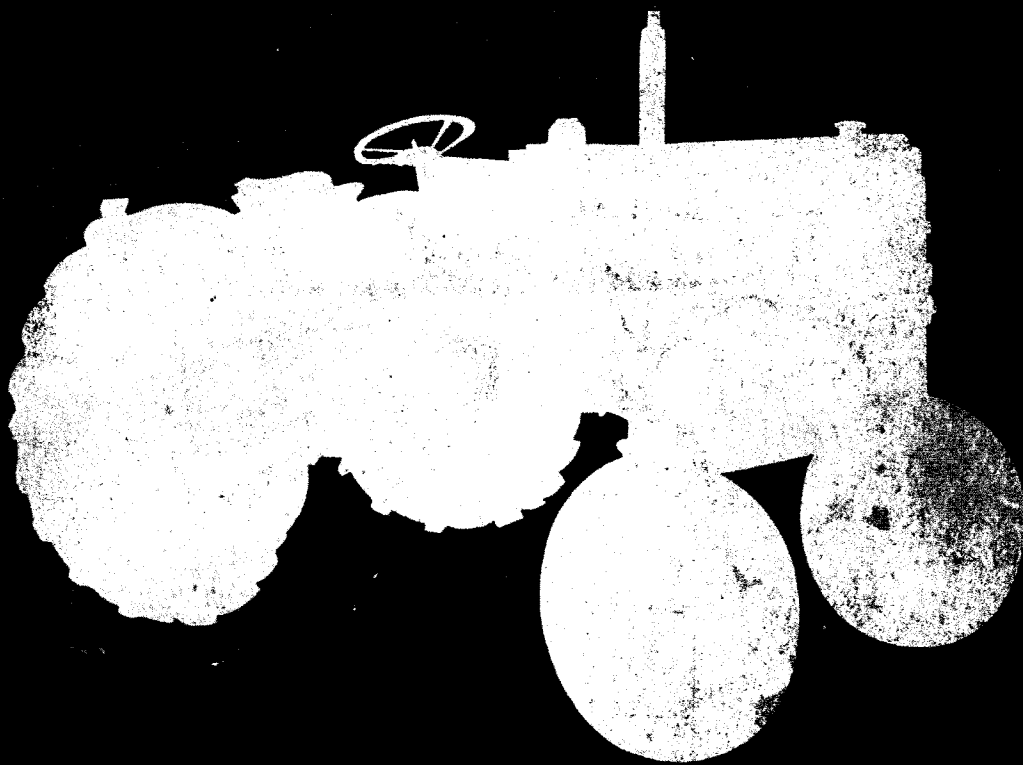


OPERATING INSTRUCTIONS

# MODEL ED-40 TRACTOR



**ALLIS-CHALMERS GREAT BRITAIN LIMITED**  
ESSENDINE · STAMFORD · LINCOLNSHIRE

FORM EPL 14

OPERATING INSTRUCTIONS

**MODEL ED-40 TRACTOR**



**ALLIS-CHALMERS GREAT BRITAIN LIMITED**

ESSENDINE • STAMFORD • LINCOLNSHIRE

FORM EPL14

Price 10 shillings

## **AVOID ACCIDENTS**

MOST ACCIDENTS, WHETHER THEY OCCUR IN INDUSTRY, ON THE FARM, AT HOME OR ON THE HIGHWAY, ARE CAUSED BY THE FAILURE OF SOME INDIVIDUAL TO FOLLOW SIMPLE AND FUNDAMENTAL SAFETY RULES OR PRECAUTIONS. FOR THIS REASON MOST ACCIDENTS CAN BE PREVENTED BY RECOGNIZING THE REAL CAUSE AND DOING SOMETHING ABOUT IT BEFORE THE ACCIDENT OCCURS.

REGARDLESS OF THE CARE USED IN THE DESIGN AND CONSTRUCTION OF ANY TYPE OF EQUIPMENT THERE ARE MANY CONDITIONS THAT CANNOT BE COMPLETELY SAFEGUARDED AGAINST WITHOUT INTERFERING WITH REASONABLE ACCESSIBILITY AND EFFICIENT OPERATION.

**A careful operator is the best insurance against an accident. The complete observance of one simple rule would prevent many thousand serious injuries each year.**

**That rule is:**

**Never attempt to clean, oil or adjust a machine while it is in motion.**

## FOREWORD

The instructions given in this book cover the operation of the Allis-Chalmers Model ED-40 Tractor. A close adherence to these instructions will result in many hours of trouble-free operation and a longer operating life for the unit.

This book is written for the purpose of giving the operator essential information regarding the day-to-day care, lubrication and adjustment of the machine. Economical operation will be assured if these instructions are followed.

Many Allis-Chalmers owners employ their dealer's Service Department for any work other than routine care and adjustments. This practice is encouraged as our dealers are kept well informed by the factory regarding advanced methods of servicing Allis-Chalmers products and are equipped to render satisfactory service.

# INDEX

|                                    | Page |                                     | Page |
|------------------------------------|------|-------------------------------------|------|
| ADJUSTMENTS . . . . .              | 7    | LINKAGE . . . . .                   | 19   |
| BRAKES . . . . .                   | 7    | LUBRICATION AND MAINTENANCE GUIDE . | 5    |
| Adjustment . . . . .               | 7    | MAINTENANCE - DIESEL ENGINE . . .   | 25   |
| Operation . . . . .                | 11   | Hints on Running . . . . .          | 29   |
| Type . . . . .                     | 2    | OPERATING INSTRUCTIONS              |      |
| CLUTCHES                           |      | Auxiliary Hand Clutch . . . . .     | 11   |
| Auxiliary Hand Clutch - Adjustment | 8    | Belt Pulley . . . . .               | 11   |
| Engine Clutch - Adjustment . . .   | 8    | Operating Tractor . . . . .         | 10   |
| DRAWBAR . . . . .                  | 18   | Power Take-Off . . . . .            | 11   |
| ELECTRICAL EQUIPMENT . . . . .     | 15   | Running-in Period . . . . .         | 10   |
| Ammeter . . . . .                  | 15   | Starting Procedure . . . . .        | 10   |
| Battery . . . . .                  | 15   | Steering . . . . .                  | 11   |
| Dynamo . . . . .                   | 15   | Stopping Tractor . . . . .          | 11   |
| Fuse . . . . .                     | 16   | Tractormeter . . . . .              | 11   |
| Light Switch . . . . .             | 16   | RADIATOR & COOLING SYSTEM . . . .   | 12   |
| Starter Motor . . . . .            | 16   | Anti-Freeze Solution . . . . .      | 12   |
| Wiring Diagram & Information . .   | 17   | Draining Cooling System . . . .     | 12   |
| FRONT WHEELS                       |      | Fan Belt Adjustment . . . . .       | 12   |
| Adjustable Front Axle . . . . .    | 22   | Hood Grille . . . . .               | 12   |
| Bearing Adjustment . . . . .       | 8    | Pressure Radiator . . . . .         | 12   |
| FUELS                              |      | Radiator Capacity . . . . .         | 12   |
| Handling & Storage . . . . .       | 3    | REAR WHEELS . . . . .               | 20   |
| GENERAL INFORMATION . . . . .      | 3    | Hydromatic Tractor Tyres . . . .    | 20   |
| Fuel . . . . .                     | 3    | Power Shift Wheels . . . . .        | 21   |
| Lubrication . . . . .              | 3    | Wheel Spacings . . . . .            | 21   |
| Safety Suggestions . . . . .       | 3    | REPAIR PARTS . . . . .              | 24   |
| GENERAL SPECIFICATIONS . . . . .   | 1    | How to order . . . . .              | 24   |
| HYDRAULIC SYSTEM . . . . .         | 13   | STORAGE OF TRACTOR . . . . .        | 23   |
| General . . . . .                  | 13   |                                     |      |
| Hydraulic Pump . . . . .           | 13   |                                     |      |

# GENERAL SPECIFICATION

## ENGINE

|                               |           |                                  |
|-------------------------------|-----------|----------------------------------|
| Number of Cylinders           | . . . . . | 4                                |
| Bore                          | . . . . . | 3 $\frac{5}{16}$ in. (84.14 mm.) |
| Stroke                        | . . . . . | 4 in. (101.6 mm.)                |
| Maximum Governed Engine Speed | . . . . . | 2000 r.p.m.                      |
| Firing Order                  | . . . . . | 1-3-4-2                          |
| Piston Displacement           | . . . . . | 137.89 cu. in. (2,260 c.c.)      |

## TRANSMISSION

### At 2000 R.P.M.

#### High Range

|         |           |                           |
|---------|-----------|---------------------------|
| First   | . . . . . | 2.2 m.p.h. (3.54 km/h.)   |
| Second  | . . . . . | 4.53 m.p.h. (7.3 km/h.)   |
| Third   | . . . . . | 5.8 m.p.h. (9.34 km/h.)   |
| Fourth  | . . . . . | 14.62 m.p.h. (23.6 km/h.) |
| Reverse | . . . . . | 4.53 m.p.h. (7.3 km/h.)   |

#### Low Range

|         |           |                           |
|---------|-----------|---------------------------|
| First   | . . . . . | 1.09 m.p.h. (1.75 km/h.)  |
| Second  | . . . . . | 2.24 m.p.h. (3.52 km/h.)  |
| Third   | . . . . . | 2.87 m.p.h. (4.62 km/h.)  |
| Fourth  | . . . . . | 7.24 m.p.h. (11.64 km/h.) |
| Reverse | . . . . . | 2.24 m.p.h. (3.52 km/h.)  |

### At 1700 R.P.M.

#### High Range

|         |           |                            |
|---------|-----------|----------------------------|
| First   | . . . . . | 1.87 m.p.h. (3.11 km/h.)   |
| Second  | . . . . . | 3.86 m.p.h. (6.21 km/h.)   |
| Third   | . . . . . | 4.93 m.p.h. (7.93 km/h.)   |
| Fourth  | . . . . . | 12.43 m.p.h. (20.00 km/h.) |
| Reverse | . . . . . | 3.86 m.p.h. (6.21 km/h.)   |

#### Low Range

|         |           |                          |
|---------|-----------|--------------------------|
| First   | . . . . . | 0.92 m.p.h. (1.48 km/h.) |
| Second  | . . . . . | 1.91 m.p.h. (3.07 km/h.) |
| Third   | . . . . . | 2.44 m.p.h. (3.93 km/h.) |
| Fourth  | . . . . . | 6.15 m.p.h. (9.90 km/h.) |
| Reverse | . . . . . | 1.91 m.p.h. (3.07 km/h.) |

## ENGINE CLUTCH (Foot Operated)

Single Plate - Dry Disc

Diameter . . . . . 10 in. (25.4 cm.)

## LIVE P.T.O. CLUTCH (located in rear axle)

Optional

Single Plate - Dry Disc - Self Energizing

Diameter . . . . . 5 in. (12.70 cm.)

