Section 1

TABLE OF SPECIFICATIONS

GENERAL

Type	Horizontally Opposed
Operating Cycle:	Otto (4 stroke)
Cooling System Type	Air
No. of Cylinders	4
Cylinder Arrangement	(See Fig. 12)
Cylinder Bore	All Models 3⅞″
Stroke	All Models 3⅝″
Piston Displacement (cubic In.)	171
Number of Mounting Bolts	4
Diameter of Mounting Bolts	⅜″ or 7/16″
Overall Width	31½″
Average Dry Weight (Series 8)	170 lbs.
Average Dry Weight (Series 9)	177 lbs.
Crankshaft Rotation	*Clockwise

FEATURES PECULIAR TO EACH MODEL:

Model	A50	A65	‡A75	‡A80
Type Certificate No.	190	205	213	217
Compression Ratio	5.4:1	6.3:1	6.3:1	7.55:1
Rated R.P.M.	1900	2300	2600	2700
Rated Horsepower at Sea Level	50	65	75	80
Maximum Allowed Manifold Press. in In.Hg. (at rated R.P.M.)	29.5	29.4	29.3	29.2
Recommended Cruising R.P.M.	1800	2150	2350	2450
Max. Recommended Manifold Press. in In.Hg. at cruising R.P.M.	27.7	26.8	26.0	25.9
Minimum Fuel Octane Rating	73	73	73	80
Max. Allowable Cyl. Head Temp. (°F)	550	550	550	550
Maximum Oil Temperature (°F)	215	220	220	220
Oil Temp. in °F. (Min. at Take-Off)	90	90	90	90
Approx. Fuel Consumption in Gals. per Hr. at Cruising R.P.M.	3.8	4.4	4.8	5.2
Approx. Max. desirable Oil Consumption in Pints per Hr.	½	¾	¾	¾
Oil Sump Capacity in Quarts	4	4	4	4
Oil Pressure (Cruising) in Lbs./Sq. in.	30-40	30-40	30-40	30-40
Oil Press. (Idling) in Lbs./Sq. in. (Min.)	10	10	10	10

IGNITION:

Type	Dual, Magneto
Magneto Type	Various
Magneto Rotation (as viewed from Drive End)	Clockwise
Crankshaft: Magneto Speed Ratio:	1:1
Radio Shielding (Optional)	C.M.C.
Spark Plugs (Shielded)	Champion 62S
Spark Plugs (Shielded)	Champion C26S
Spark Plugs (Unshielded)	Champion C26

	A50	A65	A75	A80
Right Magneto Fires Upper Plugs B.T.C.	25°	30°	29°	29°
Left Magneto Fires Lower Plugs B.T.C.	28°	30°	32°	32°
Firing Order	1-3-2-4	1-3-2-4	1-3-2-4	1-3-2-4

*NOTE: Direction of rotation as viewed from rear of engine.

‡A75 and A80 are no longer in production. They are replaced by models C75 and C85.

TABLE OF SPECIFICATIONS — Continued

VALVE MECHANISM

Type	Overhead
Intake Valve Opens	10° B.T.C.
Intake Valve Closes	50° A.B.C.
Exhaust Valve Opens	50° B.B.C.
Exhaust Valve Closes	15° A.T.C.
Intake Remains Open	240° Crankangle
Exhaust Remains Open	245° Crankangle
Valve Lift	0.40″
Valve Clearance (Running)	0
Valve Clearance (Lifters deflated)	30″-.110″

FUEL SYSTEM

Feed	†Gravity
Carburetor Type	Float (See Catalog)
††Primer Connection	1/8″ N.P.T.
Carburetor Inlet	1/4″ N.P.T.

