IMPORTANT.

Aluminium parts of the Engine must not be degreased with Trichlorethylene or similar cleaning mediums as they remove the internal and external protective paints. Use paraffin for this purpose.

INSTRUCTION BOOK

THE CARE AND MAINTENANCE OF THE TWIN CYLINDER ENFIELD MARK I AIR-COOLED DIESEL ENGINE

NOVEMBER, 1951

ENFIELD INDUSTRIAL ENGINES CO.
(Proprietors: THE ENFIELD CYCLE COMPANY LTD.)
HEAD OFFICE AND WORKS: REDDITCH, ENGLAND

Telegram: "Diesels, Redditch."
Telephone: Redditch 121 (8 lines).
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# GUARANTEE

Enfield Air-Cooled Diesel Engines and spare parts are subject only to the following express warranty which shall exclude all conditions, warranties and liabilities whatsoever, whether statutory or otherwise which might exist but for this provision.

In the event of any defect being disclosed within a period of twelve months after the date of supply, the Company undertakes, provided the part alleged to be defective is returned immediately to the Company's Works for the purpose of examination, to repair the defective part or to supply a new one in place thereof free of charge if on examination by the Company the part is found to be faulty in its material or workmanship. Such free replacement or repair does not include carriage charges to and from the Company's Works nor the cost of installing the new or repaired part.

This warranty does not apply to fuel injection equipment filters, etc., which are proprietary articles.

This warranty also does not apply to defects caused by wear and tear, overloading, misuse, dirt or neglect, nor to any parts which may have been damaged by reason of defect in some other part. The Company does not accept liability for any contingent or consequent damage which may arise under any circumstance whatsoever.

This warranty is limited to the party in whose name the engine is first registered as the user thereof and runs from the date of invoice, unless such user notifies the Sales Department of the Company of the date on which the engine is first put into service by him, in which case, such date, if agreed by the Company, will be registered as the date for the commencement of the running of this warranty.

In the event of the Engine being modified or any identification plates, numbers or marks being altered or removed, the Company's liability under this warranty ceases forthwith.
Read this Instruction Book carefully.
It can save you trouble and expense.

DON'T

OVERLOAD

APPLY FULL LOAD UNTIL ENGINE IS WARM

RUN WITH A BLACK EXHAUST

OPERATE ENGINE WITH A LEAKING FUEL SYSTEM

USE THE WRONG FUEL AND LUBRICATING OILS

EXPERIMENT
**Maintenance Time Table.**

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DAILY:</strong></td>
<td>Inspect oil level and top up as necessary.</td>
</tr>
<tr>
<td><strong>AFTER FIRST 100 HOURS RUNNING:</strong></td>
<td>Drain oil sump and fill with fresh oil.</td>
</tr>
<tr>
<td></td>
<td>Tighten up all nuts and ensure that there are no oil leakages.</td>
</tr>
<tr>
<td></td>
<td>Check and tighten all fuel pipe connections.</td>
</tr>
<tr>
<td></td>
<td>Remove and clean oil intake filter.</td>
</tr>
<tr>
<td><strong>AFTER EVERY 200 HOURS RUNNING:</strong></td>
<td>Check and tighten all fuel pipe connections.</td>
</tr>
<tr>
<td></td>
<td>Empty oil sump and refill with fresh oil.</td>
</tr>
<tr>
<td></td>
<td>Oil governor and throttle joints, etc.</td>
</tr>
<tr>
<td></td>
<td>Examine valve tappet settings and adjust as necessary.</td>
</tr>
<tr>
<td></td>
<td>Bleed air from fuel pipes at fuel filter.</td>
</tr>
<tr>
<td></td>
<td>Inspect and tighten as necessary all nuts, bolts, etc.</td>
</tr>
<tr>
<td></td>
<td>Remove fuel oil filter element and clean.</td>
</tr>
<tr>
<td><strong>AFTER EVERY 500 HOURS RUNNING:</strong></td>
<td>Dismantle lubricating oil filters and clean.</td>
</tr>
<tr>
<td></td>
<td>Inspect fuel injector nozzles and clean as necessary.</td>
</tr>
<tr>
<td></td>
<td>Clean induction air cleaners. (This period varies according to atmospheric conditions.)</td>
</tr>
<tr>
<td><strong>AFTER EVERY 1,000 HOURS RUNNING:</strong></td>
<td>Decarbonize pistons and cylinder heads and grind in valves.</td>
</tr>
<tr>
<td></td>
<td>Clean exhaust pipes and silencers.</td>
</tr>
<tr>
<td></td>
<td>Careful running-in for the first 100 hours of the engine's life will repay you handsomely.</td>
</tr>
</tbody>
</table>

---

**The Twin Cylinder ENFIELD Air-Cooled Diesel Engine**

**FOREWORD.**

The object of this Book is to enable engineers in charge of Enfield Air-Cooled Diesel Engines to operate them with the excellent results that are so characteristic of Enfield products.

In it we have endeavoured to describe, both in the text and by means of illustrations, the salient features of the design, together with the recommended methods of maintenance and the location of faults.

Each unit is treated separately and the information is conveniently grouped together so as to be available at a moment’s notice.

Though large users may have their own methods of maintenance, we commend the detailed notes to them as well as those in charge of individual engines, as a careful study of the pages which follow will prove informative and instructive.

**INSTALLATION.**

If the engine is to drive equipment by means of belts, both should be levelled up on a suitable foundation, and the accuracy of alignment established.

Do not run with belts which are too tight or out of line, as this throws undue strain on shafts and bearings, and can lead to trouble.

In the case of a direct coupled set, the driven unit must be lined up with the engine, and a flexible coupling should be incorporated between the two.

**BEFORE STARTING ENGINE.**

Every Enfield Engine is thoroughly tested and rigorously inspected before leaving the Works so that it is in a suitable condition to be put into operation immediately.

Before starting the Engine the following points should be given attention:

1. Ensure that sump is filled with one of the recommended grades of oil and that the level is up to the “Maximum” mark on the dipstick.

   The sump is filled by removing top inspection cover, Fig. 1 (6), or, on later engines, by means of the oil filler on the cylinder head cover, Fig. 1 (9).
Important Note.

If, on inspection of the dipstick the level of oil appears to be higher than at the previous oil level check, it is an indication that fuel oil may be leaking from one of the internal fuel pipes or unions. This defect must be rectified immediately and the sump drained and re-filled with clean oil.

2. See that the fuel tank contains one of the recommended grades of fuel oil and that there is no air in the fuel system.

Important Note.

It is important that fuel tanks used should not be of galvanized iron as this material is unsuitable for containing fuel oil.

3. Check that air intake cleaners are filled up to the correct level with the same type of lubricating oil as that used in the sump of the Engine.

GENERAL DESCRIPTION.

The Enfield Air-Cooled Diesel Engine has been developed into an extremely reliable and efficient power unit capable of operating for long periods with the minimum amount of maintenance and under extremes of temperature.

Due to its unique construction, all working parts are fully enclosed and protected against the ingress of injurious matter which can adversely affect the life of an engine.

Accessibility has, however, not suffered by reason of this as it is possible to carry out all routine adjustments by removing easily detachable covers which give access to valve gear, fuel injectors, etc.

Crankshaft Assembly.

The Crankshaft is of special heat-treated alloy steel and the journals and crankpins are ground to very fine limits.

The Connecting Rods are made from nickel steel stampings of exceptionally rigid design and embody central oil ducts which provide lubrication to the little end bushes.

Copper lead shell type bearings are employed for the main and big-end bearings and these ensure long life and low maintenance costs.

We advise that the crankshaft assembly should not be dismantled when stripping the engine after a long period of running. Worn crankshafts should be returned to us for re-conditioning.

Piston Assemblies.

The Pistons are of low expansion aluminium alloy, each with three compression rings and two oil control rings.

Gudgeon Pins are of the fully floating type retained by means of circlips.

Cylinders and Cylinder Heads.

The Cylinder Heads are of unique construction, the valve seats and combustion chamber and ports being a single piece special iron casting which in turn is cast into an aluminium alloy body heavily finned.

This method provides excellent heat distribution and cooling and results in an extremely robust component.

The combustion chamber is of the "swirl chamber" type with the injector nozzle protruding through at the top opposite to the tangentially formed exit passage to the Cylinder.

Double valve springs are used and the valves are in "Silchrome" material operated by overhead valve rockers and push rods.

The detachable type Cylinders are in special cast-iron of high wear resisting quality on to which are cast deep aluminium fins to ensure adequate heat dissipation.

Crankcase.

The Crankcase is in aluminium alloy, heavily ribbed for strength and of which the air cowls around the Cylinders form a part.
ENFIELD AIR-COOLED DIESEL ENGINE

Governor.

A centrifugal constant speed Governor is housed at the front of the Engine and the speed can be varied within certain limits by means of the adjustment provided.

Lubricating System.

The gear type oil pump is within the crankcase unit and is chain driven at engine speed from the crankshaft.

