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Curtiss

Curtiss Challenger

AIRCRAFT ENGINE HANDBOOK

CURTISS AEROPLANE & MOTOR
COMPANY, Inc. U. S. A.

JUNE 1929

CURTISS CHALLENGER SERIES

JUNE 1929

FOREWORD

THIS HANDBOOK has been written to aid the customer in obtaining from Curtiss Challenger engines the utmost in service by familiarizing him with the general ensemble of the engine, and aiding him in ordering replacement parts. Every effort has been made to incorporate all the information which will be of use to the operator, since a thorough knowledge of the shop practice on the construction and overhaul of the engine enables the customer to obtain the greatest amount of service from the engine.

Information concerning such points as are not covered by this book may be obtained by writing to the Curtiss Aeroplane & Motor Company, Inc., at Buffalo, New York. The Motor Engineering Department will welcome all inquiries and suggestions, in order that we may be of greater service to our customers.

JUNE 1929

INDEX

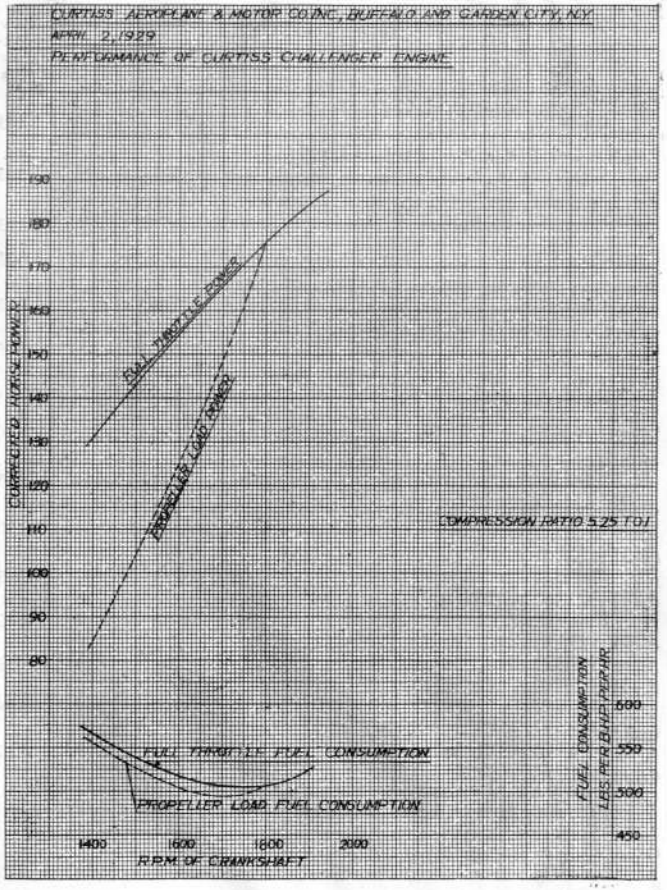
LIST OF ILLUSTRATIONS

GENERAL SPECIFICATIONS

Name	Curtiss Challenger
Model	R-600
Type of Engine (Direct Drive)	Static Air-Cooled Radial, arranged in two radial rows of 3 cylinders each, staggered.
Number of Cylinders	6
Rated H. P.	170 H.P. at 1800 R.P.M.
Displacement of Engine (actual)	627.9 Cu. In.
Bore	5 1/8"
Stroke	4 7/8"
Compression Ratio	5.2 to 1
Type of Piston	Aluminum, ribbed head
Number of Compression Rings	2 per Cylinder
Ignition System	2 Single Spark High Tension Magnetos
Carburetor (Type)	Stromberg NAU-4J Dual Carburetor
Number of Main Bearings(Deep Groove Ball Bearings)	2
Type of Oil Pumps	Gear; 1 Pressure, 1 Scavenger
Desired Oil Temperature under normal operation, (at oil sump)	160 to 170°F
Maximum Oil Temperature	180°F
Oil Pressure Desired (minimum with oil in sump at 160°F) at 1500 R.P.M.	70-90 Lbs. per Sq. In. Gage
Grade of Oil Desired	As per Curtiss Approved Oil List No. C-4499
Grade of Fuel Desired for Flight	Domestic Aviation Gasoline or as specifically recommended
Oil Consumption	0.015 Lbs. per B.H.P. per Hour

GENERAL SPECIFICATIONS

Fuel Consumption, Rated Power	0.55 Lbs. per B.H.P. per Hr.
Cruising	0.50 Lbs. per B.H.P. per Hr.
Pressure of Fuel Supply	3 to 5 Lbs. per Sq. In. Gage
Speed of Propeller	Crankshaft
Rotation of Propeller	Clockwise
Speed of Tachometer Shaft	1/2 Crankshaft
Firing Order	1, 3, 2, 4, 6, 5
Approximate Time Before Overhaul	200 Hours
Weight of Engine without Starter, Fuel Pump, Generator or Gun Control, but with Carburetor Heating Equipment, Exhaust Flanges, Exhaust Flange Gaskets, and Flange Nuts	430 Lbs.
Weight of Eclipse Starter (Hand Inertia)	20.0 Lbs.
Weight of Eclipse Starter (Electric Inertia)	32.0 Lbs.
Weight of Leece-Neville E-3 Generator	35.0 Lbs.
Weight of Leece-Neville G-1 Generator	16.0 Lbs.
Weight of C-5 Fuel Pump	1.74 Lbs.
Overall Diameter of Engine	41 3/4 In.
Length from End of Propeller Shaft to Mounting Plate	27 7/16 In.
Length from Mounting Plate to End of E-3 Generator	11 17/32 In.
Length from Mounting Plate to End of Magneto	7 23/32 In.



CHARACTERISTIC CURVES
CURTISS CHALLENGER ENGINE

JUNE 1929

SUMMARY OF CLEARANCES

Challenger Engine, List No. C-10460

	Min.	Desired	Max.	Allowable before Replacing or Readjusting
Camfollower—Diametrical Clearance in Guide	.0005	.0015	.0025	.005
Camfollower Roller Pin—Diametrical Clearance in Bushing	.000	.001	.002	.003
Camfollower Roller Bushing—Diametrical Clearance in Roller	.0005	.001	.002	.003
Camfollower Roller—Side Play in Follower	.0085	.012	.0155	.025
Cam Gear Adusting Shaft—Diametrical Clearance	.001	.002	.003	.005
Cam Gear—Diametrical Clearance on Spacer	.003	.0035	.0045	.006
Connecting Rod—Diametrical Clearance on Crank Pin	.002	.002	.003	.005
Connecting Rod—End Play on Crank Pin	.006	.008	.010	.040
Connecting Rod Articulated—Diametrical Clearance on Wrist Pin	.0000	.0005	.0015	.003
Connecting Rod Articulated—End Play in Master Rod	.004	.005	.008	.010
Crankshaft Thrust Bearing—Diametrical Clearance in Case	.0005	.001	.002	.003
Crankshaft Thrust Bearing Lock Nut—Diametrical Clearance in Cover	.022	.022	.026	.030
Crankshaft Propeller End Gear—Diametrical Clearance in Case	.003	.0045	.006	.008
Crankshaft Main Ball Bearing—Diametrical Clearance in Case	.002	.002	.003	.004
Crankshaft Spacer Anti-Propeller End—Diametrical Clearance in Case	.0065	.007	.0085	.010
Crankshaft Position when cold—Between Main Journal Propeller End Bearing Ring and Side of Cheek of Crankshaft Throw	.213	.218	.223	
Gears—All Accessory Drive Train Backlash	.002	.002	.004	.020
Gears—Cam Drive Backlash	.002	.002	.004	.020
Magneto Drive Intermediate Gear—Diametrical Clearance in Case	.001	.002	.003	.006
Magneto Drive Shaft—Diametrical Clearance in Case	.001	.002	.003	.005
Oil Pump Live Shaft—Diametrical Clearance in Body	.001	.0015	.002	.005

SUMMARY OF CLEARANCES (Cont.)

Challenger Engine, List No. C-10460

	Min.	Desired	Max.	Allowable before Replacing or Readjusting
Oil Pump Idler Shaft—Diametrical Clearance in Gears	.001	.002	.002	.005
Oil Pump Idler Shaft—Diametrical Clearance in Pump Cover	.0005	.001	.0015	.003
Oil Pump Gears—Diametrical Clearance in Body	.004	.005	.006	.010
Oil Pump Small Gear—End Play in Body	.004	.004	.007	.010
Oil Pump Large Gear—End Play in Body	.004	.005	.007	.010
Oil Pump Intermediate Drive Shaft—Diametrical Clearance	.001	.002	.003	.005
Piston—Diametrical Clearance at Top Land	.032	.034	.036	.050
Piston—Diametrical Clearance at Bottom of Skirt	.025	.027	.029	.042
Piston Pin—Diametrical Clearance in Piston	.000	.0005	.001	.003
Piston Pin—Diametrical Clearance in Connecting Rod	.000	.001	.0015	.003
Piston Ring—Top Compression—Side Clearance in Groove	.0035	.004	.005	
Piston Ring—Lower Compression—Side Clearance in Groove	.0025	.003	.004	
*Piston Ring—Oil Control Rings—Side Clearance in Groove	.0015	.002	.0035	
Piston Ring—Gap Compression Rings	.020	.020	.022	.040
Piston Ring—Gap Oil Control Rings	.016	.016	.018	.035
Rocker Arm Bearing—Diametrical Clearance in Cylinder Head	.0005	.001	.002	.003
Rocker Arm Bearing—Diametrical Clearance on Pin	.0000	.0005	.001	.003
Rocker Arm—Side Play	.015	.019	.024	.030
Tachometer Drive Shaft—Diametrical Clearance	.001	.002	.003	.005
Tappet Exhaust Valve—Gap when Cold	.009	.010	.011	
Tappet Intake Valve—Gap when Cold	.004	.005	.006	
Valve Intake—Diametrical Clearance in Guide	.004	.005	.006	.008
Valve Exhaust—Diametrical Clearance in Guide	.005	.006	.007	.010
Wrist Pin—Clearance in Master Rod Bushings	.0000	.0000	.0015	.003

* These rings do not have side clearance except at the solid portion between the oil control slots. At the slots the ring is expanded, causing it to fit tight in the groove.

This side clearance does not apply to Simplex Rings as these rings are designed to be compressed sidewise when in the grooves.