LUBRICATION SYSTEM:

Pump	Gear Type
Crankshaft: Pump Speed Ratio	1:0.5
Pump Drive Gear Rotation	*Counterclockwise
Sump Type	Wet

ACCESSORY DRIVES AND INSTRUMENT CONNECTIONS

Oil Press. Gauge Line	1/8″ N.P.T.
Tach. Drive Shaft: Std	S.A.E.
Crankshaft: Tach. Drive Ratio	1:0.5
Tach. Drive Rotation	*Counterclockwise

ACCESSORIES AND WEIGHTS

‡Magnetos (2), Eisemann	AM-4:10.69#
Magnetos (2), Eisemann	LA-4:12.02#
Magneto (2), Scintilla	S4RN-20:10.35#
Radio Shielding	2.26#
Oil Cooler (Harrison)	4.00#
Air Intake and Filter Assem.	2.56#
Propeller Hub Assembly	4.39#
Propeller Attaching Parts (Flanged Crankshaft)	0.90#
Carburetor (Stromberg NA-S3A1) (Optional)	2.70#
‡Carburetor (Stromberg NA-S3B)	2.60#
Carburetor (Marvel MA-3PA) (Optional)	3.00#
Fuel Pump (AC Diaphragm Type)	1.75#
Fuel Injector Equip. (Excello B-42)	4.00#
‡Spark Plugs (8) (Champion C26)	1.28#
Spark Plugs (8) (Champion C26S)	1.69#
Exhaust Flanges and Gaskets (4):	0.55#
Rubber Mount Bushings (8) and Steel Washers (4)	0.55#

NOTES:

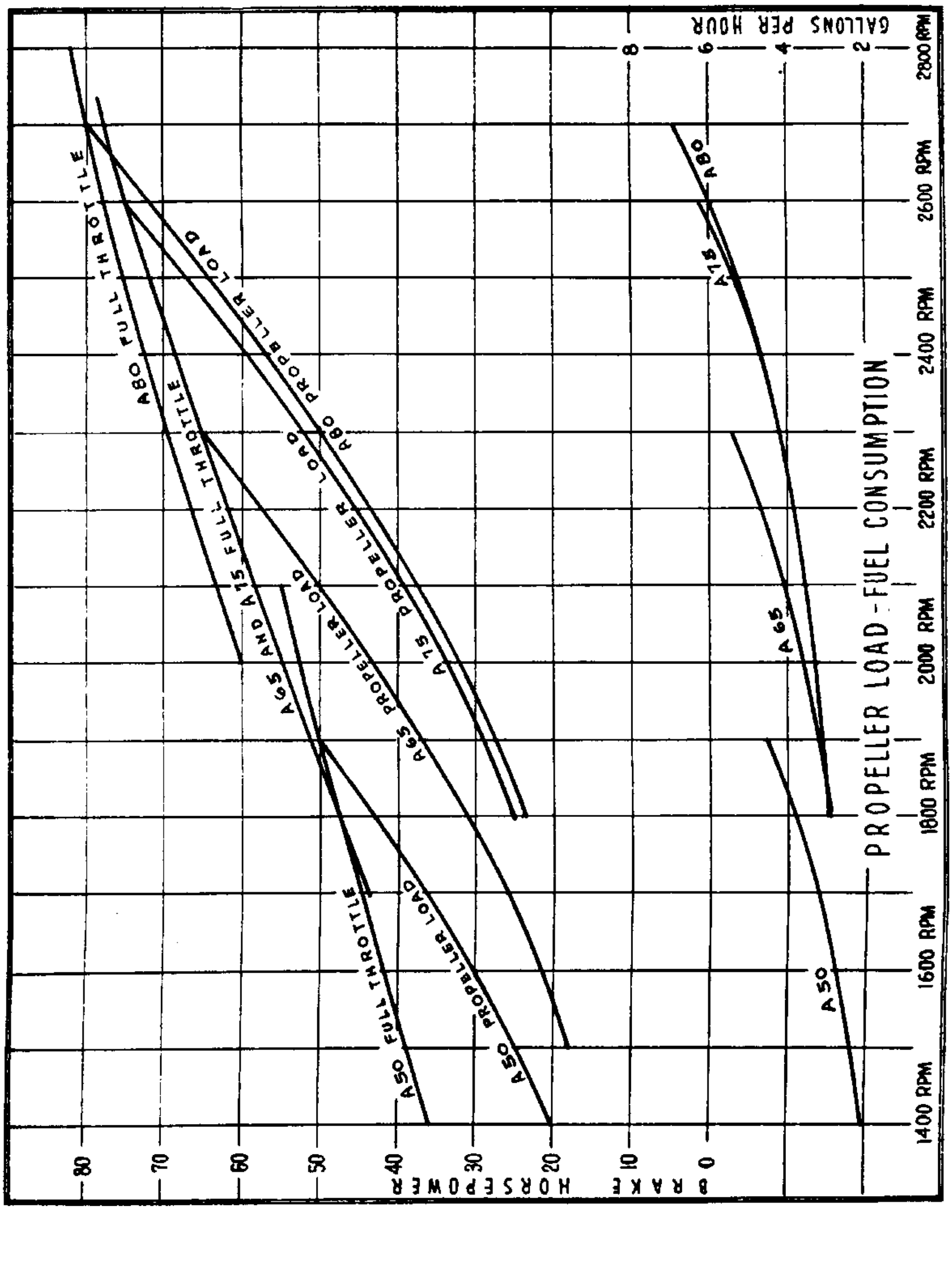
*Direction of rotation as viewed from rear of engine.