## BELT PULLEY

|                            |           |                   |
|----------------------------|-----------|-------------------|
| Diameter                   | . . . . . | 10 in. (25.4 cm.) |
| R.P.M. (Engine Speed 2000) | . . . . . | 1158              |
| R.P.M. (Engine Speed 1700) | . . . . . | 984               |

## POWER TAKE-OFF

|                                      |                                              |
|--------------------------------------|----------------------------------------------|
| Diameter . . . . .                   | 1 <sup>3</sup> / <sub>8</sub> in. (3.49 cm.) |
| R.P.M. (Engine Speed 2000) . . . . . | 643                                          |
| R.P.M. (Engine Speed 1700) . . . . . | 547                                          |
| Height from ground . . . . .         | 23 in. (58.42 cm.)                           |

## BRAKES

|                                                         |                     |
|---------------------------------------------------------|---------------------|
| Enclosed Contracting type<br>Individually foot operated |                     |
| Diameter . . . . .                                      | 6.5 in. (16.51 cm.) |

## RADIATOR AND COOLING SYSTEM

|                    |                                                   |
|--------------------|---------------------------------------------------|
| Capacity . . . . . | 2 <sup>1</sup> / <sub>8</sub> Gall. (9.66 Litres) |
|--------------------|---------------------------------------------------|

## OIL SUMP

|                    |                                                  |
|--------------------|--------------------------------------------------|
| Capacity . . . . . | 1 <sup>1</sup> / <sub>2</sub> Gall. (6.8 Litres) |
|--------------------|--------------------------------------------------|

## TRANSMISSION CASE

|                    |                        |
|--------------------|------------------------|
| Capacity . . . . . | 2 Gall. (9.092 Litres) |
|--------------------|------------------------|

## HYDRAULIC SYSTEM

|                    |                        |
|--------------------|------------------------|
| Capacity . . . . . | 3 Gall. (13.63 Litres) |
|--------------------|------------------------|

## FINAL DRIVE GEARS

|                         |                                                    |
|-------------------------|----------------------------------------------------|
| Capacity each . . . . . | 1 <sup>1</sup> / <sub>2</sub> Pints (0.852 Litres) |
|-------------------------|----------------------------------------------------|

## FUEL TANK

|                    |                            |
|--------------------|----------------------------|
| Capacity . . . . . | 11.67 Gall. (52.99 Litres) |
|--------------------|----------------------------|

## WHEEL TREAD

|                         |                                         |
|-------------------------|-----------------------------------------|
| Adj. Front . . . . .    | 48 in. to 70 in. (121.92 to 177.8 cm.)  |
| Rear Standard . . . . . | 48 in. to 72 in. (121.92 to 182.88 cm.) |

## TYRE SIZE

|                          |          |
|--------------------------|----------|
| Front Standard . . . . . | 400 x 19 |
| Front Optional . . . . . | 600 x 16 |
| Rear Standard . . . . .  | 10 x 28  |
| Rear Optional . . . . .  | 11 x 28  |

## TYRE PRESSURE

|                 |       |
|-----------------|-------|
| Front . . . . . | 28 lb |
| Rear . . . . .  | 14 lb |

## BATTERY

|                      |          |
|----------------------|----------|
| Two 6-volt . . . . . | 122 A.H. |
|----------------------|----------|

*Allis-Chalmers Great Britain Ltd. reserve the right to make changes in the above specifications or to add improvements at any time without notice or obligation.*

## GENERAL INFORMATION

**LUBRICATION** - It has long been recognised that the life of a tractor is largely determined by the kind of lubrication it receives. Always use oil and grease of high quality. Recommended oils and greases are listed in the engine handbook.

In addition to using high quality oils, it is also necessary to use oils of the proper viscosity. Oil that is too heavy cannot reach all points requiring lubrication, therefore, it will cause undue wear and engine sluggishness. Oil that is too light will not form a protective film between moving parts. For best results and to ensure lubrication between snug fitting parts refer to lubricants recommended in the engine handbook and in the Lubrication Guide.

**FUEL** - Always use 'regular' grade diesel fuels. These conform to the British Standard Specification for 'A' Class fuel. A list of recommended fuels is given in the engine handbook.

### FUEL-HANDLING AND STORAGE

#### Cleanliness

Surface finish of the highest order is necessary to obtain the extremely accurate fits required for the efficient operation of the injector pump and nozzles. It will be readily appreciated that the utmost care must be taken to keep fuel clean, paying regular attention to our recommendations relative to regular inspection and maintenance of filters, and to the provision of suitable fuel storage.

Considerable care has been taken in the design of the engine to ensure a really efficient fuel filtration, so that, providing the fuel poured into the tank is reasonably clean, the engine and injection pump are well protected. The following advice is offered to promote satisfactory fuel handling and storage.

1. Never use galvanised containers.
2. Never clean the insides of containers, or any component of the fuel system, with fluffy cloth.
3. The size of bulk storage tank should be such that intervals between draining and refilling are not too long.
4. The storage tank should be under cover and have a suitable manhole cover to provide access for cleaning. The final outlet cock should be located so as to allow 3 in. (7.6 cm.) settling depth for water and

sludge; it should feed through a detachable filter with 120 mesh screen. There should be a fall of about  $\frac{1}{2}$  in. per foot (13 mm. per 30 cm.) towards the sludge drain plug.

5. The tank vent pipe should have an inverted intake fitted with a coarse mesh filter.
6. Always drain water and sludge just before delivery of a fresh supply of fuel.

*NOTE - Always protect the hands with a protective cream when handling diesel fuel.*

### SAFETY SUGGESTIONS

Many hours of lost time and much suffering is caused by the failure to practice simple safety rules.

IT IS TOO LATE TO REMEMBER WHAT SHOULD HAVE BEEN DONE AFTER THE ACCIDENT HAS HAPPENED.

1. Do not fill the fuel tank when the engine is hot or while using a lantern or when smoking.
2. Do not attempt to oil or grease a machine or a tractor while it is in operation.
3. Do not wear loose fitting clothing that could be blown into moving parts.
4. Keep all shields and guards in position.
5. Place the gear shift lever in the neutral position when starting the engine.
6. Machinery should only be operated by those who are responsible and delegated to do so.
7. ONLY ONE PERSON - THE OPERATOR - SHOULD BE PERMITTED ON THE TRACTOR WHEN IT IS IN MOTION.
8. The rate of travel on hillsides or curves should be regulated so that there is no danger of tipping.
9. DO NOT REMOVE THE RADIATOR CAP WHEN TEMPERATURE IS ABOVE THE BOILING POINT.
10. Brakes should be properly adjusted.
11. Do not drive too close to the edge of a ditch.
12. Never operate your tractor in a closed garage or shed.

13. When the tractor is hitched to a stump or other heavy loads, always hitch to the drawbar; never hitch to the top link hole. Never take up slack in the chain with a jerk.
14. Always keep the tractor in gear when going down steep grades.
15. Do not leave the engine running unattended when anyone is adjusting or repairing a driven machine.
16. Do not attempt to operate the tractor unless you are in the driver's seat.
17. Always stop power take-off before leaving the driver's seat.
18. Never stand between the tractor and a drawn implement when hitching. Use an iron fork to handle the drawbar.
19. Do not put on or remove belt from the belt pulley when the pulley is in operation.
20. Do not leave the tractor standing with an implement raised on hydraulic lift. Always lower the implement to the ground before leaving the driver's seat.
21. DO NOT ALLOW ANY PART OF THE BODY BENEATH A RAISED IMPLEMENT.
22. Do not dismount from the tractor while it is in motion.
23. Store fuels at a safe distance from buildings.
24. Provide a first-aid kit. Treat all scratches, cuts etc. immediately with the proper antiseptic.
25. Do not hitch your load to any part of the tractor other than the drawbar.

**FOLLOW THESE RULES FAITHFULLY, AND INSIST THAT OTHERS WITH WHOM YOU WORK OR THAT OPERATE YOUR MACHINE FOLLOW THEM ALSO. REMEMBER, AN ACCIDENT IS USUALLY CAUSED BY SOMEONE'S CARELESSNESS.**

# LUBRICATION AND MAINTENANCE GUIDE

## DAILY (10 Working Hours)

1. Check engine oil level to top mark on the dipstick. Top up if necessary. Use S.A.E. 30 for temperatures above 80°F. For lowest expected temperature use S.A.E. 20 oil.
2. Clean and refill the air cleaner bowl with engine oil. In very dusty conditions this should be done twice daily.
3. Inspect the air cleaner element. Clean when necessary.
4. Check water level in the radiator.
5. Lubricate clutch shifter collar with one stroke grease gun every 20 hours. Do not over-lubricate. Remove small cover under torque tube to reach the fitting.

## WEEKLY (60 Working Hours)

1. Grease the water pump bearing. Sufficient grease should be injected to force a small amount of old grease out through a drilling in the bearing housing.
2. Check final drive, keeping each filled to level of the filler plug. Use S.A.E. 20 oil. Capacity 1½ pints each.
3. Wipe the engine over, paying particular attention to the oil pipe unions, joints in the crankcase etc., to check for leakages. If oil is leaking at any point take immediate steps to remedy it.

## FORTNIGHTLY (120 Working Hours)

1. Change the lubricating oil. Drain whilst the engine is still warm. The drain plug is located on the right hand side of the oil sump.
2. Lubricate the dynamo rear end bearing. A small hole is provided in the centre of the end cap, through which a few drops of oil should be poured. This hole is sealed from dust with a small rubber plug.
3. Check the fan belt tension and adjust if necessary.
4. Change the engine oil filter cartridge after the first 120 hours on a new engine. Subsequently, change the filter every 240 working hours.

5. Check transmission, ensuring that it is kept filled to the plug level. Capacity is 2 gallons. Use E.P.80 at all times.

## MONTHLY (240 Working Hours)

1. Remove fuel feed pump and clean the gauze filter.
2. Clean sediment bowl assembly.
3. Remove the oil filter cartridge and fit a new replacement.

## TWO MONTHLY (480 Working Hours)

1. Renew the fuel filter element.
2. Arrange to have the injectors serviced.
3. Remove and clean crankcase ventilator tube.
4. Lubricate the front axle centre pivot pin.

## SIX MONTHLY

1. Change transmission oil, drain plugs are located on the bottom of the transmission case. Magnetic drain plugs are located under the ram compartment, and at the rear of the torque tube. These should be cleaned thoroughly.

## PERIODIC MAINTENANCE

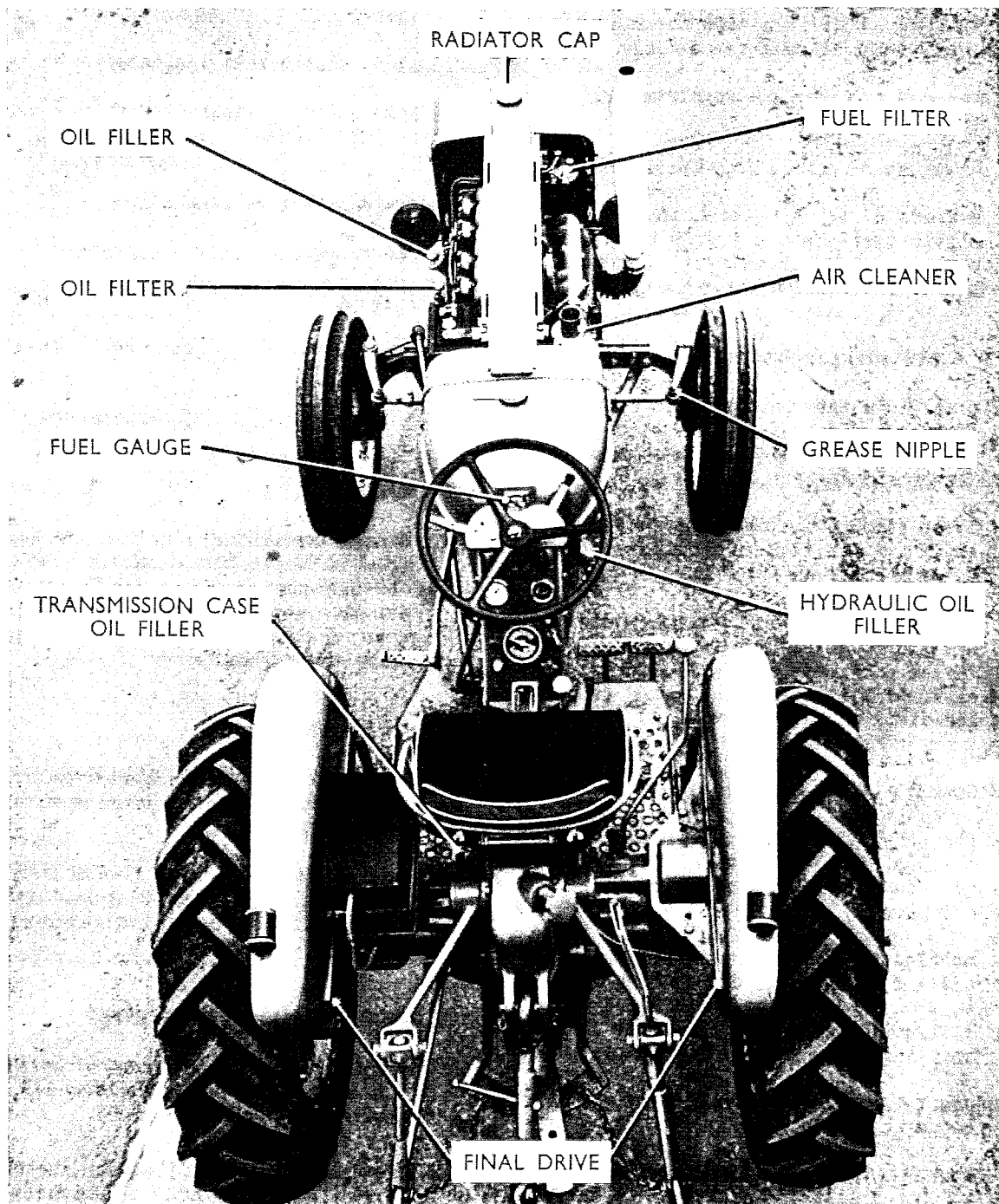
1. Remove the front wheels at regular intervals. Clean and repack bearing with roller bearing grease.
2. Keep the steering gear filled to the filler plug. Use Hypoid 90 or Hypoid 140 oil at all times. Under no circumstances should grease be used.

