TO 10 H.P. MONSOONAPE ENGINE.

GENERAL DESCRIPTION. This engine is of the rotary air
stirred type with 3 cylinders, 110 mm. by 150 mm., develop-
ing 100 H.P. at 1250 R.P.M. As the name of the engine
indicates it has only 1 valve per cylinder, and this is situated
in the cylinder head. It is fitted with a double thrust ball
bearing, which enables it to be used either as a pusher or as a
pulley. The engine works on the Otto or 4 stroke cycle, 2
strokes of the engine giving 1 cycle (4 strokes) in each
cylinder. Its chief points of difference from other rotary
engines are:

(1) Absence of carburettor.
(2) No inlet valves.
(3) Inlet ports in cylinder walls.
(4) Non-explosive mixture in the crankcase.

The engine revolves in the anti-clockwise direction as seen
by the propeller end of the engine. As in the case of all
rotary engines, it is made chiefly of steel for strength and
durability. The angle through which the engine turns between
ev 2 consecutive explosions is 60°.

Approx. oil consumption = 2 gals. per hour.

A petrol consumption = 10 gals. per hour.

Weight of engine = 350 lbs., i.e., 5 lbs. per H.P.

REMARKS. The crankshaft is made of silicon carbide
steel. It is hollow and in 2 parts, a long end and a short
end. In all single line rotary engines, it has 1 throw.

It is stationary and serves the following purposes:

(1) It provides a means of attaching the engine to the
foundation.
(2) It conveys oil to the working parts.
(3) It conveys petrol to the crankcase.
(4) It provides, in the crankshaft, the fixed point against
which the force of the explosion acts itself in
turning the engine.

REMARKS. The crankcase is made of 3 steel stampings
stirred together by steel bolts and centred by dowel pins.
It is of I-section disposed symmetrically around the cylinder
bores, situated at the 3 cylinders, each of which is gripped
between a small key. It is not directly supported on the
crankcase but carries on its faces plates or covers, known
as cotterpins, the main ball race and a self-aligning double
Cylinders. The cylinders are numbered 1 to 8 successively in a clockwise direction as seen from the rear end of the engine. The order of firing is 1, 3, 5, 7, 2, 6, 4, 8. They are made of nickel steel machined from the same blank, an exhaust valve in the head and a series of ports around the base. The key referred to above are between 3 shoulders which are turned around the inside of the cylinder. These together act as a means of fixing the cylinders in the crankcase.

Pistons. The pistons are of cast iron with slightly conical heads. A portion of the trailing edge is cut away to allow the piston in the adjoining cylinder to pass. Each piston is fitted with a piston ring and a packing ring made of hard rubber. A worn ring is fitted in a groove situated just below the cylinder and in that position it is allowed to connect the rod or the head of the piston is allowed to pass through the cylinder wall. By means of the gudgeon pin fixed in the head of the piston, the piston is held in place by means of a taper set screw.

Connecting Rods. The connecting rods are of special alloy steel. Each of these connecting rods is attached to the crank pin. All the rods are of the same size and the journals are bored at both ends. Plugs are made to connect the rod big ends, and the bushings are made of brass. The connecting rod bolts are made of light steel pipe and are fitted to each connecting rod by means of the same gudgeon pin fixed in the rod big ends. The connecting rod is a means of joining the rod and the crank pin.