‡Accessories included in Engine Dry Weight.
Add 1.04 lbs. for Flanged Crankshaft (Series 8F and 8FJ).
Magneto Weights include Drive Gears.

†A Stromberg carburetor suitable for use with a pump feed system is available. Gravity feed requires the fuel tank to be elevated and located so that the static fuel head will be at least two inches in the steepest climb and less than 90 inches in the steepest glide.

††The primer nozzle supplied for installation in the intake manifold is effective at temperatures above —7°C.(20°F.). For starting at lower temperatures a primer manifold system with jets in cylinder intake ports is recommended.

TABLE OF SPECIFICATIONS — Continued



PERFORMANCE AND FUEL CONSUMPTION CURVES FOR A50, A65, A75, A80 ENGINES — *Figure 4*

Section 2

GENERAL DESCRIPTION

1. DIFFERENCES IN ENGINE MODELS

a. DIFFERENCES BETWEEN THE CONTINENTAL SERIES 8 AND THE CONTINENTAL SERIES 9 ENGINES.

(1) GENERAL DIFFERENCES.

(a) The Series 8 engine and the Series 9 engine are very similar in general construction with the exception of differences in the machining of the crankcase, the crankcase cover assembly, magneto mounting and gears, and the ignition cable assembly.

(2) CRANKCASE.

(a) The crankcase of the Series 9 engine is the same as the crankcase for the Series 8 engine except that the journal for the starter gear has been machined, a dowel hole for the starter gear bushing and an oil passage hole for the starter gear bushing has been provided. A thicker crankshaft gear is required which meshes with the starter gear. The tapped holes for the studs attaching the crankcase cover to the crankcase are different and require longer studs to accommodate the crankcase cover.

(3) CRANKCASE COVER.

(a) The crankcase cover on the Series 9 engine is provided with an S.A.E. Standard small type starter mounting pad. The magneto mounting pads are standard two-bolt flange type but are machined to permit installing the magnetos horizontally. Impulse coupled magnetos cannot be used. The tachometer drive housing and oil screen housing on the Series 9 engine are not cast integral with the crankcase cover as they are for the Series 8. The oil pressure relief valve is located on the right side of the crankcase cover on the Series 9.

(4) MAGNETO MOUNTING AND GEARS.

(a) As mentioned above, the Series 9 magnetos are installed in a horizontal position to prevent interference with a starter installation.

(b) The magnetos used on the Series 9 engines are identical to those on the Series 8. However, when the magnetos are installed on the engine, a plug and gasket must be installed into the upper ventilator screen of each magneto to prevent moisture from entering. A different magneto drive gear is also required on the Series 9 engine.

b. DIFFERENCES BETWEEN THE A50, A65, A75, A80 MODELS.

(1) GENERAL DIFFERENCES.

(a) All the engine models are identical in general construction with differences in the power rating of the engine, maximum R.P.M., compression ratio, number of piston rings, exhaust valves, piston pin diameter and connecting rods.

(2) ENGINE RATINGS.

