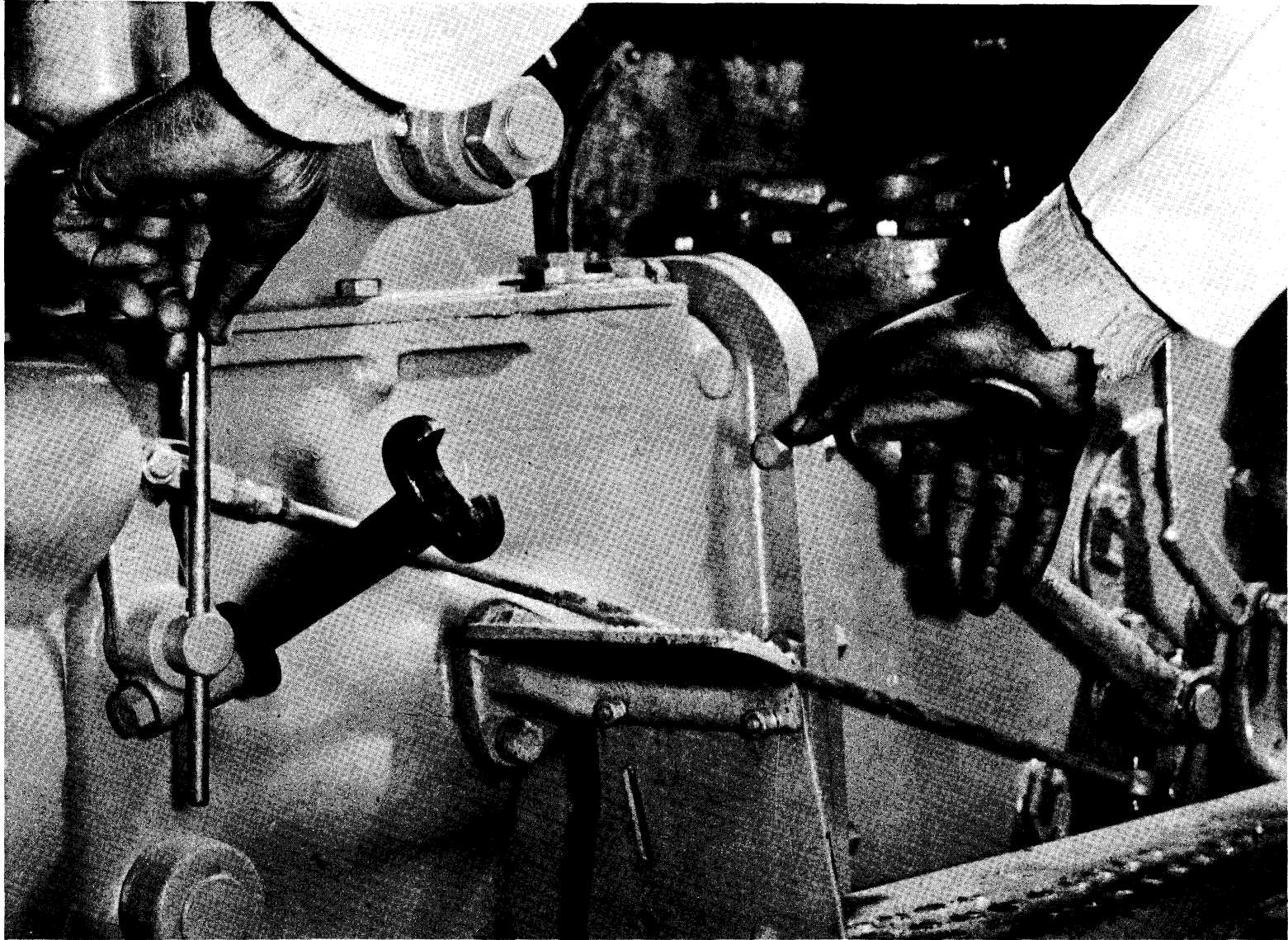


Fig. 17: Adjusting clutch. (Photograph by Graphic Arts, CSIR)

Break-down SheetSubject : Adjusting Clutch

<u>Stages</u> Go through the job or Subject. Select suitable portions for learner to master.	<u>Key Points</u> Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information.
1. Hold the end of the clutch bearing shaft.	Push the tommy bar through the hole provided near the end of the clutch bearing shaft. Doing this keeps the shaft from turning.
2. Release the clamp bolt.	Using the $\frac{11}{16}$ " spanner, loosen the clamp bolt.
3. Press the clutch pedal down.	Clutch pedal free travel should be one inch. Move the clutch pedal only one inch from its topmost position.
4. Tighten clamp bolt.	When clutch pedal is one inch from the top, re-tighten the clamp bolt. Do not allow the clutch bearing shaft to move.
5. Re-check the pedal free travel.	After you have tightened the bolt, remove the tommy bar and then press the clutch pedal slightly with your hand. If the free travel is only 1 inch, then the clutch is properly adjusted.

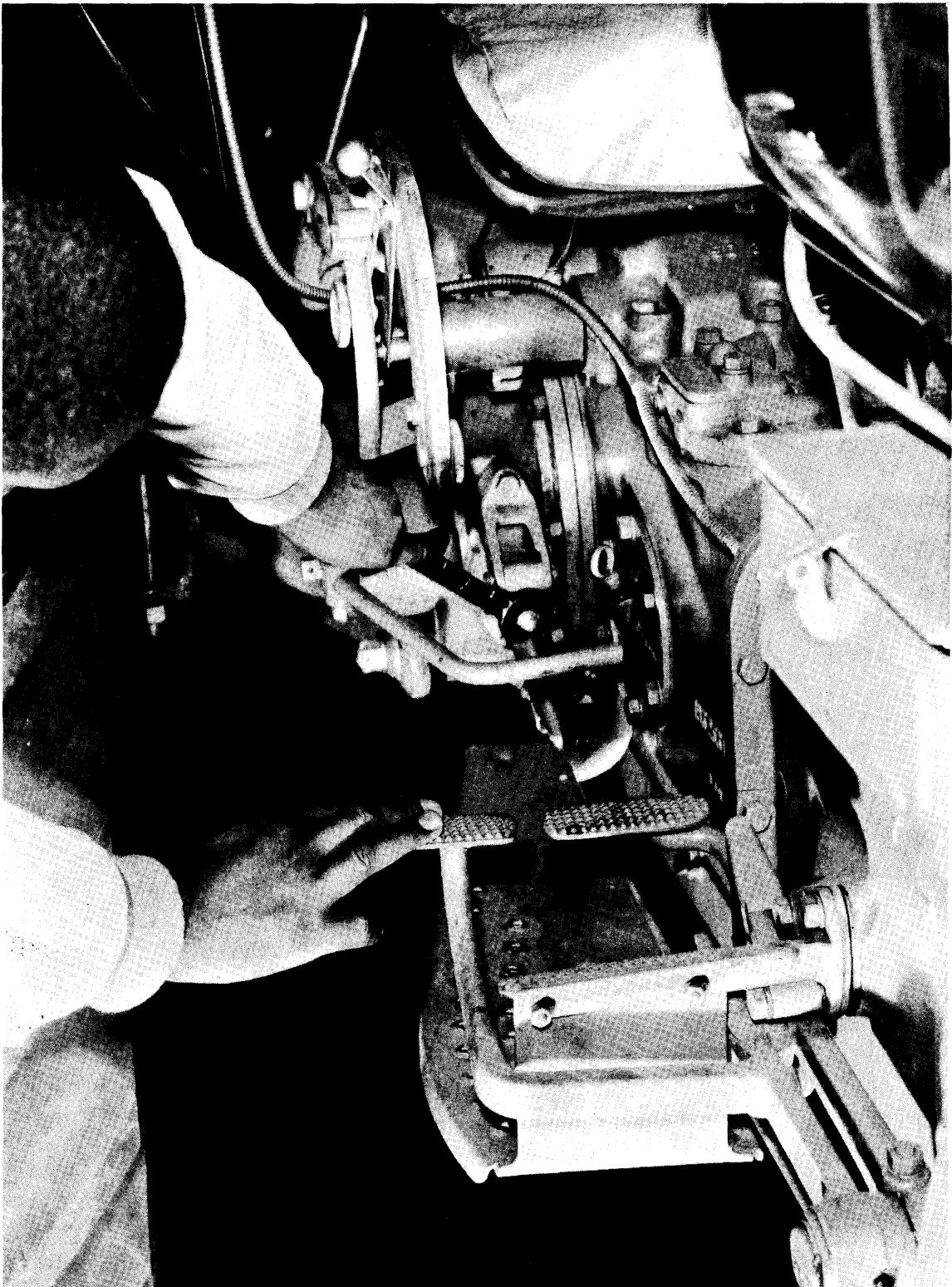


Fig. 18: Adjusting brakes. (Photograph by Graphic Arts, CSIR)

Break-down SheetSubject : Brake adjustment

<u>Stages</u> Go through the job or Subject. Select suitable portions for learner to master.	<u>Key Points</u> Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Raise the rear wheels clear off the ground.	Use a jack and make certain that the front wheels will not move by placing some obstacle e. g. brick, in front of and close to each front wheel.
2. Disconnect the brake return springs.	This can be done by unhooking one end of this spring.
3. Rotate the wheels.	Using your hand, cause the wheels to turn by pushing them.
4. Depress the brake pedal.	As the wheels rotate, press the brake pedal down lightly until the wheels stop rotating. Keep the brake pedal at that point.
5. Check the pedal's free travel.	Measure the distance between the topmost point of the pedal and the point where it meets with firm resistance. This should be $2\frac{1}{2}$ inches.
6. Adjust the brakes.	If pedal free travel is more than $2\frac{1}{2}$ inches turn the self-locking nut clockwise. If less than $2\frac{1}{2}$ inches increase it by turning the self-locking nut anti-clockwise until it remains at $2\frac{1}{2}$ inches. If the pedal free travel distance is more than $2\frac{1}{2}$ inches, the brake pedal will be stopped by the platform before brakes are engaged, thus being ineffective in bringing the tractor to a stop.
7. Connect the brake return spring.	Hook the free end onto its place.