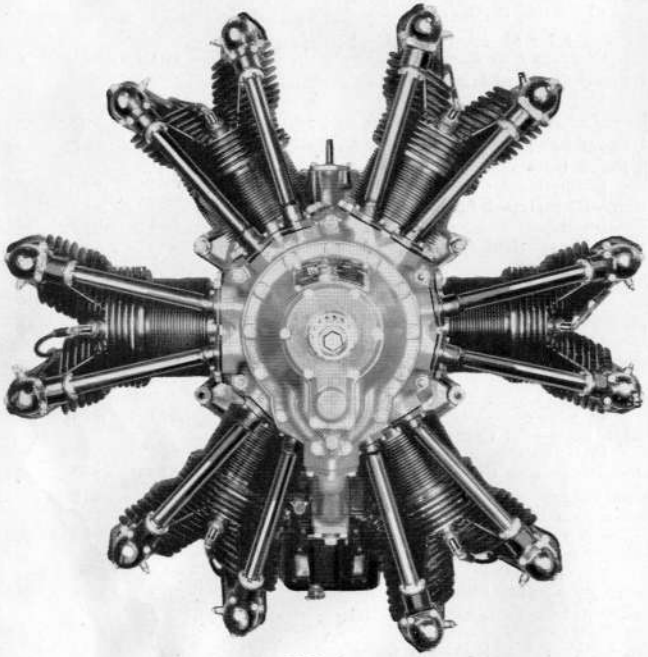


FIG. 1

PROPELLER END VIEW

FIG. 2

THREE-QUARTER PROPELLER END VIEW

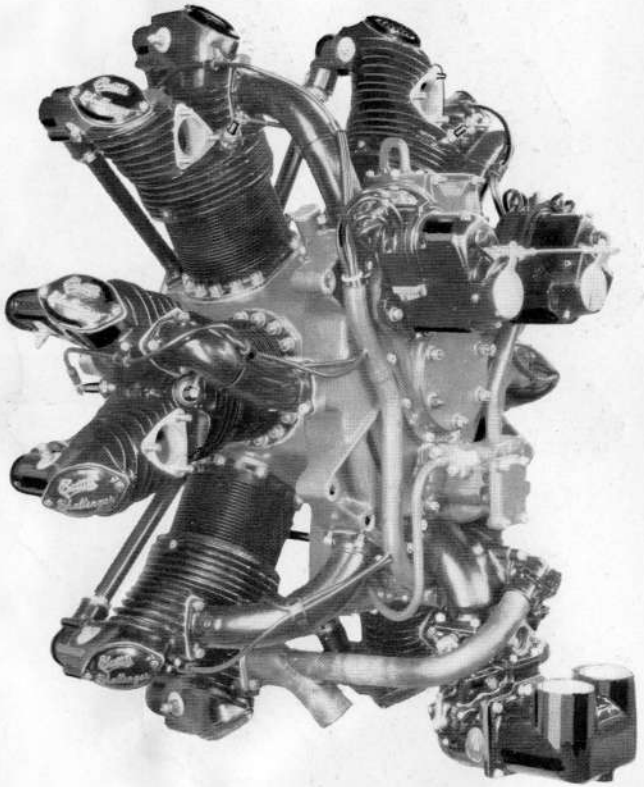


FIG. 3

THREE-QUARTER ANTI-PROPELLER END VIEW

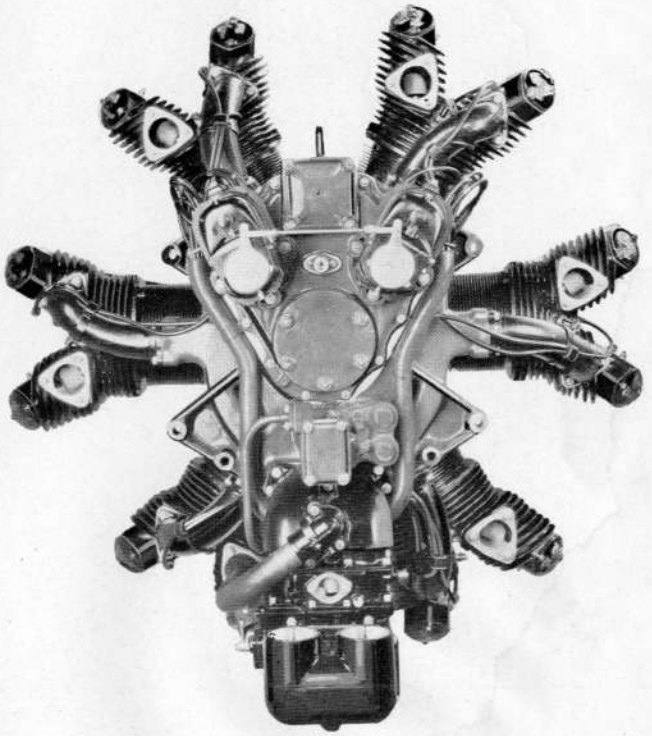


FIG. 4

ANTI-PROPELLER END VIEW

List No. C-4499
June 1,1929

OILS APPROVED FOR USE IN CURTISS CHALLENGER ENGINES

Manufacturer	Oil and Grade	Summer	Winter
Gulf Refining Co	90-95	*	
" " "	115-125	*	
" " "	Gulfpride 100		*
" " "	Gulfpride 120	*	*
Pennzoil Co., Inc.	Aviation Special		*
" " "	Extra Extra Heavy	*	*
Pure Oil Co.	Tiolene Extra Heavy	*	
Richfield Oil Co.	Richlube # 4	*	*
Standard Oil Co. of N.J.	Standard Aviation Oil # 120	*	*
Standard Oil Co. of N.Y.	Socony No. 4 Aircraft	*	
The Texas Co.	Texaco # 4	*	*
Tidewater Sales Co.	Veedol XXX	*	
Vacuum Oil Co.	Mobiloil "B"	*	
" " "	Mobiloil "D"	*	*
" " "	Mobiliol "H"	*	*

NOTE: Oils approved for winter use may be used at temperatures down to zero degrees Fahrenheit. Lighter grades are required below zero, and will be specified on request. Additions to this list will be made from time to time, as other oils are tested and approved.

For Oiling Rocker Arms

Manufacturer	Oil
N. Y. Lubricating Oil Co.	Jellux
The Texas Co.	Marfak

LIST OF APPROVED TYPE SPARK PLUGS FOR CURTISS CHALLENGER ENGINES

At present the only spark plugs tested and approved are B. G. Hornets No. 4, No. 4B, and No. 4B improved, B. G. IXA.

Additions to this list will be made from time to time as other plugs are tested and approved.

DESCRIPTION

The Curtiss Challenger engine is a double row, radial, air cooled engine. The propeller end, and the anti-propeller end rows are staggered, making the engine in fact two, three cylinder engines on a single crankcase. All accessories are mounted at the anti-propeller end.

The Challenger has a bore of 5⅛" and a stroke of 4⅞", making a nominal displacement of 603 cu. in. The actual displacement is 627.9 cu. in. With the normal compression ratio (5.2 to 1) the engine is rated 170 H. P. at 1800 R. P. M.

One notable feature of this engine is that all gears are spur gears, except the gun synchronizer drive gears. These are bevel gears.

Crankshaft

The crankshaft is a double throw shaft having the cranks in the same plane 180° apart. Counter weights are forged integrally. The shaft is mounted on two deep groove radial ball bearings, one at the anti-propeller end, and one just ahead of the propeller end crank cheek. There is also a similar bearing at the nose of the engine on the crankshaft, about three (3) inches from the splines, for the propeller hub. This bearing takes the thrust and gyroscopic forces in flight.

A spur gear is mounted on the anti-propeller end of the shaft. This gear drives the accessory drive train. At the propeller end there is a spacer or sleeve, on which the cam assemblies run, and a spur gear which slips over a spline on the crankshaft, to drive the timing gear train.

Connecting Rods

For each row of cylinders there is a master rod of the split bearing end type. There are two "link" or "short" rods attached to each master rod. One master rod operates in each of the horizontal cylinders.

All connecting rods have an "H" cross section and are machined all over. The big ends of the master rods are split, the cap being held in place by four (4) large studs, which are assembled in the cap. This places the nuts in a position where they can be easily removed or inspected, after removing the master rod cylinders. The link rods are fastened to the master rods by wrist pins held in place by a plug which is prevented from moving endwise in one direction by the master rod cap, and the other way, by the crank cheek. The wrist pins are lubricated from the connecting rod bearing by drilled passages, the oil being under pump pressure.

Crankcase

The crankcase center section is made up of two parts, joined together in the plane of the center lines of the propeller end cylinders. The anti-propeller end section has integrally cast intake passages, and bosses for the bronze bushings of the accessory drive. To the anti-propeller end of this section a cover is fastened, this cover carrying the magnetos, oil pump assembly, starter and generator mounting pads, and tachometer drive adaptor. Provision is made in the crankcase, at the top, for mounting a gun synchronizer. The case also carries a steel liner for the main bearing.

The propeller end section of the crankcase carries a steel liner for the main bearing, and also furnishes the seats for the camfollower guides.

To this section is fastened the nose, which carries the bushing for the shaft of the idler gears of the cam drive train, and also furnishes the support for the thrust bearing. In this section is also included the oil pressure regulating or relief valve, the by-passed oil going directly to the oil sump. The thrust bearing is held in place by a cover which forms a chamber in which the oil slinger operates.

An oil sump containing the pressure and scavenger oil screens is attached to the nose piece and the anti-propeller end crankcase section. The pressure screen is held in place on a conical seat by a spring, thus allowing the strainer to leave the seat, should it become clogged enough to cause enough restriction in the system. In this way a clogged strainer will not interrupt the oil supply to the bearings.

All stressed parts of the crankcase are of high tensile aluminum alloy.

Cylinder Assemblies

The cylinders are of the conventional type comprising a steel barrel with integrally machined fins and flange, and a cast head of high tensile aluminum alloy. Fins, rocker box housing and valve ports are cast integral. A cover is provided for each housing. The barrels are screwed into the heads, the joint being made gas tight and solid by a shrink fit on the threads. Inserted bronze valve seats are shrunk into the heads. The valve stem guides are a press fit in the head. The rocker arms operate on shielded ball bearings, which seat in the walls of the rocker housing.

Each rocker arm is drilled so that when being lubricated, oil is forced into the bearings, and to the seat for the push rod ball end, and the ball end tappet. There is no necessity for removing the rocker box covers to grease the rocker arms. Tulip valves are used for both intake and exhaust, each being actuated by three piano wire springs. A safety ring is incorporated to keep the valve from dropping into the cylinder, should the valve spring retaining members break or loosen.

In the head there are bosses for two spark plugs and an air starter connection.

Pistons

The pistons are of the regular Curtiss ribbed design with compression and oil control rings above, and one oil control ring below the piston pin boss. The heads are domed and form a large reservoir below the oil drain holes, to keep oil from getting into the combustion chambers of the lower cylinders, when the engine is not running. The pistons are of high tensile aluminum alloy castings.

Valve Operating Mechanism

The valves are actuated by the rocker arms and push rods. An assembly of two cams mounted upon a spur gear, runs on a sleeve or spacer, which is assembled on the crankshaft. Toward the propeller end, just ahead of this spacer, is a spur gear splined to the crankshaft; this gear meshes with a large gear which has a hollow stub shaft running in a bronze bushing located in the nose piece. Inside this hollow shaft there is assembled another shaft which is integral with a small pinion. This pinion and the larger gear have radial serrations on their webs, which, when the nut on the end of the pinion shaft is tightened, mesh and provide the drive from the large gear to the pinion. Valve timing is effected by loosening the nut of the pinion shaft, thus allowing the large gear to turn independently of the pinion. The pinion meshes with the gear to which the cams are attached.

The cams rotate at one-tenth (1/10) engine speed in the same direction as the crankshaft, and concentric with it. The cams are located in the propeller end section of the crankcase, and operate the camfollowers; the followers, in turn, operate the push rods, and the push rods the rocker arms. The rocker arm assembly is designed to eliminate side thrust from the valve stems.

Accessory Drive

All accessories are driven by a spur gear train located in the anti-propeller end section of the crankcase. The oil pumps are located at the bottom, and are driven through an idler gear from the crankshaft gear. Above the crankshaft gear, and meshing with it, is a large idler gear which drives the magnetos and generator through spur gears, and the tachometer by an extended portion of the hub. The gun synchroniser is driven from the generator drive adaptor by bevel gears. All the gears of the accessory drive train have integral shafts, which run in bronze bushings located in the crankcase, and are lubricated by oil under pressure, not by splash.