(a) The engines are rated as stated in the table of specifications, page 1.

(3) ENGINE COMPRESSION RATIO.

(a) The engines have the compression ratios and fuel Octane requirements shown in the table of specifications.

NOTE: Models A75 and A80 are no longer in production.

(4) NUMBER OF PISTON RINGS.

(a) The A65 and A75 engines have a total of three rings per piston; two bevelled back, tapered face compression rings No. 35551 in the top and second grooves and one oil ring in the third groove.

(b) The A80 engines have a total of five rings per piston, having two bevelled compression rings in the first two grooves, a plain compression ring in the third groove, and two oil scraper rings in fourth and fifth grooves.

(5) EXHAUST VALVES.

(a) The exhaust valves on these models are identical in construction with the exception that

GENERAL DESCRIPTION — Continued

the valves used on the A75 and A80 engines have stellite faces to eliminate the greater wear experienced at the increased engine speeds.

(6) CONNECTING RODS.

(a) The connecting rods on these engines are identical in construction except that the rods used on the A75 and A80 engines have a 1/16 diameter drilled oil squirt hole in the cap end of the rod to provide increased lubrication to the cylinder walls and are bushed for piston pins of smaller O.D. than used in model A65.

2. CYLINDER CONSTRUCTION

Heat-treated, aluminum alloy cylinder heads are screwed and shrunk to steel barrels. Close-spaced cooling fins are provided on barrels and cylinder heads to provide ample and efficient radiation surface. Cylinder bores are ground to a smooth finish and held within extremely close limits. Aluminum bronze spark plug inserts are screwed and pinned in, while aluminum bronze intake and steel exhaust valve seats are shrunk into the cylinder heads. Rocker boxes are cast integral with cylinder heads and are provided with oil sealed covers made of deep drawing sheet metal. They are scavenged by the drainage of oil back to the crankcase through the push rod housings. Cylinder heads have underside exhaust ports to permit more positive exhaust scavenging.

3. VALVE OPERATING MECHANISM

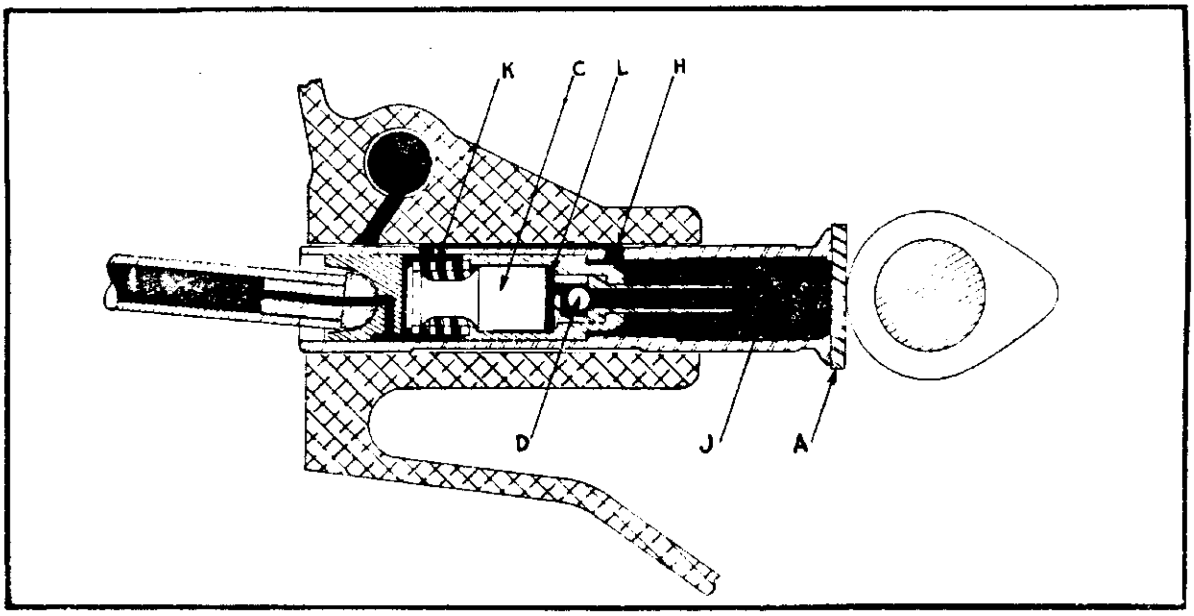
a. General. Zero lash hydraulic tappets fit aluminum alloy guides machined in the crankcase and so sealed as positively to prevent oil leakage. Tappets are drilled in such a manner that an oil passage is provided from the tappets to the push rods, rocker arm bearings, and rocker end. Push rods are made of light steel tubing with pressed-in ball ends, hardened and ground, and drilled their entire length to provide an oil passage to the overhead mechanism. The push rod is fully enclosed, and the outer end fits into a socket in the rear of the valve rocker. The rocker acts directly on the valve through a specially designed "foot" so constructed as to prevent side-thrust on the valve stem. Splash and spray lubrication keeps valve guides oiled at all times. Oil is returned to the crankcase by the push rod housing.