Exercise 3.100-Hour Maintenance.

A 100-hour period corresponds roughly to two weeks. As in the previous exercises, instructor explains that when the hourmeter reading on the tractor shows that the tractor has worked for 100 hours, the driver must carry out the service which he is going to demonstrate.

In demonstrating, he first points at the Maintenance Chart and shows learners the "C"-Service. He points out that both the "A" Service and the "B" Service have been demonstrated. He points at the picture and then locates the actual part on the tractor. He explains what is to be done to that part.

Subject : Changing Engine Oil.

First he tells learners the following points to remember before changing Engine Oil:-

- a) The Oil should be changed when the engine is hot.
- b) The tractor must be standing level.
- c) A clean container for catching the used oil must be used, and must be kept in position below the sump under the drain plug.

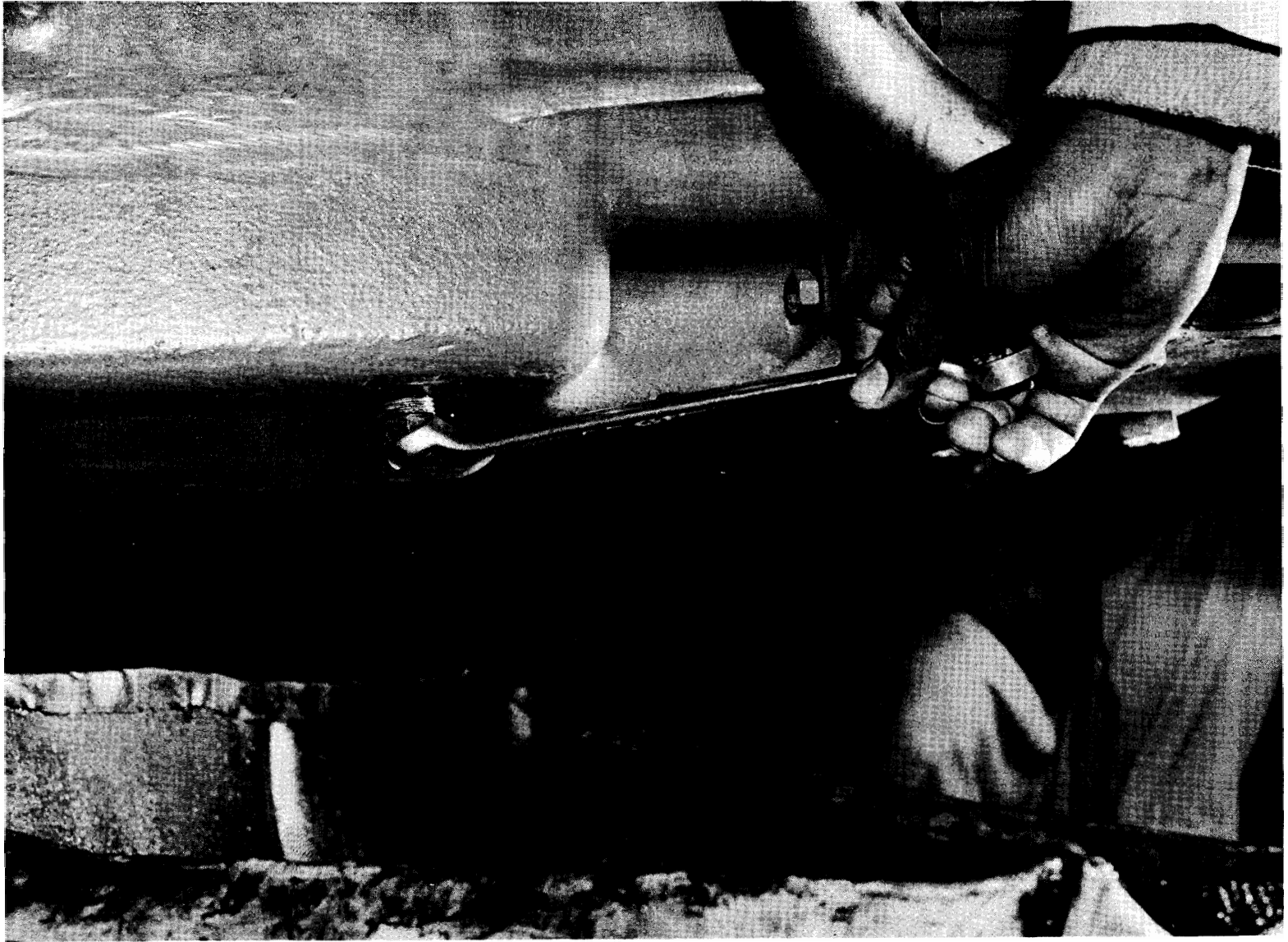


Fig. 19: Changing engine oil. Notice receptacle below drain plug. (Photograph by Graphic Arts, CSIR)

Break-down SheetSubject : Changing Engine Oil.

<u>Stages</u> Go through the job or Subject. Select suitable portions for learner to master.	<u>Key Points</u> Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Clean around both the drain plug and the filler cap.	Use a clean mutton cloth to wipe off dust and grease.
2. Remove filler cap.	Turn it anti-clockwise with your hand.
3. Remove the drain plug.	Watch out that oil does not shoot the plug into the receptacle. Allow oil to drain.
4. Replace the drain plug.	When no more oil drips out, wipe the drain plug and screw it on.
5. Select the correct oil and refill sump.	The colour code will show you the correct grade of oil. Do not over-fill sump.
6. Replace filler cap and wipe clean.	Turn it clockwise with your hand until it is firm.
7. Remove the receptacle from below the tractor.	You may forget and move the tractor while the container is still below it.

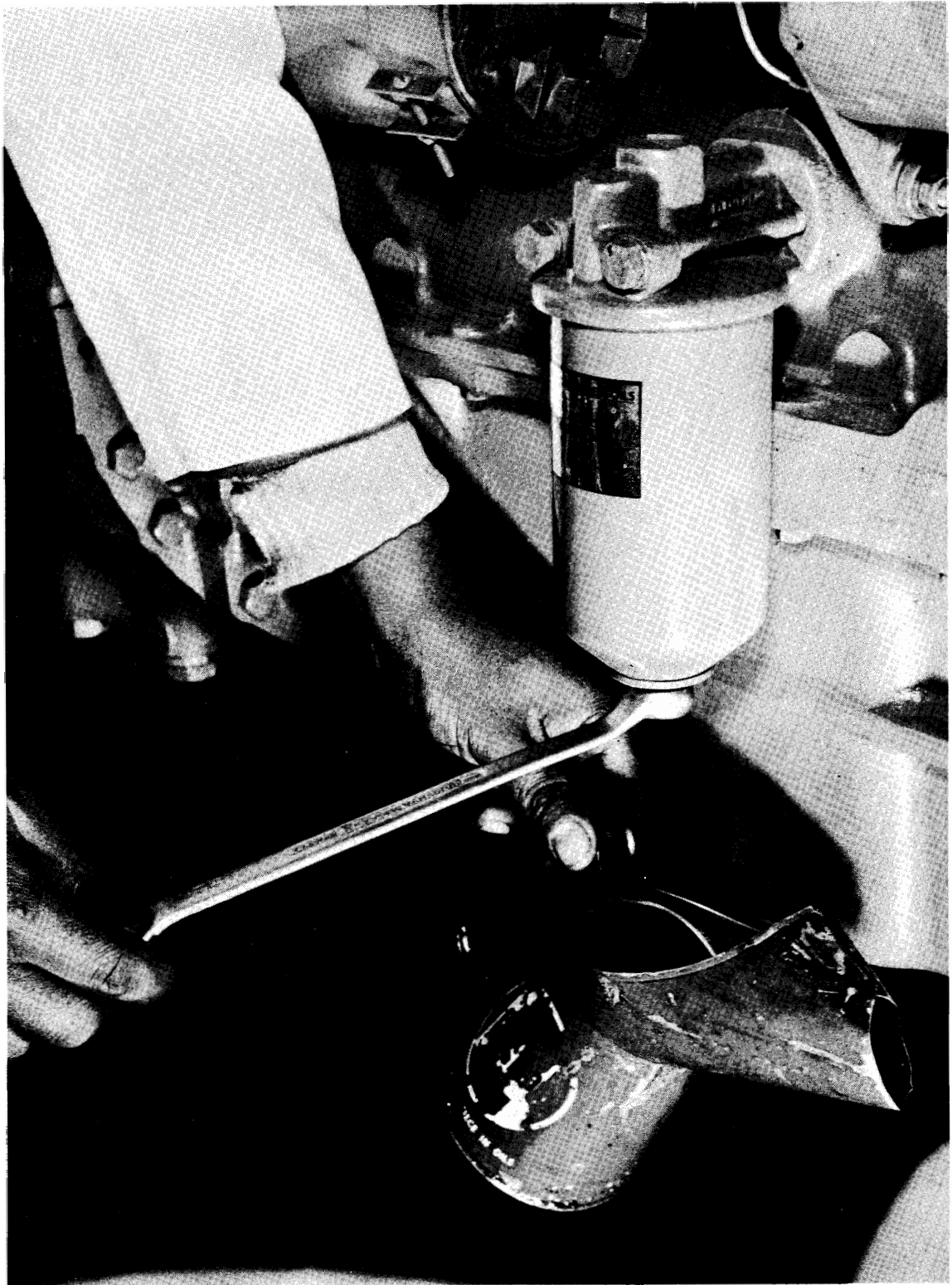


Fig. 20: Changing oil filter. (Photograph by Graphic Arts, CSIR)

Break-down SheetSubject : Changing Oil Filter

<u>Stages</u> Go through the job or Subject. Select suitable portions for learner to master.	<u>Key Points</u> Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information
1. Remove filter assembly, and discard old filter element.	Unscrew the long bolt at the top of the cannister.
2. Wash the cannister.	Use water or paraffin.
3. Dry the cannister.	Use only a linen cloth or chamois leather. Do not use waste or mutton cloth, as the fluff may remain on the inside surface and block the oil galleries.
4. Replace the old gasket.	A rubber gasket is supplied with every new filter in its box. This is used if the old one is in a bad condition, that is, if it is frayed and less effective in sealing off air.
5. Replace cannister and new filter.	When re-tightening, make sure you do not over-tighten. Use a spanner not more than 6 inches long. A longer spanner may be awkward because of lack of space.

