



Department of  
Primary Industries and  
Regional Development

## Journal of the Department of Agriculture, Western Australia, Series 3

---

Volume 3  
Number 2 March- April, 1954

Article 3

---

3-1954

### The farm tractor, part.1 - how the engine works

Follow this and additional works at: [https://library.dpird.wa.gov.au/journal\\_agriculture3](https://library.dpird.wa.gov.au/journal_agriculture3)

---

#### Recommended Citation

(1954) "The farm tractor, part.1 - how the engine works," *Journal of the Department of Agriculture, Western Australia, Series 3*: Vol. 3: No. 2, Article 3.

Available at: [https://library.dpird.wa.gov.au/journal\\_agriculture3/vol3/iss2/3](https://library.dpird.wa.gov.au/journal_agriculture3/vol3/iss2/3)

This article is brought to you for free and open access by the Agriculture at Digital Library. It has been accepted for inclusion in Journal of the Department of Agriculture, Western Australia, Series 3 by an authorized administrator of Digital Library. For more information, please contact [library@dpird.wa.gov.au](mailto:library@dpird.wa.gov.au).

# The FARM TRACTOR



## Part 1.—How the Engine Works

**N**O driver can look after his tractor properly unless he knows something of the way it works. The modern tractor is a sturdy machine designed to stand continuous hard work, but it contains a certain amount of complicated mechanism. All drivers, therefore, should know enough of the working principles of a tractor to be able to undertake the "maintenance" of the one they use.

If through neglect or ignorance a tractor does not get proper maintenance—

1. It will never be capable of undertaking its full duty.
2. Repair bills will be heavy.
3. It will break down, generally at busy times.
4. Its working life will be considerably shortened.
5. Fuel will be wasted.

In the long run the only complete guide to the maintenance of a tractor is the instruction book issued by the makers. The instruction book is the most valuable part of the tool-kit supplied with a new tractor.

*The letterpress and illustrations in this series of articles are from a handbook prepared by the National Institute of Agricultural Engineering (England) and are reproduced by courtesy of the Institute and the British Ministry for Agriculture and Fisheries.*

therein may be rather too detailed and too technical for the new-comer to tractor work to grasp at all readily. Moreover, there is an instruction book for every single model, and the maintenance instructions given for one are not always a safe guide to the maintenance of another. These articles have been written, not to replace the instruction book, but to give beginners in particular, and even in some cases "old hands," an insight into the construction and use of tractors in general. Thus they may more easily understand the detailed instructions given by the makers of the tractor they have to operate.

### THE INTERNAL COMBUSTION ENGINE

The kind of engine used in a tractor is called an internal combustion engine because it converts the heat energy of fuel into mechanical work by burning the fuel inside the engine itself.

A steam engine, for example, is not an internal combustion engine because the engine part of it—cylinder, piston and so on—is quite distinct and separate from the fire-box in which the fuel is actually burnt. The fuel burnt in an I.C. engine can be any one of the following:—Coal or producer gas, petrol or kerosene vapour, or diesel oil in the form of a finely-atomised spray.

Any owner who has no instruction book for his own particular model would do well to order one. But the information given



The general principle of all I.C. engines is the same and depends on the fact that air combined in the right proportion with any one of these fuels will form an explosive mixture. The various types of engine differ from one another only according to the fuel used, the exact arrangements for introducing and exploding it, and the number of cylinders. For tractors the most common and important type is the four-stroke engine starting on petrol and running on a special kind of kerosene known as vapourising oil.

Fig. 1 shows a diagram of a four-stroke I.C. engine cut across the middle, and viewed from the end. All the most important parts are labelled, and will be referred to throughout this book by these names.

## THE SINGLE CYLINDER FOUR-STROKE ENGINE

The cycle of operations is shown in Fig. 2.

### 1. Induction Stroke.

- (a) The inlet valve opens.
- (b) The piston moves down the cylinder.
- (c) Fuel and air mixture is sucked into the cylinder.
- (d) When the piston reaches the bottom, the cylinder is full of explosive mixture and the inlet valve closes.

### 2. Compression Stroke.

- (a) Both valves are closed.
- (b) The piston rises.
- (c) The mixture in the cylinder is compressed into a much smaller space.

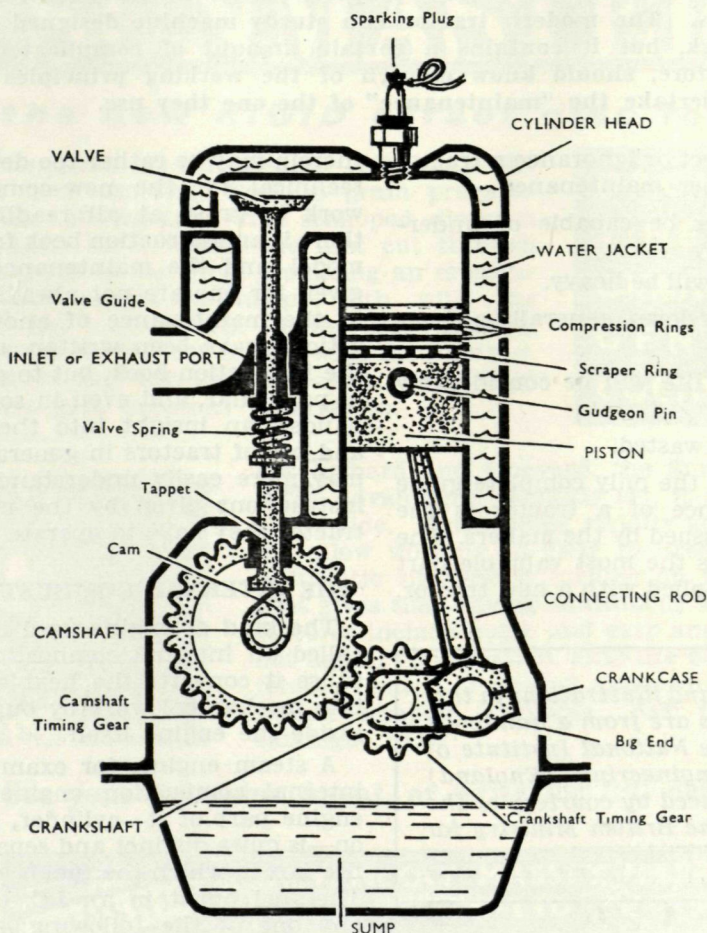


FIG. 1  
THE 4-STROKE ENGINE



# "I cannot praise this mighty utility too much"

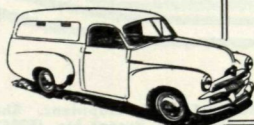
Mr. A. J. Ferguson, Cairns, Queensland, writes:  
*"Having now completed the purchase of a further three new-look Holden Utilities . . . I cannot praise this mighty utility too much. Our first Holden has clocked over 35,000 miles in 2½ years under very arduous and extreme conditions mainly the carrying of heavy loads over long distances and very rough roads . . . from Cardwell to Daintree and as far west as Mr. Garnet. We have consistently clocked mileages from 30 to 35 miles per gallon under these same conditions . . . maintenance and repairs have been confined to regular greasing and oil changing without the need for the fitting of any major parts."*

Mr. Ferguson adds: *"I feel that Holden will more than adequately perform all tasks asked of it."*  
 This is typical of letters received from owners who agree that Australia's own utility has proved itself for dependability, economy, smartness and comfort.  
 Holden is the only utility designed and built for Australian conditions. It is Australia's most popular utility because it gives more value for money.



Australia's Own Utility

Australia's Own  
Panel Van



449B



## HOLDEN\*

\* Registered Trade Mark.

Australia's Own Car



★ There are two Air Chief Car Radios specially designed for Holden.

★ Convenient hire purchase terms are available through G.M.A.C.—General Motors' own finance company.

Metropolitan & State Distributors:

**SYDNEY ATKINSON MOTORS LTD.**  
 Temple Court, William Street, Perth.  
 Phone: BF 1141

Metropolitan Distributors:

**CITY MOTORS PTY. LTD.**  
 367-371 Murray Street, Perth.  
 Phone: BA 5165

or buy from your local authorised dealer.