## TO RENEW THE OIL FILTER ELEMENT

*NOTE: When removing the filter element always drain the engine sump and refill with clean engine oil.*

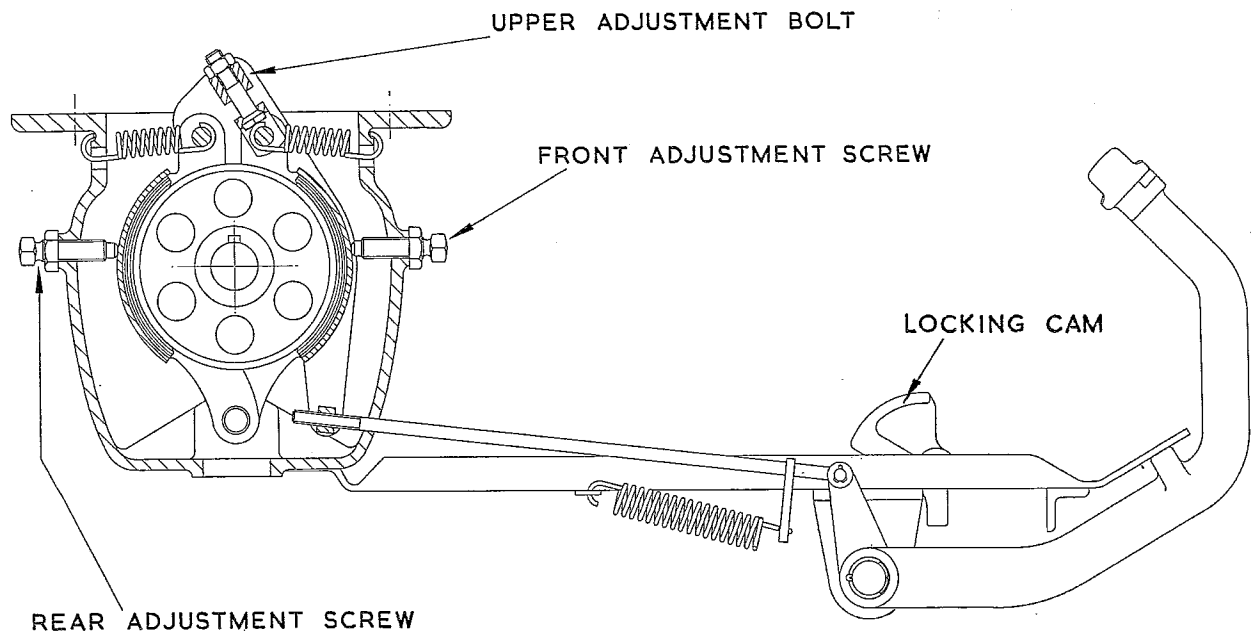
1. Drain the engine sump, clean the exterior of the filter assembly and detach the container by withdrawing the centre bolt.

2. Discard the fouled element. Thoroughly clean the container and the exposed face of the filter casting.
3. Renew the rubber seal, which is recessed into the casting groove.
4. Insert the new element into the container, carefully locating it in the recessed groove in the casting and finally secure it by tightening the centre bolt. DO NOT OVER-TIGHTEN.
5. Replenish the engine sump with clean oil.
6. Start up the engine and speed up until maximum oil pressure is registered, then examine the filter unit for oil leakage.



GENERAL VIEW

## ADJUSTMENTS

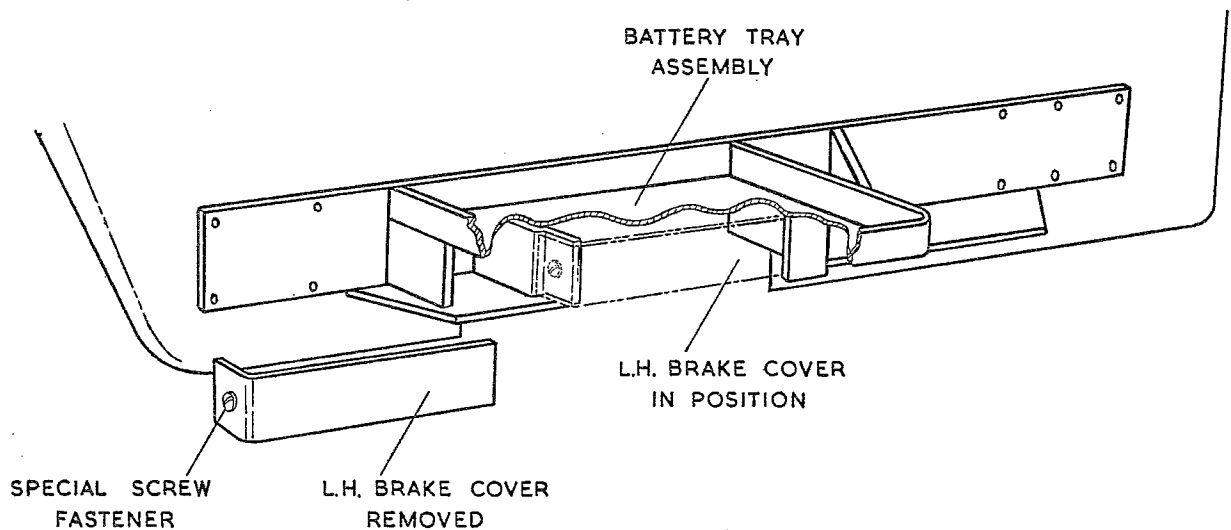


### BRAKE ADJUSTMENT

#### BRAKE ADJUSTMENT

1. Jack up the rear wheels and remove the right hand brake cover. The left hand cover

plate is beneath the battery and is removed from the rear of the tractor. Turn the special fastener screw one quarter turn anticlockwise and draw the L-shaped plate towards you.



2. Apply both brake pedals, with the latch engaged, and apply the locking cam.
3. Adjust the front and rear adjustment screws (see diagram) up to the brake shoe. Ensure that there is even pressure on both sides of the drum.
4. Release the brake pedals.
5. Unscrew the front and rear adjustment screws one eighth of a turn each, to ensure that the linings clear the drum.
6. Turn the nut of the upper adjustment bolt (see diagram) to draw back both linings to the drum. Unscrew nut until linings are just free. Check for freedom by rotating the rear wheels.
7. After adjusting both left and right hand brakes, it is advisable to test them. To do this take the tractor out on the road, latch both brake pedals together, and ensure that when the brakes are applied, the tractor comes to a stop evenly, and that the brakes are operating evenly on both wheels. If either brake is too keen, slacken off the upper adjustment nut until the pressure is even.
8. Check that the brakes are free and that the pedal latch can be engaged when the brake pedals are released.
9. It should not be necessary to adjust the pull rods with normal adjustment of the brakes. This should only be done if the brake linings are well worn, and the upper adjustment bolt shows  $\frac{1}{2}$  in. above the nut. To adjust, slacken the upper adjustment nut, disconnect the rods from the pedals, and screw in about two to three full turns on both sides. Carry out operations 2 to 6.

**CLUTCH ADJUSTMENT** - The clutch pedal travel is limited between the foot plate stop, and a pin in the torque tube.

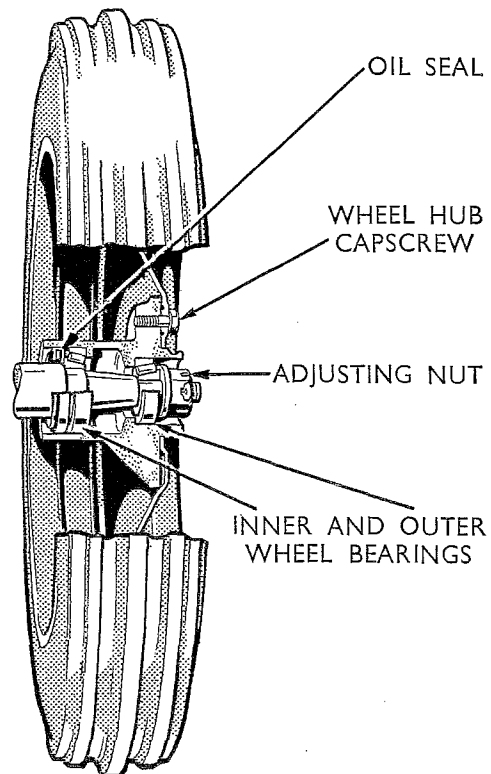
To adjust slacken clamp bolt on pedal, and insert tommy bar in shaft hole. Raise pedal against pin in torque tube.

Adjust shaft in clockwise direction, until shaft comes to a stop under light pressure. Release back approximately one eighth inch. Tighten bolt and check for  $1\frac{1}{4}$ " -  $1\frac{3}{4}$ " free movement of pedal taken between footplate and heel under pedal. Check that clutch is free when pedal is depressed.

**AUXILIARY HAND CLUTCH ADJUSTMENT** - It is essential that the Hand Operating Lever should have some free movement, or the clutch may slip. Measured at Hand Lever Ball this should be approximately  $2\frac{1}{4}$  in.

To adjust, remove Operating Lever and Rubber Cover exposing toothed adjuster wheel. Slack back locking set screw, and turn adjuster wheel forward with a screw driver towards the front of tractor to increase clearance. This should be 0.055, or nearly  $\frac{1}{16}$  in. The correct adjustment can most easily be obtained by turning the adjuster wheel backwards until all clearance is just taken up, then turning forward again 15 notches.

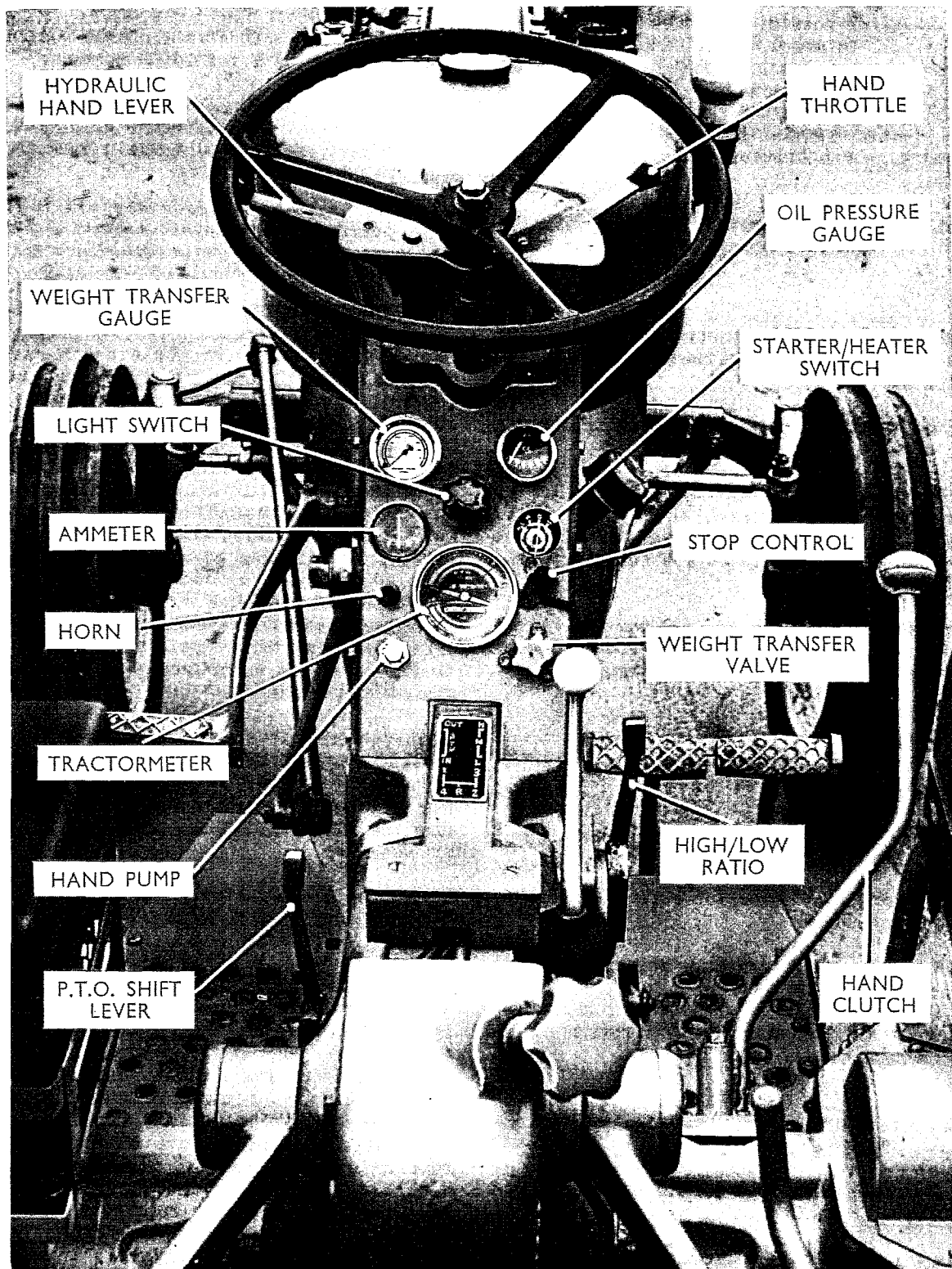
Tighten lock screw, reassemble lever and check for  $2\frac{1}{4}$  in. free movement at the ball.