N.B. Remember to place a receptacle below the oil filter to catch the outflowing oil.

Break-down SheetSubject : Cleaning battery

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information.
1. Clean top of battery posts and cables.	Use a piece of cloth soaked in a solution of Bi-carbonate of Soda and water to neutralise acids on top of battery and cables.
2. Remove cables from battery.	Unscrew the nuts which clamp the terminals to the battery and pull the cables out.
3. Clean the cable clamps.	Use a piece of cloth soaked in a solution of Bi-carbonate of Soda and water to clean the insides of cable clamps.
4. Apply petroleum jelly.	Use a small quantity of petroleum jelly ("Vaseline") to smear the cable clamps and around both terminal posts. Do not use ordinary grease.
5. Replace cables on the battery.	Make sure that you do not cross these when you replace them. The sizes of the terminal posts differ. One is larger than the other. The cable clamps will fit their respective posts according to size. Screw the nuts tight.

Break-down SheetSubject : Checking Epicyclic hub Oil level.

<u>Stages</u> Go through the job or Subject. Select suitable portions for learner to master.	<u>Key Points</u> Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information.
1. Wipe area surrounding filler plugs.	Use a clean cloth. The epicyclic hub filler plugs are situated on the rear axle, near the hub of each wheel.
2. Remove the filler plug.	Use the correct size spanner to loosen the filler plug, and then remove it with your fingers.
3. Check oil level.	Oil level is correct when it is level with filler plug hole. Push your fore-finger into the plug hole and feel the level of the oil inside.
4. Add oil if necessary.	If oil level is too low, refer to the Maintenance Chart for a guide on the correct grade of oil and add some oil through the filler plug hole. Check now and again with your fore-finger until you actually feel the level of the oil inside.
5. Replace the filler plug.	Screw it on with your fingers and tighten it with a spanner. It must not be over tight.

Exercise 4.Using the Peg-board.

Maintenance may be carried out in detail but it is not complete without systematic and detailed recording of maintenance operations carried out. A straightforward method of keeping a "log-book" without writing anything is by keeping an up-to-date peg-board. The present exercise is intended to introduce the peg-board system and to teach learners how to use it.

Learners must know how to read off hours from the tractormeter recording. Instructor assembles learners near a tractor and shows them the number which appears across the tractormeter. The figure on the extreme right of this number, which is white on a black background, must be ignored. It is the rest of the number which, for our present purpose, is important.

Instructor tells learners that this number stands for the number of hours the tractor has worked. Every time a tractor works for an hour, it records on the hourmeter. As a result, this number increases.

Instructor goes to the blackboard and writes down a number, say 00254. He assumes that this number appears on the hourmeter. It shows that the tractor has worked for 254 hours. If the tractor works for another 1 hour, this additional hour will be shown on the hourmeter, so that the new number will be 00255. After working for another 4 hours, the total number on the hourmeter will be 259 (255 + 4), ignoring the two noughts.

Instructor writes a number on the blackboard, say 00271. He asks the learners what the number will be after the tractor has worked for 8 hours. One learner says it will be 279. He writes different numbers, and asks each learner in turn to say what the number will be after the tractor has worked a few (specified) additional hours.

When all learners have learned how to read the number of hours on the hourmeter, instructor refers to the peg-board. The peg-board has many holes punched on it. These are arranged in rows across, and running down to the bottom of the board. On one side of the board, are numbers only; on the other end are numbers and letters, like BA, CBA and so on. At the top of the board, at regular intervals, is the letter A.

Explain /

Explain that each hole represents one hour a tractor has worked. One can transfer the number of hours shown on the hourmeter to the board. If the hourmeter shows 00015, it means that the tractor has worked for 15 hours. Always ignore the noughts before the number. To show this on the board, one counts 15 holes on the board, along the first line, and places a peg on the 15th hole. If the hourmeter shows 00252, it shows that the tractor has worked for 252 hours. To represent this number on the board, one counts 251 holes and then places the peg on the 252nd hole. To count 251 holes, however, would take a very long time. Peg-board makers have counted these numbers for us. We simply look at the numbers along the side of the board and choose the number nearest the one we want. For instance, we want 252. We look at the board, and see that there is 251 at the beginning of the 6th line. It means that the first hole along this line is number 251. Our number 252 is therefore the next hole. We put the peg there.

Instructor gives learners practice in transferring numbers from the black-board on to the peg-board.

Interpreting the peg-board

The letters at the top and along the right side of the board remind the tractor driver of what service has to be done to the tractor according to the number of hours it has worked. Counting along the top row across the peg-board, we notice that at every tenth hole there is the letter A. We know that every hole stands for one hour a tractor works. In other words, at every tenth hour, there is the letter A.

Looking at the Maintenance Guide, we see the letters A, B, C, up to F along the left hand side of the chart. Against each letter, is a series of maintenance operations which have to be carried out on the tractors. Below each letter on the Guide, there are numbers, for instance, below A is 10; below B is 50; C, 100; D, 200 and so on. This means that A stands for 10 hours' work by tractor; B for 50 hours; C for 100 hours; D for 200 hours, and so on. After 10 hours' work, the tractor must receive all the service operations listed under A; after 50 hours, all the service operations listed under B, and so on.

Turning to the peg-board, the letters have the same meaning: to remind the tractor drivers that as soon as the peg reaches a certain letter, say, A, the tractor must receive service operations listed under A on the chart; and as soon as the peg reaches the letters BA, the tractor must receive service operations listed under B first and then those under A. We see, for instance, that on the pegboard at the end of the second row of holes (hours), appear the number 100 followed by letters CBA. This means that after working for 100 hours, the tractor must receive service operations listed under C, plus those under B, plus those under A.

It is important to follow the order of the letters as they appear on the board. After 1000 hours, for instance, we see FEDCBA. It means that the tractor must first of all receive service operations listed under F which are:

1. Repacking rear wheel bearings with grease (on M-F 35 tractors);
2. Changing Transmission (on "35" and "65")
3. Checking Steering box oil level (on "35" and "65")
4. Washing and greasing front axle hubs ("35" and "65") and
5. Washing hydraulic pump filter ("35" and "65").

Then it must receive those service operations listed under E, followed by those under D, followed by those under C and so on until those listed under A. If engine oil must be changed under D service and the same instruction applies to C, then obviously the order is only complied with once, namely during the D service.

The peg-board can show only 1000 hours service, but the tractor may well work on for many more hours. There is no need to get a new peg-board for the same tractor simply because the board is full. At the bottom of the board appear "1000 Hours 1 2 3 4 5 6 7 8 9 10". As soon as the tractor has clocked 1000 hours, the driver should record this by pushing a peg into the hole under 1, and then clear the rest of the peg-board. If the same tractor should reach 2000 hours, the driver pegs under 2 and so on.

Tractor drivers are expected to carry out all the operations listed under A (10 hours), B (50 hours) and C (100 hours) themselves.

Operations under D, E, and F should however be carried out by a mechanic. If, therefore, the tractor reaches the "200 DCBA" mark, the driver should report to the mechanic or anyone in charge, so that the D part of the operations can be done by him. The rest (CBA) of the services will then later be carried out by the driver.

Learners must remember to leave every peg on the board until the tractor reaches 1000 hours, i.e. until the board is full.

Conclusion

The present lesson has taught the learners how to keep the tractor in sound condition. It must be stressed to the learners that their knowledge is useless unless they apply it constantly in practical situations. Conditions may arise when the driver may find that he has to make important decisions regarding the prompt carrying out of the maintenance procedures. It may happen, for instance, that urgent farming operations have to be carried out at high pressure, since delay might affect the whole crop. The driver may feel that stopping a tractor to service it may take too much time.

However, an experienced driver who has carried out maintenance operations regularly will find that the time spent on servicing a tractor is very little compared with the possible consequences of over-looking and by-passing the service needs of a tractor. A tractor driver may decide to rush on with his farming operation and successfully carry it out. But by over-looking certain tractor service needs, the damage done to the tractor, though not immediately discovered, may be great. It might cost the farmer, or tractor owner a great deal, not only in terms of Rands and cents in repair bills, but also in terms of crop losses incurred as a result of the tractor being put out of use when its services are needed for other urgent jobs.

At this point of the learners' training programme, the learner should be able to handle the tractor well on roads, as well as attend to its maintenance requirements. What he still has to learn is how to handle the tractor on actual farming operations. The next lesson is designed to help learners acquire the essential basic knowledge of driving a tractor whilst pulling a plough, planter or cultivator.

LESSON VI.OPERATING IN THE FIELDS *

Driving a tractor in such farming operations as ploughing, harrowing, planting and cultivating, requires that the driver be thoroughly familiar with the tractor. He must be able to handle his tractor well. He has to pay attention to the operation he is carrying out and at the same time, he must be able to detect any sign of tractor malfunctioning. Efficiency in carrying out the various operations can be acquired with practice. The present lesson will give the learner the basic guiding principles which should help him to greater efficiency.

The lesson is divided into several exercises designed to introduce to the driver the parts of the tractor which are especially employed in farming operations, and to teach him how to operate these. The learner becomes familiar with the most commonly used farm implements, e.g. plough, harrow, planter, cultivator, etc., and learns how to operate the three-point linkage system and the hydraulic controls.