b. Hydraulic Tappets.

The tappets are composed of only four parts which can be disassembled: the cup, cylinder, piston, and cam follower body.

They are designed to function properly with clearances ranging from .030 inch to .110 inch.

Oil lines to tappets operate on full engine pressure and are located in such a way that they register with tappet oil passages when valves are open.



Section Through Hydraulic Tappet — Figure 5

GENERAL DESCRIPTION — *Continued*

Oil under pressure from the lubricating system of the engine is supplied to the hydraulic lifter through hole (H) to supply chamber (J). (See figure 6.)

With face of the lifter on the base circle of the cam and the engine valve seated as shown in figure 5, the light plunger spring (K) lifts the hydraulic plunger (C) so that its outer end contacts the push rod, taking up the clearance at this point and all along the valve train, giving zero lash. As the plunger (C) moves outward, increasing the volume in the pressure adjusting chamber (L), the ball check valve (D) moves off its seat and oil from the supply chamber (J) flows in and fills chamber (L).

As the camshaft rotates, the cam pushes the lifter body outward, tending to decrease the volume of chamber (L) and forcing the ball check onto its seat. Further rotation of the camshaft moves the lifter body (A) outward and the confined body of oil in chamber (L) acts as a member in the valve operating mechanism, the engine valve being lifted on a column of oil. So long as the engine valve is off its seat, the load is carried by this column of oil.

During the interval when the engine valve is off its seat, a pre-determined slight leakage occurs between plunger and cylinder bore, which is necessary to compensate for any expansion or contraction occurring in the valve train. Immediately after the engine valve closes, the amount of oil required to refill the adjusting chamber (L) flows in from the supply chamber (J), thus establishing the proper length of oil column to maintain zero lash during the next cycle.

The basic principle of the hydraulic tappet is that it provides, between the cam and the push rod, a column of oil which carries the load, while the engine valve is off its seat, and the length of which is automatically adjusted so that each camshaft cycle gives zero lash.

4. CRANKSHAFT CONSTRUCTION

The alloy steel, one-piece, four-throw crankshaft is supported by three steel-backed, Tri Metal line main bearings. The crankshaft is drilled for lightness and to provide pressure lubrication of crankpin journals. The crankshaft end clearance is fixed by the front main bearing setting between the forward crank cheek and a flange machined on the shaft. Shafts No. 530196 and 530199 have a thin flange with no taper. This flange rides in a narrow recess in crankcase No. 6759-A1 and acts as an oil slinger.

5. CRANKCASE AND OIL SUMP CONSTRUCTION

The crankcase is a two-piece heat-treated aluminum alloy casting, bolted together at the vertical lengthwise plane through the crankshaft and camshaft. Rigid transverse webs hold the three main crankshaft bearings and the three camshaft journals. A specially designed oil seal prevents oil leakage at the front end of the crankshaft. Large tappet guides are formed in the crankcase in a plane below and parallel to the cylinders. Cast-in tubes are used to provide pressure lubrication of the tappet guides, camshaft, and main bearings. Circumferential stiffening ribs under the cylinder pads give additional strength and stiffness to the cylinder hold-down bosses. Four engine mount bosses for $\frac{7}{16}$-inch bolt are provided at the rear of the crankcase for mounting similar to that of radial engines To the rear and on the bottom of the crankcase there is a large flange to which the oil sump is attached.