Oil is drawn through a filter in the large capacity sump and displaced at the rate of 100 gallons an hour via an external full flow filter to the main and big-end bearings, little end bearings, valve operating gear, etc.

Cooling.

Air cooling is used and achieved by the aid of a carefully designed fan on the flywheel and capable of displacing 950 cubic feet of free air a minute.

Around the fan and flywheel is a cast aluminium fan-casing in which are formed ducts which direct air over the cylinder, cylinder heads and under oil sump.

ENGINE DATA.

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bore</td>
<td>85 m.m.</td>
</tr>
<tr>
<td>Stroke</td>
<td>100 m.m.</td>
</tr>
<tr>
<td>Capacity</td>
<td>1135 c.c.</td>
</tr>
<tr>
<td>B.H.P. (Maximum)</td>
<td>15.0 @ 1800 r.p.m.</td>
</tr>
<tr>
<td>B.H.P. (Rated)</td>
<td>13.25 @ 1800 r.p.m.</td>
</tr>
<tr>
<td>Compression Ratio</td>
<td>19.5 : 1</td>
</tr>
<tr>
<td>Fuel Consumption (Average)</td>
<td>0.39 Pts. per b.h.p./hr. @ 1500 r.p.m.</td>
</tr>
</tbody>
</table>

FUEL AND LUBRICATION OILS.

Fuel Oil.

Fuel Oil for Enfield Diesels is of the type known as "Fuel Oil for High Speed Diesel Engines" and should be to B.S.S. Number 209. It is a "light" grade of oil.

NOT FOR RESALE-FREE DOWNLOAD FROM WWW.OLDENGINE.ORG/MEMBERS/EVANS/MANUALS

ENFIELD AIR-COOLED DIESEL ENGINE

It should conform to the following specification:

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity at 60°F.</td>
<td>Between 0.840 and 0.875.</td>
</tr>
<tr>
<td>Closed Flash Point</td>
<td>Not below 150°F.</td>
</tr>
<tr>
<td>Viscosity, Redwood I at 100°F.</td>
<td>45 seconds maximum.</td>
</tr>
<tr>
<td>Calorific Value</td>
<td>19000 BTU/lb. minimum.</td>
</tr>
<tr>
<td>Distillation Test</td>
<td>Not less than 85% at 350°C.</td>
</tr>
<tr>
<td>Initial Boiling Point</td>
<td>Not exceeding 180°C.</td>
</tr>
<tr>
<td>Cold Test</td>
<td>For general use in temperate zones fuel having a cold test not higher than 20°F. will be found satisfactory. For exceptionnal climatic conditions overseas the fuel should not deposit wax or other substances likely to clog the filter when kept at a temperature 50°F. below the lowest temperature encountered in service.</td>
</tr>
</tbody>
</table>
| Sulphur                   | Not more than 1.5%.
| Ash                       | Not more than 0.01%. |
| Asphalt                   | Not more than 0.1%.  |
| Water and Dirt            | The fuel should be free from these. |
| Corrosion                 | The fuel should be free from any substances likely to cause corrosion of the metal parts with which it comes in contact. |
| Conradson Carbon          | 0.2% maximum.       |
| Aniline Point             | 60°C. minimum.      |
| Pool Diesel Oil           | Distillate.         |
| Composition               | 150°F. minimum.     |
| Flash Point, Closed       | 35 seconds.         |
| Viscosity Redwood No. 1 at 100°F. | 20°F. maximum. |
| Pour Point                | 19600 BTU/lb.       |
| Gross Calorific Value     | .84 to .875. |
| Specific Gravity at 60°F. |                     |

USE THE CORRECT FUEL OIL ONLY

FUEL OIL MUST BE CLEAN
## Lubricating Oil

The following are the recommended lubricating oils for use in Enfield Air-Cooled Diesel Engines.

### Detergent Oils

<table>
<thead>
<tr>
<th>Make</th>
<th>Type</th>
<th>Grade</th>
<th>Winter</th>
<th>Tropical</th>
<th>T'perate</th>
<th>Arctic</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. C. Wakefield &amp; Co.</td>
<td>Delaware</td>
<td>CR.20</td>
<td></td>
<td>CR.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eso Petroleum Co.</td>
<td>Esosine</td>
<td>CR.20</td>
<td>HD.20</td>
<td>HD.50</td>
<td>HD.30</td>
<td>HD.20</td>
</tr>
<tr>
<td>Price's Lubricants</td>
<td>Energo</td>
<td>CR.20</td>
<td>HD.20</td>
<td>HD.50</td>
<td>HD.30</td>
<td>HD.20</td>
</tr>
<tr>
<td>Shell Group</td>
<td>Rotella</td>
<td>CR.20</td>
<td>HD.20</td>
<td>HD.50</td>
<td>HD.30</td>
<td>HD.20</td>
</tr>
<tr>
<td>Vacuum Oil Co.</td>
<td>Mobilim</td>
<td>CR.20</td>
<td>HD.20</td>
<td>HD.50</td>
<td>HD.30</td>
<td>HD.20</td>
</tr>
</tbody>
</table>

### Non-Detergent Oils

<table>
<thead>
<tr>
<th>Make</th>
<th>Type</th>
<th>Grade</th>
<th>Winter</th>
<th>Tropical</th>
<th>T'perate</th>
<th>Arctic</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. C. Wakefield &amp; Co.</td>
<td>Castrol</td>
<td>XL.30</td>
<td></td>
<td>XL.30</td>
<td>Castrol</td>
<td></td>
</tr>
<tr>
<td>Eso Petroleum Co.</td>
<td>Esolube</td>
<td>XL.30</td>
<td></td>
<td>XL.30</td>
<td>Castrol</td>
<td></td>
</tr>
<tr>
<td>Price's Lubricants</td>
<td>Energo</td>
<td>XL.30</td>
<td></td>
<td>XL.30</td>
<td>Castrol</td>
<td></td>
</tr>
<tr>
<td>Shell Group</td>
<td>Talpa</td>
<td>XL.30</td>
<td></td>
<td>XL.30</td>
<td>Castrol</td>
<td></td>
</tr>
<tr>
<td>Vacuum Oil Co.</td>
<td>Mobilim</td>
<td>XL.30</td>
<td></td>
<td>XL.30</td>
<td>Castrol</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** A Climate is considered to be TROPICAL if temperatures regularly exceed 90°F (32°C), and ARCTIC if temperatures are regularly below 32°F (0°C).

**Important:** The use of detergent oils is strongly recommended, since they eliminate sludge, stuck piston rings and other kindred troubles. When changing from a non-detergent to a detergent oil, however, the following precautions must be taken to prevent choking of the oil filters by sludge previously formed, which will be removed from the Crankcase by the detergent oil.

---

## CONTROLS AND OPERATION

### Engine Speed

The Enfield Air-Cooled Diesel Engine is basically governor-controlled, and the operating speed is fixed according to requirements before it leaves our Factory.

### Starting

Before attempting to start the Engine, check that:

1. Fuel tank is full.
2. Engine oil level is correct.
3. Fuel is turned on. It is usually advisable not to turn off the fuel. Leaks in the pipe may cause air locks.
4. Ensure that oil bath air cleaners, Fig. 2 (6), are filled up to the correct level with the same type of lubricating oil as that used in the sump of the Engine.
5. Set Control Cam, Fig. 2 (10), in the "Starting" position, i.e., one half turn in an anti-clockwise direction.
6. Lift and turn decompressor winged Knob, Fig. 2 (11), in clock-wise direction until it clicks into raised position. The Knob need not necessarily be lifted but merely held in decompressed position with the thumb of the left hand.
7. Engage starting handle and if, on turning, the Engine is still found to be on the compression stroke, pull momentarily against compression and then release the starting handle which should cause the crankshaft to rotate slightly in the reverse direction and enable the decompressor to engage.
8. When decompressor has engaged turn the Engine over as rapidly as possible by means of the starting handle and when adequate
R.-H. Front View of Engine.

1. Lubricating Oil Pipes.
2. Governor Adjuster Screw and Lock Nut.
3. Exhaust Pipe Stubs.
4. Air Outlet Grilles.
5. Breather Cover.
6. Top Inspection Cover.
7. Fan Casing
8. Top Cover.
9. Cylinder Head Covers.
10. Oil Level Dipstick.
11. Element—Oil Temperature Gauge.

L.-H. Front View of Engine.

1. Oil Pressure Gauge Union and Pipe.
2. Oil Pump Inspection Cover.
3. Oil Sump.
5. Fuel Pump Operating Rod.
6. Intake Air Cleaner.
7. Fuel Filter.
10. Control Knob—Stop and Start.
11. Decompressor Knob.
14. Oil Pressure Gauge.
15. Oil Temperature Gauge.
16. Delivery Oil Filter.

IT WAS RIGHT WHEN IT LEFT THE FACTORY

CARE AND ATTENTION WILL KEEP IT SO
flywheel speed has been obtained, and while still turning the starting handle, release the decompressor by pressing Knob downwards.