Throughout, the instructor must remember to apply the principles as followed in the first part of this Manual. It is also of utmost importance that the learners have experience in actually doing the work - thus getting the feel of the correct performance.

Equipment: A tractor; Ploughs - Disc, Mouldboard; Harrow; Cultivator; Planter.

Layout / . . .

* NOTE: As indicated in the Introduction to the Manual this section on field operations has been dealt with in summary form.

Some detail is given on "Ploughing", but very little is supplied on "Planting" and "Cultivating". This lesson would have to be elaborated by the Instructor according to the principles used in the first part of the Manual.

Layout : A small field which has been cultivated before (not virgin). The farming implements should be towed to the field and lined up side by side in the following order: Mouldboard plough, Disc plough, harrow, planter, cultivator. A tractor should be parked in front of the row of implements, with its back towards the implements. Learners should stand facing the tractor and the implements.

Conduct of the lesson : The instructor points at the three links and explains how implements are coupled to them. He then explains how the control levers in the hydraulic system work. He mentions the uses of the various types of implements. He demonstrates as he teaches. Learners are themselves then given turns to demonstrate the linking of each implement.



Fig. 22: A mouldboard plough coupled to the tractor. (from Massey-Ferguson)

Exercise 1.The three-point linkage System

The object of this exercise is to train learners in coupling implements to the tractor by means of the three links.

First, instructor points at the three linking points, the top link and the two bottom links. He mentions that the implements normally have linking points corresponding to those on the tractor. He points at the linking points on the plough.

To couple an implement to the tractor, the driver first ensures that the top link is in position on the implement. He backs the tractor so that it is square with the implement cross-shaft, and the tractor and implement top link connections are in line. The tractor must be correctly positioned before proceeding to attach lower links. He attaches the left lower link to the cross-shaft, retains it in position by means of the lynch pin and lock ring. Then he attaches the right lower link in similar manner, using the levelling lever to bring the ball joint in line with the cross-shaft on the implement. Finally, he attaches the top link.

He instructs learners as follows:-

Exercise 1.Break-down Sheet

Subject : Coupling the plough to tractor.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might:- Affect quality Cause injury or damage Make the work easier and any special information.
1. Reverse tractor to the plough.	Back the tractor up to the end of the plough which has the cross-shaft. Reverse very slowly and stop at a point when you see that the top link connection on the tractor is in line with the forward end of the top link on the plough.

2. Fit the left lower link.	It is essential to start off with the left lower link because it has no levelling lever to adjust it once it is fixed. Make sure that this link is retained in position by means of the linch pin and lock ring.
3. Fit the right lower link.	If this is not level, the levelling lever is used to bring the ball joint in line with the cross-shaft on the plough. Retain it in position by means of the linch pin and the lock ring.
4. Fit the top link.	Place the forward end of the top link in tractor top link connection. Move the tractor slightly backward or forward until the top link pin can be entered. Secure it with linch pin.

In detaching the plough or any implement, the order is reversed thus: The top link, the right lower link and the left lower link.

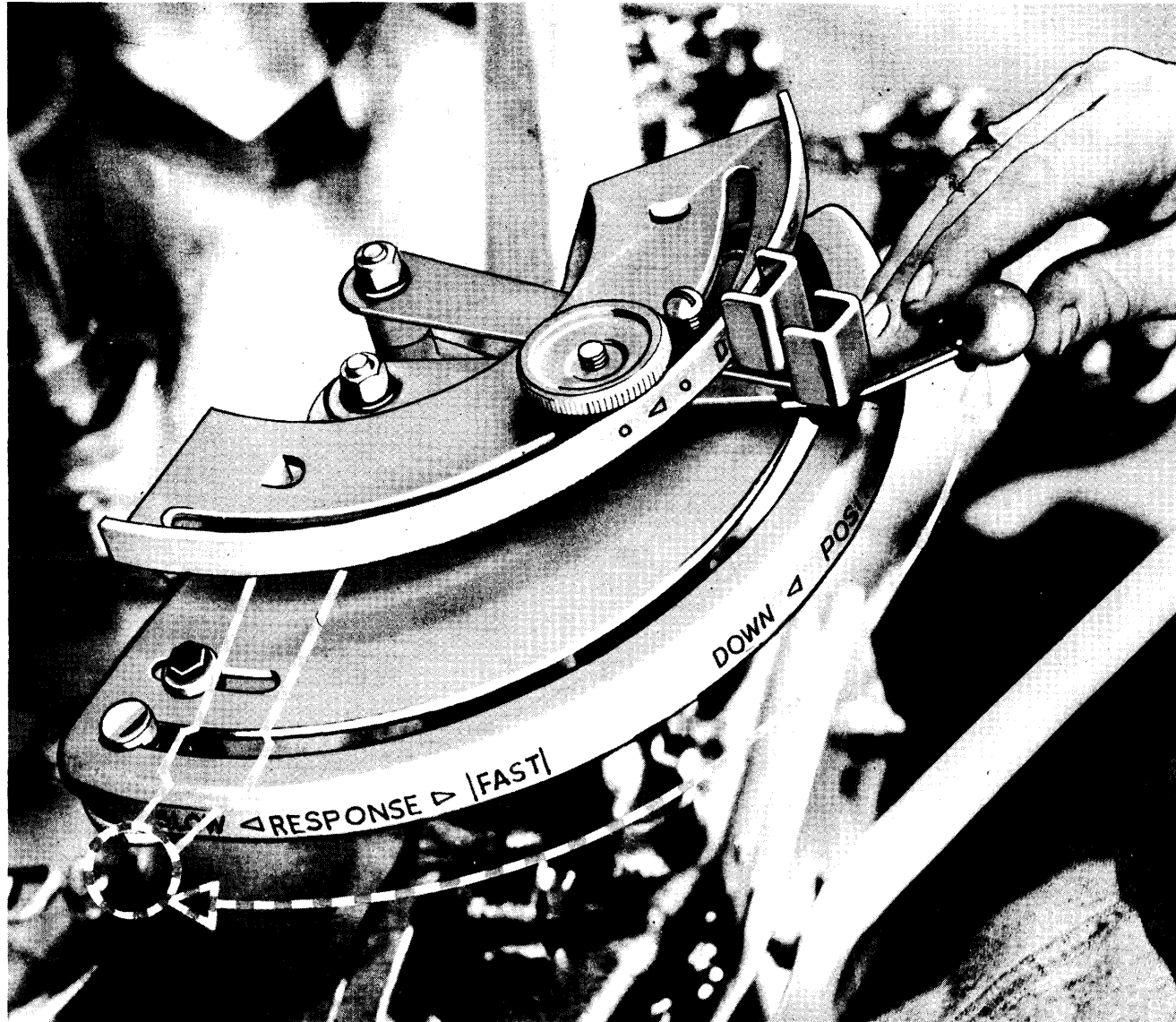


Fig. 23: Control levers in the Hydraulic System. Notice hand holding the operational lever.
(from Massey-Ferguson)

Exercise 2.The Control levers in the Hydraulic System.

The object of this lesson is to show the learners how the control levers in the hydraulic system work and then to train them in operating these levers.

The control levers should be demonstrated when an implement is coupled to the tractor.

Instructor first points at the two levers:

1. Position Control Lever
2. Draft Control Lever

Then he explains the functions and demonstrates the use of each lever separately.

1. Position Control lever (Operational Lever)

a) Functions :

- (i) To raise the implement at the headland.
- (ii) To lower the implement into working position.
- (iii) To allow the operator to control the height of above-ground tools accurately.
- (iv) To give response control.

b) Demonstrations

The plough is attached to the 3-point linkage and the Draft Control Lever is moved fully down. The Position Control lever is raised and lowered in the Position Control Range. This raises and lowers the plough.

To demonstrate the use of the lever stop, raise the implement by moving Position Control lever half-way up the quadrant. Then move the lever stop up against the lever in this position and lock with knurled knob. Measure the distance of the implement above the ground. Raise the implement fully and then lower it again to the stop. Measure again. The distance of the implement above the ground is the same as before.

To demonstrate the way Response Control works, move the Response Control to "FAST" and lock it. Raise the implement fully and then lower the Position Control lever fully to the stop. The implement will fall to the ground. Now, move the Response Control to "SLOW" and lock it. Raise the implement fully and then lower the Position Control lever fully to the stop. The implement will fall fast at first as you pass "FAST" and then more slowly as "SLOW" controls the drop.

In practical farming operation, remember:

- (i) FAST response for any kind of work in rough land, for high speed work and light cultivating, as in row crop.
- (ii) MEDIUM response for all types of ploughing operations.
- (iii) SLOW response for tined implements over normal types of land.

2. Draft Control Lever

Function : To control the depth of the implement in the soil.
It can be locked into position.

Points to remember:

- (i) Going into the land, the draft lever should initially be set to the sector marks, i. e. between the dots.
- (ii) Never use the Draft Control lever to raise an implement.
- (iii) Never work a soil engaging implement with the Position Control lever higher than the Draft Control lever.

With the plough coupled to the tractor and the tractor's engine running, Instructor gives the following instructions:-

Exercise 2.

Break-down Sheet

Subject : Lifting and lowering implement using Position Control Lever.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information.
1. Move the Response Control nut to "SLOW" position.	To lock it, turn the knurled nut upwards until it stops turning.
2. Move the Position Control Lever upwards.	Hold the knob and pull it towards you. As you do so, look at the plough. It will be lifted off the ground.
3. Move the Position Control Lever downwards.	Push it away from you past the "FAST" position until it rests against the nut. The plough will fall fast as it passes "FAST"; thereafter "SLOW" response will control the drop.
4. Move the Operational Lever towards you.	The plough will be lifted off the ground.
5. Move the Response Control nut to "FAST" position and lock it.	The nut is first unscrewed, pushed along its quadrant and then screwed firmly at "FAST" position.
6. Move the Operational Lever to "FAST" position.	The plough will drop down fast.