The oil sump is a two-piece deep drawing sheet steel stamping, welded together at the flange. A heavy sheet steel mounting flange is securely welded at the top of the sump. A steel filler tube with support bracket is welded to the oil sump body. A bayonet-type oil gauge rod is combined with the oil filler cap.

6. CONNECTING RODS

Connecting rods are of conventional split-bearing design and of heat-treated alloy steel forgings. The split crank journal end bearing is of replaceable thin steel-back shell-type, Tri Metal lined. At the piston pin end is a pressed-in bronze bushing.

On A75 and A80 Engine an oil squirt hole is provided in the connecting rods to insure more positive oiling of the cylinder walls.

7. PISTON AND PISTON PIN CONSTRUCTION

Pistons are heat-treated aluminum alloy permanent mold castings. The ring grooves are

GENERAL DESCRIPTION — Continued

arranged to carry two compression rings and one oil control ring above the pin on A50, A65 and A75 engines. An additional compression ring and an additional oil control ring were used on A80 engines.

Piston No. 40731 is cam ground to provide better fit in the cylinder at operating temperature. It requires the large diameter piston pin No. 25256.

The full-floating type piston pin is a case-hardened, seamless steel alloy tubing, machined and ground. Each end is fitted with an aluminum plug to prevent scoring of the cylinder walls.

8. CRANKCASE COVER

The aluminum alloy crankcase cover casting at the rear end of the engine provides support for the magnetos, oil pump, and tachometer drive. It also houses the oil suction tube, the oil drain, oil screen, the pressure relief valve and oil lines to match the several crankcase oil lines. The entire assembly with accessories is removable as a unit.

9. LUBRICATING SYSTEM

To reduce the number of external oil lines, an oil sump is attached directly to the crankcase. Oil is drawn from the oil sump through a suction tube extending down into the sump and delivered under pressure to a screen from which it goes through drilled passages in the crankcase cover and crankcase to all drive bearings, through the crankshaft, and to the crankpins. Engine oil from the pressure pump is carried through drilled passages in the crankcase to the hydraulic tappets. After entering the tappets, it travels out through the overhead mechanism through hollow push rods, and is spilled over the rocker arm and valve mechanism. As it drains away, it thoroughly oils the valve stems and valve guides. The oil is returned to the crankcase by way of the push rod housings, and drains back into the oil sump through the opening at the rear of the crankcase. The cylinder walls and piston pins are lubricated by spray. The excess oil in the crankcase is returned to the oil sump. The pressure relief valve is set to give approximately 35 pounds of pressure at speeds of from 1900 to 2300 R.P.M.

Refer to the Section on Table of Limits for Charts showing the lubrication system.

10. EX-CELL-O FUEL INJECTION

The injector mounting on these engines is at the forward end of the crankcase and the injector drive is taken from the front end of the camshaft. The air throttle assembly is mounted just back of the injector, on the lower side of the crankcase, and standard air intake pipes lead from the throttle assembly to the intake elbows. Tubes from the injector are firmly clamped to the air intake pipes and conduct the fuel from the injector to spray jets located in the intake elbows just outside the intake ports. The valve which meters the fuel to the injector and the throttle controlling the air to the engine are linked together so that any degree of opening or closing simultaneously affects them both.

The mounting of the injector at the forward end of the crankcase, just back of the propeller, is ideal for air cooling. An air scoop and filter assembly is attached to the air intake manifold and throttle assembly. The air filter is attached by four quick acting fasteners. An upward sloping vent line from the injector to a high point in the fuel tank is required. The whole unit streamlines neatly into the cowling of the airplane with merely an opening at the front to accommodate the opening of the air scoop.