**GENERAL MOTORS-HOLDEN'S LTD.** — Sold and Serviced by Holden Dealers throughout Australia.



# START *The Two-Tankful Test* TODAY



**SHELL**

WITH

AN EXCLUSIVE SHELL DEVELOPMENT

**I.C.A.**

Ignition Control Additive

**THE GREATEST PETROL DEVELOPMENT IN 32 YEAR**

(TETRA ETHYL LEAD WAS INTRODUCED IN 1922)

## HOW THE TWO-TANKFUL TEST WORKS

### FIRST FILL-UP

If the petrol in your tank is less than one quarter of the tank's capacity, fill up today with Shell with I.C.A. But there will be ordinary petrol mixed in with your Shell with I.C.A., so . . .

### SECOND FILL-UP

Make certain that your next tankful is Shell with I.C.A. After these two tankfuls you will FEEL the difference in engine performance and you will continue to buy Shell with I.C.A. for more power and more mileage per gallon. Prove for yourself that Shell with I.C.A. is the greatest petrol development since tetra-ethyl lead was introduced

**SEE** the difference  
**FEEL** the difference

I.C.A. is an exclusive Shell development. Shell has universal patent rights (Aust. Patent No. 152857) covering the use of Tricresyl Phosphate in Motor Fuels. Therefore do not be misled by vague claims for unspecified and unproven additives. Only I.C.A. can give you the benefits of Tricresyl Phosphate. You will be truly delighted with the performance of your car after using two tankfuls of Shell with I.C.A.



**FROM ALL SHELL DEALERS**  
The Shell Co. of Aust. Ltd.  
(Inc. in Gt. Britain)

MS542M



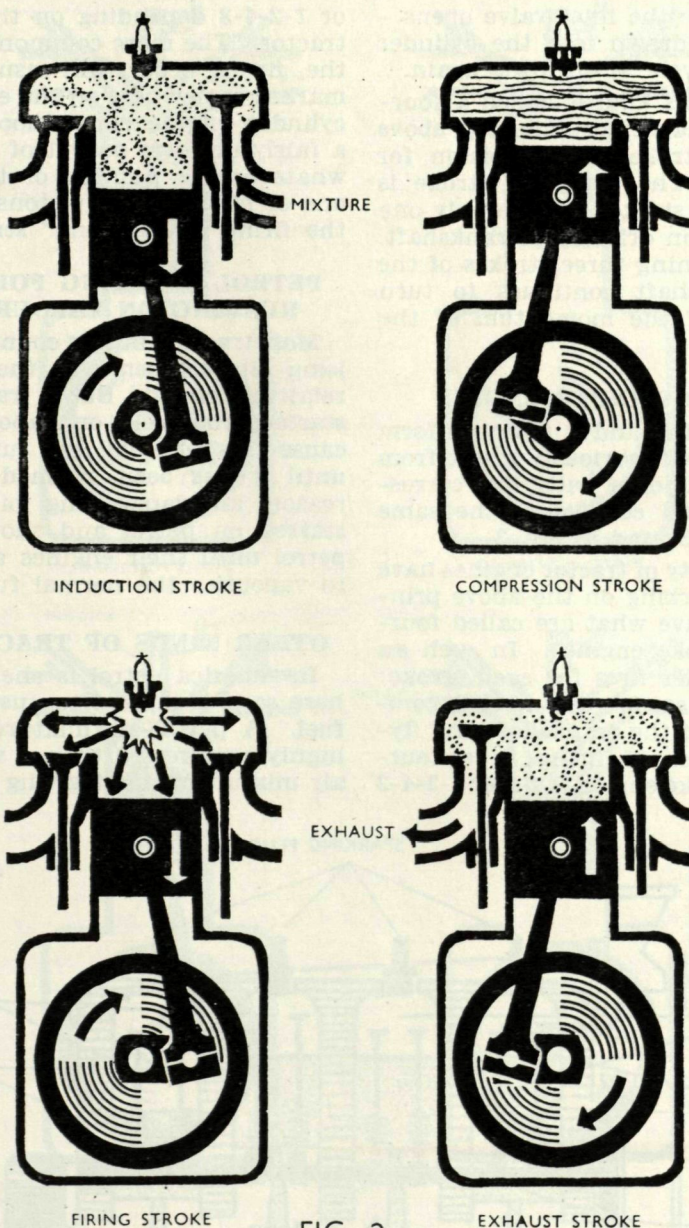


FIG. 2

### 3. Firing Stroke.

(a) At the end of the compression stroke both valves are still closed.

(b) As the piston reaches the top of this stroke a spark at the sparking plug ignites the compressed mixture.

(c) The force of the explosion of that mixture drives the piston down the cylinder.

### 4. Exhaust Stroke.

(a) The exhaust valve opens as the piston reaches the bottom of the firing stroke.

(b) The piston moves up the cylinder again.

(c) The burnt gases are driven out past the exhaust valve.

(d) The exhaust valve closes.



Then once more the inlet valve opens—fresh mixture is drawn into the cylinder and the whole cycle starts over again.

An engine of this kind is called a four-stroke engine because, as indicated above there are four strokes of the piston for each explosion. The explosion stroke is the only working stroke, i.e., the only one in which the piston drives the crankshaft. During the remaining three strokes of the cycle the crankshaft continues to turn round because of the momentum of the flywheel.

### THE FOUR-CYLINDER ENGINE

Smoother running and a more uniform output of power will obviously result from using several cylinders with the corresponding pistons all coupled to the same crankshaft as indicated in Fig. 3.

The vast majority of tractor engines have four cylinders working on the above principle, i.e., they have what are called four-cylinder four-stroke engines. In such an engine one cylinder fires for each stroke: that is, two cylinders fire during each complete revolution of the crankshaft and flywheel. The order of firing in a four-cylinder four-stroke engine is either 1-3-4-2

or 1-2-4-3 depending on the make of the tractor. The more common is 1-2-4-3: but the firing order will usually be found marked somewhere on the engine. A four-cylinder engine runs smoothly and gives a fairly uniform output of power because, whatever the position of the crankshaft, one or other of the pistons is actually on the firing or "working" stroke.

### PETROL STARTING FOR TRACTORS RUNNING ON VAPOURISING OIL

Most tractors in this country use vapourising oil (kerosene) as fuel because it is relatively cheap. But a tractor cannot be started from cold on vapourising oil because this fuel will not turn into vapour until it has been warmed up. For this reason all vapourising oil tractors are started on petrol and should be run on petrol until their engines are hot enough to vapourise the normal fuel properly.

### OTHER KINDS OF TRACTOR ENGINE

In America petrol is cheaper than it is here so it is more often used as a tractor fuel. A petrol-air mixture can be more highly compressed than a vapourising oil-air mixture without giving trouble on the