Valves. The single valve in the cylinder head performs the following functions: (a) It acts as an exhaust valve by opening and allowing the exhaust gases to escape. (b) It allows a quantity of air sufficient for the combustion of the charge entering the cylinder through the ports in the head of the cylinder. During this portion of the cycle, the valve is mounted in a steel cage which also carries the valves.
The valve stem is located in a case iron bush at the centre of the cage which is in position by means of a backing ring screwed into the valve head. The valve is made heavier than is necessary for mechanical strength and is of such weight as to balance the unbalanced force of the tappet rod which would otherwise serve to keep the valve open. The valve spring consists of a valve and the loops to which it is attached around the arm of the valve arm. The free ends of the valve wire are bent around a screw pin passing through the valve stem. Another type employs the valve spring in formed spiral and uses the valve spring, taking its bearing against the valve arm and a detachable collar on the valve stem. The valves operated by the camshaft which consists of a cam keyed to a bronze brass sleeve running on the small end of the shaft. The cam operates the tappet rods which work through tubular levers. Each tappet rod is formed of a seat and a rod joined together. The tappet works in a slot in the camshaft, and at its inner end is a roller which rests against the stem. The tappet rod extends from the rear of the valve arm of the exhaust valve and is adjustable. Camshaft is driven at half the engine speed by means of a pulley which is fitted on the inner face of the cover of the engine. It must be remembered that the engine is running at the speed of the camshaft, so that the rollers at the end of the tappet rods are rotating the camshaft the same time. This causes the tappet rods to be lifted as they pass the cam and to thereby open the valves. The distance between the valve arm and the bottom of the rods is valve stem, where the tappet roller is at the bottom of stem, should be as follows:

Engine size = 0.5mm.

The type shown in the valve arm engages the valve stem on a pin, which bears against the end of the stem. FOR OPERATIONS: Starting with any cylinder and drawing in pure air through the open exhaust valve. The cylinder moves in 0.459 inches R.D.C., at which point the exhaust valve is closed. The cylinder then begins to expand, creating a partial vacuum and 50° before R.D.C. At this point the ports of the cylinder are uncovered by the piston and
Rich petrol vapour enters from the carburettor, mixing air already there and forming an explosive charge. When B.D.C. the ports are again covered by the piston; on cylinder moves around to T.D.C. on compression. Ignition occurs 20° before T.D.C. and the cylinder is forced forward on the power stroke until it is 90° past T.D.C. The exhaust valve opens and emission spent then remains for the remainder of the cycle.

- Admission of pure air: 8° to 10°
- Partial vacuum: 13° to 15°
- Admission of rich gas: 18° to 30°
- Compression: 30° to 50°
- Power stroke: 0° to 90°
- Exhaust stroke: 90° to 160°

**VALUE TIMING.** Set any cylinder; for example, exhaust closing position, i.e., 80° before B.D.C. To position set No. 4 cylinder vertically upright. Set a regulating pointer and turn the crankshaft to the horizontal position in just about to lift the tappet rod. Then move the pointer. Set the remaining tappet rod and clearance to the exhaust closing position for each cylinder, i.e., before B.D.C. These instructions refer to the actual cycle of operation of the engine.

**IGNITION TIMING.** Set any cylinder, for example, in ignition position, i.e., 20° before T.D.C. on the power stroke. To get this position set No. 5 cylinder vertically upwards. Turn the magneto so that the points break and mesh the magneto driving gear with the distributor to the plug. The timing of the engine is complete.

**MAGNETO.** The magneto is mounted on the left backplate of the engine. Its driving mechanism enters the backplate and carries a small pin which is driven by a large wheel keyed to the flywheel. The gear ratio is 4 to 1, i.e., the magneto makes 8 revolutions to 4 of the engine and so gives 2 sparks per revolution. There will be 8 revolutions of the engine during which period each cylinder will have completed 4 cycles. The current is controlled by the magneto in the following manner—force the cable current passes by a high tension wire to an insulated holder fitted on the backplate. A sensitive spring is used to ensure that the contact brush is kept in constant contact with the circular carbon brush in the brush holder.
The distributor which is mounted on the outside of the engine, distributes fuel to the spark plugs through a fine brass tube. The distributor varies with the engine, and its function is to regulate the current to the spark plugs at varying speeds. The distributor must be mounted on the engine, and its function is to regulate the current to the spark plugs at varying speeds.