Mechanically the Ex-cell-o injection system is of simple design. The injector unit consists of a cylindrical plunger fitted into a pumping bore, the plunger being reciprocated for pumpage and rotated for positive valving. As the rotation of the plunger is at one half the crankshaft speed, one plunger is made to serve all cylinders by discharging to them in the firing order. Motion of reciprocation and of rotation is positive and supplies an equal charge to each cylinder. A return spring on the plunger keeps its cam in contact with the fixed roller. If the engine backfires the reverse rotation merely pumps from the discharge lines to the fuel intake without any injury whatsoever to the injection device.

The function of the injector is to supply metered quantities of fuel to each cylinder, each cycle. This is accomplished by making the injector a positively driven pump of constant stroke to which the fuel is metered on its intake side.

GENERAL DESCRIPTION — Continued

The actual metering of fuel is into some eighteen or twenty inches of vacuum produced by the pump plunger, the plunger positively forcing to the engine the fuel which is metered. The fact that the fuel is metered on the intake side, as is the air throttled on the intake side of the engine, makes the fuel and air inherently self compensating for variable load. Thus with the fuel metering valve and the air throttle linked to it held in any fixed position, if the load is reduced and the speed increases, substantially the same amount of fuel and air is divided among more cylinder inductions and each individual charge is correspondingly smaller. Inversely, if the speed is pulled down with load, again substantially the same amount of fuel and air is divided among less cylinder inductions and each charge is correspondingly larger. This is of vital importance for an injector engine must be capable of a power dive and also function perfectly when the speed is reduced by the extra load of a climb. The use of a variable pitch propeller is also made possible by this ability to compensate for load which is inherent in this injection system.

Another advantage of this fuel injection system, which is inherent, is the ability to compensate for the varying atmospheric pressure encountered when flying to altitude. This is accomplished by restricting the fuel in the injector to the maximum required by the engine, as is the maximum air inducted by the engine dependent upon the valves or other breathing restrictions. With these restrictions of fuel and air comparable on the ground, and the maximum output of the engine dependent upon them, they will be comparable at other atmospheric pressures where the total output is correspondingly reduced. Likewise, any part-throttle fuel and air which is in proportion on the ground will be in proportion at any altitude for atmospheric pressure applies to them both at any and all altitudes in which the airplane is flown.

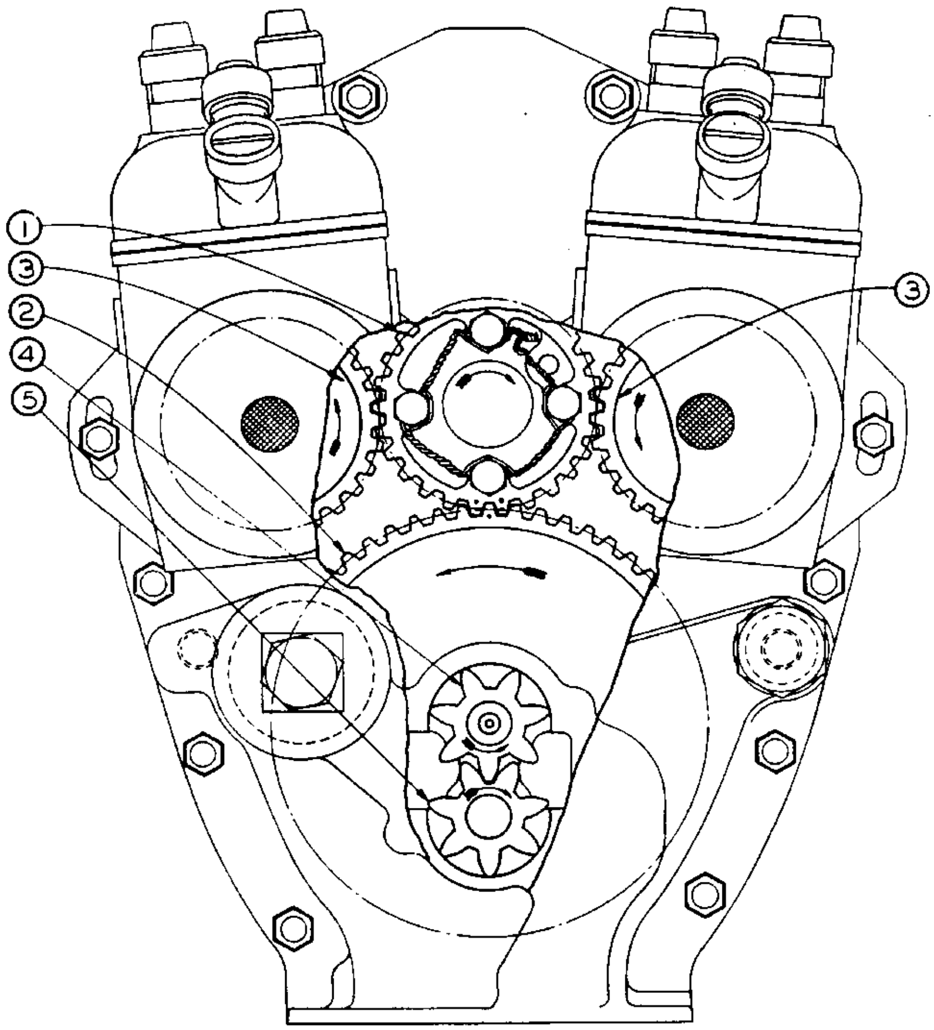
The order in which the fuel is discharged from the fuel outlets of the injector is in accordance with the firing order of the engine. As these four cylinder engines fire in the sequence of 1, 3, 2, 4, the plunger ports serve the outlets connected to the cylinders in that respective order. Thus the discharge duct of the plunger is set to first serve the outlet to number one cylinder, and 180 (crankshaft) degrees later it discharges into number three cylinder, etc.