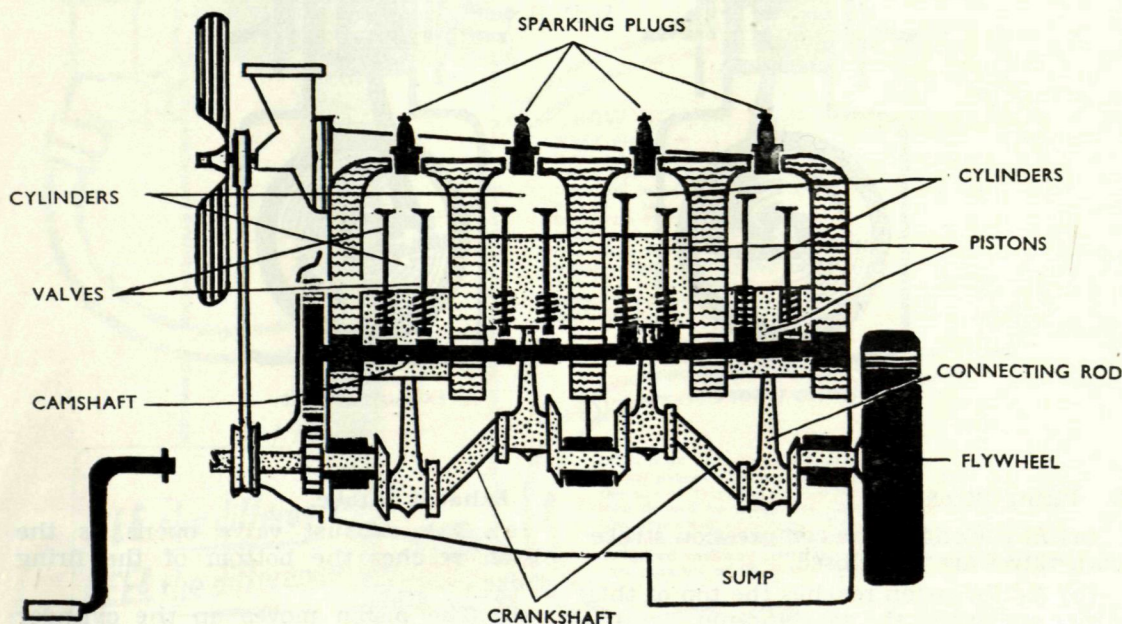


FIG. 3

### THE 4-CYLINDER ENGINE



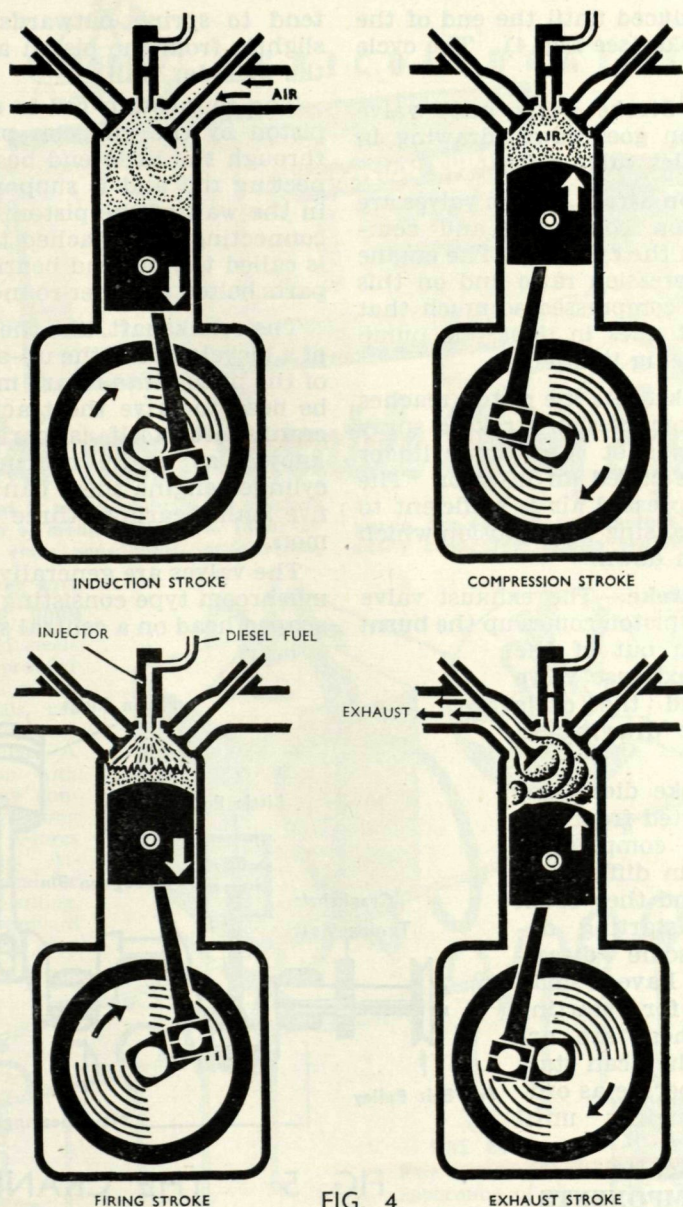


FIG. 4

## THE DIESEL CYCLE

firing stroke: or, as we generally say, an engine running on petrol can have a higher compression ratio than an engine running on vapourising oil. With a higher compression ratio more power can be obtained from the same size of engine, and so, if it has been specially designed for the purpose, a petrol engine will generally be more powerful than a vapourising oil engine of the same size.

### THE DIESEL ENGINE

In some parts of the world vapourising oil is either expensive or difficult to obtain, and the only cheap fuel is diesel oil. In those places tractors with diesel engines are popular; some tracklaying tractors of this type are also to be found in this country. The diesel engine works on the same principle as the vapourising oil engine, but there is no sparking plug and



fuel is not introduced until the end of the compression stroke (see Fig. 4). The cycle is as follows:—

1. **Induction Stroke.**—The inlet valve opens—the piston goes down, drawing in pure air—the inlet valve closes.

2. **Compression Stroke.**—Both valves are closed—the piston comes up and compresses the air in the cylinder. The engine has a high compression ratio and on this stroke the air is compressed so much that it get hot—as it does in a bicycle pump when a tyre is being inflated.

3. **Firing Stroke.**—As the piston reaches the top of the compression stroke a spray of diesel fuel is shot into the cylinder through a nozzle called an injector. The heat of the compressed air is sufficient to ignite the fuel, causing an explosion which drives the piston down.

4. **Exhaust Stroke.**—The exhaust valve opens and as the piston comes up the burnt gases are driven out of the cylinder. The exhaust valve then closes and the cycle starts again by drawing in fresh air.

Most four-stroke diesel engines can be started from cold but their high compression ratio makes them difficult to turn by hand, and they often have auxiliary starting devices. Thus some diesel-engined tractors have a small petrol engine for starting them, while others are arranged so that they can start on petrol, and operate as ordinary petrol engines until they warm up.

## TRACTOR COMPONENTS

This section aims at showing how the principles of the internal combustion engine are put to practical use in a tractor.

### THE TRACTOR ENGINE

The piston must make a gas-tight joint with the inside wall of the cylinder and yet be free to move up and down. This gas-tight fit is obtained by three or more cast-iron rings (piston rings) which are let into grooves around the piston. The rings

tend to spring outwards and so project slightly from the piston and press against the cylinder wall.

The connecting rod is connected to the piston by the gudgeon pin, which passes through the little-end bearing in the connecting rod and is supported at each end in the wall of the piston. The end of the connecting rod attached to the crankshaft is called the big-end bearing and is in two parts bolted together round the crankshaft.

The crankshaft, like the pedal and crank of a bicycle, turns the up-and-down motion of the piston into rotary motion, which can be used to drive the tractor wheels. The crankshaft itself is carried in bearings known as main bearings—in a four-cylinder engine there can be two, three or five main bearings, three being most common.

The valves are generally of the poppet or mushroom type consisting of a mushroom-shaped head on a central stem. They move

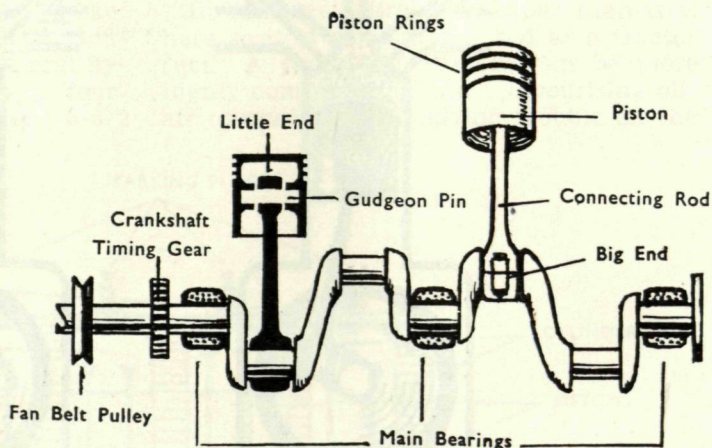


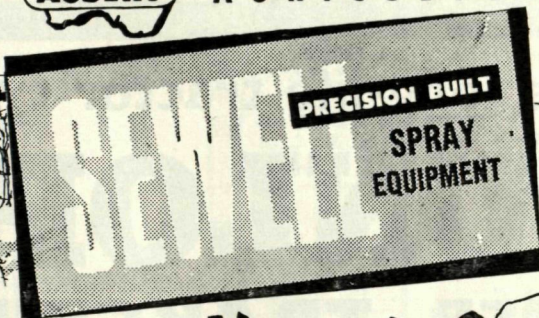
FIG. 5 THE CRANKSHAFT

up and down in "sleeves" called valve guides and are held in the closed position by valve springs. There are two common arrangements—side valves and overhead valves as shown in Fig. 6. Practically all tractors, except the Fordson, have overhead valve engines. In tractors, overhead valves are operated by push rods from a camshaft at the side of the engine.