CARBURATION. The carburation system of this machine is very simple. Petrol is pressure fed from a tank, through a metal pipe and a fine adjustment valve into a branch inside the crankcase, and from there into the carburettor which is situated between the two cylinders. A small amount of air enters the engine through the leading end of the crankcase and in expanding the spray of petrol from the jet. The air is further assisted by the churning action of the connecting rods and the eccentric of the engine. The mixture is drawn into the cylinders through ports in the crankcase just above the cylinders when these ports are uncovered by the eccentric towards the end of the suction stroke.

LUBRICATION. This is by pressure and centrification combined. There are two pumps, "S" and "W" type "C" flow. The oil is pressure fed from the pump, through a copper pipe inside the crankcase, and through a branch into the throat box, along the race and main engine oil race. The surplus oil passes into the crankcase through holes drilled for the purpose and passes out through the cylinder walls through the ports in the crankcase. The main supply of oil passes through a hollow plug in the rear of the crankcase, down the shaft and crankcase into the short end of the crankcase, from whence it is forced to a series of holes in the crankcase. The oil then passes through grooves in the sides of the crankcase and is thrown centrifugally into the interior of the crankcase, lubricating the crankpins, oil tightness between the crankpins, and on passing the camshaft, and the camshaft and the valve race. The oil then overflows back into the crankcase and passes on to the cylinder walls as in the case of the flow from the thrust box. Some of the oil also passes through the hollow upper roller to the rocker arm pins. "S" flow. The oil is pressure fed from the pump, through a branch pipe inside the crankcase, and from there to the long end of the crankcase into the annular space or space between the plug in the long end of the crankcase and out of the ball, to 2 grooves or channels cut in the end of the crankcase.
Fig. 6.

A. Branches from Oil Delivery Pipe between Pump and Crankshaft.

B. Right Foul Glasses.

The Right Foul Glasses are half filled with air and each stroke of Pump Pressure is indicated by a Palamos.
of the master connecting rod big end. Holes are drilled through these grooves to each wrist pin and the wrist pins are drilled to correspond with these holes, so that the oil may pass through to lubricate the wrist pin bushes. From these holes the oil passes into steel tubes (which are fixed to the connecting rod and along the webs, oiling the gudgeon and wrist pins and bushes. In later type engines, the steel tubes are dispensed with, and oil passages along the face of the connecting rods to gudgeon and wrist pins are made. The injection from the gudgeon pins passes through holes in the side of the piston, lubricates the rings and the cylinder walls. The surplus is blown out through the exhaust valve and lubricates the exhaust valve guide and stem.

PULSIDORS. Branches are taken from the "B" and oil supply pipes before they enter the crankshaft, and lead to the pulsidors, the purpose of which is to ensure whether the oil pump is working properly. The number of pulsations per minute is also a measure of the engine, which may be calculated as follows:

R.P.M. of engine = Pulsidors per minute × 14.

PRESSURE PUMP. The pump for forcing air into the tank to obtain a pressure feed is of the reciprocating stroke type. The pump is composed of a casing for crankcase in which is mounted a small crankshaft, worm and worm wheel driven by a small belt. The worm drive is geared to 1 of the crankshaft, and 9 to 4 of the engine: 5/3 result of the engine therefore gives 1 delivery of air. The casing is formed with cooling fins and has automatic self-cleaning and exhaustion valves in its head. On the down stroke of the piston, air is sucked into the cylinder past the inlet valve. On the upstroke of the piston, the air in the cylinder is compressed and forced past the exhaust valve which is actuated by pulling to the petrol tank. The pressure is mounted on the engine backplate between the oil and magneto, and below the engine crankshaft and main drives from the same large wheel.

OIL PUMP. The oil pump is similar to that used on Gnome engines, excepting that the bore of the 2 pumps is the same, 15 mm. The worm drive is geared 2:1 to the pump crankshaft and 9 to 4 of the engine. (The oil is scavenged on the engine backplate opposite to the magneto and is driven from the same large wheel.)