Carburetion

A dual Stromberg carburetor (NA-U4J type) is used. This has a fuel strainer built in just ahead of the needle valve. There

is a spacer elbow which has a jacket cast integral, this jacket being supplied with heat from the exhaust, thus forming a "hot spot." From this jacket the exhaust gases enter the jacket incorporated in the carburetor, and from there pass to the outside. The carburetor is located at the lowest point on the crankcase, so that gravity feed may be employed. If desired, a C-5 fuel pump can be mounted on the engine to furnish pressure feed to the carburetor. After leaving the carburetor, the gas enters the spacer elbow, then goes to the induction passages in the crankcase, and from them it is distributed to the cylinders by cast aluminum alloy intake pipes fastened to the cylinders.

Ignition Equipment

There are two single spark, high tension magnetos on each engine, both driven by spur gears and Oldham couplings. The left magneto fires the plugs nearest the propeller.

Both magnetos fire at the same time, and both have provision for connecting up a booster magneto, for aid in starting.

Lubrication System

The lubrication system of the Challenger is similar to those of other Curtiss engines. A unit of two gear pumps is mounted on the anti-propeller end cover of the crankcase, and is driven by spur gears from the crankshaft. The oil flows from the tank to the inlet side of the unit, this being the inlet to the pressure pump. After passing through the inlet pump, the oil is discharged through the pressure oil strainer into the strainer chamber, and from there to the oil distributing groove in the crankcase at the antipropeller end of the crankshaft. Here most of the oil enters the crankshaft, but part goes around the crankshaft and through ducts to the accessory drive bushings in the crankcase. Some oil issues between the end of the crankshaft and the gear which drives the accessory drive train.

From the bushing of the magneto drive idler gear shaft, the oil is supplied to the shafts of the magneto drive gears, and to the gun control.

There is an auxiliary pressure relief valve assembled in the oil sump, so that for starting conditions in cold weather the oil will "relieve" at this point, instead of at the relief valve in the nose. The discharge from the auxiliary relief goes directly to the oil sump, and from there to the scavenger pump. There should be no necessity for adjusting this valve as the oil pressure for running can be adjusted by the relief valve in the nose.

After the oil enters the crankshaft, it passes through drilled passages to the crank pins, and the master rod bearings, and

from each master rod bearing through drilled passages to the wrist pin bushings of the master rod. Here some of the oil emerges from between the ends of the wrist pin and the bushing, while the remainder of the oil enters the tube in the wrist pin, and lubricates the wrist pin bushing of the short rod. The oil tube of the wrist pin can always get a full supply of oil no matter how the wrist pin turns. The oil "spilled" from the wrist pin bushings (both master and short rods) and connecting rod bearings lubricates the cylinders, pistons and piston pins by splash.

The crankshaft is hollow at the propeller end, and is plugged to form an oil chamber about ten inches long. This portion is supplied with oil by the drilled passages from the anti-propeller end, and lubricates the camfollowers and their guides, the cams, the timing gears, and the idler gear shaft of the timing train. A hole in the crankshaft supplies the cam gear bushing with oil, and another supplies the idler gear shaft through a drilled passage in the nose piece. From the idler gear bushing, the oil is led to the pressure relief valve in the nose. This valve stops the oil flow until the proper pressure is reached, then opens and allows the excess to pass into the oil sump. The timing gears are lubricated by splash from the cam gear bushing, as are the cams, camfollowers, and camfollower guides.

The oil which drains from the crankcase and nose section, drains by gravity to the oil sump through a screen, and is returned to the tank by the scavenger pump. A drilled passage in the crankcase serves as an intake pipe from the oil sump to the scavenger pump.

There is an oil slinger on the crankshaft at the nose to keep oil from issuing around the crankshaft.