FRONT WHEEL BEARING ADJUSTMENT

**FRONT WHEEL BEARING ADJUSTMENT** - The front wheels are mounted on taper roller bearings. At frequent intervals jack up front axle, check wheels for side play. If side play exists it will indicate bearings are loose and it will be necessary to adjust bearings. To adjust bearings, remove the hub cap and tighten the nut on end of spindle until all play is removed and bearings have a free rolling fit.

## OPERATING INSTRUCTIONS



**RUNNING-IN PERIOD.** The tractor engine is tested and ready for work; however, for best results operate the tractor under medium loads only for the first ten to twenty hours of operation. If possible it should be operated at the full governed R.P.M. of the engine. Do not overload the engine. Use a lower gear when the engine speed drops. The engine oil should be changed after the first 30 hours of operation—thereafter follow the instructions outlined in the Lubrication and Maintenance Guide.

Check the fan belt tension after the initial half to one hours running and adjust if necessary.

**STARTING THE ENGINE.** Starting equipment comprises the hand pump, and the combined starter/heater switch.

Before attempting to start the engine, ensure that:—

1. There is sufficient fuel in the tank.
2. The fuel line cocks are open and the fuel cut-off control is in the starting position.

*NOTE: Never attempt to start the engine without first turning on the fuel, otherwise air may be drawn into the system.*

#### STARTING PROCEDURE

In conditions above +40°F (+4°C)

1. Ensure that the hand throttle is in the three quarter to full position.
2. Ensure that the engine cut-off is pushed fully inwards.
3. Move the starter/heater switch clockwise to the start position to operate the starter motor. When the engine fires release the switch which will return to the OFF position.

**Cold Starting Instructions.** In conditions below +40°F (+4°C).

1. Release the fuel cut-off lever and open the hand throttle fully.
2. Turn the starter/heater switch anticlockwise for 25 seconds to operate the heater.

3. Move the starter/heater switch to the second position anticlockwise and operate the hand pump for 15 seconds (10 to 15 strokes).
4. Keeping the switch in the same position, cease priming for 5 to 10 seconds.
5. Recommence priming, when firing should be audible, but if not, cease priming for a few more seconds and again recommence priming until starting.

*NOTE: If the engine does not start after carrying out the above mentioned procedure, the fuel system should be checked carefully and possibly de-aerated.*

**OPERATING THE TRACTOR** — The engine clutch is provided for engaging or dis-engaging the power of the engine from the tractor. When using the clutch, depress pedal fully and allow both the tractor and the clutch to come to a full stop before attempting to shift gears. Reducing engine speed to low, idle before depressing the clutch pedal to prevent clashing gears. With the engine running, push the clutch pedal forward to release the clutch. Hold in this position until the clutch stops revolving. Move the gear shift lever to the desired position as indicated on the gear position plate. Open the throttle far enough to prevent stalling. Release the clutch pedal slowly and evenly to avoid jerking. Failure to follow these instructions may result in damage to the gears.

A dual range of speeds is provided, controlled by the HIGH/LOW RATIO lever. The forward position provides the high range, whilst the rear position provides the low range. The centre position (NEUTRAL) stops power to the drive wheels.

*NOTE: The engine clutch must be used when changing from HIGH to LOW ratio.*

Operate the engine at low engine R.P.M. and select the desired transmission gear to suit the work being done. Severe overloads may be thrown on the engine if the tractor is operated at reduced engine speeds on heavy loads. To shift to low or first gear with the gear shift lever in the neutral position, disengage engine clutch, move gear shift lever to the left and forward. Second, move from neutral to the right and back, third gear right and forward, fourth gear, to the left and back. Reverse, move to the centre and then to the rear. Always stop the tractor before changing gears, because changing gears in motion may result in damage to them.

**TRACTORMETER** - This records hours, based on an engine speed of 1700 R.P.M.

The upper outer scale reads the engine R.P.M. The lower outer scale reads the power take-off R.P.M.

The four inner scales read the M.P.H. in each of the forward speeds. M.P.H. in high range can be read off the upper set of four scales, whilst the lower set of four give the M.P.H. in low range.

**STEERING** - Easy turns may be made by simply turning the steering wheel to right and left as desired. Foot brakes are provided for making short turns. Turn the steering wheel in the direction required and then apply brake on the side towards which the tractor is being turned. Do not attempt short turns when travelling at high speeds.

**BRAKES** - When using the brakes for stopping apply pressure to both brakes so that the brakes are engaged evenly. This will bring the tractor to an even stop without skidding. A latch on the brake pedals is conveniently located for locking the brakes in the engaged position, to hold the tractor on an incline or for belt work.

**STOPPING TRACTOR** - Push clutch pedal forward, allow the tractor to stop, or if necessary apply the brakes. Place the gear shift lever in the neutral position and release the clutch pedal.

**STOPPING ENGINE** - To stop the engine, pull out the engine cut-off control fully.

**OPERATING POWER TAKE-OFF** - The power take-off is used to provide power for P.T.O.-driven machines and operates at a speed of 547 R.P.M. at 1700 R.P.M. of the engine, and at 643 R.P.M. at 2000 R.P.M. of the engine. A shift lever is provided for engaging or dis-engaging

the P.T.O. To engage P.T.O. push the clutch pedal forward in the same manner as for shifting gears in the transmission.

Allow the clutch to stop and if the tractor is in motion allow it to stop. Pull over the P.T.O. lever located to the left of the operator's seat. If the P.T.O. is engaged, do not attempt to shift transmission gears until the driven machine stops. This P.T.O. will keep on running when the hand clutch is dis-engaged. The belt pulley will run when P.T.O. is engaged.

**OPERATING BELT PULLEY** - The belt pulley spline drive fits on to the P.T.O. shaft. To fit the belt pulley, remove the four setscrews which retain the P.T.O. guard and P.T.O. shield. Slide the belt pulley spline drive over the splined shaft. Use the four longer setscrews provided with the pulley. The pulley should be set to left of the P.T.O. shaft, when looking from the rear of the tractor.

To engage the belt pulley, push the clutch pedal forward in the same manner as for shifting gears in the transmission. Allow the clutch to stop and place the gear shift lever in the neutral position. Engage the P.T.O. lever to drive the pulley.

**NOTE:** *If any work is to be carried out on the driven machine, the engine should be stopped.*

**AUXILIARY HAND CLUTCH** - In addition to the engine clutch, which is foot operated, an additional clutch can be provided. This is located in the final drive housing and it enables the operator to stop the tractor, but allows the belt pulley, and power take-off to continue in operation.

Do not use the hand clutch as a substitute for the engine clutch for stopping the tractor in the higher gear ratios. Only use it to operate the live P.T.O. with the P.T.O. driven implements.

# RADIATOR AND COOLING SYSTEM

**RADIATOR CAPACITY** -  $2\frac{1}{8}$  gallons. Drain cocks are located at the bottom left hand side of the radiator and on the engine block (right hand side).

Remove the radiator cap to prevent air locks when draining the system.

**OPERATING TEMPERATURE** - The water temperature is controlled by a by-pass thermostat which permits an immediate circulation from the cylinder head back into the block when the engine is cold. The temperature rises evenly throughout the engine until the thermostat opens.

**PRESSURE RADIATOR** - The pressure radiator permits the use of a higher and more efficient operating temperature. The cooling solution - clean water - will not boil in the pressure radiator until a temperature of 230°F is reached.

**DRAINING THE COOLING SYSTEM** - To drain, open the drain cocks located on the lower radiator outlet, and on the right hand side of the engine block.

**CAUTION:** *In freezing weather be sure to drain both points. Loosen the radiator cap to prevent air locks which will retard draining. Stay near to the tractor and make sure that the system is completely drained.*

To remove the radiator cap, turn to the left until it stops. Push down and continue to turn to the left until the cap releases.

**CAUTION:** *Never remove the radiator cap when the temperature is above the boiling point. A bad scald may be the result.*

Ensure that the cooling system is refilled BEFORE starting the engine. Cold water poured into a hot engine may crack the liners. Running the engine without water will almost certainly damage the engine.

Clean rain or soft water should be used in the cooling system if available. Hard or alkaline water will form a scale which will impair radiation if allowed to build up in the cooling system.

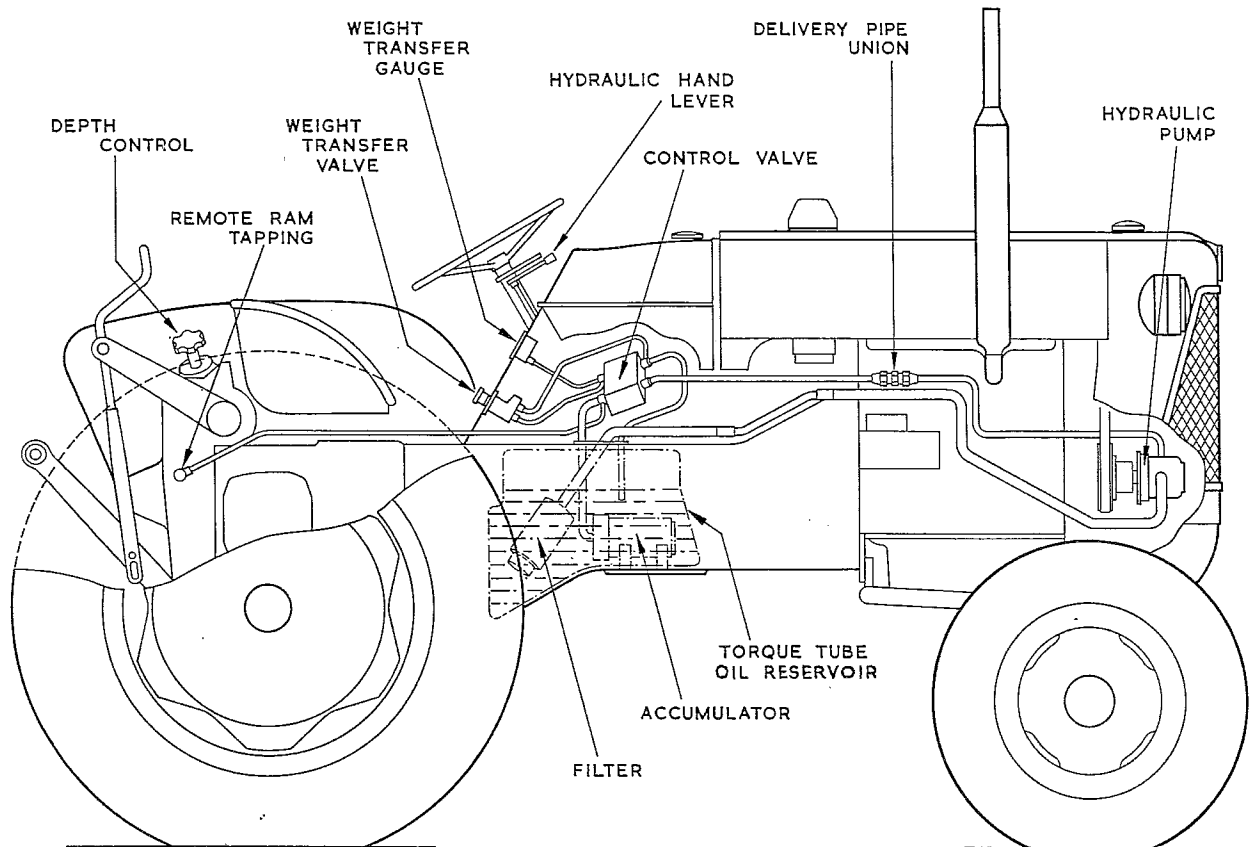
Soluble oil is beneficial to the cooling system. It will not prevent the accumulation of lime, but it will retard such formation. This water-soluble oil is obtainable from your Allis-Chalmers dealer.