**Note.** It is desirable that a minimum speed of 120 r.p.m. of the starting handle is obtained in order to ensure a certain start.

**COLD STARTING.**
When surrounding temperatures are low, it is desirable to make use of the cold start injectors, or, when fitted, the heater plugs.

**Cold Start Injectors.**
To use these, the following procedure should be adopted:—
1. Unscrew each needle valve, Fig. 3(2), two complete turns in an anti-clockwise direction, and rotate the engine a few revolutions.

![Fig. 3. Cold Start Injector.](image)

| 1. Injector Body | 2. Needle Valve | 3. Non-Return Valve |

---

(2) Fill priming pump with a mixture of 75% fuel oil and 25% lubricating oil.
(3) Place nozzle of priming pump on to each non-return valve, Fig. 3(3), and inject one complete pump full of this mixture into each cylinder.
(4) Screw home each cold start injector needle valve after injecting priming mixture. The method of starting the engine is then the same as that given in the preceding paragraphs.

**Heater Plugs.**
These are 2-volt, and on no account may a higher voltage be passed through them.
They should be brought into circuit for 20 seconds before and during starting, and should be switched off immediately the engine commences to run.

**Ether.**
This can be used to facilitate starting when cold conditions prevail, but it must be employed with extreme care.
To use, make up a mixture consisting of lubricating oil and ether combined in the ratio of 10%, ether and 90% lubricating oil.

Not more than a teaspoonful (2 c.c.) of this mixture should be placed in each air cleaner after removing covers, Fig. 22 (1), which should be refitted immediately afterwards.

Then start the engine in the normal manner.
Inspect the oil level in the filter bodies after a few applications, and drain off any surplus oil.
After starting up, allow the Engine to warm up for a few minutes. **Do not abuse the ability to apply full load with a cold Engine, but allow the oil to circulate.** More damage can be done by loading a cold engine than would result from a normal day's running.

It is important that the temperature of the lubricating oil should be kept as near as possible within the "green" operating range shown on the dial.
The oil pressure gauge reading when the Engine is cold should be approximately 60 lbs. and after the Engine has been run for about a quarter of an hour it should fall to approximately 35 lbs.
If the oil pressure, when cold, exceeds 80 lbs./sq. in. this shows that the release valve has stuck and should be removed for cleaning.

---

17
Stopping.

(1) Take load off engine.
(2) Move Control Lever, Fig. 2 (10), to the “STOP” position, i.e., a quarter turn in anti-clockwise direction.

Note. DO NOT TURN OFF THE FUEL.

FAULTY STARTING.

In the event of the engine being difficult to start, first of all, check up that there is an adequate supply of fuel in the fuel tank and that there are no air locks.

Then make sure, by means of the vent cock, Fig. 2 (12), that fuel is being delivered to the fuel pumps. Loosen fuel delivery pipe nuts, Fig. 9 (10), on fuel injector and turn the engine by hand to check that fuel is reaching the nozzles. The sound emitted from a nozzle which is working correctly is characteristic and can be heard quite easily.

Check that the compression is good when turning the engine over by hand.

Failure to start after an engine has been overhauled may be caused by incorrect fuel pump timing (see diagram) or badly balanced fuel pump deliveries. See that they are correct.

Faulty starting sometimes occurs because one or other of the valves has stuck in its guide, due to the formation of “lacquer” on the valve stem. If on the compression stroke a hissing sound is heard in the ports, the head should be removed and the valves cleaned.

ERRATIC RUNNING.

There are two main causes of misfiring in a compression ignition engine.

(1) The fuel is not reaching the combustion chamber.
   (a) Pump not delivering.
   (b) Fuel escaping before it reaches the nozzle.
   (c) Defective nozzle.
(2) The compression is insufficient to cause air in the cylinder to reach a temperature high enough to ignite the charge.

Bad pulling powers can also be caused by an air lock in the fuel pipes or by a partly choked filter. Vent the fuel system and change the filter element but on no account run without one.

Poor compression can be caused by a scored cylinder, cracked piston, piston rings gummed or badly seating valves.

Turn the engine by hand to test compression and listen at the crankcase breather and valve ports for “blow-by.”

If the compression is good it is highly probable that a fuel injector nozzle is at fault. The absence of the distinct injection note would indicate this.

To deal with this see Chapter on “Engine Auxiliaries,” page 43. A fault in the fuel pump, i.e., delivery valve stuck or delivery valve spring broken, can also cause trouble similar to that displayed by a faulty fuel injector.

Notes on stripping and examination of this component are contained on page 43, under “Engine Auxiliaries.”

SMOKE IN EXHAUST.

If, when the engine is hot, black smoke is visible in the exhaust gas, this is probably due to a faulty spray from one of the injector nozzles.

Black smoke also indicates overloading although it can be caused by bad compression or a partially choked air filter.

A clean exhaust is essential, and an engine displaying a black exhaust should not be allowed to remain in service as trouble with valves, cylinder heads, pistons and piston rings will undoubtedly result.

When the engine is running on a very light load, or before it is properly warmed up, there may be a tendency for a pale blue haze to appear in the exhaust gas which is characterised by a pungent odour. This should disappear when more load is applied.

LUBRICATION SYSTEM.

The oil sump has a capacity of 12 pints, as shown by the “FULL” mark on the dipstick, Fig. 1 (10). A detachable filter is fitted in the base of the sump through which oil is drawn by the gear type oil pump.
Removal of Oil Pump.

To remove the oil pump unscrew nuts securing governor cover to timing cover and take off cover and governor spring. Unscrew nuts and set screws fixing timing cover, Fig. 2 (13), to crankcase.

**Fig. 4.**

Oil Pump Assembly.

1. Oil Pump Body.
2. Oil Pump Driving Gear and Spindle.
3. Oil Pump Driving Sprocket.
4. Oil Pump Gear Driven.
5. Spindle Oil Pump Gear Driven.

The pump discharges the oil at the rate of 100 gallons an hour by way of a pressure relief valve to an external oil filter where it passes to the main feed oilways.

By this means oil is fed to the main and big-end bearings, little-end bearings, governor mechanism, camshaft and valve gear.

**OIL PUMP.**

The gear type oil pump contains one set of gears and is driven by means of a chain from the Crankshaft.

Details of the oil pump unit are given in Fig. 4.

**Fig. 5.**

Oil Sump and Intake Oil Filter.

1. Drain Plug.
2. Intake Oil Filter and Drain Plug.
3. Drain Plug.
4. Oil Pipe.
5. Drain Plug.
6. Oil Sump.
7. Nuts Fixing Top Cover
8. Top Cover—Oil Filter.
10. Filter Element.
11. Drain Plug with Outer Gauze.
and disconnect fuel pump operating rod, Fig. 2 (5), from the operating lever, which is inter-connected with the governor.

Disconnect oil pipes, Fig. 1 (1), from base of sump and filter and remove lubricating oil filter, Fig. 2 (16). Take off pipes to oil pressure and temperature gauges.

Remove set screw from governor fork and withdraw timing cover with starting handle assembly, etc., when the oil pump will be revealed immediately below the Crankshaft (see Fig. 10).

After removing split pin, nut and washer withdraw oil pump sprocket, Fig. 10 (2), leaving the driving chain in position.

Unscrew the four nuts holding the oil pump body to the front face of the crankcase and extract the oil pump unit.

Reverse the procedure to reassemble the units taking care that the governor fork is located correctly in the sliding sleeve.

**Adjustment of Oil Pump Driving Chain.**

The stud holes in the oil pump body are elongated to provide adjustment for the pump driving chain.

Above the oil pump body, on a boss cast in with the crankcase, will be found an adjusting set screw and locknut, Fig. 10 (4).

To adjust the driving chain slacken off the four nuts holding the pump body to the front face of the oil sump, unlock the adjusting set screw and screw downwards until the correct degree of tension is obtained on the driving chain.

Tighten up nuts holding the oil pump body in position and lock up adjusting set screw.

---

**OIL FILTERS.**

Two oil filters are fitted, one on the intake side of the pump to prevent injurious matter reaching the oil pump, and one on the delivery side. The former is part of the oil sump drain plug and the latter is mounted externally on the timing cover beneath the governor.

The filtering element in each should be removed and carefully washed every 500 hours.

**Removal of Filter Elements.**

The INTAKE oil filter forms part of a drain plug, Fig. 5 (2 and 11), in the oil sump and is easily extracted by unscrewing this plug and withdrawing it from the sump.

---

Fig. 6
Delivery Oil Filter.
ENFIELD AIR-COOLED DIESEL ENGINE

In the event of the oil pressure dropping below 35 lbs. p.s.i., with a warm engine, this can be an indication that:

(1) The oil pressure gauge is faulty.
(2) The oil release valve is being held off its seating by foreign matter either in the housing or on the seating.

Removal of Oil Release Valve.

First remove the brass cap nut, Fig. 7 (7), which will expose the valve body (1), end cap (5), adjusting screw (4) and locknut (6). Do not disturb the locknut otherwise the spring setting will be affected.