N. B. For Fast drop, make sure exercise is carried out on soft ground to avoid breaking the implement when it drops fast.

Exercise 3.The Soil Working Implements

The exercise is designed to make learners familiar with soil-working implements, such as the plough, harrow, planter and cultivator. It also makes learners familiar with coupling various implements.

Instructor names the implements, one at a time. He mentions and points at the important parts of each implement. Then he mentions the main functions of the individual implements.

- a) The Plough : The two main types : Mouldboard and Disc. Ploughs are used for turning, loosening and aerating the soil.
- b) The Harrow : For breaking the sods, destroying weed and mulching.
- c) The Planter : For planting seeds of crops such as maize, peanut, cotton. It adds fertilizer as it plants seed. There are special planters for potato seeds.
- d) The Cultivator : This loosens the top soil and destroys weeds. Also known as tiller.

After this, instructor asks learners to practise hitching the various implements on to the tractor. He emphasizes the importance of adjusting the level of the plough correctly. The plough has to be made level with the flat surface of the ground on which the tractor stands. This is important because it is easier to control the depth of the implement's penetration into the earth if it is level with the surface of the ground. When coupled the plough must not be raised on one side and lowered on the other. Raising of the side should be made in accordance with the type of the soil. In heavy soils, it may be necessary to raise some shares so that they reduce the tractor's load.

To raise the side of the plough, the levelling lever on the right lower link is used. The same lever is used for lowering the side.

The top link is also adjustable. It can be extended as well as shortened. If extended, it lowers the back part of the plough. If shortened, it raises the back of the plough. For normal ploughing operations the top link should be kept at its normal length which is indicated by the wider marks engraved on it. These are referred to as master grooves.

Exercise 4.Ploughing.

The object of this exercise is to show the learners how to handle the tractor and the plough when ploughing.

The instructor explains to the learners what they should do and watch out for, e. g. that the link connections are firm; that furrows follow contours, etc. Then he demonstrates the principles involved by making the opening furrow. It is preferable to demonstrate on a strip of ground which has been ploughed before and harrowed. The idea is to demonstrate these principles without encountering much difficulty.

Conduct of the lesson

The learner reverses the tractor to the plough. A plough is coupled. It is important to keep the plough level. To ensure this, all the share points should touch the ground. He lifts the plough and then drives to the edge of the field. He stops the tractor. Then he studies the contour of the field and counts six paces from the end of the field along the contours.

He shifts the dual range selector lever to "Low". This range gives the tractor more power, whilst "High" range gives more speed. In the "Low" range, the gears are simply 1, 2 and 3 respectively, but in "High" range they become 4, 5 and 6 respectively. In selecting the gears, you choose the one which will enable the tractor to work without being too strained. In other words, you select the gear which will be powerful enough for the particular task, and still leave the tractor capable of more reserve power in the same gear range. In ploughing, you use gear number 3 in the low range.

Before making the opening furrow, the learner makes a headland furrow. This furrow runs across the contours of the field, about six paces from the end of the field. It is kept shallow, about 4 inches deep, by using only one share and lifting the others with the levelling lever.

As the tractor runs, the driver must constantly check the instruments on the tractor to see that the tractor is functioning properly, for instance, that the battery is being charged and that oil pressure is normal. If any of these is not working properly, or if he hears an unusual engine sound indicating engine malfunctioning he should immediately report to the mechanic or to his senior.

Exercise 4.

Break-down Sheet.

Subject : The Opening Furrow.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information.
1. Study the contour of the land.	To cut down soil erosion, ploughing should follow the contours, i.e. across the slopes.
2. Open the 1st headland furrow.	The first headland furrow should run parallel with the edge of the field. It should be about 6 paces from the edge. It should be shallow, about 4 inches deep, and should always be turned towards the land to be ploughed. Headland furrows facilitate the quick penetration of the plough and make an even finish at the end.
3. Make the 1st opening run.	This should be about 50 yds. from the edge of the field along the contours. Look over the left shoulder and lower the plough as the rear wheels climb out of the headland furrow.
4. Fixate on 3 objects in line with the tractor.	The first object should be in the field. The second should be at the end of the field and the third should be outside the field. These should be stationary e.g. marker poles, trees or other landmarks. These enable you to make a straight opening.
5. Make a straight furrow.	To achieve this, fixate on the object nearest the tractor, then when you are close to this, shift your gaze to the middle one. When you approach the end of the field, shift your gaze to the distant object. If you want to turn your head and look back, stop the tractor and do so.
6. Open the 2nd headland furrow.	About 6 paces from the end of the field, lift the hydraulics, flick the steering wheel to the left, and turn the tractor to the left, parallel with the end of the field. When you reach the other end, make a U-turn to the left, and lower the plough. Open a straight headland furrow about six paces from the end of the field. At the other end of this furrow, lift hydraulics and make a U-turn to the left. When you reach the 1st opening turn left and lower the hydraulics.

<p>7. Make the 2nd opening run.</p>	<p>With the tractor spanning the first furrow, throw another furrow out in the opposite direction, ensuring that no unploughed land is left in the centre. When the rear wheels climb out of the headland furrow, lift the hydraulics and simultaneously flick the steering wheel to the left. You flick the steering wheel at the end of every furrow to avoid sod falling back at the end of the furrow.</p>
<p>8. Make a 3rd opening run.</p>	<p>Steer so that the Right-hand front wheel is positioned to enable the plough to close the opening of Runs 1 and 2.</p>
<p>9. Make a 4th opening run.</p>	<p>Steer so that the Right-hand front wheel is positioned to enable the plough to close the opening of Runs 1 and 2.</p>

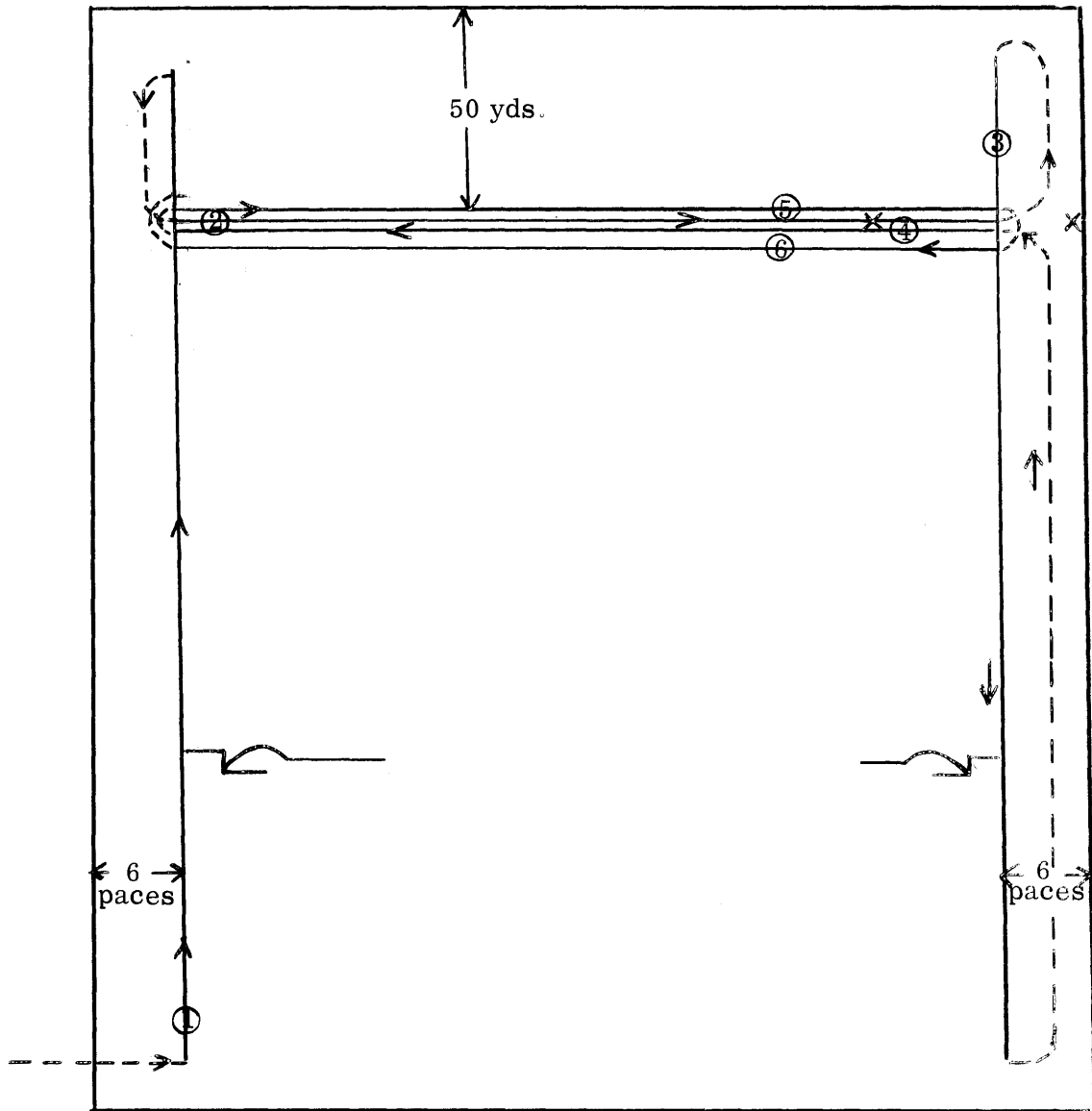


Diagram showing opening in arable land.

- ① 1st Headland furrow
- ② 1st Opening run
- ③ 2nd Headland furrow
- ④ 2nd Opening run
- ⑤ 3rd Opening run
- ⑥ 4th Opening run
- x Fixating objects (sights)

Stopping a tractor with implement attached.

The learners should already be familiar with methods of stopping a tractor. In ploughing, as in other operations, it is important to do much work in as little time as possible. As a result, where possible, some movements should be eliminated. In stopping a tractor, certain movements and their sequence are very important in speeding up the operations. The following is a break-down of the exercise on stopping the tractor.