**FAN BELT ADJUSTMENT** - Loosen the dynamo adjusting screw, taking up any undue belt slackness by turning the dynamo on its mounting. Care should be taken to avoid over-tightening the belt. The tension needed should be just sufficient to drive without slipping. Ensure that the dynamo is correctly aligned, otherwise undue strain will be thrown on the dynamo bearings.

**ANTI-FREEZE** - Before and during freezing weather it is advisable to fill the cooling system with anti-freeze. Ethylene glycol or distilled glycerine are the most suitable solutions.

**HOOD GRILLE** - The hood grille can be removed by removing four screws at the top and bottom. This enables the outside of the radiator to be cleaned, or a chaff screen to be fitted when required.

# HYDRAULIC SYSTEM



HYDRAULIC SYSTEM DIAGRAM

**GENERAL** - The system is filled with 3 gallons of hydraulic oil. It may be necessary to augment this quantity of oil. Always check the oil level after running and top up if required. A dipstick is fixed to the hydraulic oil filler cap.

**HYDRAULIC PUMP** - The front-mounted pump used is a gear type model, continuously driven via a coupling from the fan pulley. It delivers 5 gallons per minute at a pressure of 2,500 p.s.i.g. at an engine speed of 2,000 R.P.M. It draws oil from the torque tube reservoir through a filter.

**SHOULD THE RAM NOT LIFT** - If the ram does not lift, carry out the following procedures:-

**NOTE:** *It is most important to check whether the pump is delivering oil or not. If the pump is not delivering, SEVERE DAMAGE WILL BE CAUSED in a very short period.*

1. Check that there is sufficient oil in the reservoir.
2. Check the oil flow in the ½ in. delivery pipe. To do this, slacken off the union above the starter motor. If oil is delivered at this point then the pump is working and the control valve is faulty. If no oil is delivered then the pump is faulty. In either case consult your Allis-Chalmers dealer.
3. Ensure that the oil filter is clean.
4. Check for obstruction in the pipelines.
5. Ensure that the rubber hoses and hose clips are not faulty.

**HYDRAULIC HAND LEVER** - A three-position lever, which is located to the left-hand side of the steering column, controls lift, lower and hold. Moving the lever down lowers the implement and moving the lever up raises the implement.

*NOTE: In the RAISE, upper position, the lever is spring loaded back to HOLD, centre position. The lever locks in the LOWER position, it must be depressed and pushed forward to return to HOLD position.*

**WEIGHT TRANSFER** - The hydraulic system is so designed that weight is transferred from the implement to the rear wheels and can be applied in conditions which require increased wheel adhesion.

An accumulator is charged when the weight transfer valve is screwed inwards and the hand lever put into the RAISE position. A figure is then registered on the weight transfer gauge which indicates the pound loading added to the rear wheels at a particular setting of the valve screw.

Should weight transfer be required the following procedure must be carried out:-

1. Screw in the weight transfer valve (located on the instrument panel).
2. Charge the accumulator by putting the hydraulic hand lever momentarily to the RAISE position and then releasing it. Return the lever to LOWER. It will then be seen that the gauge is registering a load on the rear wheels, depending on

the number of threads screwed up in operation 1.

Under normal conditions weight transfer will not be required and the valve will be fully unscrewed. To obtain weight transfer follow the above procedure.

If the weight transfer valve is fully or partly screwed up, then the accumulator will have been automatically charged when the implement was lifted at the previous headland.

When changing over from heavy to light implements, it will be found necessary to unscrew the weight transfer valve fully in order to allow the implement to fall.

It is only necessary to use weight transfer on difficult land where excessive wheel-spin is encountered. It is not recommended that weight transfer should be used in good conditions where adequate wheelgrip is available.

*NOTE: Heavy soil-engaging implements should always be set without the use of weight transfer.*

**DEPTH CONTROL** - Behind the driver's seat is fitted a depth screw stop. This can be set to control the depth of the implement. Adjust the stop until the required depth is obtained.

# ELECTRICAL EQUIPMENT

*NOTE: Except for minor adjustments, refer to your dealer.*

**AMMETER** - The ammeter indicates the charging or discharging rate of the battery. Should the ammeter register discharge with the lights off, disconnect the battery cable to prevent discharge until the trouble is located and corrected. Such a condition is usually caused either by a worn or frayed wire causing a short circuit, or by cut-out relay points being stuck together.

If the ammeter fails to register a charging rate, one of the following faults may be the cause:

1. Loose or corroded wire connections.
2. Broken wires.
3. Faulty ammeter.
4. Oily or gummy dynamo brushes or commutator.
5. Worn dynamo brushes.

**BATTERY** - The starting and lighting system uses two six volt batteries, designed and built to meet the requirements of the tractor.

**CHECK THE ELECTROLYTE (SOLUTION) IN EACH BATTERY AT LEAST ONCE PER WEEK TO ENSURE THAT IT IS AT THE CORRECT LEVEL.** This level should be maintained to the upper edge of the separators. Never add anything to the solution except distilled water or, in an emergency, clean rain water. Boiled water should not be used. The water supply should be stored in clean covered vessels of china, rubber or lead.

Do not allow lighted matches or an open flame of any kind to come in proximity to the battery cell covers. The need for frequent addition of water to the battery indicates that the charging rate maintained is too high. This can only be remedied at a Lucas Service Depot or by an approved Agent.

In cold weather, only add water immediately before running the engine so that the charging will mix the electrolyte and water and prevent freezing. **A FULLY CHARGED BATTERY WILL NOT FREEZE IN VERY COLD TEMPERATURES.** If the battery is only partly charged it will freeze and be ruined.

Weekly readings of each battery cell should be taken with a battery hydrometer. These readings should be as follows (at 70°F):-

- 1.280 - Fully charged
- 1.200 - Half charged
- 1.110 - Discharged.

Normal charge rate is 8½ amps.

When readings have been taken, the electrolyte should be returned to the cell from which it was taken.

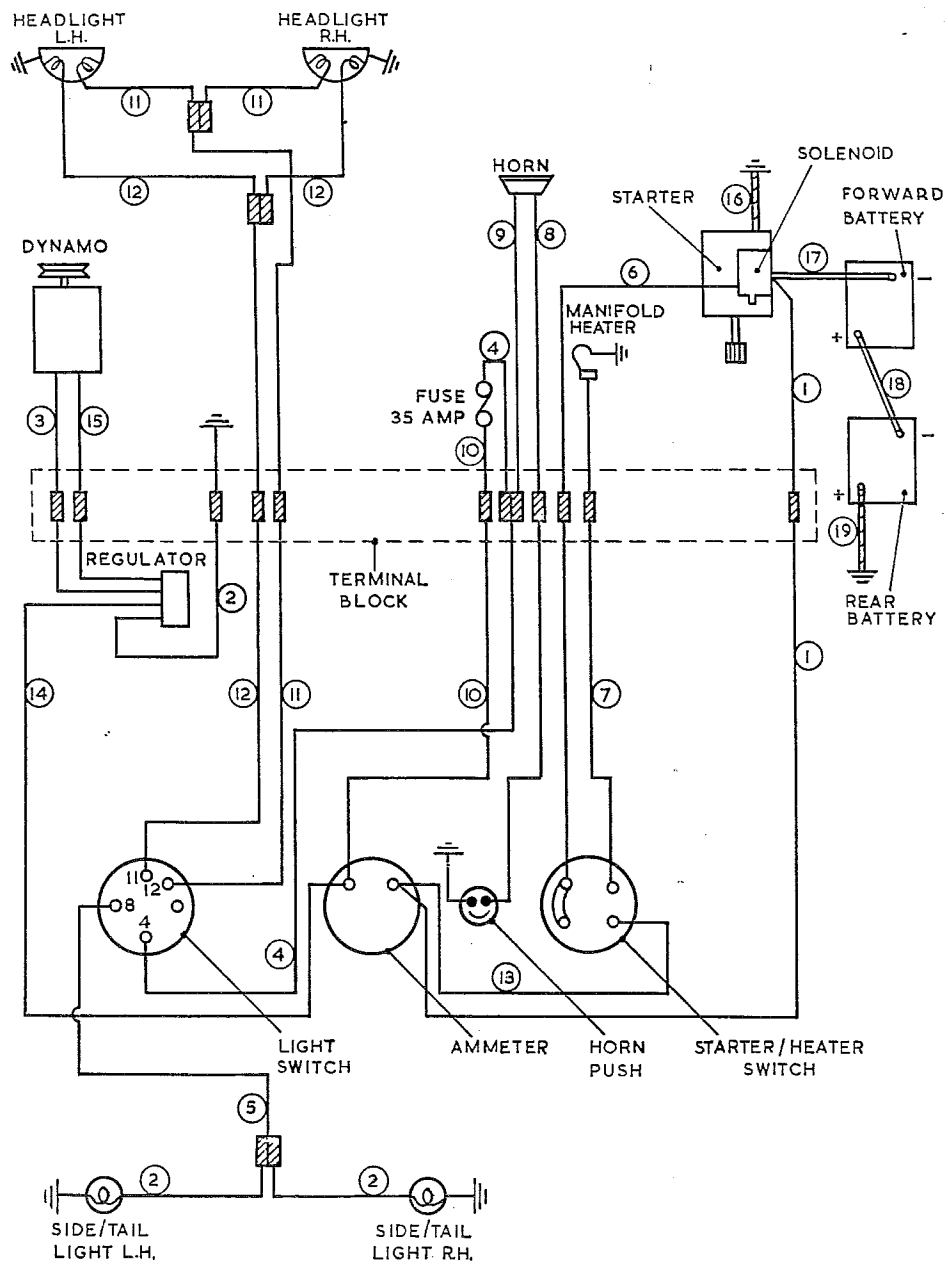
The dynamo charging rate is governed by a voltage control regulator housed with a cut-out relay in the control box. This voltage regulator automatically controls the dynamo output, thereby maintaining a satisfactory charging rate and preventing the battery from overcharging under varying temperatures and operating conditions.

Keep the battery clean by using a stiff bristle brush—not metal. If the terminals are corroded or if the battery is acidsoaked, brush-wash with a soda solution (¼ lb of soda to one quart of water). Vent plug must be kept in position when cleaning the battery. After washing the battery, ensure that the gas escape holes in the vent caps are open. Should the battery be removed from the tractor, disconnect the earthed positive terminal first. When re-installing, make certain that the earth cable is connected last, and is attached to the positive post.

Any non-insulated metal across the top of the battery will cause a short, thereby discharging the battery.