Unscrew the valve body from the oil sump by means of the large spanner flats provided. To remove the piston valve, unscrew the end plug by means of the smaller spanner flats provided, when the spring and valve may be withdrawn for inspection. Clean the valve and its housing and reassemble.

A damaged seating should be lapped in with a small quantity of fine grinding-in paste by means of applying a semi-rotary action to a short length of wood inserted into the piston.

Remove all traces of grinding-in paste from the valve and its housing before reassembly.

If for any reason the spring setting has been disturbed it is best re-adjusted in the following manner:

(1) Re-fit valve assembly into the engine, leaving the cap nut off and the locking nut loose.
(2) Turn adjusting screw in an anti-clockwise direction until no further movement is obtained.
(3) Start engine from cold and turn adjusting screw in a clockwise direction until a maximum pressure of 60 lbs./sq. in. is reached on the oil pressure gauge.
(4) Tighten up locking nut and refit brass cap nut.
(5) When the engine has reached normal running temperature, check that the oil pressure is about 35 lbs./sq. in. and if not, adjust accordingly.

Note. If the valve is removed from a warm engine and refitted, there is no way of setting the valve to blow at 60 lbs./sq. in. other than waiting for the next time that the engine is started from cold when the necessary adjustment should be made.
VALVE TIMING AND ADJUSTMENT.

The Valve Timing, which is shown in Fig. 8, is as follows when valve clearance is .002 in.:

- Inlet opens ... 5° before T.D.C.
- Inlet closes ... 40° after B.D.C.
- Exhaust opens ... 40° before B.D.C.
- Exhaust closes ... 5° after T.D.C.

**Fig. 8.**

Valve Adjustment.

The correct clearances are .002 in. for inlet and exhaust valves which must be set when the engine is COLD.

Access is gained to the valve gear chamber by removing the cylinder head covers, Fig. 1 (9), these being secured to each cylinder head by four nuts.

Care should be taken to check that the valves are fully closed before any adjustments are made, and this can be done by rotating the starting handle until the valve to be adjusted has fully opened. Continue to turn the starting handle a further half turn, i.e., 180°, to ensure that the valve tappet is on the base of the cam.

By removal of the top inspection cover, Fig. 1 (6), a check can be made that the tappet of the valve being timed is on the base of the relative cam.

Slacken off the valve adjusting screw locknut, Fig. 9 (7), and after inserting a .002 in. feeler between the valve stem and the valve rocker pad, adjust screw to give the correct clearance.

After tightening the locknut, re-check that the clearance has not altered.

When refitting the cylinder head covers make sure that the joints are not damaged. If they are, replace them.

It is important that the decompressor is not engaged when carrying out these adjustments.

**CYLINDER BARRELS, CYLINDER HEADS, CAMSHAFT AND VALVE GEAR.**

Cylinder Heads.

Each cylinder head is a single casting with cast-iron valve seats and is secured to the crankcase by six special alloy steel studs. The head retains the cylinder barrel in the crankcase.

**Note.** The cylinder head nuts are in special high tensile steel, and to distinguish them from other 7/16 in. B.S.F. nuts they are made 1/2 in. thick.

Cylinder Head Gaskets.

The thickness of the solid copper Gasket is important. It is strongly advised that in the event of a replacement being required a genuine ENFIELD spare should be used.

Cylinder Barrels.

The cylinder barrels are a special type of casting and are a push fit in the crankcase where they are held in position by the cylinder head and studs.

DO NOT INTERFERE WITH THE TIMING

CHECK VALVE CLEARANCES PERIODICALLY
Valves.
The valves are of conventional design with double concentric springs, held in position by split conical cotters, Fig. 12 (5), which seat in collars (6).

Rocker Gear.
The Rockers, Fig. 9 (3), are bushed and carried on the rocker shafts (4), the ends of which are mounted in the aluminium rocker brackets (5).

These Rockers have a drilled oilway running from the valve adjuster to the rocker bush so that oil which passes along the hollow push rods provides lubrication for the rocker shaft and bushes. The adjusting screws (8) are secured to the ends of the rockers by locknuts (7).

Decompressor.
The decompressor takes the form of a cam, Fig. 11 (11), on the front end of the camshaft and is brought into operation by the decompressor winged knob, Fig. 2 (11), on the top left-hand side of the top cover.

Rotating and lifting the winged knob causes the decompressor cam to slide along the camshaft and insert itself under the exhaust valve tappet where it prevents the valve from fully closing.

Camshaft.
The camshaft, Fig. 11 (4), runs in two phosphor bronze bearings which in turn are pressed into a detachable valve tappet block, Fig. 11 (9).

Each bush is retained in position by a set screw, the end of which is formed to register with a drilled hole in the bush. Both bushes are supplied by oil through the medium of oil galleries on the under side of the valve tappet block where they are, in turn, connected with the main oil feed line.

The profiles of the cams receive oil from drilled holes in the valve tappets, Fig. 11 (10), which are fed from the oil galleries cast in the base of the valve tappet block.

The camshaft is driven at half engine speed by a duplex chain, Fig. 10 (9), and thrust is taken by the flange on the camshaft front bush and a hardened and ground steel washer at the rear face of the camshaft chainwheel sleeve which is locked in position by the starting dog, Fig. 10 (10), screwed on to the end of the camshaft.
Removal of Camshaft.

The removal of the camshaft is accomplished by first of all taking off the top cover, Fig. 1 (8), to do which necessitates withdrawing the cylinder head covers, the three set screws securing the timing cover, Fig. 2 (13), to the top cover, Fig. 1 (8), and the fuel pipe from fuel filter to "T" piece.

Before lifting the cover, turn and lift decompressor knob, Fig. 2 (11), into the "decompressed" position.

The front timing cover should then be removed as described under the heading of "REMOVAL OF OIL PUMP."

Then remove starting dog on end of camshaft, Fig. 10 (10), and after removing driving chain, withdraw camshaft chainwheel, Fig. 10 (12).

The valve push rods should then be disconnected and the valve tappets pushed clear of the cams on the camshaft.

After removing the set screw securing the front camshaft bush in position, the camshaft together with the decompressor cam, chainwheel sleeve, etc., can be withdrawn.

Reverse the procedure to reassemble, taking care that the decompressor winged knob is still in the "decompressed" position.

VALVE TIMING GEAR.

The timing gear consists of a sprocket on the crankshaft and one on the camshaft, driven by means of a duplex chain, and is located at the front of the engine beneath the timing cover.

As the timing is fixed no adjustment is necessary in the normal way, but if, in the course of dismantling the engine the relative position of the chain sprockets, etc., is disturbed, care must be exercised in re-timing.

After removal of the starting dog, Fig. 10 (10), camshaft sprockets (12), and camshaft chainwheel sleeve, turn the engine by hand until the top dead centre mark on the rim of the flywheel coincides with the top dead centre mark across the aperture in the top of the fan casing.

Fit the camshaft chainwheel sprocket and sleeve so that the arrow on the back of the sprocket is in line with a similar arrow on the camshaft sleeve and insert driving peg Fig. 10 (13), into the appropriate tapped hole.

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Front View of Engine with Timing Cover Removed.

1. Oil Pump.
2. Oil Pump Driving Sprocket.
3. Oil Pump Driving Chain.
5. Circlip.
6. Collar—Governor Spring.
7. Governor Weight.
8. Chain Tensioner—Camshaft Driving Chain.
9. Camshaft Driving Chain.
10. Starting Dog.
11. Overload Stop.
13. Locating Screw.
15. Carrier—Governor Weights.

DO NOT RUN WITH A SLACK TIMING CHAIN

LUBRICATE CONTROL CONNECTIONS OCCASIONALLY
ENFIELD AIR-COOLED DIESEL ENGINE

Rotate the camshaft chainwheel, complete with camshaft and camshaft sleeve, until the marked tooth on the front of the sprocket coincides exactly with the timing mark on the crankcase. Fit chain and check timing.

Then refit starting dog and tighten up.

Check that the valves are correctly timed with the engine STONE COLD and that the valve tappets are set to .002 in. clearance by rotating the engine until the top dead centre mark on the flywheel is 3/4 in. before the top dead centre mark on the timing aperture.

In this position try and rotate the push rods operating the inlet valves when there should be just sufficient pressure to prevent the push rods from being turned.

Refit top cover, timing cover, etc., taking care to ensure that the decompressor winged knob is still in the decompressed position.

CAMSHAFT CHAIN] ADJUSTMENT.

The tension of the camshaft chain is maintained by a patented chain tensioner, Fig. 10 (8), fitted to the front of the crankcase between the camshaft and crankshaft sprockets.

It consists of a steel-faced rubber pad riveted to an aluminium alloy shoe.

This shoe pivots on a stud in the front face of the crankcase and also carries a rat-trap type of spring which tends to force the shoe towards the outer face of the crankcase.

In the back of the shoe will be found an adjusting screw locked with a nut, the head of the screw contacting the side wall of the crankcase.