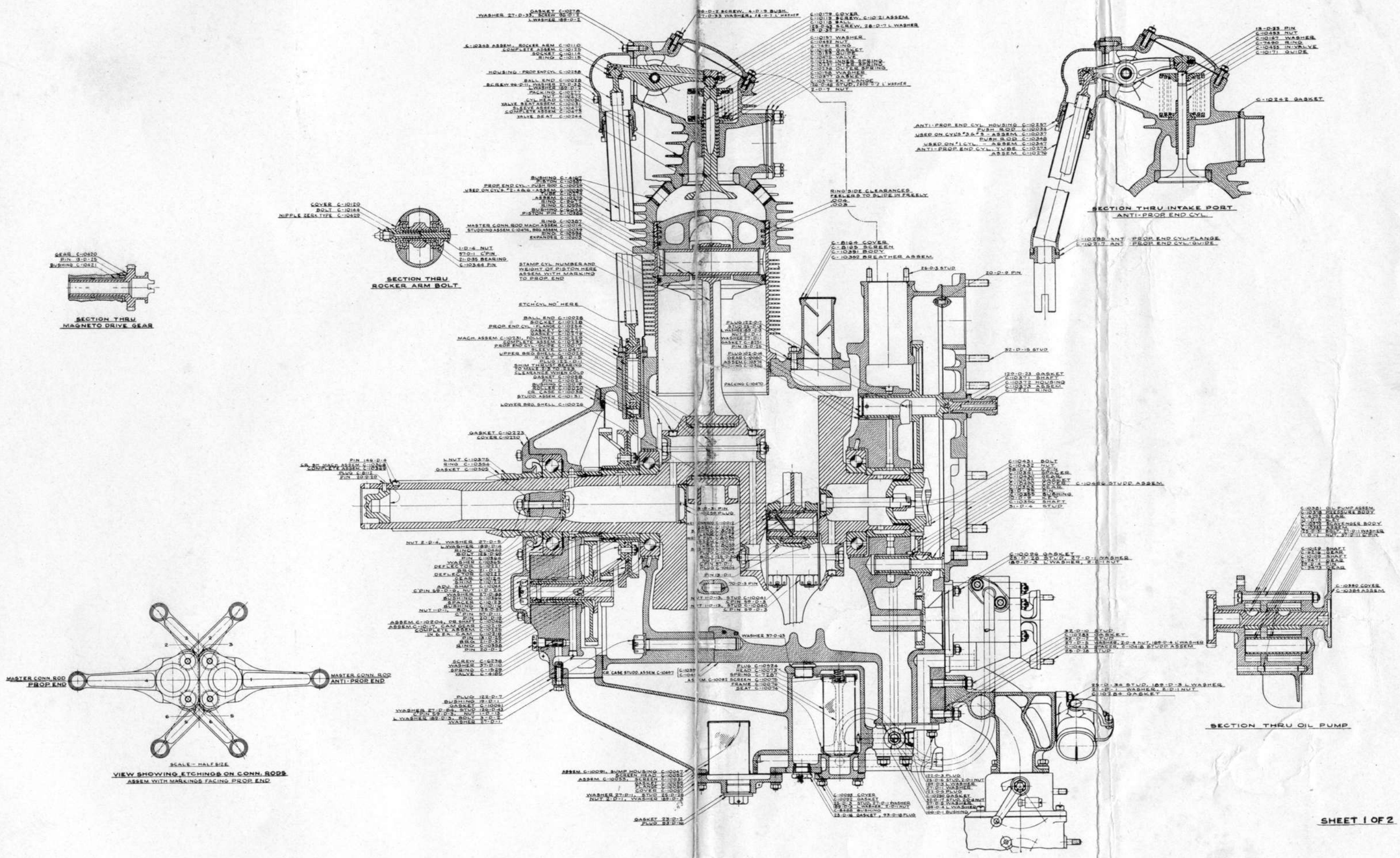


FIG. 5

CURTISS CHALLENGER—BASIC ASSEMBLY—LONGITUDINAL SECTION

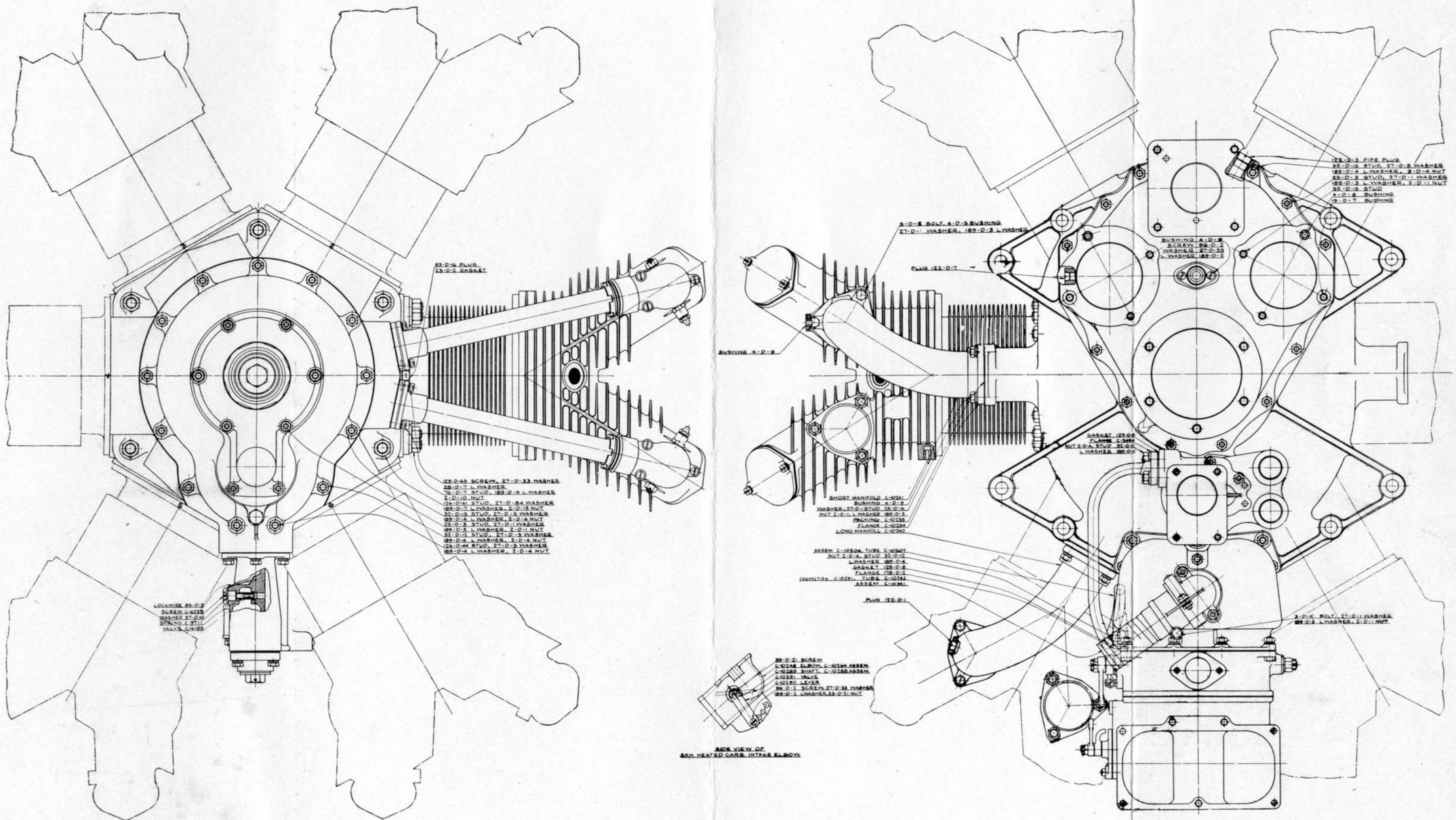


FIG. 6

CURTISS CHALLENGER—BASIC ASSEMBLY—PROPELLER AND ANTI-PROPELLER END VIEWS

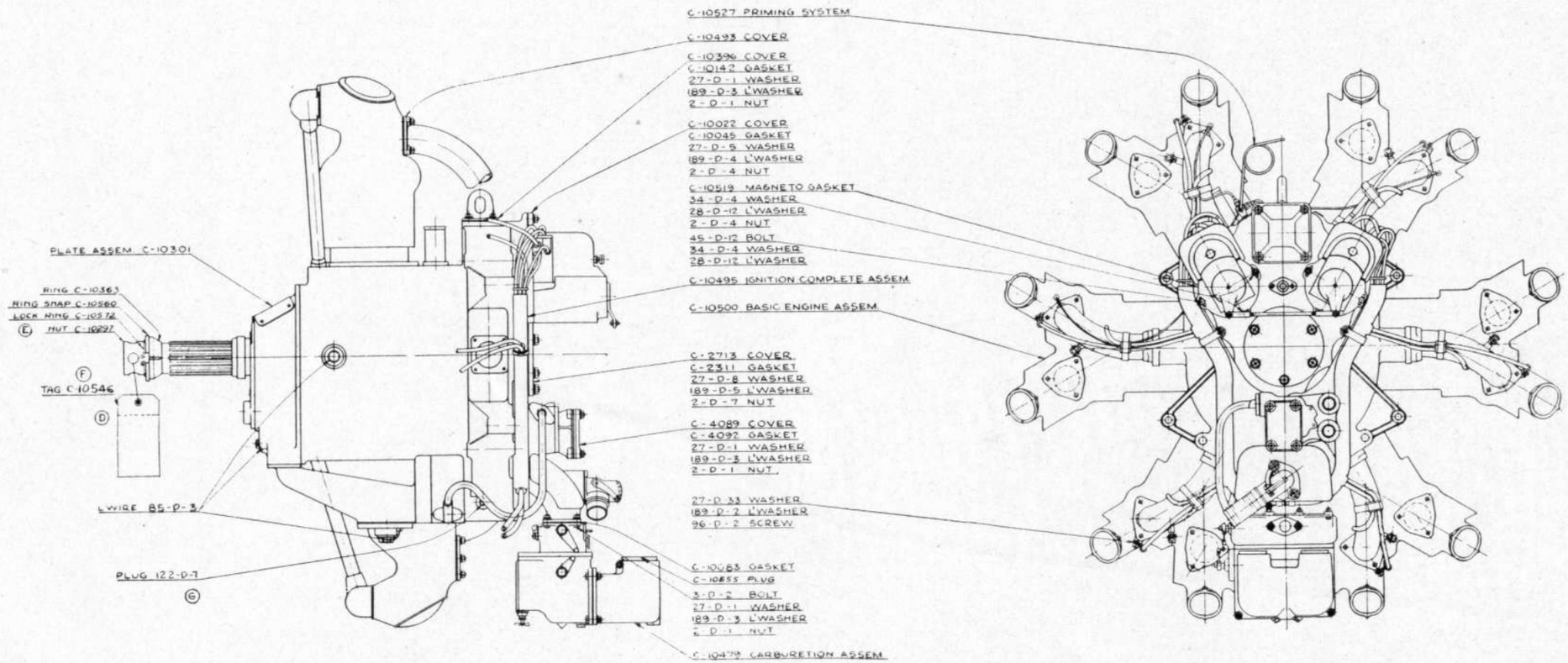


FIG. 7

CURTISS CHALLENGER—COMPLETE ASSEMBLY

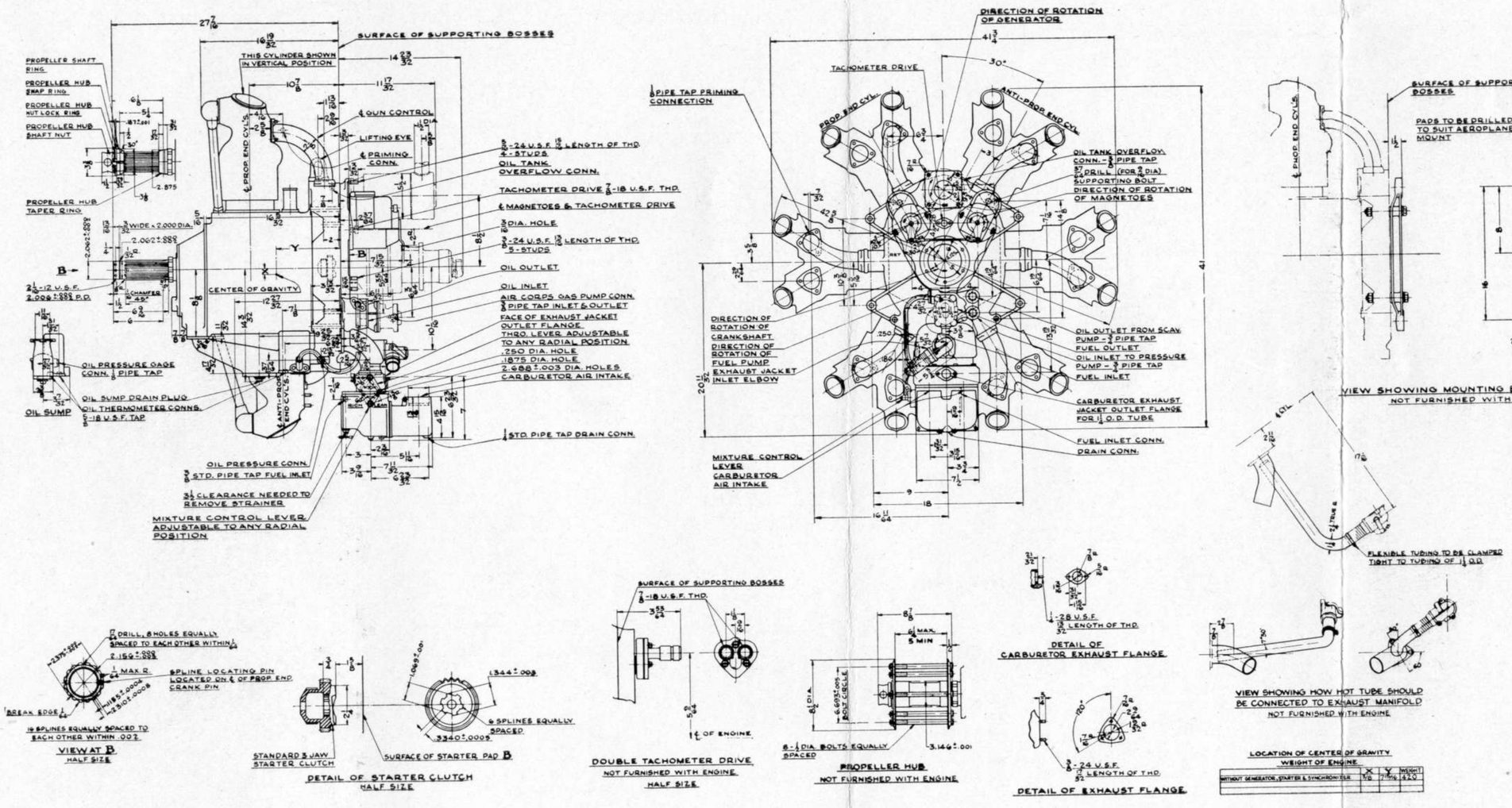


FIG. 8

CURTISS CHALLENGER—INSTALLATION DRAWING

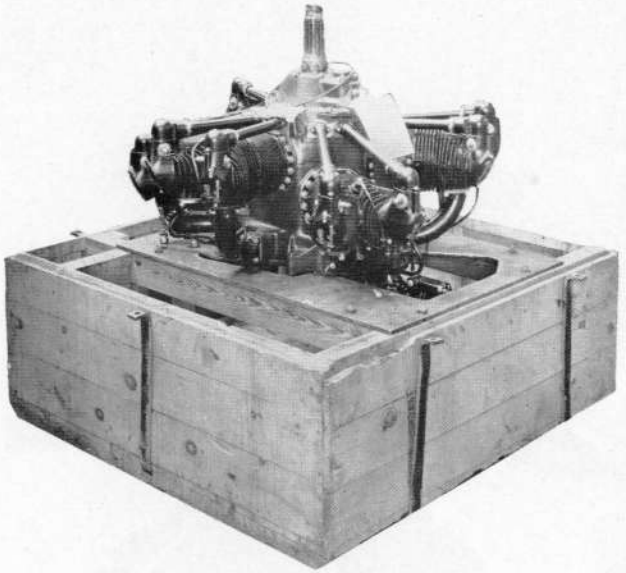


FIG. 9

CURTISS CHALLENGER ENGINE IN SHIPPING CRATE

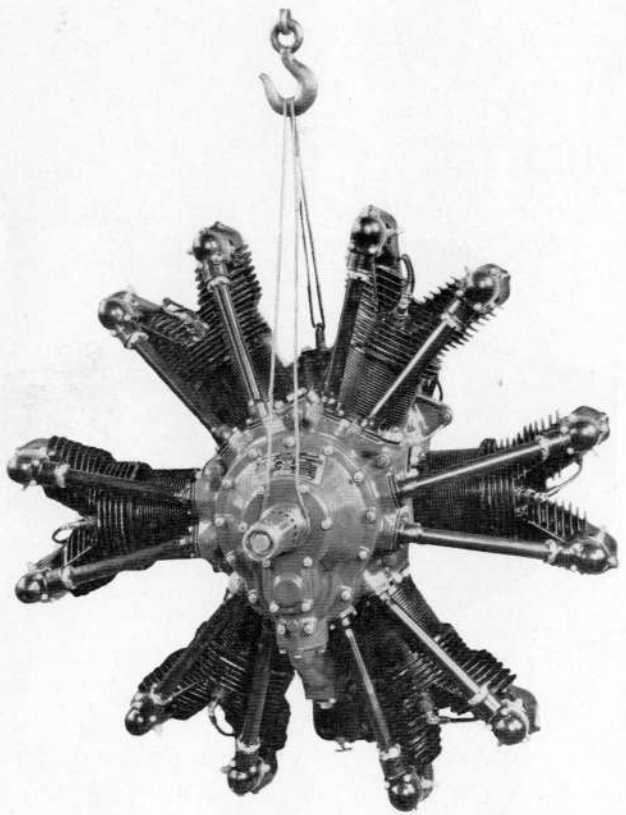


FIG. 10

CURTISS CHALLENGER METHOD OF SLINGING

UNPACKING

Curtiss Challenger engines are shipped from the factory enclosed completely in substantial boxes. The engine is bolted to a steel plate on sills on the bottom of the box.

To unpack the engine, remove the six bolts holding the steel straps together. The cover and the four sides of the box may then be lifted vertically from the bottom half. The tool kit, accessories and other miscellaneous equipment are boxed in a separate compartment of the packing case. Tilt the base of the shipping box until the crankshaft is horizontal, and place a suitable support under the propeller shaft. The engine is then in position for installing in the airplane. One ¼" diameter flexible wire cable sling, approximately 8' long is sufficient for lifting. Pass the cable through the lifting eye and down around the propeller shaft. The cable should be taped to prevent marring or scratching. Support the weight of the engine, and remove the bolts so that the lower part of the box can be taken away.