**The Camshaft.**—The valves are opened and closed at the correct times by means



ANOTHER **AGSERV** AGRICULTURAL TRIUMPH



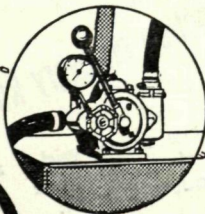
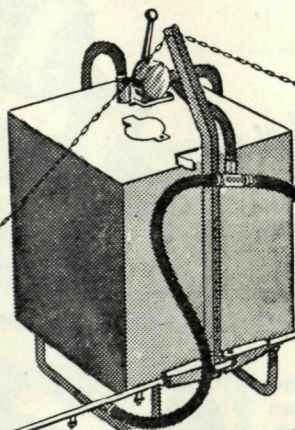
# Australia's most Versatile Spray Equipment

Sewell Equipment is precision-built for efficient operation at low or medium pressure. Ideal for pastures, crops, vines, vegetables, scrub, sheds,

yards, fire-fighting or livestock. Equipment is easily connected, booms are interchangeable.

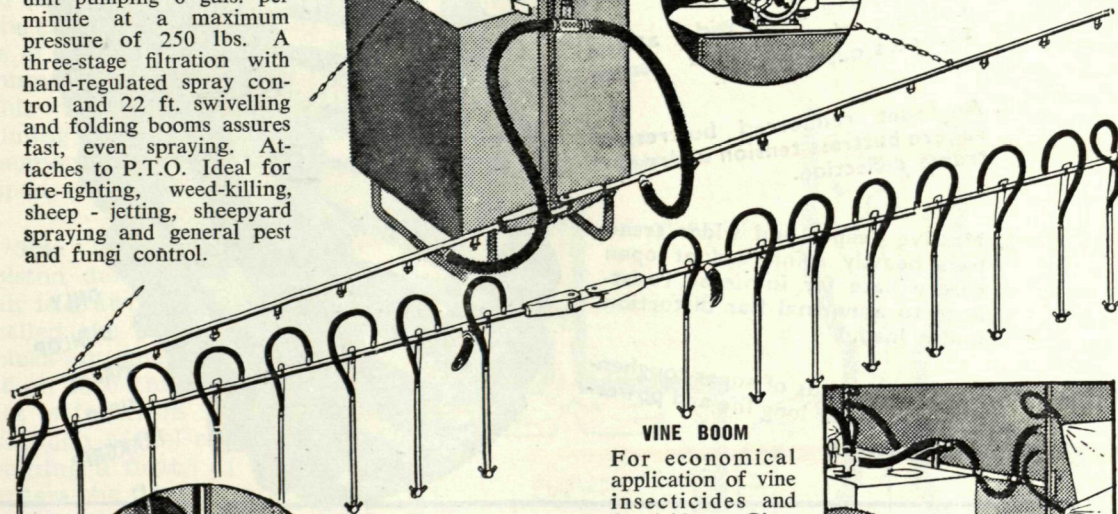
## SEWELL BOOM SPRAYER WITH PASTURE AND CROP BOOM

A 65-gallon welded steel-tank, corrosion - proofed with a 4-cyl. radial piston unit pumping 6 gals. per minute at a maximum pressure of 250 lbs. A three-stage filtration with hand-regulated spray control and 22 ft. swivelling and folding booms assures fast, even spraying. Attaches to P.T.O. Ideal for fire-fighting, weed-killing, sheep - jetting, sheepyard spraying and general pest and fungi control.



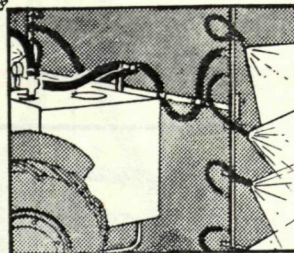
## SPRAY CONTROL

Only Sewell Equipment features this exclusive and efficient control unit.



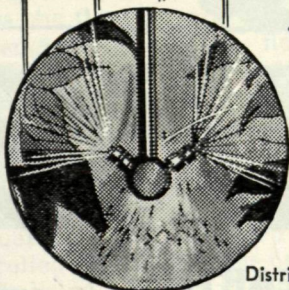
## VINE BOOM

For economical application of vine insecticides and fungicides. Gives double row coverage. Booms are fitted with four nozzles each.



## VEGETABLE BOOM

Specially adapted for efficient row spraying of vegetables. Boom is 14 ft. with 12 non - clogging nozzles assuring fast, labour-saving spraying.



Distributors in W.A.:

**Wm. Haughton & Co. Pty. Ltd.,** 115 St. George's Terrace, Perth.

Agents: Dalgety & Co. Ltd. and Goldsbrough Mort & Co. Ltd., Perth.

To: (Your State distributor)  
Please forward full information on the

NAME

ADDRESS



fit the long-life tractor tyre

# DUNLOP

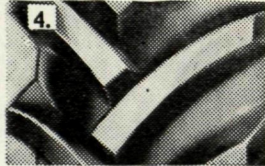
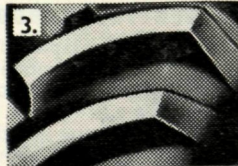
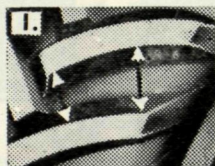
## SUPER TRAKGRIP

*for super traction on every kind of soil*

1. Open-centre tread wider at the buttress than at the centre squeezes out all trash.
2. Angle-set reinforced buttresses relieve buttress tension under extreme deflection.
3. Massive deeper and wider tread bars heavily reinforced at open centre base for immense resistance to abnormal Bar distortion under load.
4. Broader treads of super-toughened rubber for long life and powerful traction.



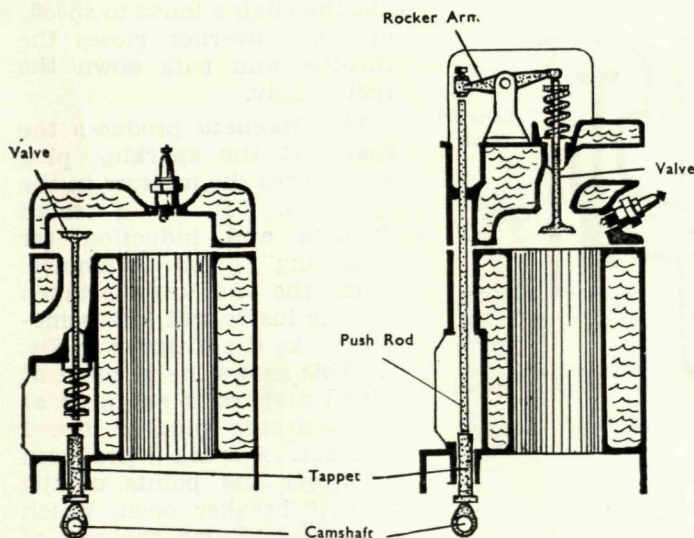
ONLY  
DUNLOP  
MAKES  
SUPER  
TRAKGRIP



### THE GREATEST GRIP ON EARTH

DTG.1305





SIDE VALVE

FIG. 6

OVERHEAD VALVE

of cams, which are merely projections from the camshaft. The setting of the camshaft is of great importance in the running of the engine. On this will depend the valve timing, that is, the exact moments at which the valves open and close.