By slackening the locknut the set screw can be turned so that the correct degree of tension can be obtained on the camshaft driving chain.

After this has been achieved the locknut should be tightened up.

REPLACEMENT OF CAMSHAFT SPROCKET AND/OR CAMSHAFT.

The following notes are given to act as a guide in the event of a new camshaft sprocket or camshaft having to be fitted.

Fig. 11.

View of Valve Tappet Block.

3. Fuel Pump Tappet Roller.  10. Valve Tappet
7. Locating Screws—Tappet Bushes.

Remove front cover after first disconnecting oil pipes and governor linkage.

Remove cylinder head covers and top cover.

Check that the clearance between the valve rocker end and the top of the valves is correctly set to .002 in. for all four valves, when the tappets are on the base of the cams.

Remove starting dog and camshaft chain.

Withdraw camshaft sprocket together with its locating peg from the camshaft sleeve.

Set the T.D.C. mark on the flywheel to coincide with the mark on the sighting hole in the fan casing.
Mark lines \( \frac{1}{2} \) in. before and \( \frac{1}{2} \) in. after the T.D.C. line on the flywheel. Rotate flywheel until the \( \frac{1}{2} \) in. line before T.D.C. on the flywheel coincides with the line on the fan casing.

Rotate camshaft by means of the decompressor cam until one of the inlet valves (towards the back of the engine) is just beginning to lift.

Keeping the camshaft in the last position mentioned, slide the new sprocket on to the camshaft sleeve. The camshaft chain is then placed evenly round the engine sprocket and the sprocket gently rotated until one of the holes in the sprocket coincides exactly with one of the holes in the chainwheel sleeve, with the right hand leg of the chain pulled reasonably tight to engage the camshaft sprocket teeth.

During this process care must be taken not to alter the position of the crankshaft and the camshaft.

By making use of the vernier adjustment provided by the eight holes in the sleeve and the seven holes in the sprocket it is possible to make timing adjustments of one-third of a degree (crankshaft).

Temporarily place the shouldered locating peg into the coinciding holes of the vernier arrangement and connect up the chain by means of the split link. Check the timing of the exhaust valve by rotating the crankshaft in a clockwise direction until the \( \frac{1}{2} \) in. mark after the T.D.C. mark on the flywheel coincides with the mark on the casing.

The exhaust valve should just be closing.

The opening and closing points of the inlet and exhaust valves respectively, should be equally disposed about the T.D.C. mark on the flywheel, and any difference should be equalised by making use of the vernier adjustment.

If the timing is correct, lightly punch or lance marks to identify the coinciding location peg holes in the sprocket and sleeve.

Remove chain and camshaft sprocket and tap the previously marked hole \( \frac{1}{2} \) in. B.S.F. so that when the sprocket is reassembled the shouldered locating peg can be screwed home flush with the face of the sprocket to engage the previously marked hole in the camshaft sleeve.

Refit chain and starting dog.

Set the engine at T.D.C. and stamp an arrow on the camshaft sprocket to be in line with the arrow marked on the crankcase immediately below it.

Check timing again before boxing up.

Decarbonising and valve grinding should only be necessary at intervals of approximately 1,000 hours, provided that the valve clearances have always been maintained correctly and that the recommended grades of oil have been used.

**Removal of Cylinder Heads.**

The removal of the cylinder heads is a comparatively simple matter.

First of all disconnect the exhaust pipes and remove the air exit grilles, Fig. 1 (4).

Then remove the nuts holding the cylinder head covers, Fig. 1 (9), in position and withdraw these.

Unscrew the four set screws (two on each side) which pass from the top cover into the cylinder head casting and Slacken off all nuts on the top cover, and fan casing studs, so that withdrawal of the cylinder heads is facilitated.

Disconnect the fuel pipes, Fig. 9 (10), from the injectors to the fuel pumps and also the fuel leak-off pipes, Fig. 9 (11), from the injectors to the nipples screwed into the cylinder heads.

The valve adjusters should then be slackened off and the valves depressed to enable the push rods, Fig. 9 (6), to be withdrawn.

Unscrew the nuts fixing the rocker brackets to the cylinder heads and extract the rocker brackets complete with shafts and rockers.

Unscrew the nuts holding the fuel injectors, Fig. 9 (12), in position and withdraw the injectors. If the copper sleeves, which protect the nozzles, come out with the nozzles they should be gently prised off.
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The six nuts holding each cylinder head to the cylinder barrel can then be removed and the cylinder heads, with valves, taken off, care being taken not to damage the joint between fan casing and cylinder head.

Should the seal between the cylinder head and barrel prevent easy removal of the head, gently tap the head with a raw hide hammer, at the same time avoiding marking the joint faces.

IN NO CIRCUMSTANCES MUST WEDGES BE USED.

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![Image](28x59 to 567x783)

Fig. 12. Inlet and Exhaust Valve Assembly.


Removal of Valves.

Place the head face downwards on the bench with a suitable block under the valve heads so that the valve springs can be depressed and the split cotters and collars extracted.

Removal of Valve Guides.

If the valve guides are worn and have to be replaced at any time, they can be driven out from the inside of the head by means of a copper drift.

GRIND IN VALVES EVERY 1,000 HOURS

When fitting new guides make sure that they are driven fully home to ensure that they will hold the valves square with the valve seats. The valve seatings should be recut after fitting new guides.

To prevent damage to the cone face of the valve guide a tool of the type illustrated should be used. This tool can be purchased from us if desired.

Valve Grinding.

If the valves are not seating satisfactorily they should be ground into their respective seats, using a fine grade carborundum grinding paste.

All traces of the grinding compound must be removed before reassembling.

If the valves require re-facing this should be done in a valve-facing machine, and the valves then lightly ground to the seats.

Valve Seats.

Valve seats, when worn or pocketed, should be recut with special cutters which can be purchased on application.

Decarbonising.

Carbon which has been formed on the piston top, cylinder head and valves, should be removed with a soft scraper (preferably aluminium strip) and extreme care exercised so that the piston crown is not scratched.

Any carbon which is in evidence in the ports should also be removed.

Replacement of Cylinder Heads.

Before replacing the cylinder head it is advisable to anneal the solid copper joint used between the head and the cylinder barrel.

This can be done by heating the joint to a red heat and quenching in water, but if the joint is in any way damaged, a new one of the same thickness must be used.

USE THE CORRECT THICKNESS GASKETS
After reassembling the valves, the cylinder head can be refitted taking care that the holding down nuts are pulled down evenly and firmly, and that the valve rockers rotate freely on the rocker shaft.

Do not forget to adjust the valve clearances or to bleed the fuel system before starting up the engine.

**Note. Do not over-tighten cylinder head stud nuts, a 6 in. tee spanner should be ample for the job.**

**Cylinder Barrels.**

The cylinder barrels used are of special design employing a high quality cast-iron liner on to which the aluminium fins are cast.

---

**Fig. 13.**

Method of Removing Cylinder Barrel.

1. Cylinder Barrel.
2. Wood Block.
3. Extractor Screws.
4. Bridge Piece.

---

**CONNECTING RODS AND PISTONS.**

The connecting rods, Fig. 14 (13), are alloy steel stampings of exceptionally rigid design, employing a big-end bearing of the shell type with a copper lead-bearing material, Fig. 14 (9).

The small ends are phosphor bronze bushed and the gudgeon pins are locked in the piston by circlips.

Each piston (8) is fitted with three \( \frac{3}{8} \) in. wide high pressure compression rings (4) and two \( \frac{3}{16} \) in. wide high pressure stepped scraper rings (7), one being above the gudgeon pin and the other below.
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PISTONS.

The pistons are low expansion aluminium alloy castings and are round with relief in the gudgeon pin boss areas only.

On top-dead-centre the piston normally is flush with the top of the cylinder barrel and must not **project** beyond this or valves may be damaged.

PISTON RINGS.

Ring gap clearance should be .008 in. to .012 in. when new and if, during overhaul, this is found to be in excess of .025 in. the rings should be replaced.

Clearance in the grooves is normally .002 in. to .004 in., and when this is in excess of .010 in. for the top ring and .008 in. for the remaining rings, replacements should be fitted.

Always fit a chrome plated ring in the top groove.

GUDGEON PINS.

The gudgeon pins, Fig. 14 (3), are an interference fit in the bosses of the piston when cold and an easy push fit in the small-end bush.

They are retained by circlips which can be removed with special pliers manufactured for this purpose.

A gudgeon pin should not be forced into or out of a piston when cold. When removing or replacing a gudgeon pin, first dip the piston into boiling water and tap out or push in the pin while the piston is still hot. Take care to remove all traces of moisture immediately afterwards.

Piston bosses must on no account be reamed out.

An extractor bolt with nut and distance tube must be employed to withdraw the gudgeon pin for piston removal and replacement, having first removed the circlip nearest the front of the engine.

CRANKSHAFT AND MAIN BEARINGS.