Do not use "dope" solvent, alcohol mixtures, or benzol for cleaning the engine, as they are paint removers. Avoid wetting the magnetos. Light grade Corol compound manufactured by the Simonize Company, Chicago, Ill., is used for rust prevention on and in the engine. It need not be removed when the engine is put into service.

INSTALLATION

The most important fact to remember in making any installation for an air cooled engine, is that there must be a sufficient quantity of air not just striking the engine, but flowing past it, to properly cool the engine. If necessary the streamline effect must be sacrificed to some extent to get enough air flowing over the cylinder barrels and the crankcase. Particular attention must be paid to building the engine compartment cowls so that there will be no restriction of the air flowing from the engine.

All pipe lines should be of sufficient diameter, and as short and straight as possible. Where the two ends of a pipe are fastened to members which can move relatively, there must be a flexible connection somewhere in the pipe line, otherwise the pipe is very apt to break.

The engine mount should be well braced, and the structure should show no excessive vibration when the engine is in operation. Detail engine mount designs will be provided upon request. Great care must be taken to have the mounting bosses plane, that is their surfaces should form a perfectly flat area which the engine may be fastened against, so that no distortion

will occur when the mounting bolts are tightened. When installing the engine, hoist it carefully to the required height, and gradually work the accessory end through the structure until the engine is in position. Put the engine mounting bolts in place and draw them up a little at a time until the engine is fastened securely to the mount. The nuts of the mounting bolts should be carefully cottered. **Always use a plain steel washer between the mounting boss of the engine and the nut of the mounting bolt.**

Wiring

Wiring to the magnetos and the booster magneto should check with diagram C-10582 for Scintilla magnetos and switches. Be sure to connect the ground wire from the booster magneto to the switch, as failure to do so will allow the booster magneto to be "live" at all times. Under such conditions it is possible to get a spark in the engine even though the ignition switch be in the "OFF" position. Failure to connect this ground wire may cause a serious accident. All wires leading to the switch should be carefully insulated from contact with the metal members of the airplane, and fastened so that no relative motion can take place. This is important, because if a ground wire becomes bare and touches a metal portion of the ship, it will put the magneto to which it is connected out of action.

When wiring the switch, be sure to connect the left magneto to the switch so that when the lever is at "LEFT," the engine will be running on the left magneto only.

Engine Controls

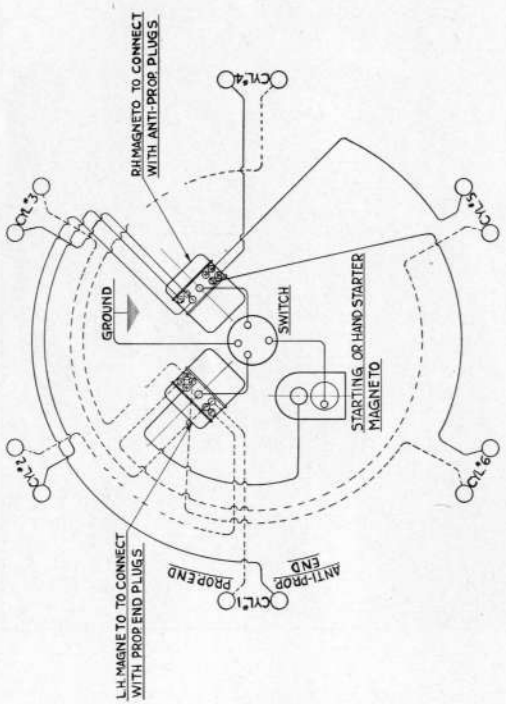
The throttle and mixture controls should open and close fully and easily, but there should be sufficient friction on the levers in the cockpit to prevent any changing of the levers in flight, except at the pilot's will. Positive controls must be used. Care should be taken that the lever arms of the system are of such a length that the levers furnished with the carburetor will not be bent or broken if the travel on the quadrant is not just right.

Exhaust Stacks

In making up a ring type exhaust manifold, there should always be a short piece of flexible tubing between each cylinder and the exhaust manifold. Slip joints have been used to some extent, but unless they are very carefully designed and made, they are liable to give trouble. The equipment for leading the hot gases to the carburetor spacer heater jacket should be made according to the installation drawing (Fig. 8). After leaving the carburetor jacket, the gases should be led through as short a pipe as possible outside the cowl, and not back into the exhaust manifold.

FIG. 11

CURTISS CHALLENGER INSTALLATION IN CURTISS ROBIN



FIRING ORDER
1-3-2-4-6-5

FIG. 12
WIRING DIAGRAM FOR IGNITION ASSEMBLY

Fuel System

Challenger engines are supplied with or without a fuel pump, as desired. If no fuel pump is supplied, the carburetor should be connected by ½″ tubing to a gravity tank with an 18″ minimum pressure head at the carburetor. If the fuel pump is supplied, it should be connected in the system by ½″ tubing with the relief connected to the supply tank. The fuel lines should be as simple as possible, and free from bends in which air pockets can form. Before starting the engine, it will be necessary to fill the carburetor using the hand fuel pump. The motor driven fuel pump should maintain from 3 to 5 pounds per square inch gage pressure.

It is recommended that all fuel connections between different units in the installation, which might vibrate relatively, be made with a short length of gasoline resisting rubber hose, using a connection designed to prevent actual contact of the hose with the fuel in the tubes. Be careful to avoid bends which could cause air pockets to form.

The drain from the carburetor air scoop should be led outside of the airplane fuselage.

Domestic aviation gasoline or its equivalent should be used for flight.

Lubricating System

To locate the oil tank, have the center line of the service capacity of oil at height of the center line of the pump.

This position will give satisfactory results. If this procedure cannot be followed, it should be approximated.

Oil tanks should have a minimum service capacity of 1 gallon of oil for each 10 gallons of fuel. There should be at least 200 cubic inches of air space above the service level, as the tank will be subjected to pressure if too full as the mixture of oil and air returning to the tank from the engine in the form of foam will fill up an expansion space that is too small. Often there is a small quantity of oil left in the oil sump after running, and this will be pumped into the tank immediately upon starting, thus raising the oil level slightly, and if the expansion space is not of sufficient size, the oil will be forced into the vent pipe. Here the oil, because of its viscosity, will block the tube. Pressure in the tank will then increase, because of the continued pumping of oil and air into the tank. It is quite possible for the pressure to become high enough, in cold weather, to burst the tank.

Locate the tank filler openings so that the expansion space cannot be filled with oil. The vent should be located in such a position that the oil in the tank will never close it in normal flight. This vent should be connected with ½″ tubing to the vent connection on the engine. On engines up to and including

No. 211, the vent connection is located in the upper right corner of the anti-propeller end crankcase cover. On engines that followed No. 211, the vent is located in the anti-propeller end crankcase section, a little to the right of the lifting eye.

The suction line from the tank to the pump should lead from the lowest point in the tank when the airplane is level or climbing. The discharge into the tank should be directed or baffled, or so located that no oil can pass into the vent line.

The oil pressure gage should be connected to the engine with 1/4" annealed copper tube, precaution being taken to guard against harmful effects of vibration. The oil thermometer should be connected into the fitting provided for it in the oil sump. There is provision for mounting two (2) thermometers in the oil sump.

The main lines from the tank to the engine should be short, with as few bends as possible. Tubing of 1", outside diameter, should be used. Brace the tubes to eliminate vibration, if necessary.

Ordinarily there will be no necessity for installing an oil cooler on Challenger engines as the heat given to the oil is very small, and is easily dissipated in the crankcase, lines, and in the tank. Under extreme conditions a cooler may be necessary, in which case information as to design and mounting will be furnished by the Motor Engineering Dept. of the Curtiss Aeroplane & Motor Co., Inc., upon request.

Propeller

In mounting the propeller on the splined shaft, extreme care should be exercised. CLEAN THE SPLINE ON THE SHAFT AND IN THE HUB, THE CONES, THE THREADS ON THE SHAFT AND IN THE NUT. Lubricate the above parts with cylinder oil. **Do not use graphite in any form.** The hub should be a push or light drive fit on the shaft.

Tighten the nut as tight as possible, using a bar four feet (4 ') long and 7/8" in diameter. After the hub is in place on the shaft, the rear cone ring nut should be safety wired with soft iron wire.

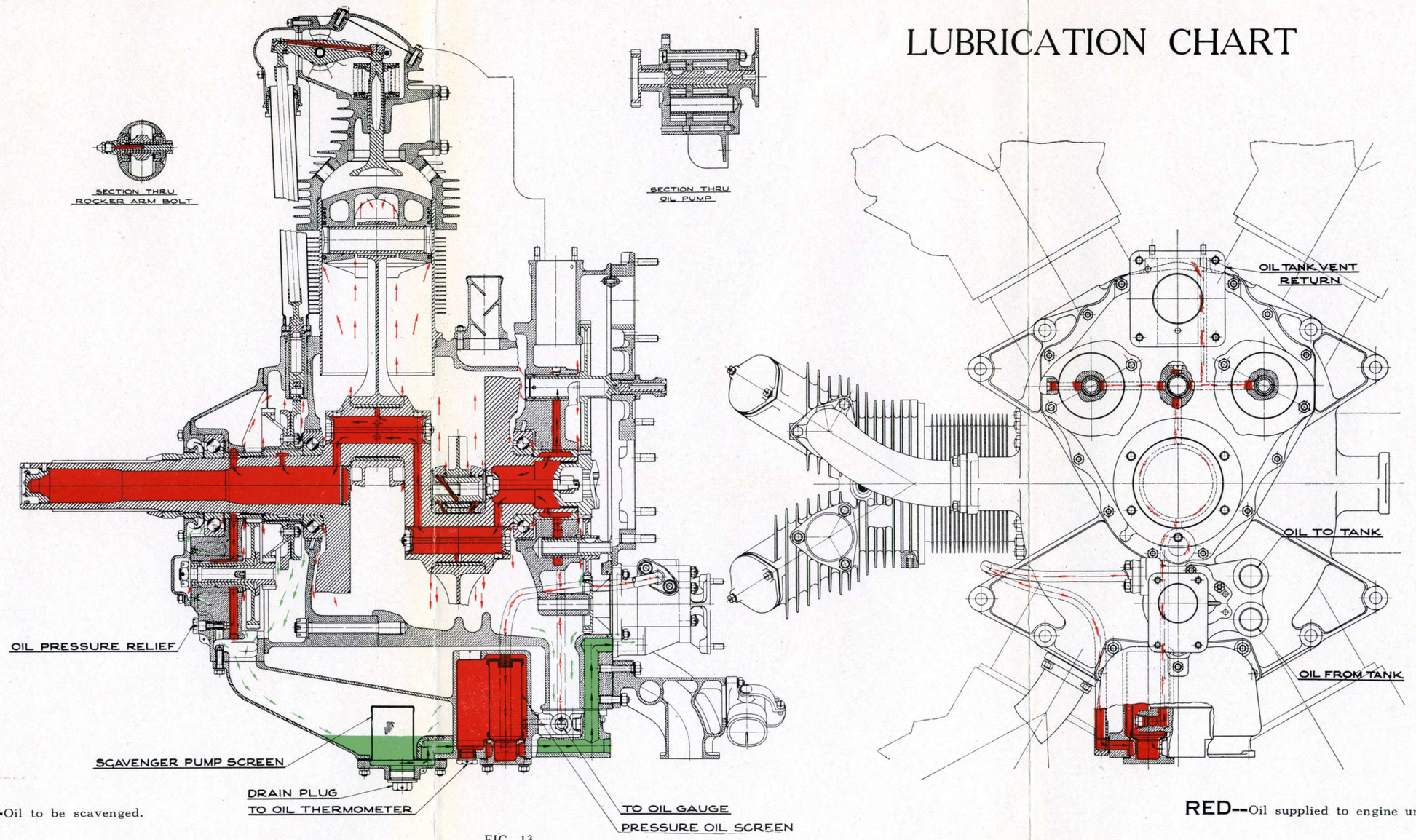
Turn the engine over a few times by hand, to ascertain that the propeller has ample clearance at all points. The propeller should be carefully tracked within 1/8". A propeller that is out of track, or out of balance, should not be used.