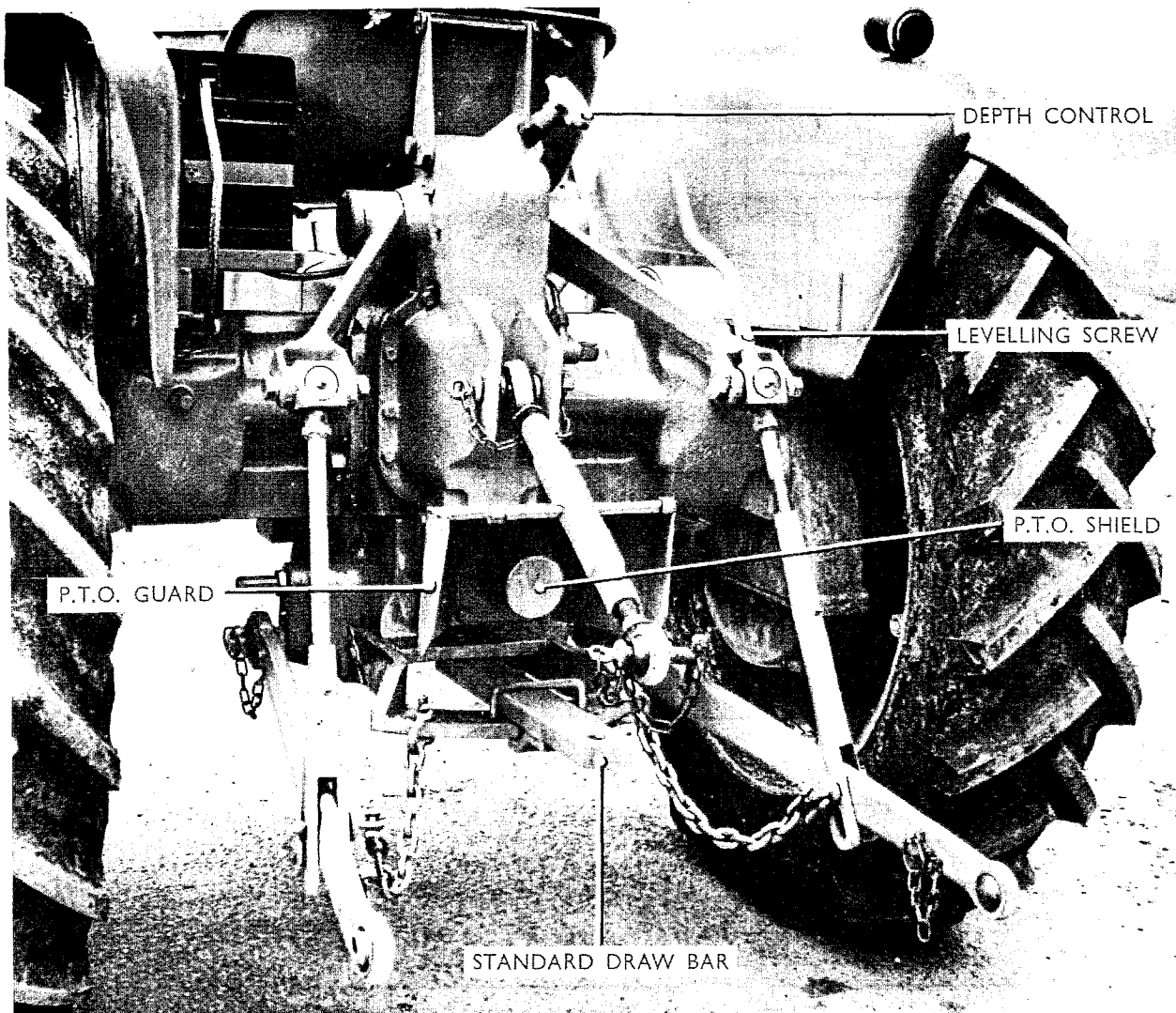
If the tractor is not to be used for some considerable time, it is advisable to remove the battery, have it fully charged, and stored in a basement or some similar place. The storage temperature should be as low as possible, but above freezing.

**DYNAMO** - The tractor is shipped with the lead disconnected from the field terminal. This lead must be reconnected when the tractor is put into use and the battery has been charged.



WIRING DIAGRAM FOR INDUCTION MANIFOLD HEATER

## STANDARD DRAWBAR



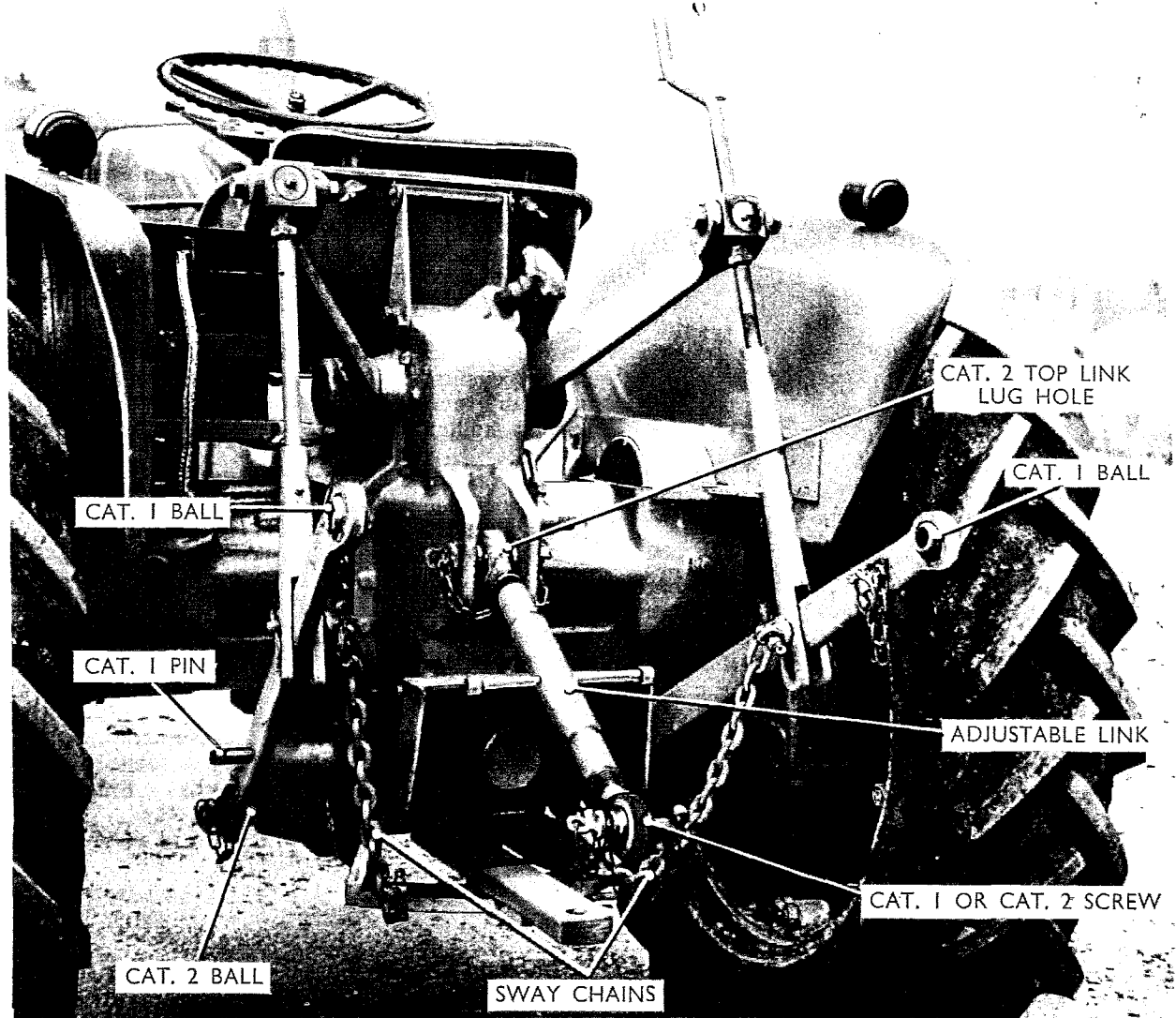
STANDARD DRAWBAR

**DRAWBAR** - The standard swinging drawbar, pivoted at the front end, is secured in the central position by a U clip. It has a lateral adjustment of 6 in. on each side of the centre line (measurement at the drawbar hole). The height to the top of the drawbar from the ground is approximately 17½ in.

An alternative drawbar to S.A.E. standards may be fitted if required.

The illustration shows the tractor with the P.T.O. shield and P.T.O. guard fitted. The P.T.O. shield can be easily coupled to the propeller shaft guard on the implement.

## LINKAGE



LINKAGE

**LINKAGE** - The linkage is provided to take three point carried implements to both Category one and Category two standards.

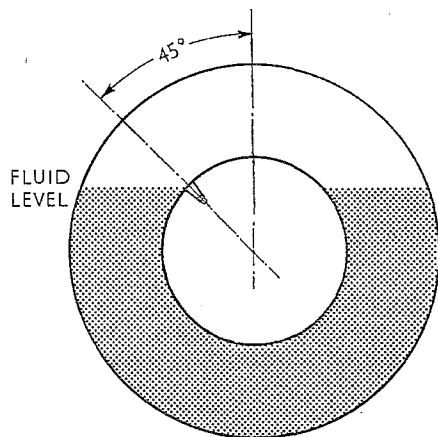
The two lower links are reversible, and are easily changed to conform to Category one or Category two standards. (See illustration.)

The upper, adjustable link, can be adapted to Category one or Category two standards by changing the screw. (See illustration )

The centrally mounted sway chains are positioned to prevent the implement swinging on to the wheels when in a raised position.

The lower link pivot pins have three optional positions (see illustration). The centre hole gives the normal draft angle. The upper hole should normally be used to increase the draft angle for heavier conditions, while the lower hole gives reduced draft angle.

## STANDARD REAR WHEELS



FLUID LEVEL

**HYDROMATIC TRACTOR TYRES** - As water alone will freeze in cold weather, Allis-Chalmers Tractor tyres are filled with the proper quantity of 15% calcium chloride solution. Calcium chloride will in no way harm the casing, tubes or valves. This mixture will form a slush at 10°F. If tractor is to be operated at temperatures below 10°F., additional calcium chloride should be added.

The rear tyres are filled about  $\frac{3}{4}$  full of the solution and then inflated to the standard recommended air pressure. To check level, turn valve about 45° from vertical as shown in sketch. This amount of solution will give approximately the same weight as three cast iron wheel weights on each wheel. If more weight is needed for difficult traction conditions, wheel weights may be added. Tyre companies have instructed their Service Stations concerning liquid ballast for tractor tyres and they have the necessary facilities for mixing and injecting this fluid into the tyres.

If the valve core is to be removed for any cause, it will be necessary to jack up tractor and turn the wheel, until the valve stem is on top, otherwise the solution will be lost.

Calcium chloride and water solution as supplied in tractor tyres is not dangerous, but because it may attack clothing or cause skin irritations on some persons, especially if it comes in contact with open cuts or sores, we urge everyone to avoid coming in direct contact with it.

A remedy, after having contacted this solution, is simply to wash the skin with plenty of clean water.

When ploughing, the furrow wheel has greater traction than the land wheel; do not decrease pressure to equalize, instead increase the pressure in the furrow wheel to 16 lb.

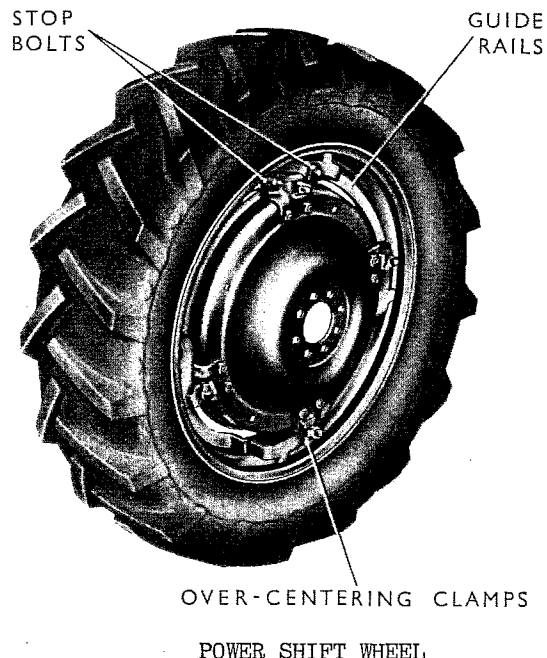
High pressure will cause no damage to tyres unless excessive slippage occurs.