**The Carburettor.**—As the piston descends, a stream of air is drawn over a small hole called the jet from which it picks up some fuel and carries it on into the cylinder. The jet is fed from the fuel tank through a fuel chamber containing a float. If more fuel enters the float chamber than the engine needs, the float will rise until the valve at the top closes the pipe from the tank. When the engine needs more fuel, the float will fall and allow more to enter the float chamber. The quantity of fuel reaching the jet is controlled by the setting of a needle valve (see Fig. 8).

**The Vapouriser.** — When petrol is used, the fuel picked

ourises, i.e., turns into gas. up from the jet rapidly vap- Such a mixture of air and petrol vapour explodes easily. Vapourising oil does not turn into gas unless it is heated. It leaves the jet as a very fine spray made up of small drops of fuel, which must then be heated in a vapouriser to turn them into gas.

The vapouriser is a narrow box, one side of which is heated by the hot gases leaving the engine on each exhaust stroke. When the engine has been running for a short time on petrol the vapouriser becomes hot. If the engine is then turned on to vapourising oil, the spray of fuel from the jet will be heated and turned into a gas, which forms with air an easily exploded mixture (see Fig. 8).

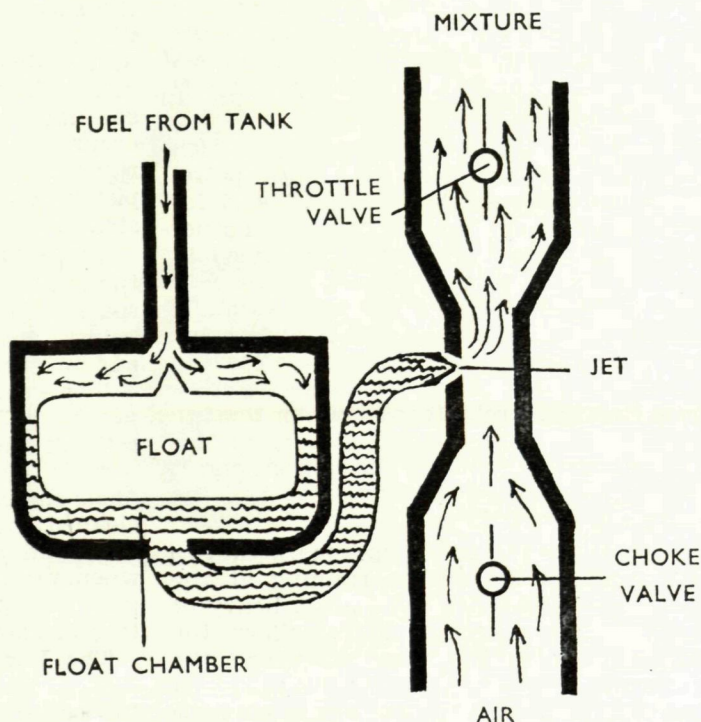


FIG. 7 THE CARBURETTOR



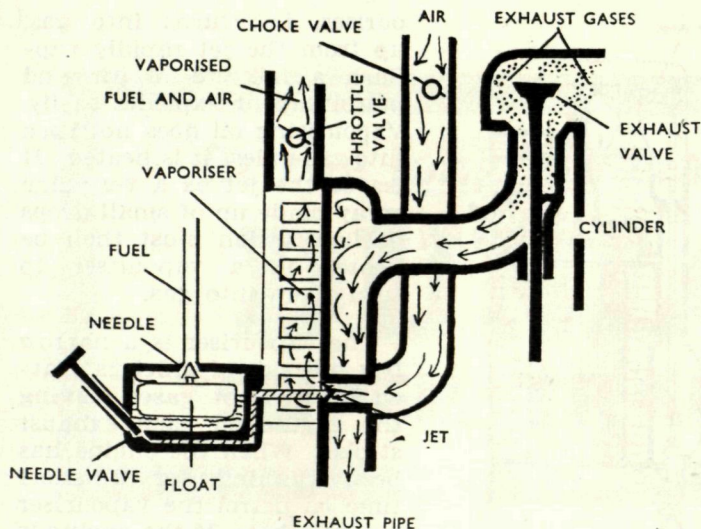


FIG. 8 THE VAPORISER

**The Throttle** is shown in Figs. 7 and 8. It is a flat disc of metal which can be set so that it partially blocks the induction pipe, i.e., the pipe along which the fuel-air mixture flows to the engine. The speed and power of the engine are controlled by the amount of mixture that the throttle allows to enter the cylinders. In Fig. 7 the throttle is open, in Fig. 8 it is closed.

**The Choke.**—The engine requires a “rich mixture” for starting, i.e., more petrol vapour in the mixture than is needed for normal running. For this reason another disc, similar to the throttle, is placed in the air intake so that the air has to flow past it before reaching the jet. Normally this disc—called the choke—is wide open, but for starting it is partially closed to restrict the flow of air and make the mixture rich in petrol. It is shown in the two diagrams—in the top one it is open for normal running and in the bottom one it is partially closed for starting, i.e., the engine is “choked.”

**The Governor** is an automatic device which keeps the engine running at the same speed whether the load is heavy or light. The governor control allows the driver to alter the speed at which the governor keeps the engine running. If the load on a tractor increases so that the engine speed tends to fall, the governor opens the throttle and gives the engine more fuel. When the load decreases so

that the engine tends to speed up, the governor closes the throttle and cuts down the fuel supply.

**The Magneto** produces the spark at the sparking plug which fires the mixture in the cylinders. It is a small dynamo and induction (or “shocking”) coil combined. When the end cover is taken off, the inside will look something like the diagram in Fig. 9. This shows the moment at which a spark is produced at the sparking plug in No. 1 cylinder. A spark is produced whenever the points of the contact breaker open, which occurs each time the end of the rocker arm passes the cams on the stationary cam ring. The spark appears

at No. 1 plug because the rotor arm of the distributor is passing the end of No. 1 plug-lead. In the magneto shown, this rotor arm is geared to revolve at half the speed of the contact breaker, so that when the points next open the rotor arm of the distributor will be opposite No. 2 pluglead. The magneto must be “timed” so that the points open, i.e., the spark occurs, in the right cylinder and at the right time in relation to the position of the piston at the end of each compression stroke.

**A Sparking Plug** is the means whereby the mixture is ignited in the cylinder by a spark appearing at the gap between its points. Sparking plugs must be kept clean and in good order or the spark they give will be weak. In that case the mixture will not be ignited properly: starting will be difficult and power will be lost.

It is most important, therefore, that plugs should be taken out periodically and cleaned thoroughly.

Not all sparking plugs are alike, and, whenever possible, the particular type of plug recommended by the makers of a tractor should be fitted.

**The Impulse Starter** is a device which makes tractors easier to start. When turned slowly a magneto gives a weak spark that makes starting difficult, so while the engine is being turned slowly some means has to be found to increase the magneto