In this low pressure system the fuel is injected into the inducted air during the suction stroke of the engine. The metered quantity of fuel, which is conducted through the fuel discharge tubes, is atomized by the spray jets mounted at the intake ports of the engine. In the spray jets the fuel is passed through ducts tangent to a central depression, or whirl-chamber, which causes the fuel to revolve so rapidly that it is torn asunder or finely atomized as it is discharged from the final orifice. The final orifice, and the ducts leading to the whirl-chamber, are each a number of times larger than is the free opening in an 80 mesh screen, so only an 80 mesh screen in the sediment bowl is needed to guard against foreign matter carried by the fuel. Light, hydraulically operated, valves in each spray jet seal the fuel in the discharge lines against the intake manifold depression and keep the fuel lines solidly filled with fuel between each spray discharge. This fog of finely atomized fuel, which is discharged in the shape of a solid cone, is picked up by the inducted air and vaporized as it is carried into the cylinder. It is the vaporizing of this fuel in the intake port, or as it is carried into the cylinder, which absorbs heat and causes a greater weight of charge to be inducted.

The Ex-Cell-O injector system may be incorporated in re-manufactured engines. See your nearest Authorized or Approved Continental Service Station for prices and details. We do not recommend installation of injector systems in the field on engines originally equipped with carbureters, nor do we recommend installation of injector engines in aircraft not originally so equipped.

Ex-Cell-O injector equipment is not listed in this manual. Parts and service information may be obtained from our Service Department.

High injector parts, some of which are still available, are listed in Section 14.



Cutaway View Showing Gear Train — Figure 6

GEAR TRAIN ANALYSIS

Figure 8 shows the complete gearing arrangement from the crankshaft power take-off to all accessories. The arrow on each gear indicates direction of rotation as viewed from the rear of the engine, and the following analysis describes each gear function with its speed in relation to the crankshaft.

(1) The crankshaft gear is driven from the crankshaft attached to the rear end of the crankshaft by cap screws and turns in a clockwise direction at crankshaft speed.

(2) The cam gear is driven by the crankshaft gear (1) at ½ crankshaft speed in a counter-clockwise direction.

(3) The right and left magneto drive gears, driven by the crankshaft gear, turn in a counter-clockwise direction at crankshaft speed.

(4) The oil pressure pump driver gear is driven by cam gear (2) through a male-female square coupling, and turns in a counterclockwise direction at ½ crankshaft speed.

(5) The oil pressure pump driven gear is driven by gear (4), and turns in a clockwise direction at ½ crankshaft speed.