The crankshaft, Fig. 14 (5), is of special alloy steel and is supported in two large diameter copper lead plain bearings.

Oilways are drilled in the journals and crankpins to provide oil under pressure at these points.

GUMMED RINGS USUALLY DENOTE WRONG OIL OR OVERLOADING
Main Bearings.

The main bearings are of the shell type lined with a copper lead material, Fig. 14 (2 and 6).

Circumferential grooves are cut in the bores and outside diameters, the latter mating up with the main feed holes in the crankcase.

Oil passes to the inner groove in the bearings by means of drilled holes and thence along oilways in the crankshaft to the big-end bearings.

Fitting Main Bearings.

The crankshaft is located endwise by the flanges on the front and rear bearings, and the end play should not be less than .008 in.

The clearance between the crankshaft journals and the main bearings is .002 in. to .003 in. when new, and the journals should be re-ground when .003 in. oval or taper.

Each re-grind should be .005 in. and four re-grinds are allowable. Undersize bearings in steps of .005 in. are available to suit the re-ground journals.

When fitting new main bearings it is preferable to heat the crankcase to approximately 100°C, before inserting the bushes. The heat applied must be general and can best be achieved by dipping the case into boiling water.

Note. In service, copper lead bearings acquire a bluish tinge. This is not an indication that overheating has occurred as in fact the changed colour is a protective oxidation which should not be removed.

Big-End Bearings.

The big-end bearings are shell type copper lead lined, in two halves, and are interchangeable and replaceable.

Play in the big-ends should not exceed .005 in., and when this wear figure is reached new bearings should be introduced.

Crankpins should be re-ground when more than .003 in. oval and new undersize bearings fitted.

It is not recommended that connecting rods and caps are filed as otherwise new connecting rod assemblies will be required when standard bearings are fitted.

Connecting rod bolts, Fig. 14 (12), must be pulled up dead tight, and on no account must they be slackened off to bring the split pins into line.

To bring the holes into line the nuts should be very carefully filed with a smooth file, taking care to keep the faces true.

Note. In service, copper lead bearings acquire a bluish tinge. This is not an indication that overheating has occurred as in fact the changed colour is a protective oxidation which should not be removed.

REMOVAL OF CRANKSHAFT.

The removal of the crankshaft is carried out in the following manner:

Disconnect governor connecting rod, Fig. 2 (5), and after removing fuel filter and connecting pipes, remove timing cover complete, as described on page 17.

Remove cylinder head covers and top cover. Disconnect fuel pipes and withdraw cylinder head assemblies and push rods.

Slacken off nuts securing valve tappet block to top of crankcase, remove starting dog from end of camshaft and remove chain sprocket and sleeve as an assembly.

Withdraw valve tappet block assembly with camshaft, tappets, bushes, fuel pumps and fuel pump operating mechanism.

Withdraw oil pump assembly and after unscrewing the nuts, withdraw oil sump complete with filter, etc.

Dismantle governor mechanism and after pressing back tab on crankshaft chain sprockets, remove nut and pinions.

Slacken off crankshaft nut (flywheel end) and extract flywheel and fan with an extractor of the type illustrated, Fig. 20. Then remove fan casing.

Through the orifices now revealed at the top and bottom of the crankcase, entrance can be gained to the connecting rod bolts and nuts. Rotate the crankshaft until the nuts are in the most accessible position and remove the split pins and nuts.

MAKE SURE NUTS ARE KEPT TIGHT ALWAYS
Take off connecting rod caps and bearings and push the connecting rods and piston assemblies upwards through the cylinder barrels.

The rear main bearing housing, complete with oil seal, should then be extracted by means of the extractor holes provided when the crankshaft can be withdrawn from the rear end of the crankcase.

To reassemble, reverse the above procedure, taking care that the piston rings are inserted into the cylinder barrel without breakage. To facilitate this a spring band can be used to close the rings sufficiently to enable them to close in the bore.

**Do not forget to bleed the system and refill with clean oil before starting the engine.**

**Note.** New split pins should always be fitted into the big-end bolts after they have been removed in the course of dismantling the engine.

---

**Fuel Injection System.**

The fuel injection equipment consists of fuel injection pumps, Fig. 11 (1), which will be found mounted one each side of the valve tappet block, and injector nozzles and holders, Fig. 9 (12), secured to the top face of each cylinder head.

In normal circumstances the equipment requires little maintenance apart from occasional cleaning of the injector nozzles. If misfiring occurs, a black exhaust, knocking, lack of power or overheating, this may be an indication that the injector nozzles require cleaning, or is due to an air lock in the fuel system.

To carry out this work, after ascertaining which cylinder head is faulty by removing the exhaust pipes and inspecting the exhaust gases, proceed as follows:—

Remove the appropriate cylinder head cover and disconnect the fuel pipe, Fig. 9 (12), from fuel pump to nozzle holder and remove the leak-off pipe, Fig. 9 (11).

Unscrew nuts securing the nozzle holder to the cylinder head. Remove the faulty injector and with a small piece of wood, soft brass or copper, clean carbon formation away from the hole in the nozzle.

---

**Fuel Pumps.**

The possibility of fuel pumps giving trouble is remote but should it be determined by test that a fault lies in a pump a new one must be fitted, unless the doubtful part is the delivery valve, Fig. 15 (3), and/or spring, Fig. 15 (14).

To fit a replacement pump the following procedure must be adopted:—

Take off top inspection cover, Fig. 1 (6), unscrew nuts securing suspected pump to valve tappet block.

Disconnect fuel pipe, remove pump and fit new one.
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After bleeding fuel system reconnect piping and retighten. For details of retiming, see page 48.
Refit top cover.
A faulty delivery valve or spring is usually indicated by misfiring on one cylinder due to its being starved of fuel. Additionally, difficulty may be experienced in starting the engine.
To fit a replacement valve or spring, proceed as follows:—
After removing top inspection cover disconnect fuel pipe to injector nozzle and unscrew delivery valve holder, Fig. 15 (13), and extract valve and spring.
Fit new valve and/or spring, after carefully washing in clean fuel oil.
Reverse procedure for reassembly.

INJECTOR NOZZLE HOLDERS.

No attempt should be made to fit replacement parts to nozzle holders as these are set before the engine leaves the factory and any alterations to the setting may result in difficult starting or in general running.
Should a defect occur in a nozzle holder the following procedure for fitting a replacement should be adopted:—
Remove cylinder head cover and disconnect fuel pipe and leak-off pipe.
Assemble original nozzle valve to new nozzle holder, reconnect piping and bleed fuel system.
With the nozzle pointing in an upward direction turn the engine over slowly by hand and ensure that a fine spray is emitted from the nozzle and that there are no signs of “dribble.”
Slacken off fuel pipe couplings and fit nozzle holder assembly to cylinder head. Tighten up securing nuts and bleed fuel system before retightening top inspection cover.
Important. On every occasion when the system is bled following replacing or checking the fuel injection equipment, the sump must be drained and refilled with clean oil.

Fig. 15.
Fuel Pump Assembly.

1. Delivery Pipe.
2. Washer.
3. Delivery Valve and Seat.
4. Delivery Valve Joint Washer.
5. Locking Pin and Joint.
6. Inspection Cover Plate.
7. Clamp Screw.
8. Cover Plate Screw and Ring.
9. Spring Plate (Lower).
10. Hole for inserting pin to enable spring ring to be withdrawn.
11. Stop Piece.
12. Delivery Pipe Coupling Nut.
13. Delivery Valve Holder.
14. Delivery Valve Spring.
15. Pump Body.
16. Pump Plunger and Barrel.
17. Toothed Quadrant.
18. Control Rack.
19. Regulating Sleeve.
20. Upper Spring Plate.
22. Plunger Guide.
23. Spring Ring.
24. Valve Spring.
25. Delivery Valve and Spring.
27. Pump Plunger.
28. Control Rack.
29. Toothed Quadrant.
30. Control Sleeve.

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NOZZLE VALVES AND BODIES ARE NOT INTERCHANGEABLE

CHECK FUEL SYSTEM FOR LEAKAGES AND DEAL WITH IMMEDIATELY
In carrying out adjustments or replacements scrupulous cleanliness must be observed and all parts washed in clean paraffin or fuel oil. Never scrape components except with wood, soft brass or copper. Use paper rather than cloth.

Fuel Injector and Holder Assembly.

1. Leak-off Nipple.
2. Fuel Inlet Connection.
4. Compression Screw.
5. Spring Cap Nut.
6. Valve Spring.
7. Spindle.
8. Valve.

Fig. 16.

TIMING FUEL PUMPS.

Timing of fuel pumps must be carried out by the "spill" method and the following procedure is based on the understanding that the valve timing has not been disturbed, or if disturbed, correctly retimed in accordance with the instructions given on page 27.