Exercise 5.Break-down Sheet

Subject : Stopping the Tractor with implements attached.

<u>Stages</u>	<u>Key Points</u>
Go through the job or Subject. Select suitable portions for learner to master.	Anything in a Stage which might :- Affect quality Cause injury or damage Make the work easier and any special information.
1. Close the throttle.	Turn the hand throttle lever away from you, in an anti-clockwise direction.
2. De-clutch.	With your left foot, depress the clutch pedal to the first position.
3. Apply brakes.	With your right foot, depress the brake pedal. This will cause the tractor to stop.
4. Switch the engine off.	Pull the fuel cut-off.
5. Push fuel cut-off back.	Leave the fuel cut-off at the position of starting the engine. This cuts time in subsequent starting as it eliminates pushing of the fuel cut-off.
6. Release clutch.	Lift your left foot from the clutch pedal and let it come up.
7. Place dual range Selector lever into neutral position.	Shift the lever to the middle position.
8. Lower implement.	Turn your head over your right shoulder and, using your right hand, push the operational lever away from you. This will cause the implement to settle on the ground.
9. Return operational lever to full lift position.	The implement will not be lifted until the engine of the tractor is started. This is useful because it ensures the automatic lifting of the implement even if the driver has forgotten to pull the position control lever after starting the tractor.

Exercise 6.Planting.

The object of this exercise is to make the learner driver familiar with the use of a planter. The method of operating a planter is the same as that for ploughing. The main difference lies in the importance attached to:

- a) Straight driving in using a planter.
- b) Making the correct measurement of distances between rows.
- c) Always ensuring that seed and fertilizer bins have enough seed and fertilizer.
- d) Some planters are driven by P. T. O.

The correct spacing between rows is important because the success of subsequent operations, e. g. cultivation and harvesting, depend on the proper spacing in planting. Before planting begins, the distance between planter wheels must be measured accurately and adjustments made. The correct seed spacing plates must be fitted.

When planting is to start the distance between rows on the land is measured and marks are clearly made. These enable the driver to maintain a straight course in planting. The driver must constantly look backwards to make sure all is well. It is possible to detect irregularity in the seed dropping through the plate hole in one of the rows. If the driver hears this, he should stop the tractor and attend to it.

In planting, the first line must have sights which help in the same manner as in ploughing. The subsequent lines use a marker which is attached to the planter.

Exercise 7.Cultivating.

This exercise aims at showing the learner drivers the important principles to bear in mind when cultivating. Cultivation is normally done between the rows of plants.

As in planting, adjustments are made on the cultivator before cultivation begins. The cultivator tines should work between rows of plants. The distance between rows is known. It should be checked by actually measuring the space between two rows. In adjusting the tines, some space must be allowed. In other words, the tines should not be made to run very close to the plants.

In actual cultivation process, the tractor pulling a cultivator should move a short distance between the rows. Then the driver should stop and inspect the cultivator to see if the adjustment is accurate. If the cultivator tends to be too close to the plants, further adjustments are made, before full scale cultivation begins.

The depth of the cultivator should be checked now and again. It is very important that the driver keeps his tractor straight to avoid uprooting the crop.

ANNEXURE I.

TESTS

TESTS

These are conducted at the end of the training period. The intention is to find out how well the learners have grasped the contents of the course. If a learner has been following the course from the beginning, the tests should not be difficult. There is nothing tricky about them.

How to conduct the tests.

It is important that prior to testing, each learner is kept ignorant of the contents of the test material. Learners should be told that they are going to be asked questions on what they have learned. They will also be asked to do some of the operations they have been practising. They must be careful to do everything they are asked, and not leave out anything on any operation they are asked to do. The order of carrying out the operation is very important.

In setting out to conduct the test, only the tester and one testee should be present at a time. Nothing must be allowed to disturb the testee.

The learner who has gone through a test should not be allowed to meet the other learners who have not been examined on that particular test. Nor must the other testees be allowed to see what goes on in the testing situation until their turns come up. The tester does not encourage or discourage the candidate in any manner during the tests.

Scoring the tests.

A tick (✓) is made against the item that the testee gets correct, and a cross (✗) against the ones he omits. In tests which are scored as a whole after the operation has been completed, e. g. parking a tractor, the score is a unit of 10 points. Afterwards the ticks for each test are totalled up. If the score on a test is less than 75% ($\frac{3}{4}$), the

testee fails that test. If the testee fails more than two tests, he is not good as a tractor driver.

In unit tests, e.g. parking, the testee is given up to three trials. If he fails after his third attempt he has failed the particular test.

TEST 1.Naming the Parts.

Instructor asks the learner driver to name the parts as they are pointed out, e.g.

"What is this ?" (pointing to the part)

SCORE SHEET

Learner's Name / Number		Item		
		TOM	DICK	HARRY
1.	Combined Starter Switch	✓	✓	✗
2.	Fuel Cut-off	✓	✗	✗
3.	Gear Shift Lever	✓	✗	✓
4.	Dual Range Selector Lever	✓	✓	✗
5.	Clutch Pedal	✓	✗	✗
6.	Brake Pedals	✓	✓	✗
7.	Parking Latch	✗	✓	✓
8.	Steering Wheel	✓	✓	✓
9.	Hand Control Lever	✓	✓	✗
10.	Tractormeter	✗	✗	✗
11.	Oil Pressure Gauge	✓	✓	✓
12.	Ammeter	✗	✓	✓
13.	Transmission Filler Cap	✓	✗	✗
14.	Power Take Off (PTO) Lever	✓	✗	✓
15.	Transmission Oil Dip Stick	✓	✗	✗
16.	Fuel Tank	✗	✓	✗
17.	Battery	✓	✗	✓
18.	Radiator	✓	✓	✓
19.	Hydraulic Control Levers	✗	✗	✗
20.	Wheel Valve	✓	✗	✗
TOTAL		15	10	8

TEST 2.Basic Maintenance Requirements

This test is divided into 3 sub-tests, corresponding to checks made of oil, water and fuel, respectively. The aim of the test is to assess the extent to which learners have grasped the order of carrying out the tasks. It is important also to see if they maintain cleanliness. In each sub-test, learner actually does the checking. As he carries out the steps involved, he makes a comment explaining what he does, how he does it and the reasons for doing it.

Sub-test 2.1 Checking Engine Oil.

Item		Learner's Name / Number		
		TOM	DICK	HARRY
1.	Wiping area around dipstick			
2.	Pulling dipstick out			
3.	Wiping dipstick			
4.	Replacing dipstick			
5.	Pulling dipstick out			
6.	Reading oil level			
7.	Replacing dipstick			
8.	Wiping area around filler cap			
9.	Opening filler cap			
10.	Adding oil			
11.	Replacing filler cap			
12.	Checking oil level again			
TOTAL				

Sub-test 2.2Checking and Topping up Radiator

Item		Learner's Name / Number		TOM	DICK	HARRY
1.	Wiping area surrounding filler cap					
2.	Removing filler cap					
3.	Checking water level					
4.	Adding some water					
5.	Replacing the cap					
TOTAL						

Sub-test 2.3Checking and Filling up Fuel Tank

Item		Learner's Name / Number		TOM	DICK	HARRY
1.	Wiping top of the tank and filler cap					
2.	Removing the filler cap					
3.	Checking the amount of fuel in tank					
4.	Wiping funnel or nozzle of hose or suction pump					
5.	Putting funnel spout into mouth of tank					
6.	Pouring fuel into tank					
7.	Replacing filler cap					
8.	Wiping off all spilt or overflowing fuel					
TOTAL						

TEST 3.Driving Forwards

This test aims at assessing the learner's ability to drive the tractor smoothly in a forward direction. This involves the manipulation of several controls and includes climbing on to the driver's seat, starting the tractor and steering it correctly. Note is made of all the movements the driver makes. A good driver should not be doubtful in his manipulations. He should also follow the proper sequence in manipulating the controls.

Learner's Name / Number		TOM	DICK	HARRY
Item				
1.	Check engine oil, water and diesel fuel.			
2.	Mount driver's seat.			
3.	Check that brake is engaged firmly.			
4.	Ensure that PTO lever is in neutral position.			
5.	Depress clutch pedal.			
6.	Shift Dual Range Selector lever into "S".			
7.	Shift gear lever into neutral position.			
8.	Release clutch pedal.			
9.	Move the cut-off control to Starting.			
10.	Set hand throttle lever halfway open.			
11.	Start the engine.			
12.	Close hand throttle lever.			
13.	Depress clutch pedal.			
14.	Shift Dual Range Selector lever to Low.			
15.	Engage First Gear.			
16.	Grip Steering wheel.			
17.	Release brakes.			
18.	Let the tractor move by releasing clutch gradually.			
19.	Steer the tractor straight.			
20.	Stop the tractor.			
21.	Shift gear lever to neutral position.			
TOTAL				

TEST 4.Reversing

Item		Learner's Name / Number			
1.	Depress clutch pedal				
2.	Shift Dual Range Selector lever to Low				
3.	Engage Reverse gear				
4.	Grip steering wheel				
5.	Release brakes				
6.	Face backwards				
7.	Let Tractor move (by releasing Clutch)				
8.	Steer tractor straight				
9.	Stop the tractor				
10.	Shift gear to neutral position				
TOTAL					

TEST 5.Rules of the Road.

1. On which side of the road must you always drive ?
2. On which side must you normally overtake another vehicle ?
3. Name 4 occasions when you may not overtake another vehicle.
4. What must you do when another vehicle is overtaking you ?
5. Where may you not leave your vehicle (park) on the roadway.
6. What must you remember when following another vehicle ?
7. What does a white continuous line along the road mean ?
8. What do you do if you want to turn to the left ?
9. Why do you signal ?
10. If you have to stop on the road, where do you park your vehicle ?
 - a) In a town area ?
 - b) Outside a town area ?