The propeller should be designed to allow the engine to turn approximately rated speed at full throttle, when the ship is in level flight.

Tachometer Drive Connection

The tachometer drive connection is located in the center of the accessory gear train cover, between the starter and the generator. It is driven by the large intermediate gear of the

LUBRICATION CHART



GREEN--Oil to be scavenged.

RED--Oil supplied to engine under pressure

FIG. 13

magneto drive. The connection is of the U. S. Air Corps standard form with 7/8" — 18 Thread. The adapter drive rotates at 1/2 crankshaft speed in a counter-clockwise direction as viewed from the anti-propeller end. For training plane installations, a double tachometer drive is furnished.

OPERATION OF THE ENGINE

Inspection

Before starting the engine, make sure that all nuts and bolts are tight, and that all controls are in proper working order. Inspect the engine mounting bolts and the cylinder "hold down" nuts for tightness. Check the propeller hub nut, to **be sure that it is tight, and locked.** Make sure the propeller "tracks". Lubricate the rocker arms with any oil which is listed on the list of approved oils (C-4499). Put in enough to make sure all surfaces are well lubricated. Make certain there is oil and gasoline enough in the tanks, using oil that is recommended on the Curtiss Approved Oil List C-4499, and a grade of fuel that is at least equal to domestic aviation gasoline. Check the throttle, altitude (mixture) control and spark control. See that the tachometer, oil pressure gage, and oil thermometer are in proper operating condition. **Turn the engine by hand, with the switch "OFF" to be sure that everything is free.**

If the engine has been in storage or idle for a considerable period, the following procedure should be observed to insure the proper lubrication of the cylinder walls: Inject about a tablespoon full of hot cylinder oil into each cylinder, and turn the engine over by hand **at least twenty (20) times,** (with no fuel in the carburetors), the throttle in wide open position and the ignition switch "Off".

Starting

There has been considerable discussion of the method to start a Curtiss Challenger engine. The personnel using Curtiss engines in the past have been familiar with the starting of water-cooled engines, particularly, in the winter time. Water-cooled engines offer an easier problem in starting, because usually hot water and hot oil are put into their respective systems before starting; thereby creating a very satisfactory starting condition. The air-cooled engine does not have the advantage of warm water around the cylinders and it is therefore necessary in the winter time, at temperature below freezing, to heat the lubricating oil before putting it into the tank. This warm oil will assist in thinning the oil on the cylinder walls to permit the engine to be cranked easier, either when cranking by hand or with a starter.

Every Challenger engine should be equipped with a priming system which delivers gasoline to cylinders No. 1, 2 and 3. The driver of an automobile uses the choke when starting his

engine. An aircraft engine does not have a choke, but a primer is used in its place. Bearing this fact in mind, the primers should be used four (4) to six (6) times before attempting to start the engine. In preparation for starting in cold weather, the propeller should be turned over several times with the throttle closed, to be certain that gasoline gets into the cylinders.

The installation should be equipped with a hand magneto or battery booster apparatus. This is necessary inasmuch as in cold weather the starter cannot turn the engine at sufficient speed to get the proper ignition from the magnetos. With the throttle "cracked" or open about one-tenth (1/10) of the travel of the quadrant and the switch "OFF", the inertia starter should be brought up to speed slowly. Do not attempt to bring the speed up quickly as it is only wasted effort.

When the starter has reached the maximum, as determined by the cranking speed of the handle, the switch should be turned to the position marked "BOTH", and the starter engaged in the cockpit, at the same time cranking the booster magneto, or operating the battery booster. If the engine does not start in the first two (2) or three (3) turns of the propeller, additional priming is undoubtedly necessary. After the engine starts, the primer should be used in the same manner that one should use the choke when starting an automobile engine. If the engine does not run smoothly, and indicates that it will stop firing, it should be kept running by use of the primer and the booster magneto, until it runs smoothly.

During the starting operation, the magneto should be left "full advance", unless hand cranking is necessary, and under this condition the magneto should be retarded about half way. Good starting will not result with the magneto in "full retard" position. Whenever the engine is cranked by the propeller, very great care should be taken to keep the switch in the "OFF" position, until the person cranking is ready for the final starting.

It is to be pointed out that it is possible to overprime the engine. Too much priming is dangerous, inasmuch as it washes the oil from the cylinders, and might result in "scuffing" the pistons. Usually a rich mixture is indicated by a soft explosion with black smoke issuing from the cylinders which have fired. If the engine fails to start because of too much priming, the throttle should be opened wide with the switch "OFF", and the propeller rotated in the reverse direction to draw in air through the exhaust valves, to lean out the mixture. And if too much priming has resulted in washing the oil from the cylinders, about a tablespoonful of hot oil should be put in every cylinder, and the engine rotated in order to re-lubricate the cylinder walls.

Some trouble is experienced with air-cooled engines in cold weather, with water condensation getting on the spark plugs, which may hinder starting. If this is the case, the spark plugs, should be removed, and thoroughly heated to dry out the moisture.

It will probably be necessary to run the engine between 700 and 1000 R. P. M. when it is first started in cold weather. It is more dangerous to "run in" an engine at very low speeds than it is to run it up to 1000 R. P. M., inasmuch as the oil will not throw into all the cylinders at the lower speeds. If the engine is run too long at a speed so low that this condition exists it may result in "scuffing" the pistons.

Care should be taken to shut off the primer immediately after starting, as there is a possibility that gasoline will be sucked into the induction system, causing an over-rich mixture, and dilution of the oil on the cylinder walls.

Providing care is taken in cooling the engine off after being up to power, by idling for several minutes, it is not necessary to shut off the supply of gas to the carburetor and run the carburetor dry. This procedure (shutting off the fuel), which is the result of past practice, pumps all available fuel from the carburetor, induction system and cylinders, and increases the difficulty in starting. It should be borne in mind that if the carburetor is not "run dry", the propeller should not be turned until the engine is cold, even though the switch may be in the "OFF" position, because there may be some particle of carbon hot enough to cause ignition. This procedure however, as stated above must be followed with extreme caution. **Shut off the gasoline after the engine has stopped.**

Observations at Start

The oil pressure should be noted immediately to determine whether or not the oil pump is functioning. If there is no oil pressure after fifteen (15) seconds STOP THE ENGINE AND FIND OUT WHY THERE IS NONE. REMEDY THE TROUBLE. When the engine has a fuel pump, the fuel pressure should be from 3 to 5 lbs. per square inch gage.

After the engine is warmed up and the oil has reached a temperature of at least 100° F. (38° C.), the throttle should be opened wide long enough to determine whether or not the engine is "revving up" properly, and whether or not both sets of ignition equipment are functioning satisfactorily.

Oil Pressure Regulation

Never change the oil pressure until it has been checked carefully with the engine warmed up thoroughly. Be sure that the oil used is of a proper grade. The pressure can be varied by varying the thickness of the washers on the relief valve located in the nose of the engine. There is another relief valve in the oil sump, but there should be no necessity for adjusting this valve. The oil pressure is set correctly when the engine leaves the factory, and should require no readjusting. An improperly designed oiling system in an airplane, or a broken line, will cause variation in the pressure, and these facts must be considered carefully before regulating the pressure. **The pressure gage should be checked for accuracy. Keep all Suction Lines Clean.**

CARBURETOR SETTING FOR NAU-4J STROMBERG CARBURETOR FOR CHALLENGER ENGINES

Venturi	$1\frac{7}{16}$"
Main Metering Jet	No. 48½
Main Air Bleed	No. 65
Upper Well Bore	$\frac{5}{16}$"
Upper Row Well Holes	4 No. 55
Lower Row Well Holes	4 No. 48
Idle Metering Jet	No. 63
Idle Air Bleed	No. 50
Idle Discharge Nozzle Orifice	No. 50
Suction Mixture Control Nozzle	No. 40
Float Needle Seat	No. 9
Valve Closes Completely	

Float Lever $\frac{7}{8}$" below parting surface with gasoline feed pressure three (3) pounds per square inch gage.

Magneto Timing

Left Magneto Fires Full Advance B. T. C. 36°
Right Magneto Fires Full Advance B. T. C. 36°

MAINTENANCE OF CHALLENGER ENGINE

A general inspection should be made before and after each day's flying. It is not necessary to remove spark plugs unless the action in operation indicates that there is a defective plug. All plugs should be inspected every 10 hours.

In freezing weather the oil in the lubricating system should be drained immediately after flight, while the engine is still warm. This, of course, is not necessary if the engine will not be idle long enough for the oil to become cold. When making ready for flight, if the oil is heated to at least 150° F, (65° C) before putting it into the tank, the engine will start much easier. This procedure will also eliminate a long period of time for "warming up" the engine.

After 10 hours of flight service, check the magneto breaker points. They should be **clean** and have a gap of .012".

The tappet clearances should be kept at .005" for the intake, and .010" for the exhaust, when the engine is cold. Check the clearances every 10 hours.

Check all outside nuts, bolts and connections after each 25 hours of flight service.

An overhaul is recommended when the engine performance indicates that it is necessary, which should not occur until after two hundred (200) hours of normal flight service.

After an overhaul "run in" the engine slowly, starting at 800 R. P. M.

Always use a NEW oil of a grade approved for use in the engine.

Let the engine run at 800 R.P.M. for an hour, and then increase the speed by steps of 100 R.P.M. every fifteen (15) minutes. For a test propeller that allows the engine to run at 1800 R.P.M., with the throttle wide open, this procedure should be followed up to and including 1600 R.P.M., then run at 95% of rated speed for not more than 5 minutes, then throttle down to about 1000 R.P.M. for ten minutes. Then check the engine to see if it "revs up" properly. Throttle down and let it idle for about ten (10) minutes, then shut off the ignition and the fuel. This approximates the "running in" procedure carried out at the factory. Be alert at all times for indications of trouble. Shut the engine down quickly at any such indication and **INVESTIGATE.**

For propellers that do not allow the engine to turn at its rated speed, start running at 800 R.P.M., and then increase the speed by increments of 100 R.P.M., every fifteen (15) minutes until the engine speed is 95% of the full throttle propeller speed. Run at this position five minutes and throttle back to 1000 R.P.M. Check the full throttle "revs." and the magnetos, and then let the engine idle for a short time.

For Simplex Rings the following should be carried out:

If the running in is done in the ship the propeller probably will not "turn over" more than 1450 to 1500 R. P. M. If the running in is done with a test club which is made for the engine the club should turn 1800 R.P.M.