To retime the fuel pumps, use the following method:

1. Set control cam, Fig. 2 (10), in the "Starting" position, i.e., one half turn in anti-clockwise direction.
2. Disconnect fuel pipe at bleed cock, Fig. 2 (12), on top cover, remove top cover and temporarily connect fuel pipe to "T" piece.
3. Rotate engine by hand until the "spill" mark on the flywheel rim is in line with the mark on the sighting aperture in the fan casing.
4. Check that the fuel pump cam is lifting the tappet on fuel pump you are timing, if not, turn the engine until it does, and the "spill" mark reappears in line with the mark on the sighting aperture.
5. Disconnect the fuel pipes from the pump to injector. Remove delivery valve holder, Fig. 15 (13), and extract valve (3) and spring (14).
6. Refit delivery valve holder only and reconnect the pump end of the fuel injector pipe so that the injector end is pointing in an upwards direction.
7. Turn on the fuel and if it flows from the nozzle end of the injector pipe, rotate the engine in an anti-clockwise direction (viewed from the starting handle) until the flow ceases.
8. Turn the flywheel slowly backwards until the fuel just begins to flow and then reverse the direction of rotation of the flywheel until the flow just ceases.
9. After making absolutely sure that the fuel has ceased to flow and if the "spill" mark on the flywheel is not now exactly in line with the mark on the sighting aperture, adjust the fuel pump tappet and repeat the procedure in the preceding two paragraphs, i.e., 7 and 8.
ENFIELD AIR-COOLED DIESEL ENGINE

Note. If "spill" mark has passed the sighting aperture mark when rotating the engine in a clockwise direction, lengthen tappet, and if it has not reached the mark shorten the tappet.

(10) After adjustments have been made to the fuel pump tappet, ensure that further movement of the pump plunger is possible at the top of its stroke by inserting a screwdriver between the tappet roller and the appropriate cam on the camshaft and gently prise them apart.

(11) When timing has been adjusted correctly wash the fuel pump delivery valve and spring and refit to fuel pump.

(12) Turn flywheel one complete revolution and time the other fuel injection pump in exactly the same manner as above.

(13)* Reconnect fuel pipes and replace top cover, thereafter bleeding fuel system before attempting to start the engine.

In view of the position of the fuel pumps it is not possible to avoid a certain amount of fuel draining down into the engine sump during the timing operation.

The lubricating oil must therefore be changed before the engine is run.

BALANCING FUEL PUMP DELIVERY.

The fuel delivery from the fuel injection pumps is carefully balanced before the engine leaves the factory, but should the balance be in any way disturbed by fitting a new pump or pumps, it is essential that the fuel delivery is so adjusted that each pump delivers the same amount of fuel to each cylinder when the engine is running at normal speed.

Balancing the delivery is achieved in the following manner:

Remove cylinder head covers, disconnect fuel injector pipes and leak-off pipes from nozzle holders and remove nozzle assemblies from cylinder heads.

Reconnect fuel injector pipes to nozzle holders so that the fuel sprayed from the nozzles can be caught and measured in a suitable receptacle.

Turn on fuel delivery and bleed fuel system before continuing further.

Fuel Pump Operating Mechanism and Governor.

1. Adjusting Screw—Governor.
2. Spring Collar.
3. Governor Control Lever.
4. Coupling Rod.
5. Lock Nut.
6. Ball Joint.
7. Control Shaft Lever.
9. Overload Stop.
10. Push Rod.
12. Fuel Pump Operating Lever, L-H.
13. Pin.
15. Stop/Start Cam.
17. Thrust Washer.
18. Lock Nut.
20. Control Rod.
22. Lock Nut.
23. Fuel Pump Operating Lever, R-H.
24. Pin.
25. Thrust Washer.
27. Governor Fork.
28. Spring Collar.
29. Governor Spring.
30. Lock Nut—Governor Adjuster.

Set fuel pump operating levers, Fig. 17 (12 and 23), in a vertical position which should correspond to 10 mm. movement of the fuel pump control rack. This approximates to the normal full load running position of the pump racks at 12 h.p. and 1500 r.p.m.
ENFIELD AIR-COOLED DIESEL ENGINE

Adjust overload stop (9) so that it just touches the cam (15) when the fuel pump operating levers are vertical. This is the approximate "running" position.

Adjust control rod (20) so that pins (13) can be fitted without moving the lever from the vertical position.

Turn starting handle a few times to ensure that the system is properly working and then at a given moment commence to collect the fuel discharge from each nozzle for a period of 200 revolutions of the starting handle, i.e., 400 revolutions of the crankshaft.

During this period keep the overload stop down on the cam and keep cranking steady.

Compare the volume of fuel discharged and if (a) the two discharges do not differ more than .2 c.c. the control rod (20) can be locked up; (b) the two discharges are identical but do not lie between 6.8 c.c. and 7.0 c.c. then the overload stop (9) must be readjusted.

To increase delivery shorten the stop and to reduce delivery lengthen the stop.

If the L.H. pump discharges more than the R.H. one, lengthen the control rod (20) and re-measure the volume of fuel discharged. When the two discharges are equal adjust the overload stop (9) so that the discharge from both nozzles is 6.8 c.c. per 200 revolutions of the starting handle. If the R.H. pump gives more than the L.H. pump shorten the control rod (20). Re-measure and adjust the overload stop as above.

When the correct setting has been obtained turn off fuel supply, slacken off coupling nuts on injector nozzle holders and refit to cylinder heads.

After bleeding the fuel system, tighten up coupling nuts and refit top cover.

Note. When running the engine at the governed speed the overload stop should be so adjusted that a clearance of 3/4 in. exists between the stop and the cam.

The above volumes of fuel delivered are correct for engines operating at the full-rated horse-power and at 1500 r.p.m.

Engines operating at loads and speeds different from this may call for a slightly different setting and details can be obtained on application.

FUEL FILTER (C.A.V. TYPE).

The filter element should be removed from the fuel filter every 200 hours and thoroughly washed in clean fuel. A new filter element should be fitted about every 9 to 12 months.

To clean the filter proceed as follows:
(1) Turn off fuel supply.
(2) Slacken off large securing nut, Fig. 2 (8), and remove top cover.
(3) Lift out filter element and clean as described above.
(4) Replace filter element and top cover and bleed fuel system before starting up the engine.

FUEL FILTER (VOKES TYPE).

The filter element should be removed from the fuel filter every 200 hours and thoroughly washed in clean fuel. A new filter element should be fitted about every 9 to 12 months according to conditions.

To clean the filter proceed as follows:
(1) Turn off fuel supply.
(2) Slacken off cap nut, Fig. 19 (3), and remove filter case (7).
(3) Lift out filter element (8) and dismantle by straightening one end of the fixing strips and removing top cap. The inner perforated case and fabricated element can then be withdrawn and cleaned as described above.
(4) Re-assemble filter element and fit cover and cap nut.
(5) Bleed fuel system before starting up engine.

GOVERNOR.

The governor is of the centrifugal type and is housed in a chamber cast into the timing cover where it is exposed on removal of the governor cover. See Fig. 10.

It consists of two weights (7) held in a carrier (15) which in turn is keyed to the end of the crankshaft.

As the speed of the engine increases on starting up, the governor weights fly outwards, and this movement causes the
sliding sleeve (14) (which is prevented from rotating with the crankshaft by the governor fork) to thrust forward towards the governor cover.

The action of the spring is to oppose this thrust, thereby counteracting the tendency for the weights to fully open.

The movements described are transmitted by the governor fork, this being secured to the governor spindle by means of a set screw, and mounted externally on the governor spindle is a governor lever which is pegged in position.

By suitable linkage the actions of the governor lever are conveyed to the fuel pumps so that the fuel delivery is controlled by the requirements of the engine acting through the governor.

**Governor Adjustment.**

Adjustment is effected by the slotted screw, Fig. 1 (2), in the governor cover, this screw having a LEFT-HAND thread and being locked in position by a nut.

In the normal way no adjustment should be necessary, but if at any time the setting has been disturbed, it is a simple matter to regain the original position.

To do this turn the locking nut (LEFT-HAND thread) in a CLOCKWISE direction and with the engine running rotate the adjusting screw ANTI-CLOCKWISE to increase the speed and CLOCKWISE to decrease the speed.

Once the correct setting has been obtained tighten up the lock nut.

**Dismantling Governor.**

To dismantle the governor first of all remove the four nuts fixing the governor cover and after disconnecting the oil pressure and temperature gauge pipes at the sump end, withdraw the cover.

Take out the governor spring and remove the circlip on the end of the crankshaft which limits the travel of the governor.

Unscrew the set screw fixing the governor fork to the governor spindle and extract governor spindle after disconnecting the connecting link.

The sliding sleeve, thrust washer, etc., can then be withdrawn, and the governor carrier together with weights, extracted by means of a suitable extractor.
ENFIELD AIR-COOLED DIESEL ENGINE

FLYWHEEL AND FAN

The flywheel is a nickel cast-iron casting statically balanced, and is keyed to the rear end of the crankshaft and retained by a nut and split pin.

On earlier engines a pressed steel centrifugal type fan is employed, which is bolted to the flywheel.

On later engines, however, the fan is an integral part of the flywheel casting.