## SPARKING PLUGS

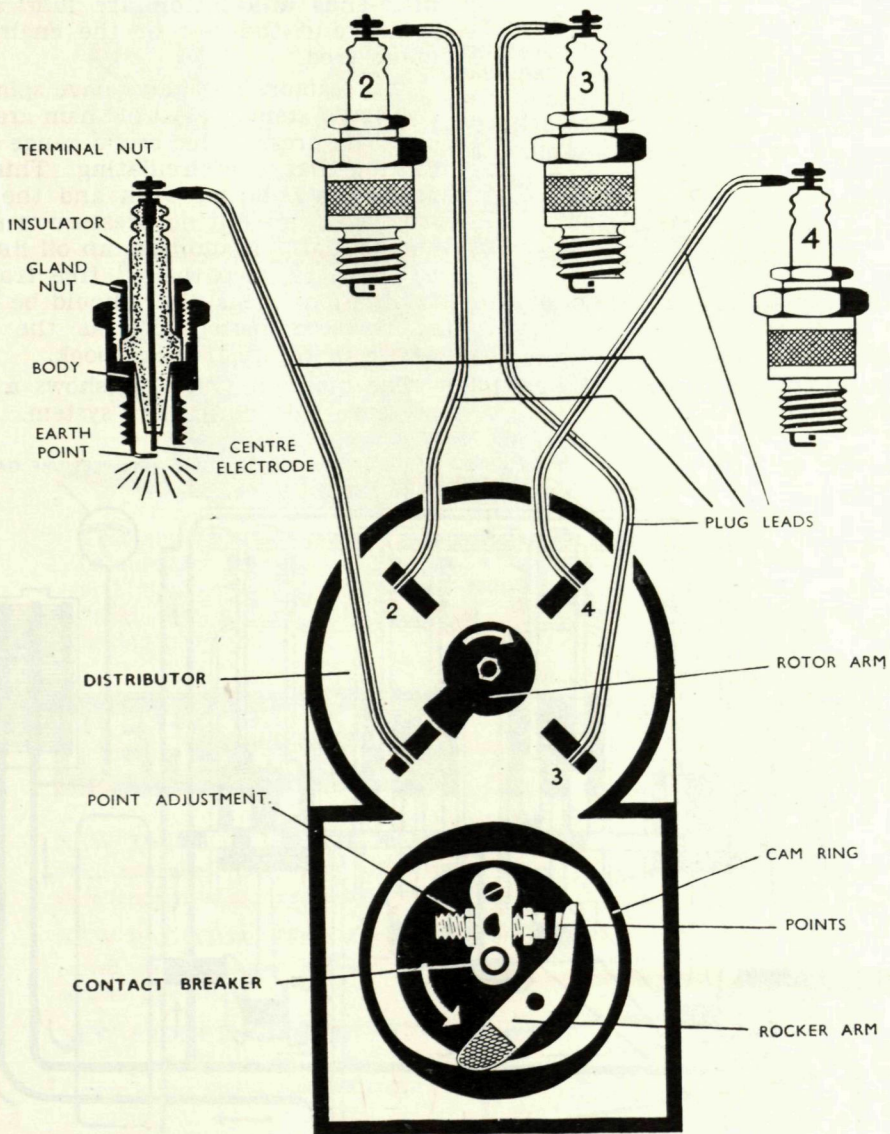


FIG. 9 THE MAGNETO



speed. When the engine is turned the impulse starter prevents the magneto from turning with it until the piston reaches the top of the compression stroke. At this moment the magneto is released, and is driven round at high speed by a spring so that it delivers a "fat" spark. The spark thus produced by hand-turning is as good as the spark delivered in normal running at normal engine speed. The impulse starter engages automatically when the engine stops and can be heard to "click" as the engine is turned over by hand. As soon as the engine starts it disengages itself automatically. Any modern tractor can therefore be started simply by pulling up the starting handle.

**The Lubrication System** can be one of the following:—

1. **Splash.**—The big-ends dip into trays carrying oil in the sump, and so cover the inside of the engine with oil.

2. **Pressure Feed.**—Oil drawn from the sump through a screen is pumped through pipes to every part of the engine (see Fig. 10).

3. **Force Feed and Splash** is a combination of the above. Usually the big-ends, little-ends and piston are lubricated by splash and the rest of the engine by a pump feed.

Few tractors nowadays have splash lubrication systems. Most of them are wholly or partly pressure fed and a gauge is fitted to show that oil is circulating. This should be watched during work and the engine stopped at once if no pressure is showing on the dial. In addition, an oil filter may be fitted to keep the oil free from contamination. This filter should be cleaned or replaced periodically as the makers advise in the instruction book.

The diagram (Fig. 10) shows a typical pressure-fed lubrication system. After

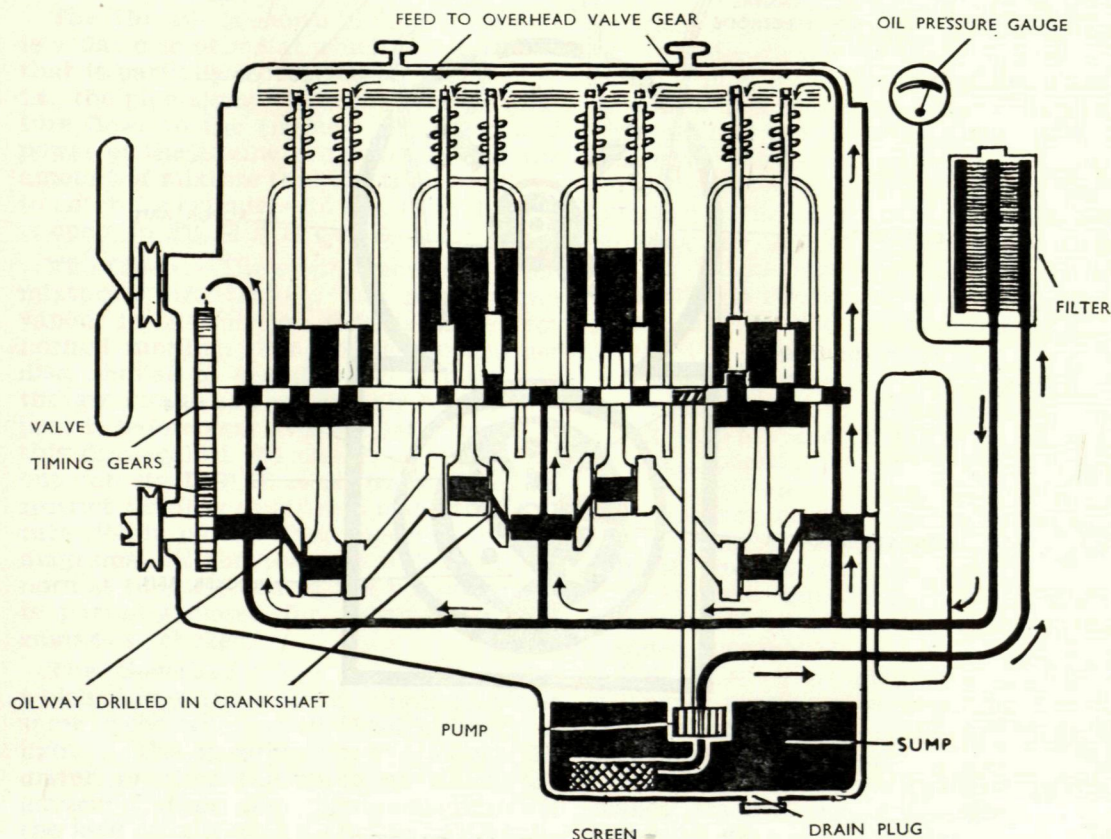
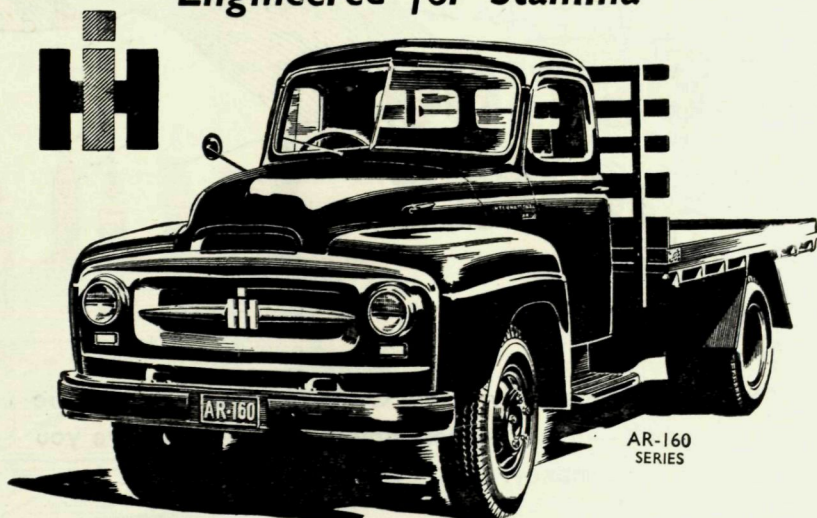


FIG. 10 A FORCE FEED LUBRICATION SYSTEM



# THEY'RE "STAMINEERED"

*Engineered for Stamina*



Cost-conscious operators buy International Trucks year after year because they know quality pays off. They know that every new feature and improvement in the Australian-made Internationals is the result of "trial by torture", International Harvester's engineering and testing programme.