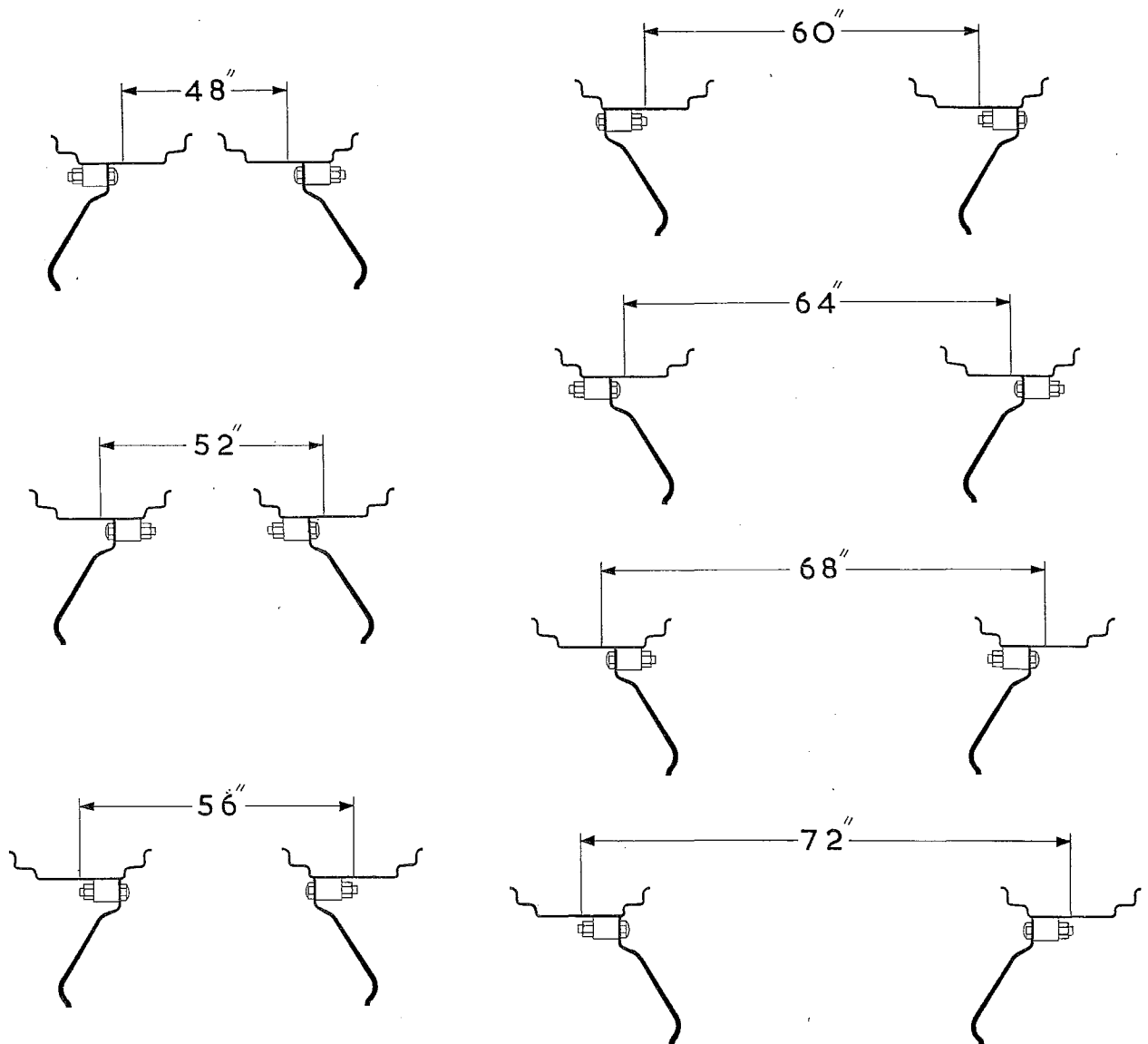
When mounted implements are used, additional pressure should be used. Use about 1 lb. additional air pressure for each 800 lb. of weight added.

Do not inflate tube when removed from tyre more than enough to make it fill out round. Tubes inflated beyond their elastic limit may not return to their original shape and size.

Extra weights are available for mounting on the front and rear wheels if extreme conditions cause excessive loss of traction.

**REAR WHEEL ADJUSTMENT** - Wheel spacing is adjustable to meet the requirements of the various implements and row spacing of different crops.





REAR WHEEL SPACINGS

The rear wheels are adjusted by assembling the wheel disc and rim as shown in the illustration, and by turning the rims in or out. The six lugs on the rim can be positioned on either side of the wheel disc as shown. When turning the rims they must be changed from one side of the tractor to the other, i.e. when changing settings 48", 60" or 64" to or from settings 52", 56", 68" or 72", interchange the rims in order to keep the tread turning in the proper direction as indicated by the arrows on the tyre walls. The obtainable spacings are as shown in the illustration.

**POWER SHIFT WHEELS** - To operate the power shift wheels proceed as follows:-

Loosen the four over-centering clamps and remove the two anti-slip stop bolts. Install one stop bolt in the desired hole in the guide rail and use it as a stop for locating the position of the rim. Place the tractor in reverse or low gear, depending on whether the spacing is to be made wider or narrower. Hold the brake on the opposite wheel and engage the clutch. It may help to engage the clutch sharply to start movement on the wheel. The wheel will automatically adjust itself along the curved guide rails to the required setting. Tighten the over-centering clamps and position the second stop bolt on the opposite side of the over-centering clamp. The two stop bolts prevent any slip or unwanted track alteration during work.

Rear wheel spacings from 48 in. to 60 in. in 4 in. increments may be obtained by this method. Additional spacings of 56 in. to 72 in. may be secured by turning the dished wheels outward. To make this change, raise the tractor from the ground and block securely. Place the wheel on the opposite side of the tractor. This will keep the direction of the tyre tread correct. The direction of travel should be with the open end of the 'V' towards the rear.

The minimum setting of 44 in. cannot be obtained, although this position is available on the guide rail, due to the wheel fouling the mud guard. Therefore, ensure that the stop is fitted to give not less than 48 in. wheel centres.

**ADJUSTABLE FRONT AXLE** - The following table

gives the position of the spindle supports, wheels and spacings obtainable.

The front axle tread width is changed by removing the two retaining bolts holding the spindle support in the front axle bar and loosening the clamps on the track rod.

The 'toe-in' adjustment of wheels must be adjusted each time the spacing of the axle is changed. To make this adjustment, have the tractor on level ground, place the wheel in the straight ahead position, with the steering wheel in the central position. Adjust the wheels so that they are  $\frac{1}{8}$  in. to  $\frac{3}{16}$  in. narrower in front than at the rear, at hub height on the rim. Additional width adjustment can be secured by turning the wheels in or out on the hub.

| Position of Spindle Support<br>in Front Axle Bar | Wheels Turned<br>Towards<br>Tractor | Wheels Turned<br>Away From<br>Tractor |
|--------------------------------------------------|-------------------------------------|---------------------------------------|
| Set in completely                                | 48½ in.                             | 56¾ in.                               |
| One hole out of front axle bar                   | 52½ in.                             | 60¾ in.                               |
| Two holes out of front axle bar                  | 56½ in.                             | 64¾ in.                               |
| Three holes out of front axle bar                | 60½ in.                             | 68¾ in.                               |
| Four holes out of front axle bar                 | 64½ in.                             | 72¾ in.                               |
| Five holes out of front axle bar                 | 66¾ in.                             | 74½ in.                               |

## STORAGE OF TRACTOR

When the tractor is stored for any length of time, the following precautionary measures are helpful in preserving various parts, also in avoiding future difficulties.

1. Store the tractor under cover. If this is impossible, be sure to cover the air stack and exhaust pipe.
2. Drain the radiator and the engine block.
3. Drain the fuel tank, filters, pipework and injectors to protect from corrosion, and avoid gum content collections.
4. Leave the radiator and fuel caps slightly loose in order to protect the gaskets.
5. Block the tractor up to remove weight from the tyres and to keep the tyres from contact with a moist floor.
6. Remove the battery. Store it as recommended under "Electrical Equipment".
7. When the tractor is removed from storage, it should be serviced throughout, including draining and refilling the oil sump with fresh oil.

## REPAIR PARTS

**HOW TO ORDER REPAIR PARTS** - When ordering repair parts for your tractor, supply the following information:-

1. The tractor and engine serial numbers. The serial number of your tractor is located under the seat on the left-hand side of the transmission.

Example: "ED-40 25900"

The engine serial number is located on the top right-hand side of the cylinder block above the dynamo.

Example: "LSD9713"

2. State the common name of the part you wish to order, or a description of the part and its location on the tractor.
3. Always print your name and post office address where parts are to be shipped; also specify whether material is to be shipped by freight, express or parcel post.

**IMPORTANT** - Unless claims for shortages or errors are made immediately upon receipt of goods, they will not be considered.

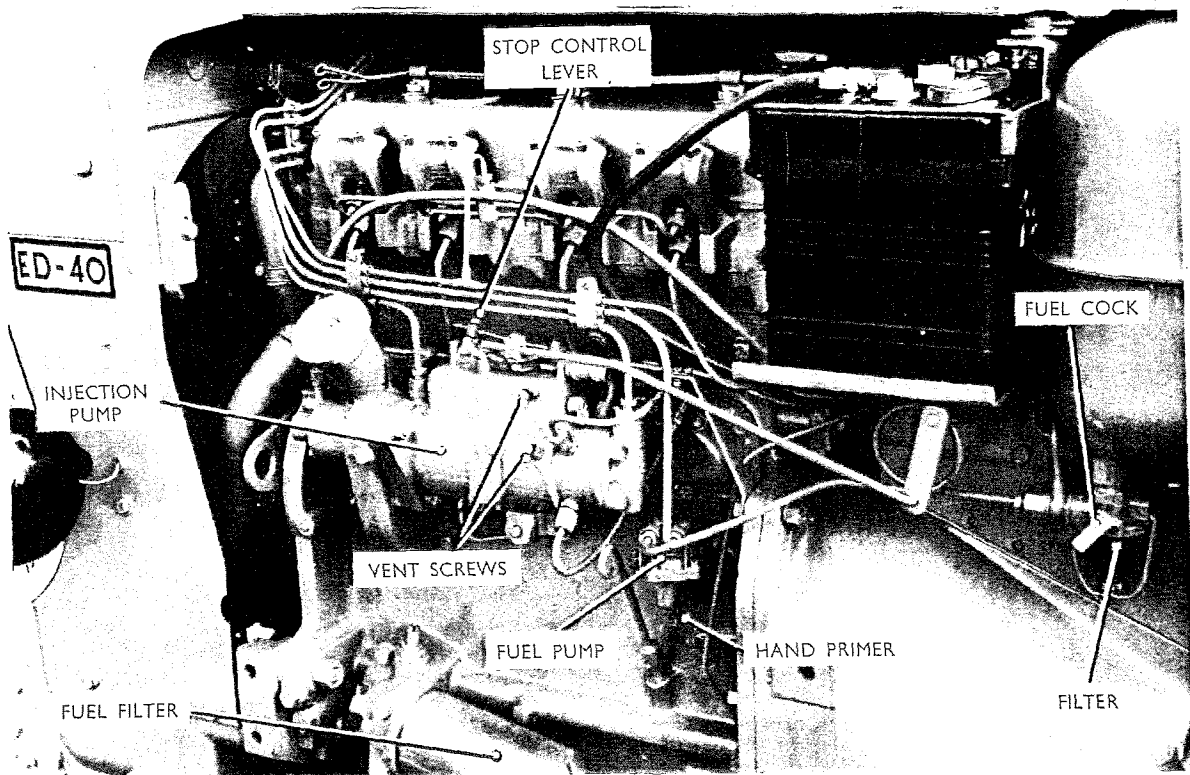
When broken goods are received, a full description of the damage should be made by the carrier agent on the freight bill. If this description is insisted upon, full damage can always be collected from the transportation company.

No responsibility is assumed for delay or damage to merchandise while in transit. Our responsibility ceases upon delivery of shipment to the transportation company, from whom a receipt is received showing that shipment was in good condition when delivered to them; therefore, claims (if any) should be filed with the transportation company and not with Allis-Chalmers Manufacturing Company.