Removal of Flywheel.

To remove the flywheel it is necessary to use an extractor of the type indicated in Fig. 20.

Fig. 19.

Vokes Fuel Filter.

5. Head Casting. 11. Drain Plug.

Fig. 20.

Flywheel Extractor.

(1) EXTRACTOR PLATE
(2) EXTRACTOR BOLT

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DIRT IN THE FUEL SYSTEM CAUSES TROUBLE

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USE THE PROPER EXTRACTOR TO REMOVE FLYWHEEL
ENFIELD AIR-COOLED DIESEL ENGINE

After removal of the split pin and crankshaft nut, the two extractor bolts, Fig. 20 (2), should be inserted into the screwed holes, one on each side of the flywheel boss and the bridge piece (1) placed across the end of the crankshaft.

By screwing in the extractor bolts equally the flywheel will be withdrawn from the crankshaft.

If the flywheel does not appear to move under the pressure exerted in this manner, strike the bridge piece at the point immediately over the end of the crankshaft with a raw hide mallet or copper hammer while tension is being applied through the medium of the extractor bolts.

Under no circumstances must a hammer be used on the rim of the flywheel.

Removal of Fan. (Early Engines only.)

This is accomplished by simply unscrewing the eight screws fixing the flange of the fan to the flywheel.

The fan can then be removed by hand, care being taken not to cause damage to any part of it.

Note. It is preferable to mark fan to place before removal in order that it can be replaced in exactly the same position on flywheel.

JOINTS.

Whenever it is found necessary to remove the various inspection covers, etc., the relative joints should be inspected, and if in any way damaged they should be replaced with new ones.

In fitting the new joint it is essential that the joint faces of the mating components are very carefully cleaned and treated with a proprietary jointing compound or shellac so that an oil-tight joint is ensured.

CRANKCASE BREATHER.

The crankcase breather, see Fig. 21, is situated on the top inspection cover beneath a detachable domed cap (12).

It consists of two non-return valves (2 and 7) one of which allows the engine to "breathe" and the other which provides for the return to the engine of the oil which is collected in the galleries.

Surrounding the breather chamber is a filter element (6) which should be removed at intervals and carefully washed in degreasing fluid or petrol and dried before refitting.

It is important that this is not allowed to become clogged, as otherwise pressure may be built up in the crankcase, causing leakage of oil past joints and oil seals.

Fig. 21.

Top Inspection Cover and Crankcase Breather.

1. Top Inspection Cover.
4. Inspection Cover Clamp.
5. Clamp Screw.
6. Filter Element.
9. Washer—Breather Valve
10. Felt Washer.
11. Retaining Spring.
13. Wing Nut.

KEEP BREATER VALVES AND FILTER CLEAN
Removal of Crankcase Breather, and Filter Element.

The internal parts of the crankcase breather are made accessible by unscrewing the wing nut (13) securing the aluminium domed cap (12) to the top inspection cover.

After withdrawing the cap, take out the filter element (6 and 8) and the spring (11) which holds the uppermost non-return valve (7) in position.

This valve, which is of Neoprene rubber, should, together with its seating, be wiped free from foreign matter from time to time.

The wing nut (13) MUST NOT be screwed down too tightly as it can cause the retaining spring (11) to damage the breather valve—upper (7).

To reach the valve (2) controlling the return of oil to the sump, it is necessary to take off the top inspection cover by unscrewing the two clamping screws (5).

After removing the split pin and slotted nut, the valve can be withdrawn for cleaning.

When refitting, the slotted nut must not be screwed down too tightly as this may distort the support plate (3) and prevent the breather valve from functioning properly.

When reassembling the filter (6) and guard (8), care must be taken to ensure that the felt washers (10) above and beneath the filter element are correctly replaced.

Air Intake Filter.

The filtering elements in the oil bath air cleaners should be removed every 500 hours, or more frequently in extremely dusty conditions, and thoroughly washed in petrol.

Clean out the oil in the base of the air cleaner and refill with clean lubricating oil up to the level indicated on the body of the cleaner.

Fig. 22.

1. Filter Cover. 3. Filter Body.
ENFIELD AIR-COOLED DIESEL ENGINE

Instructions on re-fitting Fan Casing, Bell Housing and A.C. type Generator after removal in the course of overhaul.

1. Fit fan casing to crankcase leaving out the joints between the air discharge outlet flanges.
2. Check fan casing spigot face and bore with clock indicator. The maximum reading should be .006in. on the face and .004in. on the bore.
3. With feelers, ascertain gap between air discharge flanges and mating flanges on crankcase and cylinder head. This gap should be constant all the way round. If not constant, adjustment should be carried out by means of a smooth file or scraper.
4. Fit gaskets of the appropriate thickness, allowing .002/.003in. for contraction under tightening up load. Laminated gaskets are supplied for this purpose.
5. Re-check alignment and readings with those obtained after check (2). The thickness of the original gaskets is stamped on each air discharge flange, i.e., .30 indicates the use of a .030in. gasket.
6. Fit bare shaft extension and check concentricity with clock indicator. The maximum out of truth allowed is .004in. By rotating the bare shaft one hole at a time on the flywheel, the most accurate position can be found. The flange of the bare shaft extension and the flywheel should then be marked accordingly.
7. When an A.C. type built-in generator is fitted and after the rotor has been placed in position on the bare shaft extension, a clock indicator reading must be taken. The inaccuracy must not exceed .002in. and to bring the reading within this figure, turn rotor on shaft in the same manner as that laid down for bare shaft on flywheel as (6).
8. Fit generator stator into bell housing and assemble unit on to fan casing.
9. The clearance between the rotor and the stator should not be less than .013in. generally. A sewing needle or a piece of wire of the correct diameter should be used for this as a feeler gauge does not readily conform to the curvature of the stator and rotor.
10. After fitting bell housing to fan casing check gear box spigot face and bore with clock indicator. The face should be within .006in. and the bore .004in. Fit gear box.

Important.—It is essential that all spigot faces and bores are clean and free from foreign matter or bruises.
<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>CAUSE</th>
<th>FAULT</th>
<th>INDICATION AND NOTES</th>
<th>REMEDY AND PAGE REFERENCE</th>
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</thead>
<tbody>
<tr>
<td>Starting Speed too low</td>
<td>(1) Inexperience</td>
<td></td>
<td>Starting handle speed should be at least 120 Turns per minute, i.e., 2 Turns per sec.</td>
<td>Experience brings proficiency.</td>
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<tr>
<td></td>
<td>(2) Excess Oil Drag due to:</td>
<td></td>
<td>Engine will not spin freely when decompressed.</td>
<td>Use correct grade of oil. (See page 12).</td>
</tr>
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<td></td>
<td>(a) Incorrect oil.</td>
<td></td>
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<td></td>
<td>(b) Abnormal low temperature.</td>
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<tr>
<td></td>
<td>(3) Excessive drag on driven machinery</td>
<td></td>
<td>Engine will not spin freely when decompressed.</td>
<td>Disconnect coupling and re-test. Seek out cause and remove.</td>
</tr>
<tr>
<td>Lack of Compression.</td>
<td>(4) Valves not closing because :</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(a) Seating badly.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(b) Incorrect Tappet clearances.</td>
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<td></td>
<td>(c) Sticking in Guides.</td>
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<td></td>
<td>(d) Decompressor Cam stuck.</td>
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<td></td>
<td>(5) Cylinder compression leak at:</td>
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<td></td>
<td>(a) Cylinder Head Gasket.</td>
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<td></td>
<td>(b) Injector Seatings.</td>
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<tr>
<td></td>
<td>(c) Piston Rings (gumming up).</td>
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<tr>
<td>Choked Exhaust.</td>
<td>(6) Excessive soot in Exhaust Ports,</td>
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<td></td>
<td>Exhaust Piping and Silencers.</td>
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<tr>
<td>Faulty Injection.</td>
<td>(7) Control lever not in correct position.</td>
<td></td>
<td>The colder the engine the more fuel is required for starting. A healthy injection “click” should be audible at each stroke.</td>
<td>Ensure lever is fully in start position (page 13). Prime if necessary. (See pages 16–17).</td>
</tr>
<tr>
<td></td>
<td>(8) Shortage of fuel due to:</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>(a) Obstruction between Tank and Pipes.</td>
<td></td>
<td>If engine starts it may be weak and/or stop. Opening the fuel delivery cock on engine or uncoupling fuel pipe unions may show no flow, restricted flow or flow may appear normal, but soon dies and stops. Watch for any signs of water in fuel. Sound of injection may be absent or noticeably abnormal.</td>
<td>(a) Clean out fuel piping if necessary. (b) Clean out Tank Air Vent. (c) Dismantle filter, clean container and element in clean fuel. (See page 53). Note: After (a) or (c), bleed out fuel system (see page 18).</td>
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<td></td>
<td>(b) Choked Fuel Tank Air Vent.</td>
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<tr>
<td></td>
<td>(c) Choked Fuel Filter.</td>
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