## NEW "STAMINEERED" FEATURES

**NEW TWO-PIECE EXHAUST VALVE** which minimizes valve stretch and keeps valve tappet re-adjustments to a minimum.

**NEW RADIATOR STABILIZER**—improved design, greater stability, longer radiator core life.

**NEW FRONT ENGINE MOUNTING**—stronger front support bracket gives a more secure and dependable engine mounting.

International Harvester Company of Australia Pty. Ltd.  
(Incorporated in Victoria)

District Sales Offices in all Capital Cities  
Works : Dandenong and Geelong.

**NEW HOLLEY CARBURETTOR** — efficiency, economy and serviceability increased by improved, simplified carburettor. Easy replacement of inlet valve, seat and float assembly by removal of a single screw reduces maintenance time and costs.

**NEW 35-AMPERE GENERATOR** — increased capacity, more current for ignition and accessories, keeps battery in top condition for dependable starting.

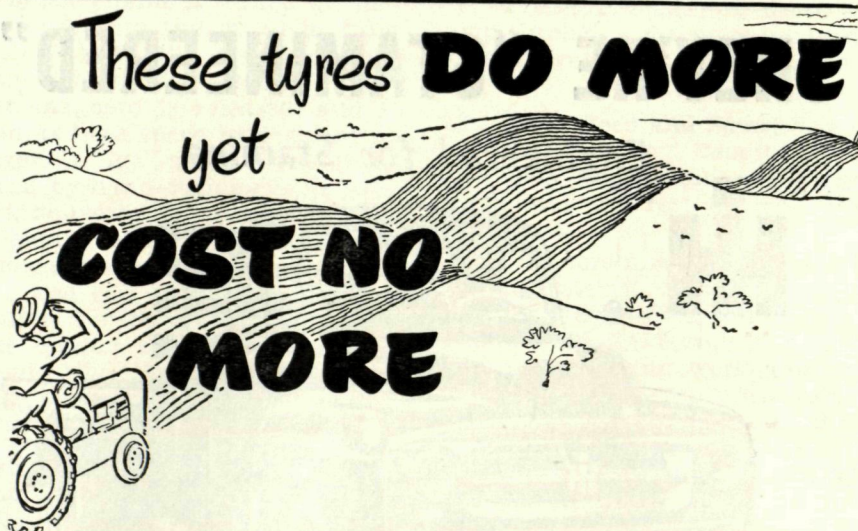
*See your local International Truck Dealer or call at the International Motor Truck Branch in your capital city. Ask about the confidential terms. Trade-ins accepted. AR-Line Internationals are your best truck buy today!*

## INTERNATIONAL TRUCKS

GET THERE FASTER... WITH MORE

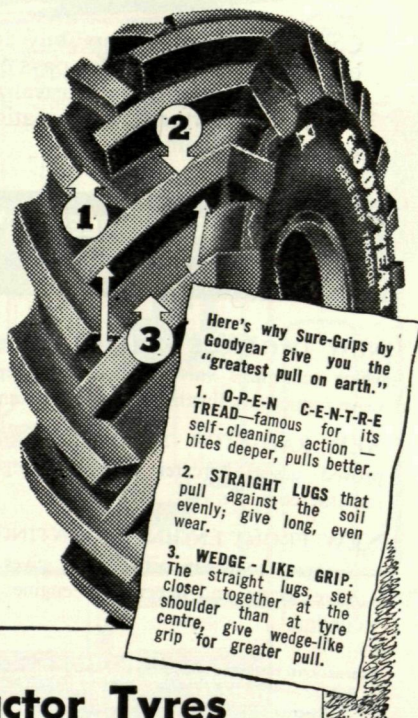
FM1461-24





**SURE-GRIP** Tractor Tyres by Goodyear that **pull** where others won't—in any season, any weather—they give you most for your money.

The ruggedness and long, even wear, plus the greater pull of **Sure-Grip** Tractor Tyres by Goodyear are the reasons why more farmers, the world over, prefer **Sure-Grips** to any other make. That's your best proof that Sure-Grips, by Goodyear, with the famous, self-cleaning, **o-p-e-n c-e-n-t-r-e** tread, are the best tyres for your tractor — especially as they cost no more.



Insist on

**SURE-GRIP** Tractor Tyres  
by **GOOD YEAR**

V608



being pumped through a filter the oil is carried by pipes to the various bearings, reaching the big-ends through oil-ways drilled in the crankshaft. In the drip feed to the overhead valve gear, the oil finds its way down the push rods and tappets to lubricate the cams before returning to the

top of the radiator. The radiator is a series of tubes with fins, through which air is drawn by the fan. As the water is cooled in the radiator it becomes heavier, falls to the bottom and passes to the lower part of the cylinder jacket, to replace the warm water leaving at the top.

It is usual on tractors to have a pump or impeller at some point in the circuit to assist the circulation and improve the efficiency of the cooling.

In practice, tractors running on vapourising oil tend to keep cool, especially on light loads. In a cool engine the fuel is not completely vapourised, with the result that maximum power is not developed and unburnt fuel passes the pistons to the lubricating oil in the sump with harmful effect. There are three main methods of controlling the engine temperature:—

1. Radiator blinds.
2. Radiator shutters.
3. A thermostat controlling the pump circulation.

1 and 2 are most satisfactory when used in conjunction with a thermometer, which can be read from the

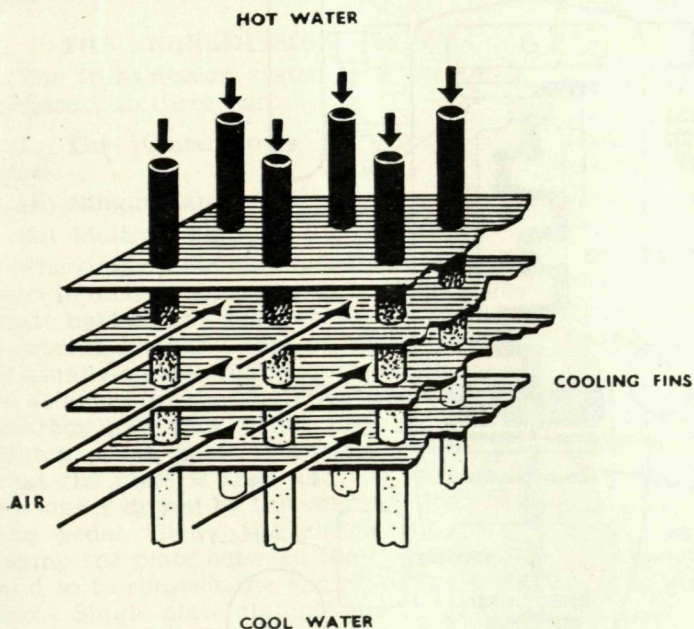


FIG. 11 RADIATOR SECTION

sump. Lubrication of the cylinder walls and little-ends is effected by splash from the crankshaft and by oil-mist.

**The Cooling System.**—An internal combustion engine, with its large number of explosions per minute in each cylinder, needs some cooling device to prevent damage by excessive heat. Water is used, and the usual method of cooling is by the thermo-syphon system. In this system the water circulates because hot water is lighter than cold. Hot water from the parts of the engine nearest to the cylinders rises and passes through a pipe to the

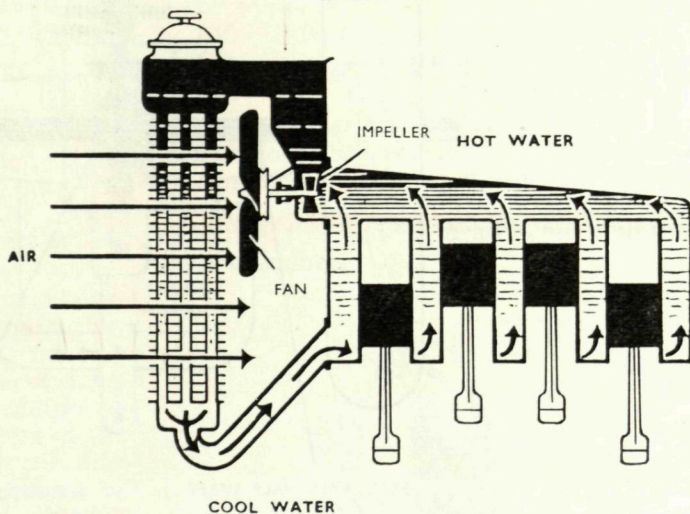


FIG. 12

THE COOLING SYSTEM



driver's seat. The thermometer is best fitted near the top of the radiator, where the water should be kept just under boiling point. Radiator blinds can be raised to keep the engine warm for starting or during cold weather and periods of light loading, and lowered for warmer weather or heavy loads.