TEST 6.Maintenance (Oral)

Item	Learner's Name / Number				
1.	Q: <u>How often should you carry out the "A" Service ?</u> A: Daily or every 10 hours.				
2.	Q: <u>What operations do you do under "A" Service ?</u> A: 2.1 Check engine oil 2.2 Clean fuel sediment bowl 2.3 Check gearbox oil level 2.4 Fill Radiator 2.5 Check battery 2.6 Fill fuel tank 2.7 Check tyre pressure 2.8 Tighten nuts and bolts 2.9 Air cleaner 2.10 Grease points				
3.	Q: <u>What operations do you do after 50 hours ?</u> A: 3.1 Draining fuel filter 3.2 Checking fan belt tension 3.3 Checking clutch clearance 3.4 Checking brakes				
4.	Q: <u>What operations do you do after 100 hours ?</u> A: 4.1 Changing engine oil 4.2 Changing oil filter 4.3 Battery cleaning 4.4 Check Transmission oil level				

Item	Learner's Name / Number				
5.	<p>Q: <u>What are the first things to do before you drive a tractor ?</u></p> <p>A: 5.1 Check engine oil</p> <p>5.2 Check water</p> <p>5.3 Check fuel</p>				
6.	<p>Q: <u>What is the most important thing to observe always when servicing a tractor ?</u></p> <p>A: Cleanliness</p>				
7.	<p>Q: <u>What safety precautions should you observe when</u></p> <p>Q: 7.1 <u>handling fuel ?</u></p> <p>A: Keep all open fires away e.g. cigarettes.</p> <p>Q: 7.2 <u>Opening radiator filler cap after engine has been running ?</u></p> <p>A: Turn it slowly</p> <p>Keep your head away in case water shoots out.</p> <p>Q: 7.3 <u>Topping up battery ?</u></p> <p>A: Do not allow battery water to splash on your clothes.</p>				
8.	<p>Q: <u>Before pulling out dipstick from the engine what cleanliness precautions must you take ?</u></p> <p>A: Wipe the area surrounding dipstick.</p>				
9.	<p>Q: <u>What is the peg-board used for ?</u></p> <p>A: 9.1 To record the number of hours tractor has worked.</p> <p>9.2 To show when service must be carried out.</p> <p>9.3 To show which service must be carried out.</p>				

Item	Learner's Name / Number				
10.	Q: <u>What does each hole on the pegboard stand for ?</u> A: The number of hours the tractor has worked.				
11.	Q: <u>What do you use for greasing the battery terminals ?</u> A: Petroleum jelly, e.g. "Vaseline"				
12.	Q: <u>When in driving a tractor, you notice that there is some unusual sound from engine or the instruments show that the tractor is not functioning well, what should you do ?</u> A: Stop the tractor immediately and report to your supervisor.				
13.	Q: <u>What service do you carry out when the pegs on the board reach the end of the line ?</u> A: The service indicated by the letters printed on the right-hand side of the board.				
14.	Q: <u>Where do you find out how many hours the tractor has worked ?</u> A: From the tractors hourmeter.				
15.	Q: <u>Where should you keep your feet when the tractor is running ?</u> A: On the footrests.				
16.	Q: <u>How should you keep the outside of your tractor always after work ?</u> A: Free from dirt and dust by washing and wiping.				

TEST 7.Parking from the right

For this test, the four poles used during the exercise are employed. The learner is expected to park the tractor within the four poles. The trainer watches all the movements a learner makes, but does not help the learner. The learner passes this test if he is able to park the tractor without knocking down any of the poles. The learner is given three chances. If he fails to park a tractor after these, he fails the test.

TEST 8.Maintenance. Practical Test.

This test aims at assessing the learner's ability to carry out maintenance operations on the tractor. In conducting this test, care should be taken that the learner understands the reasons for carrying out the operations. Some operations need not be carried out practically, as long as the learner can describe in detail what is required to be done.

Test on 10 hour Maintenance.

The learner must first mention, in proper sequence, all the services carried out on the tractor after 10 hours' work, namely:

- Check engine oil
- Clean fuel sediment bowl
- Check gearbox oil level
- Fill radiator
- Check the battery
- Fill fuel tank
- Check tyre pressure
- Tighten nuts and bolts
- Air cleaner
- Grease points

Then the learner is to demonstrate any one or two of the operations. He may be asked to demonstrate the cleaning of fuel sediment bowl. The examiner watches to see that the testee is observing cleanliness requirements, and that he is carrying out every step in the operation. The test breakdown items for all the 10-hour maintenance services should follow the pattern as indicated in Test 8: "Cleaning Fuel Sediment Bowl".

TEST 8.

Cleaning Fuel Sediment Bowl

	Learner's Name / Number				
Item					
1.	Closing tap from fuel cut-off.				
2.	Cleaning outside of bowl.				
3.	Unscrewing the bottom nut.				
4.	Pulling out glass bowl.				
5.	Emptying glass bowl of its contents.				
6.	Rinsing it with fuel.				
7.	Replacing glass bowl.				
8.	Opening tap from fuel cut-off.				
TOTAL					

TEST 9.

Test on 50-hour Maintenance

The learner must first enumerate in their correct order all the services carried out on the tractor after 50 hours' working. These are:

- Draining fuel filter
- Checking fan belt tension
- Checking clutch clearance
- Checking brakes

The learner is thereafter asked to demonstrate one of these services, e.g. draining fuel filter. He must go through all the stages in their proper order, as indicated in Test 9 : 'Draining fuel filter'.

Test 9. Draining Fuel Filter

Learner's Name / Number					
Item					
1.	Loosening the vent plug of the primary filter				
2.	Opening the drain tap				
3.	Closing the drain tap				
4.	Tightening the vent plug				
TOTAL					

TEST 10.

Coupling an Implement to Tractor

Learner's Name / Number					
	Item				
1.	Reverse tractor to the implement				
2.	Fit the left lower link				
3.	Fit the right lower link				
4.	Fit the top link				
TOTAL					

TEST 11.

The Opening Furrow and Adjusting Depth of the Plough

This is an oral test. The learner is expected to describe the various stages. The learner is asked the following questions:-

- a) How would you go about making an opening furrow ?
- b) After you have made the opening, describe how you would adjust the plough for deep ploughing and shallow ploughing.

TEST 11. The Opening Farrow and Adjusting Depth of the PloughScore Sheet

	Learner's Name / Number				
Item					
1.	Study how the contours of the land run				
2.	Tilt the plough to the left with the levelling lever to raise the front plough shares				
3.	Count 6 paces from end of the field along contours				
4.	Open the first headland furrow across contours				
5.	Mark the opening run with stakes				
6.	Make the first opening run along contours				
7.	Count 6 paces at end of opening run along contours				
8.	Open the second headland furrow across contours				
9.	Throw 2nd opening run in opposite direction ensuring that no unploughed land is left in centre				
10.	Tilt plough to lower the front plough shares				
11.	Position tractor with right wheels in the opening and make 3rd opening run				
12.	Position tractor with right wheels in opening and make 4th opening run				
13.	Adjust the plough to make it level				
14.	Throw another furrow and check depth of the plough				
15.	If the plough is too deep, shift the Draft control lever up, towards you, to raise it				
16.	If the plough is not deep enough, shift the Draft control lever down to lower it				
17.	When it is deep enough, tighten the nut to lock it in one position				
TOTAL					

APPENDIX A

DESIGN OF THE STUDY

APPENDIX A.

DESIGN OF THE STUDY

1. The aim of the study was to develop a systematic programme for training Bantu farm tractor drivers in

- 1.1 the basic skill of tractor driving;
- 1.2 the driving of a tractor in actual farming operations e. g. ploughing, planting and cultivation;
- 1.3 the maintenance of a tractor during the operation as well as at periodic servicing prescribed by the tractor manufacturers.

The training programme would culminate in the writing of a manual which would be a standard guide for the training of Bantu tractor drivers.

2. The study would take the following course:

- 2.1 the field worker would acquaint himself with all the routine farming activities in which a tractor is engaged.
- 2.2 A preliminary description and analysis of the job of tractor driving would be made.
- 2.3 The field worker would undergo training in tractor driving and maintenance, followed by actual participation in farming operations involving the use of a tractor.
- 2.4 In the light of practical experience gained through participation in 2.3 above, the field worker would make a more thorough and comprehensive final description and analysis of the job of tractor driving.
- 2.5 Breakdown of the job of tractor driving.
- 2.6 The writing-up of the manual for training tractor drivers.
- 2.7 Trying out of the techniques embodied in the manual by actually training some Bantu as tractor drivers.

3. In implementing the design .

- 3.1 Acquaintance with the routine farming activities involving the use of a tractor was covered by a visit of the field worker to the farms to observe the various

farming /

farming activities. The farms visited were selected under the guidance of the Sponsors, who in turn made all the necessary arrangements with the farmers concerned. In the selection of farms, care was exercised to ensure variety with regard to the size of the farm and the diversity of the farming activities.

On each farm visited, the investigator conducted informal interviews with the Bantu operatives engaged in tractor driving. He checked to ascertain whether there were any formal training centres, and sought to discover the nature of whatever training facilities were available.

3.2 Preliminary Analysis of the job of tractor driving.

In this stage of the study, the investigator interviewed experienced tractor drivers on the farms he visited. The object of the interviews was to prepare a systematic job description of a typical tractor driver.

3.3 Field worker training and participation in actual farming operations.

The investigator had to be thoroughly familiar with the use of the controls of a tractor. This step in the design could not be carried out because of certain difficulties. Instead, he received training in instructing learners at a course given by the Sponsors. This was supplemented by informal practice with the tractor on the Sponsors' fields.

3.4 A more thorough and final analysis of the job of tractor driving.

The experience gained in 3.3 above highlighted certain demands and cues not mentioned in the previous draft job description. In the light of this experience, the investigator was able to decide what ought to be amended or added on to the preliminary job description.