Follow the schedule shown here. Pay very close attention to **Oil Pressure** and **Oil Temperature.** If the oil pressure drops or the oil temperature rises suddenly, SHUT DOWN AND FIND OUT WHY.

Check both switches from time to time to make sure all plugs are firing.

Check the engine all over after "running in" before flying. With Prop. that turns 1400 to 1500 with Wide Open Throttle.

R. P. M.	Running Time Hrs.-Min.
800	0-30
900	0-30
1000	1-30
1100	1-00
1200	1-00
1300	0-30
800	0-15
W.O.	30 sec.

With Prop. that turns 1800 with Wide Open Throttle.

R. P. M.	Running Time Hrs.-Min.
800	0-30
900	0-30
1000	0-30
1200	0-30
1300	0-30
1400	1-00
1500	1-00
1600	0-30
800	0-15
W. O.	30 sec.

Lubrication Instructions

1. Lubricate the rocker arms every five (5) hours.
2. Change the oil in the lubricating system every ten (10) hours.
3. Put five (5) drops of **light** cylinder oil in the oil cups of the magnetos every ten (10) hours.
4. When assembling the engine, be sure to have plenty of oil on ALL bearing surfaces. All bearings should be oiled while being assembled.

Cleaning of Oil Screens

The pressure oil strainer should be removed every 15 hours, and thoroughly cleaned.

The scavenging oil strainer should be removed, and cleaned every 15 hours.

STORAGE AND SHIPPING

If the engine is to be stored or shipped, all external steel parts should be sprayed with light grade Corol compound, or similar anti-rust compound. Remove the spark plugs and spray the compound in the cylinders. Replace the spark plugs. **Be sure the propeller shaft (and its threads) has a coating of compound or grease.**

If anti-rust compound is not available, put about a tablespoonful of cylinder oil in each cylinder, and turn the crankshaft 25 or 30 times to spread the oil over the cylinder walls.

TEARDOWN INSPECTION

Foreword

When the observer looks over the anti-propeller end of the engine toward the propeller end, everything to the left of the vertical plane through the center line of the crankshaft is referred to as being on the left (L.H.) side, and correspondingly those on the right of the plane, the right (R.H.) side.

Keep all parts clean. If the parts are not to be worked on immediately, cover the steel parts with light grade Corol, or other rust preventing compound.

It is recommended that each assembly be removed as a unit, and be kept as such until ready for the overhaul of the unit.

Disassembly

When it becomes necessary to completely disassemble the engine for re-conditioning, it is recommended that the following order be carried out:

1. Remove the oil drain plug.
2. Remove the spark plugs.
3. Remove the starter and generator.
4. Remove the oil pump.
5. Remove the carburetor and the carburetor spacer
6. Remove the ignition wires and conduits.
7. Remove the magnetos and test them.
8. Remove the anti-propeller end crankcase cover and the accessory drive gears.
9. Remove the oil sump assembly.
10. Turn the engine to a position with the propeller shaft up and remove the cylinder assemblies. Loosen the push rod housings, and remove them with the cylinders. It is possible to remove the push rods and housings separately, but time will be saved by removing push rods, housings, and cylinders in one operation. **Remove each piston after its cylinder has been taken off.**
11. Remove the nose section of the crankcase and the cam drive gear train.
12. Remove the propeller end half of the crankcase center section.
13. Remove the No. 1 master connecting rod.
14. Remove the No. 4 master connecting rod.
15. Remove the crankshaft from the crankcase.

Be sure to inspect each part thoroughly as it is removed from the engine. Then later, when the assemblies are being overhauled, inspect them again. Renew all assemblies that are not in excellent service condition.

Spark Plugs

The spark plugs should be inspected. The gaps should be measured, and then the plugs taken apart, using the special wrenches supplied by the manufacturer. Before taking a plug apart inspect its electrodes carefully. The ground electrode or pin may have to be driven out a small amount to prevent the electrodes from interfering with each other, and becoming damaged. The metal of the ground electrode is soft, and extreme care must be exercised when forcing the electrode out, to prevent bending or breaking it. The plugs should be cleaned by using gasoline and a stiff brush. **Keep each core with its respective shell.** Any carbon deposit on the core should be removed by rubbing it with fine sandpaper, making sure that the plug is cleaned well afterward. Do not use emery in any form.

When assembling the plugs make sure that they are tight. The gaps should be as specified by the manufacturer (0.015" for the B.G. Plugs), and if they are more, the ground electrode may be driven in enough to close the gap to that dimension.

All plugs should be tested with a booster magneto or high tension spark coil.

Starter and Generator

After these accessories are removed, inspect and test them. Repair if necessary.

Oil Pump Assembly

The oil pump assembly, which is a complete unit, can be removed by disconnecting the oil pressure line, and removing the nuts holding the pump to the cover. The pumps should be completely disassembled and inspected.

Carburetion Assembly

The exhaust heater assembly should first be taken off. Then the carburetion assembly can easily be removed by taking off the carburetor, and then the carburetor spacer.

The carburetor should be serviced according to the instructions given in the section devoted to the carburetor.

Ignition Assembly

The ignition cables and distributor blocks may be removed as a unit, after the ignition wire clips are disconnected from the engine.

The magnetos should be removed from the crankcase cover, and inspected according to the magneto manufacturer's directions. These directions may be found in the section assigned to the magneto.

Accessory Gear Train

After removing the crankcase cover, all the gears in the accessory drive gear train may be removed.

Be sure that all steel parts are covered with grease, oil or other rust preventative.

Inspect all parts closely for defects and wear.

Oil Sump Assembly

The removal of the oil sump housing makes the removal of No. 5 and No. 6 cylinders much easier. After removing the housing, the strainers should be taken out, inspected, and cleaned. Clean the entire housing carefully. Note any foreign material that may be found in the strainers.

Cylinder Assemblies

Remove the intake manifolds if there is any doubt about the condition of the gaskets. Remove the two screws holding the push rod housing to the crankcase, and the cylinder hold-down nuts. Rock the cylinder gently from side to side and remove by pulling straight outwards. Be careful that the push rods do not fall out, **and that the piston does not swing over against the studs.** As soon as the cylinder is removed the piston should also be taken off ,to avoid injury in subsequent operations.

To disassemble the valve gear proceed as follows: Remove the rocker box covers. After removing the rocker arm bearing covers and retaining bolts, the ball bearings can be removed by working the rocker arm back and forth. The rocker arm can be slipped out through the hole where the push rod housing elbow is attached.

The valves should be tested for leakage. Tap the valve stem to make sure the valve is seating properly. Then fill the ports with gasoline and note whether or not the valves leak.

A jig to hold the valves in place is helpful when removing the valve springs. This can easily be made from a block of wood trimmed so that it will bear on the valves when the cylinder is placed on it. Be sure the wood is clean. Depress the valve springs with the valve spring depressing tool supplied in the tool kit, and remove the locking pin and the valve spring retaining cone nut. Remove the springs and washers. Take off the wire lock rings located just below the threads of each valve stem. Holding the valves, take the cylinder off the jig, and place it in a horizontal position on a bench. Remove the valves, taking care that they do not strike the cylinder walls.

Cam Gear Train

To remove the cam gear train it will be necessary to take the camfollowers and their guides from the propeller end of the center section of the crankcase. Then remove the thrust bearing

cover at the nose, and loosen and remove the thrust bearing locknut. Be careful not to injure the oil slinger. Take the nuts off the studs holding the nose section and pull along the crankshaft until the thrust bearing can be taken off by hand. After the thrust bearing is removed the nose section can be taken off. The cam drive idler gear will come off with the nose section, leaving the crankshaft gear, and the cam and gear assembly accessible. Note carefully the condition of the crankshaft gear, its steadying bearing in the nose section, and the bronze bushing of the cam assembly.

Nose Section

After this section has been removed, take the cotter pin from the nut of the idler gear shafts, remove the nut and disassemble the gears. Examine the bronze bushing closely and the shaft of the idler gear, to determine their condition. Remove the oil relief valve from the section. Inspect all parts, and then clean the nose section and parts thoroughly.

Propeller End Crankcase Section

This section can readily be removed after the gear train has been taken out by merely removing the nuts from the large studs, and pulling the case off over the crankshaft.

Connecting Rod Assemblies

Although the crankshaft can be removed with No. 4 master rod assembly in place it is advisable to remove both connecting rod assemblies from the crankshaft before removing the shaft from the anti-propeller end crankcase center section. Remove one rod assembly at a time being very careful to avoid striking the studs in the cap against the crank pin.

Crankshafts

Crankshafts should be carefully removed from the crankcase, cleaned and inspected. Remove the oil retaining plugs from the crank pins. Be careful to keep these plugs tagged so that they will go back in the same place they were removed from. There is a plug with a hexagonal head at the end of the crank shaft (propeller end). This can be removed by use of a socket wrench as the aluminum pin which locks it in place can be readily sheared off. Remove the remaining portions of the pin and remove the burr from the hole in the shaft. At the anti-propeller end of the crankshaft, the crankshaft gear acts as a plug. This and the plug opposite should be removed so that this portion of the shaft can be easily cleaned. All the inside of the crankshaft should be washed out thoroughly with clean gasoline then dried. Examine the inside of the crankshaft as thoroughly as possible then spray it with Corol compound or swab with oil, so that it will not rust.

TOP OVERHAUL

The first thing to be done during a top overhaul is to remove all the rocker box covers, all screws holding the push rod housings to the cylinders and to the camfollower guides, and to loosen the packing glands in the rocker box housings. Loosen and remove all the intake manifolds, and inspect the condition of the gaskets and rubber packing very closely . Remove all spark plugs, and then loosen all the cylinder "hold-down" nuts. Although it is not absolutely necessary to remove the oil sump from the engine in order to loosen the nuts on cylinders 5 and 6, the job will be a good deal easier to do if the oil sump is removed. After all the nuts are loosened, remove all from each cylinder, except two (2) to hold it in place. Remove one cylinder at a time, and be very careful to see that the piston does not fall against the studs.

After each cylinder is removed, remove the piston from the connecting rod for cleaning and inspection. Before the piston ring can be removed, it will be necessary to remove one of the piston pin locking rings. This can be done with a small diameter round bar sharpened to a point. Force the point underneath the ring in the groove milled in the piston pin hole and pry the end of the ring from the groove, and then gradually work the rest of the ring out. If a piston pin should be tight in the piston, heating the piston with hot water or steam will usually expand it enough so that the pin will be easily removed. If this does not free the pin enough, it will be necessary to tap the pin out with a piece of fibre and a hammer. Be sure to support the piston so that the connecting rod does not take the force of the hammering.

Clean the piston and inspect it very closely for cracks. Look the rings over carefully to see that they are bearing all around. It is advisable to remove all the rings, and clean out the piston ring grooves in the piston, but do not use a tool that will scratch the fillets at the bottom of the groove. Clean the rings well with gasoline and check them for gap. Any rings which are worn so that the gap is larger than that shown in the summary of clearances under the heading of allowable, should be replaced. Clean out the piston pin bosses in the piston with gasoline and a clean cloth. Do not use emery paper or other abrasive.

If the piston pin has been overheated at any time it will show a dark blue or a dark straw color. If after the piston pin has been washed and polished, it shows a normal steel color, it is safe to use it in the engine again.