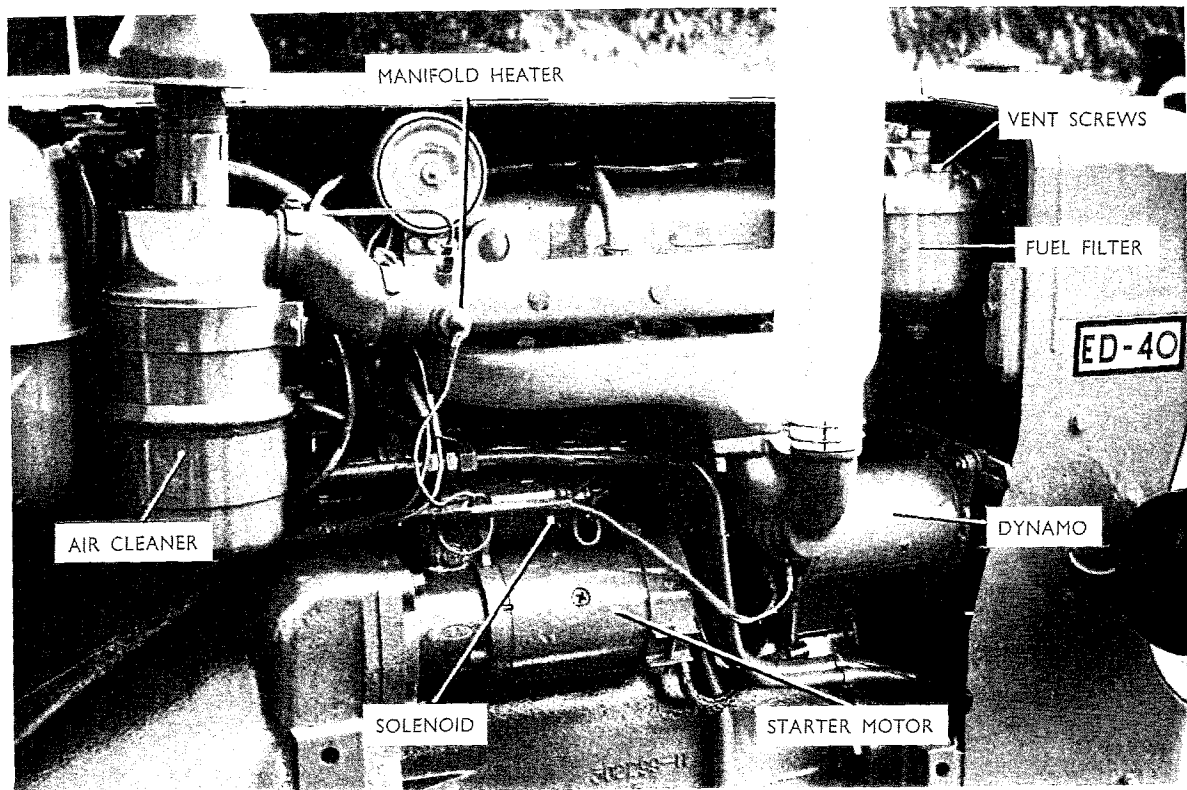
The right is reserved to change the construction or material of any parts where it seems desirable to do so, without incurring the obligation of installing such changes on units already delivered.

**MAINTENANCE**

**DIESEL ENGINE**



ENGINE - LEFT HAND VIEW



ENGINE - RIGHT HAND VIEW

## DO

### DO KEEP THE ENGINE CLEAN.

- DO use lubricating oil of correct specification.
- DO keep all bolts and nuts tight.
- DO rid the fuel system of air and keep tight all joints and unions in the fuel supply system.
- DO use only filtered fuel oil. Never tip into the tank a half-empty barrel of fuel oil, the bung of which may have been out for weeks.
- DO be careful always to replace the bung in any partially-emptied oil or fuel container.
- DO attend immediately to fuel and lubricating oil leaks.
- DO check that the dynamo is charging.
- DO carry out the maintenance operations at the appropriate times.
- DO when in doubt ask for advice from your dealer.

## DO NOT

- DO NOT race the engine with clutch out or with gear in neutral.
- DO NOT run the engine unless the gauge shows oil pressure.
- DO NOT continue to run the engine if black smoke is coming from the exhaust.
- DO NOT if the engine stops without apparent reason, fail to make sure first of all that fuel is reaching the fuel pump.
- DO NOT on any account take the fuel pump to pieces.
- DO NOT use cotton waste or any fluffy cloth when cleaning.
- DO NOT run the engine with vacuum pipe disconnected or with the air cleaner removed.

## LEAKAGES

Leakages in the fuel pipe line are of two kinds.

There may be

(a) leakage on the pressure side, between the fuel pump and the injectors;

(b) leakages on the feed from tank to fuel filter and from there to the fuel pump inlet.

Leakage on the pressure side can be detected in the same way as in the oil pipe lines. Wipe the unions down and watch them whilst the engine is running.

Do not strain the unions on the fuel pipes from the fuel pump to the injectors.

If leakage from a union on a fuel pipe persists after tightening the unions, it may be that one of the 'nipples', by which the joint is made, has split.

Renewal of a nipple is a job for the repair shop.

Leakage between the fuel tank and fuel pump allows air to enter the fuel pipes.

This may cause misfiring, because air, instead of fuel, is passing to one or more of the injectors.

If serious, so that air passes to all the injectors, the engine will stop and refuse to start.

There may be other reasons why air has entered the system.

Shortage of fuel in the tank is one possible cause.

Examine the level of the fuel in the tank first of all. An empty tank, or one in which there is so little fuel that the end of the delivery pipe inside the tank is sometimes uncovered because the fuel runs away from it, will give trouble.

Under these conditions air may enter the pipe instead of fuel, and even if it is only a little, a bubble or two, that is enough to cause trouble.

If the engine has been standing for a while, the very small quantity of air that is always in the fuel may have collected to form one or two bubbles, enough to cause trouble.

If, therefore, misfiring, engine stoppage or difficult starting occurs after the engine has been standing, that may be the cause.

Leakage between the tank and the fuel pump may be suspected if

- (a) the tank has plenty of fuel in it; and
- (b) the engine has been running quite well up to the moment when this trouble has begun.

The remedy is:

1. Tighten all unions on the pipe line between the fuel tank and fuel pump.
2. Tighten the joint on the top of the filter.

**TO GET RID OF AIR IN THE SYSTEM** - Should air enter the system due to lack of fuel, dismantling of the fuel filter or fuel pump, or for any other reason, the fuel system must be de-aerated. Unless this is done it will not be possible to start the engine.

*NOTE: It is essential to ensure that there is an ample supply of fuel in the tank (at least three gallons), before commencing de-aeration of the fuel system.*

When de-aerating the fuel system, fuel is allowed to escape from certain connections in order to release air trapped in the system. It is essential that this is carried out in the correct sequence and the fuel escaping should be free from air bubbles before tightening the connection.

The correct procedure is as follows:-

1. Slacken the air vent screw on the front side of the governor control.
2. Slacken the vent valve fitted on one of the two hydraulic head screws.
3. Unscrew, by two or three turns, the vent plug on top of the filter cover (not the return pipe to the tank).
4. Operate the hand primer and when fuel, free from air bubbles, issues from each venting point, tighten the screws in the following order:-
  - (a) Filter cover vent screw.
  - (b) Head locking screw.
  - (c) Governor vent screw.

5. Slacken the pipe union nut at the pump inlet, operate the priming device and re-tighten when fuel, free from air bubbles, issues from around the threads.
6. Slacken unions at the injector ends of two of the high pressure pipes.
7. Set the hand throttle at the fully open position and ensure that the stop control is in the 'run' position.
8. Turn the engine until fuel oil, free from air bubbles, issues from both injector pipes.
9. Tighten the unions on the injector pipes and the engine is ready for starting and running.

#### FUEL INJECTORS AND HOLDERS

All nozzles should be removed from the engine for examination at regular intervals. Just how long these intervals should be, however, is difficult to generalise, because of the widely different conditions under which engines operate. Where operating conditions are good and the fuel tank and filtering systems are maintained in first-class order, it is often sufficient if the nozzles are tested every 480 working hours.

The nearer the ideal conditions of good combustion with adequate cooling and absolutely clean fuel are realised, the less attention the nozzles will need, and so the longer their efficient life. In this connection, since the efficiency of this equipment vitally affects the performance of a diesel engine, it will repay the user handsomely to see that it never runs with any of the nozzles out of order.

#### LOCATING A FAULTY INJECTOR

The first symptoms of nozzle trouble usually manifest themselves under one or more of the following headings:-

- (a) Misfiring.
- (b) Increased cylinder knock.
- (c) Engine overheating.
- (d) Loss of power.
- (e) Excessive smoke from exhaust.
- (f) Increased fuel consumption.

Do not immediately assume, however, that the nozzles are the cause of the trouble, for

such features as faulty engine valve timing, badly leaking engine valves, incorrect pump timing, dirty or damaged fuel filters, wrong fuel, water in fuel, defective engine lubrication or incorrect fuel pump maximum fuel setting may cause similar signs of distress.

Assuming, therefore, that everything else is in order and the nozzles are still suspect, the particular nozzle/s causing trouble may be detected as follows:-

1. Set the engine at a fast idling speed and release the high pressure pipe union nut at each injector in turn.
2. This will cut out each injector in turn, and when no change is noticed in the running of the engine this will indicate the faulty injector.

Great care should be taken to prevent the hands from getting into contact with the spray, as the working pressure will cause oil to penetrate the skin with ease.

After fitting the spare nozzle holder and nozzle unit, the faulty unit should be placed in the tool kit securely wrapped in clean greaseproof paper or rag for attention at the maintenance bench. The cleaning of nozzles should on no account be attempted 'on the spot'.

In order to test the doubtful nozzle, first remove the nuts from its flange and then withdraw the complete unit (i.e. nozzle holder and nozzle) from the cylinder head, turning it round the oil feed pipe so that the nozzle is pointing outwards away from the engine. Do not bend the pipe.

Next, slacken the unions of the other nozzle holder fuel feed pipes (to prevent fuel being sprayed into their cylinders) and turn the engine with the starter until the suspected nozzle sprays into the air, when it will be seen at once if the spray is in order. If the spray is unduly 'wet' or 'streaky', or obviously to one side, or if the nozzle 'dribbles', disconnect the unit and replace it with a complete spare unit (nozzle holder and nozzle).

#### HINTS ON RUNNING

##### FAILURE TO START

Starting difficulties are not always attributable to faulty fuel injection equipment and may result from poor compression caused by cylinder wear, 'gummed up' rings, sticking or badly seated valves, or from insufficient tappet clearance.

1. Ensure that there is fuel in the tank and that the fuel cock is turned on. If the tank has run dry, the pump must be filled and primed.
2. Check the position of the 'shut off' control.
3. Inspect for oil leaks at the injector pipe connections and tighten if necessary.
4. Fill and prime the pump to remove all air from the system.
5. Inspect the filter element and replace if clogged. Prime the system after re-assembling the filter.
6. Remove each injector in turn and, after re-connecting the high pressure injector pipe with the nozzle directed away from the engine, turn the engine and ensure that fuel passed through the injector is correctly sprayed and atomised. Replace any faulty injectors.

#### ROUGH RUNNING

Possible causes of rough running, together with appropriate remedies are listed as follows:-

1. Air in the Pump  
Slacken each injector pipe coupling in turn (at the injector end) whilst the engine is running and re-tighten when oil, free from air bubbles, leaks past the union threads. If engine running does not improve, fill and prime the pump.
2. Leaking Injector Pipe Unions.  
Inspect all unions for signs of oil leakage and tighten as necessary.
3. Clogged Filter.  
Remove and replace the paper filter element and prime.
4. Water in Fuel  
The presence of water in the fuel will be detected when the filter bowl is removed. Should water be present in quantity, the tank and fuel system should be drained, flushed and replenished with clean fuel. The bulk storage tanks should also be checked and the sludge and water drained off before use.
5. Faulty Injectors  
Remove each injector in turn, re-connect the high pressure pipe with injector

nozzle pointing away from engine and, whilst turning the engine, ensure that fuel passing through the injector is correctly sprayed and atomised. Replace faulty injectors.

If rough running persists after the above tests have been made, the advice of the nearest C.A.V. agent should be sought.

#### COLD STARTING EQUIPMENT

The system is equipped with a cold starting aid which provides pre-heating and priming of the inlet manifold and combustion chambers when starting in temperatures below 32°F. (0°C.)

The first movement anti-clockwise of the starter switch operates the cold starting aid

fitted in the inlet manifold. A small quantity of fuel flows from the reservoir tank through the heater, wherein it is vaporised and then ignited by the heater coil.

A second movement anti-clockwise operates the starter motor and the ignited fuel is drawn into the engine.

#### IDLING SPEED ADJUSTMENT

If the pump has been newly fitted, the engine idling speed must be adjusted by the spring-loaded screw on top of the injection pump.

With the engine warm, turn the screw clockwise to increase the idling speed and anti-clockwise to decrease; idling speed should be approximately 450 R.P.M. with the minimum of 'hunting'.