3.5 Break-down of the job of tractor driving.

Guided by the available data and practical experience, the investigator then broke down the job of tractor driving firstly, into major categories. This was followed by a finer break-down of each category into all the steps involved in each operation. This breakdown followed the T. W. I. principles. In addition use was made of the available literature on the training of drivers. The breakdown had, however, to be geared to fit in with Bantu concepts and abilities.

3.6 Writing-up of the Manual

The Manual was written in English. Actual photographs were used to illustrate some points.

3.7 Trying out the Manual

The Manual was tried out in draft form by using it to train a group of learner tractor drivers. The final contents of the manual, therefore, incorporate all the changes necessitated by this trial implementation.

APPENDIX B

JOB DESCRIPTION - FARM TRACTOR DRIVER

APPENDIX B.JOB DESCRIPTION FARM TRACTOR DRIVERSummary

Operates a tractor and attached implements to carry out a variety of farming operations such as ploughing, planting, cultivating, spraying crops with insecticides, operating a baler, etc. This involves:

1. Driving tractor along roads or in the fields, adjusting speed and direction of travel by selectively (and sometimes simultaneously) manipulating gears, brakes, clutch and other controls;
2. Attaching implements to tractor by means of link connections and setting and adjusting implements (e.g. width of spaces between planter units) according to the particular operation to be performed;
3. Controlling and manoeuvring both tractor and attached implements to carry out farming operations, ensuring e.g. that crop rows are evenly spaced, earth-working implements are at the correct depth, etc.
4. Keeps tractor clean and services it at set intervals according to a standard maintenance procedure. Service requirements include e.g. adjusting brakes, cleaning or changing oil filter element, adjusting fan belt tension, draining primary fuel filter, etc. While driving constantly ensures tractor is functioning properly, e.g. by checking panel instrument readings and listening to engine sounds.

1. Driving

Drives tractor along roads and in the fields selectively manipulating the controls and co-ordinating his movements (e.g. simultaneously steering, closing hand throttle, and declutching to stop tractor suddenly) according to traffic regulations, the condition of the road, readings on panel instruments (e.g. rev. gauge), the nature of the load he is towing (e.g. plough) etc.

Before starting the tractor ensures that the gear lever and dual power range selector lever are in neutral positions. To start the engine, pushes fuel cut-off control into the starting position and turns the starter-switch in a clockwise direction. Then depending on the speed of travel and power required, engages the dual range power selector lever into either High or Low range, and selects one of six forward gears or the reversing gear: Example: Requires additional power to tow a heavy load and therefore engages the Low power range and the powerful though slow first gear; to drive the tractor with no additional load along a smooth, flat road engages the High range and may select the sixth gear, the least powerful but fastest of the tractor gears.

To move off, depresses clutch, releases the brakes and then slowly lifts his foot off the clutch pedal and opens up the hand throttle (i.e. the hand control lever). Regulates engine speed by pulling hand control lever towards him (to increase speed) and away from him (to reduce speed). Manoeuvres the tractor steering it in the required direction; e.g. to reverse park the tractor into a small space judges distance to swing into the space before straightening out.

Adjusts speed of travel according to condition of road, e.g. slows down on curves and rough surfaces, and the nature of the load if he is pulling a trailer. In the fields usually drives between 1750 and 1800 revs. per minute. On roads, observes road rules and traffic signs, e.g. keeps to left hand side of road, gives appropriate hand signals, observes stop or yield signs, etc. Is constantly alert to react to unexpected occurrences, e.g. to simultaneously close hand throttle and declutch (while still controlling steering wheel) in order to stop suddenly in front of an obstacle in the road.

2. Attaching and Setting implements

Attaches implements (e.g. ploughs, cultivators, trailers) to tractor by aligning with and securing link connections to implement cross-shafts. Sets and adjusts implements e.g. depth of plough, distance between cultivator tines according to the particular farming conditions under which they are to be used.

All implements are hitched to the tractor by means of the three-point linkages. Other implements, e.g. planter, are linked to the power take-off shaft as well. Most implements have also to be set and adjusted before they are used.

To hitch an implement, aligns the link connections with the implement cross-shafts by backing the tractor straight up to the implement. Pushes the ball joint of the link connection of the left lower link by hand into the cross shaft of the implement. Secures it in position by means of the linch pin and lock ring. Attaches the right lower link in similar manner, using a levelling lever to bring the ball joint in line with the cross-shaft of the implement. Then mounts the tractor, and places the forward end of the top link in the top tractor link connection, moving the tractor slightly backward or forward until the top link pin can be entered and secured with linch pin.

In adjusting implements, considers the type of work they are going to do. Some implements are set for rows which are wide apart, e.g. planters set for planting mealies, or cultivators working between rows of mealies. Some implements are set to work deep or shallow into the soil, e.g. ploughs and cultivators. Others can have their sides raised or lowered, e.g. ploughs.

In setting implements, incumbent may have to use precise measuring devices, e.g. rulers or tape measures, such as when setting the distance between cultivator tines. (A tine on the cultivator is that part which actually penetrates the soil when the cultivator is being used.) To adjust cultivator tines, incumbent uses the appropriate size spanner to loosen the nut which attaches each tine to the cross-bar of the cultivator. Then he measures the distance along this cross-bar to the next point where a

tine should be. The distance depends on the width of crop rows, it may e.g. be 18 inches. He screws the tine on at this point and tightens it by means of a spanner.

In other adjustments, e.g. in regulating the depth of a plough, he moves the draft control lever on the Hydraulic system of the tractor up or down its quadrant until the required depth is attained. The depth to which he adjusts depends on the type of work to be done. To open a headland furrow, for instance, the depth is about 4 inches. In ploughing, the plough enters the soil deeper than in cultivating. If the plough is too deep, the tractor may be strained.

3. Carrying out Farming Operations

Carries out a variety of farming operations such as ploughing, planting, cultivating, spraying crops, cutting and raking grass etc. by manoeuvring tractor and attached implements e.g. to follow contours of the land, to keep crop rows evenly spaced, etc.

Performs a number of farming operations such as ploughing, planting and cultivating. Also uses the tractor to carry out such specialised mechanical farming operations as sawing wood, pumping water out of resevoirs, cutting and raking grass, operating a baler, and spraying crops with insecticides.

In most farming operations, incumbent normally follows the contours of the land. In ploughing, for instance, only the headland furrows follow the slope of the land. Always tries to make straight runs, so that the rows are evenly spaced. To achieve this, he makes use of guiding marks, such as poles fixed onto the ground, on which he fixates.

In carrying out farming operations, attends to the tractor as well as the implement attached to it. In planting, must make sure that the seed or fertilizer is replenished before it runs out. Checks the amounts in the cans by stopping the tractor and opening the cans to see how much remains. In ploughing, must check to see that the share bolts are still intact. If the share bolt is broken, the plough share turns and faces backwards. Can detect this by merely turning his head to look at the plough behind. In ploughing, as in cultivating, must raise the implement at the end of the row by lifting the operational lever of the Hydraulic system. Lower the implement upon entering the field by lowering the operational lever.

Works systematically, e.g. in ploughing first uses levelling lever to lift the plough shares. Leaves only one share down to open a 4" headland furrow. Makes the first opening run along the contours, making certain that it is straight. Makes another headland furrow at the opposite end of the field. Then makes the second opening run,

alongside /

alongside the first one. As he ploughs, adjusts the depth of the plough by means of the draft control lever, until he is satisfied that the plough is deep enough. Makes the third and fourth runs, and then continues ploughing, lifting the plough by means of the operational lever when rear wheels cross the headland furrow, and lowering the plough when they cross the headland furrow into the field.

4. Maintenance

Maintains the tractor ensuring it is clean, in good working condition and regularly serviced. At set intervals services tractor as indicated by a Maintenance Chart carrying out such operations as precisely adjusting brakes and clearance of the clutch.

The tractor has to be kept in a good working condition. Maintains it during farm operations as well as at regular intervals prescribed by the manufacturers.

Is guided by the Maintenance Chart which shows the type of service to be carried out after the tractor has worked a specific number of hours. The hours are recorded on the hourmeter of the tractor. Records the types and frequency of service on the peg-board. The latter also indicates at what point a tractor must be serviced, and the nature of service required, e.g. the pegboard shows that at 200 hour point, the tractor must receive D, B, C & A services. The Maintenance Chart shows incumbent what each of the services comprise.

The A Service, e.g., includes:

- (i) Checking engine oil level,
- (ii) Cleaning fuel bowl,
- (iii) Tightening bolts and nuts,
- (iv) Checking and cleaning air cleaner,
- (v) Checking battery,
- (vi) Checking fuel in the tank,
- (vii) Checking radiator water.

In carrying out the different services makes use of various tools, e.g. screwdrivers, spanners, grease gun, tractor jack.

In Service B, is required, among other things, to adjust the clutch. This entails using precise measurements to fractions of an inch in adjusting the clearance of the clutch. If the adjustment is not accurate, it may cause the quick wearing out of the clutch plate. In adjusting the brakes, also uses these precise measurements. Must first raise the rear wheels, turn them freely and apply the brakes by

depressing /

depressing the brake pedal. If the pedal's free travel is more or less than $2\frac{1}{2}$ inches, adjusts the brakes by turning the self-locking nut in this manner: if more than $2\frac{1}{2}$ inches, turns the nut clockwise. If less than $2\frac{1}{2}$ inches, increases the pedal's free travel by turning the self-locking nut anti-clockwise until it remains at $2\frac{1}{2}$ inches.

As the tractor runs, incumbent reads the instruments to see if the tractor is working well. Also listens for unusual engine sounds and looks out for leaks of oil which may be a pointer to engine malfunctioning. If the tractor heats up fast or uses more fuel than is usual, these may be signs that something is wrong in the tractor.

Besides carrying out the regular maintenance requirements on the tractor, also cleans the tractor with water, and guards against causing its bodywork to be dented or its tyres to be mutilated. Reports any faults which he cannot understand to his superior.

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