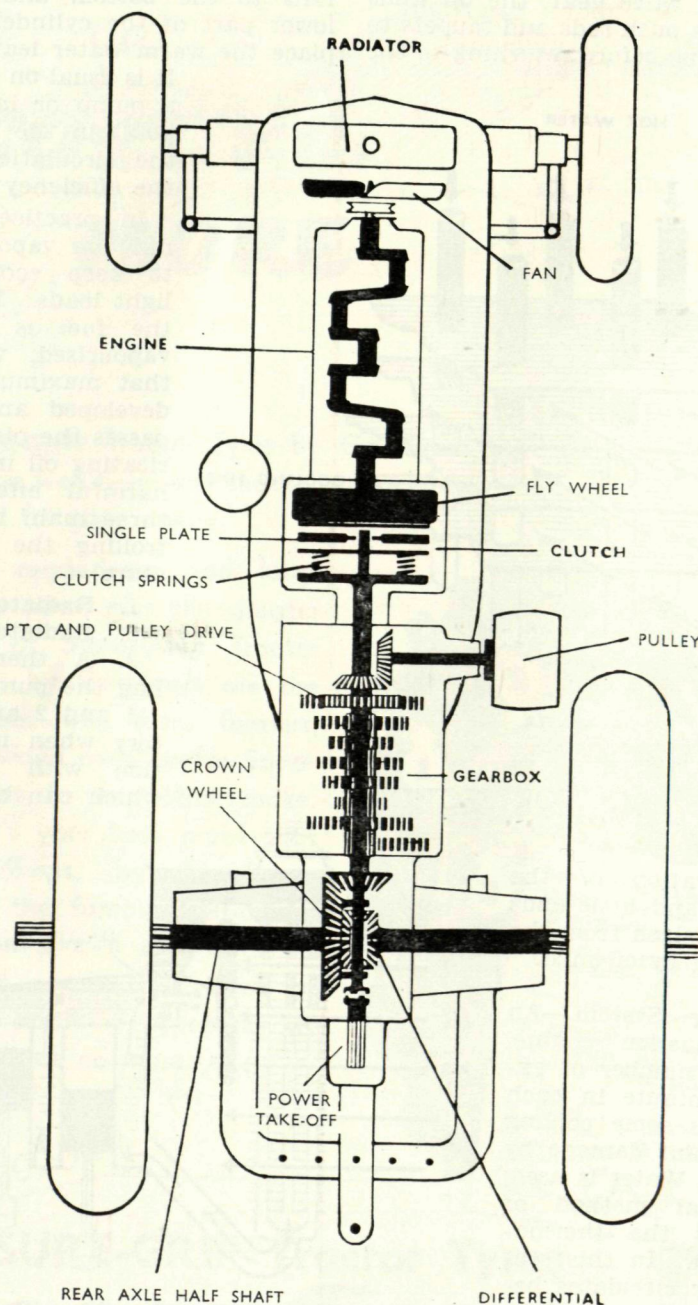


FIG.13 THE TRANSMISSION SYSTEM



Radiator shutters are opened and closed by a hand lever from the operator's seat.

Some tractors use a valve called a thermostat which is fitted between the top of the cylinder and the radiator. When the water round the cylinders is hot enough, this valve opens and allows the water to flow to the radiator for cooling.

### THE TRANSMISSION SYSTEM

The transmission system of a tractor is divided into three parts:—

1. **The Clutch** may be one of two types:—

(a) Single plate.

(b) Multiple plate.

The single plate clutch is the more common in modern tractors. It consists of one plate held tightly between two surfaces by powerful springs. One of these surfaces is usually on the engine flywheel, the other is attached to the shaft which drives the gearbox and back axle. Pressing on the clutch pedal, parts these two surfaces so that the plate is free, and the gearbox is no longer driven by the engine. Releasing the pedal allows the clutch springs to clamp the plate between the two surfaces, and so to connect the engine to the gearbox. Single plate clutches are fitted in a separate compartment in the transmission system where no oil can reach them and

are known as dry clutches. The multiple plate clutch consists of a number of plates, half which are driven by the engine and half fixed to the shaft driving the gearbox. These plates are arranged alternately—one engine driven, then one that drives the gearbox and so on. When the clutch pedal is depressed the plates are allowed to spread, so that they do not touch and drive each other. In the same way when the pedal is released the clutch springs clamp the plates together, and the engine drives the gearbox. Multiple plate clutches are usually fitted in a part of the transmission to which the engine oil can penetrate and thus, running in oil, are known as wet clutches.

2. **The Gearbox** gives a choice of tractor speeds so that the power of the engine may be used to the best advantage, and the speed chosen for each farming operation. The gearbox is designed to allow gear changes only when the tractor is stationary, and the gears should not be changed while the tractor is moving.

3. **The Back Axle** is the final drive from the gearbox to the rear wheels. It consists of two half shafts and a differential gear which enables the driving wheels to turn at different speeds when going round corners.

*(To be continued)*

### BEEHIVE REGISTRATION

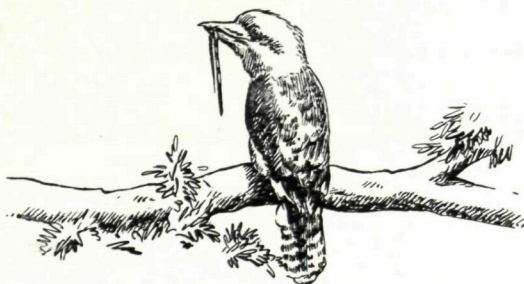
**T**HE Director of Agriculture (Mr. G. K. Baron Hay) wishes to remind all beekeepers that under the Bees Act, 1930-1950, any person keeping bees must be registered for the current year, the period of registration ending on December 31, annually.

Persons owning hives of bees who have not previously registered are required to pay a registration fee of 2s. 6d. for any number of hives up to 25. A further fee of 1s. should be paid for each additional 25 hives or lesser numbers in excess of the first 25. Persons registering for the first time as beekeepers are also required to take out a registered brand for which a further fee of 7/6 is payable.

Beekeepers who have previously registered must re-register and are reminded

that re-registration fell due on January 1, 1954.

In applying for registration or re-registration, beekeepers should forward the full name, address, and particulars of location. Country applicants should add exchange to cheques drawn on country bank branches.





# 'PHENOVIS'

BRAND OF PHENOTHIAZINE

## THE MOST EFFICIENT WORM DRENCH

INFESTATION OF YOUR SHEEP WITH EVEN SMALL NUMBERS OF PARASITES CAN REDUCE THEIR APPETITE BY 50% AND CAUSE LOSS OF WOOL PRODUCTION AND GROWTH.

### WORMY SHEEP

Eats only 3 lbs.  
Grass daily.



### HEALTHY SHEEP

Eats 5 lbs.  
Grass daily.



Don't let worms starve **your** sheep. Obtain your highest return from worm free sheep.

**Drench with 'PHENOVIS'.**

★ One of a series of advertisements designed to convey as a simple story the results of many years of research. Acknowledgment is made to many research workers whose results have been published in the Australian Veterinary Journal and elsewhere.

**IMPERIAL CHEMICAL INDUSTRIES  
OF AUSTRALIA & NEW ZEALAND LIMITED  
ALL CAPITAL CITIES**



PHE. 16X. 4110