Test all the valves by filling the ports with gasoline (with the cylinder horizontal), and inspect the valves for leakage. Note each valve as this will give a clue as to which are going to need the most grinding, and also which will need reseating. Remove all the valve springs, using the depressing tool furnished in the tool kit. Some difficulty may be encountered in removing the valve nut locking pins, but with a little practice they can be

removed easily, as each hole is considerably larger than the diameter of the pin. Remove the valve washer retaining bushing (cone nut), and then the springs will all come off easily. Just below the threads on the valve stem there is a locking ring (safety ring), which will have to be removed before the valve can be taken out. Remove the valves and inspect the valves and seats. Those that appear to be in good condition and did not leak much, should be just touched up by grinding enough to show the high spots. Then if the valve appears to need refacing, it should be refaced to an angle of 45°. This retouching will also show the condition of the seat. If necessary the seat should be recut.

After refacing the valve (if necessary), and recutting the seat, grind the valve in. One or two minutes should suffice to make the valve gasoline tight. In all probability the valve stem guides will not need replacing, except at very long intervals. If these should need replacing, the old ones should be driven out and new ones driven in place. The replacement valve stem guides are oversize about .007 in. and should be driven in with a tool furnished by this company upon request . In any case after replacing valve stem guides, the valve seats in the heads MUST be recut.

After the valves are all ground, clean the cylinder thoroughly, paying special attention to the valve seats to make sure that none of the abrasive will remain. Likewise clean the valves thoroughly, put them back into the cylinder, put the lock rings on, and then assemble the springs on the valves. The split cone bushing should be screwed down until the top of the valve spring retaining washer is flush with the locking pin. Then with the depressing tool hold the washer down far enough that the lock pin can be inserted in the valve stem. Place the cylinder horizontal and fill the intake and exhaust ports with gasoline to test the valves. There should be no leakage, or at the most a very slight sweat at the valve. As soon as the valves of one cylinder are tight the cylinder is ready to replace on the engine. It will probably be easier to assemble the rocker arms on the cylinders before the cylinders are placed on the engine, although this job can be done without a great deal of trouble on an assembled engine.

All rocker arms should be inspected very closely before being reassembled on the engine. Pay particular attention to the condition of the push rod socket as this must be in good condition and be safely locked into the rocker arm by means of a small snap ring. The tappet adjusting screw should be inspected closely to make sure that the ball is free to move in all directions. Examine the cylindrical extension on this ball to see that the corners are not chipped. Try the rocker arm after it is assembled in place with the grease gun, to make sure that the oil is passing freely through the drilled portions of the rocker. See that the locking screw at the tappet end is in good condition.

Assemble the engine, one piston and one cylinder at a time as this will guard against getting nicks in the pistons from the studs in the crankcase. Be sure that BOTH piston pin retaining rings are in their proper places. Oil the piston and cylinder thoroughly before assembling the cylinder on the engine.

Assemble the push rods in their proper positions, remembering that there are three different lengths of push rods on this engine. The longest push rods are two in number, and are for cylinder No. 1; the next longest rods are four in number, and are for cylinders No. 3 and 5, all the remaining rods being shorter than any of those mentioned above, and are for cylinders No. 2, 4 and 6. Assemble the push rod housings making sure that all screws are tight, and that all packing nuts are screwed up so that the packing will not leak.

After all the cylinders are in place (with the push rods) set the tappet clearances (.005″ for the intake and .010″ for the exhaust).

Assemble all the intake manifolds. Be sure that these manifolds are fastened tightly to the cylinders, and that the rubber packing for each manifold is squeezed down sufficiently to keep air from being sucked into the manifold.

Use the gun furnished in the tool kit to lubricate the rocker arm, making sure enough oil enters so that it can be seen to issue from the ends of the rocker arm. Replace all rocker box covers. It is advisable to use new gaskets under the rocker box covers, as the old ones usually dry out after being used for some time.

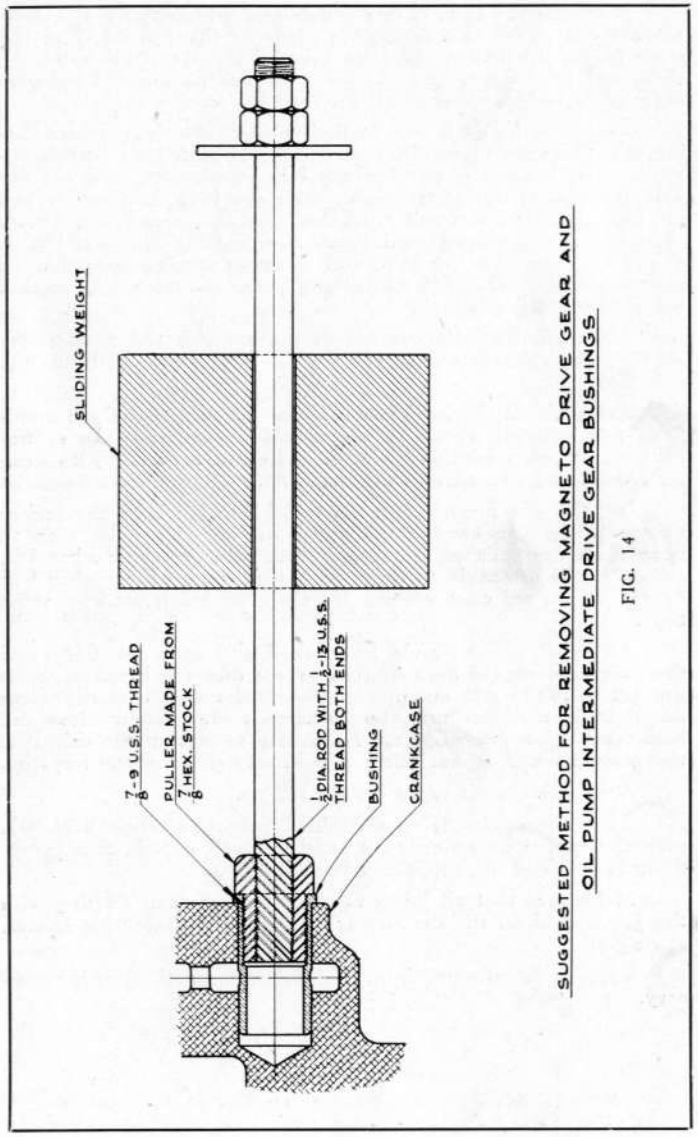
All spark plugs should be cleaned and gaps set .015″ and the magnetos should be inspected to see that the breaker points are set as .012″ gap and are clean. Make sure that the wires are tight in the distributor box, and that the ground wires and high tension booster wires are fastened securely. Make sure that the ground wires do not chafe against any parts of the airplane.

Assemble the oil sump on the engine.

After the engine is all assembled (except the spark plugs), turn the engine over slowly by hand to make certain that everything is free and in proper running condition.

Make sure that all joints in the intake system, starting with the joint to clean the carburetor and the carburetor air spacer, are tight.

Remove the strainer from the carburetor and clean if necessary.



SUGGESTED METHOD FOR REMOVING MAGNETO DRIVE GEAR AND OIL PUMP INTERMEDIATE DRIVE GEAR BUSHINGS

FIG. 14

COMPLETE OVERHAUL

CRANKCASE ASSEMBLY

Anti-Propeller End Section

Each section of the crankcase should be cleaned and dried. Look the castings over carefully for cracks, especially at studs.

Measure up the shafts of the idler gear and magneto drive gears. Compare their diameters with the diameters of their respective bushings. The clearance of the idler gear shaft in its bushing should not be greater than .006", and that of the magneto gear shafts not more than .005". If any of the clearances are greater, renew the bushing or bushings, and cut them to give from .001" to .003" for the magneto gear shafts, and .001" to .003" for the idler gear shaft.

The following is suggested as the easiest method of removing the bushings from the crankcase. The bushing for the magneto drive idler gear shaft can be very readily removed by simply driving it out with a mandrel. **Be very careful to avoid losing the locking pin, as it can be used again.** The other three bushings are somewhat harder to remove and the use of a device as shown in figure 14 is suggested. Tap the bushing with a 7/8"-9 U.S.S. tap and screw the removing tool into the bushing. Then the bushing can be removed by merely hammering the nut on the end of the tool with the sliding block. It is possible to remove the bushing in many other ways but this probably will be the most satisfactory way as it is less liable to damage the crankcase.

The new bushings are the correct outside diameter to fit in the case and should be driven in place with a mandrel. Care must be taken in driving these bushings to line up the lock pin holes in the crankcase, and in the bushings. Insert the lock pins, and peen the hole in the bushing over enough to prevent the pin from getting out.

After this it will be necessary to ream the bushings to size. The magneto drive intermediate drive gear shaft bushing should be reamed to .999"- 1.000" dia., and the other three bushings should be reamed to .749" - .750" dia. A jig which may be obtained from the Curtiss Aeroplane & Motor Company, Inc., must be used for finishing these bushings to insure the correct mesh for the gears, as a mistake of a few thousandths of an inch in the distances between the centers of two of the gears might be enough to cause faulty operation.

After the bushings have been tested with plug gages, and are correct, wash the case very thoroughly, to insure that no particles of the abrasive or of the bronze remain.

Inspect the steel liner for the crankshaft ball bearing, to make sure that it is in good condition.

Propeller End Section

This section of the crankcase carries no bushings for gears, nor any other part that requires any special assembly, except the steel seat for the crankshaft ball bearing. This seat should be inspected carefully for condition, but no attempt should be made to replace it (or the one in the anti-propeller end section) in the field, as the assembly of this ring and its consequent machining should be done only at the Curtiss plant. These seats should have indefinite life. Inspect the casting closely for cracks. Wash this section very thoroughly, and dry it with an air stream. Put oil or Corol compound on all steel surfaces to prevent rust. After this section is thoroughly clean, the crankcase is ready to have the crankshaft assembled in it.

CRANKSHAFT ASSEMBLY

Wash out the inside of the shaft with gasoline until it is clean, then oil the inside so it will not rust and replace the plug in the shaft. Use Permatex to prevent leaks. Tighten it up to where it was before and put in a new aluminum locking pin. DO NOT USE ANYTHING BUT ALUMINUM FOR THE LOCKING PIN, AS THE PIN MUST BE SHEARED OFF WHEN REMOVING THE PLUG, AND A HARDER MATERIAL WILL DAMAGE THE THREADS. Peen the lock pin hole in the shaft just enough to stop the pin from getting out of the hole.

Measure the crankpin diameters (with micrometers), and record the dimension. Take at least four (4) measurements for each crankpin, two (2) in the plane of the throw and two at right angles to the throw. Use these dimensions for determining the bore of new bearings, if they are to be fitted.

Inspect the crankshaft very thoroughly to make sure there are no cracks, and that the bearing surfaces are in good condition.

If it is necessary to recondition a crankpin, the work should be done at an authorized Curtiss Flying Service Station or at the factory.

Clean the shaft thoroughly with gasoline, using a spray if available, then dry it, and if the shaft is not to be used right away, be sure to cover it fully with some light rust-proofing compound such as light grade Corol compound.

The ball bearings which form main bearings should be tested to see if they run freely and quietly. Put a drop or two of light oil in the outer race before spinning each bearing. A serviceable bearing should spin easily and quietly. If there is more than .025" end play in the bearing, the bearing should be replaced by a new one.

There is a plain bearing at the anti-propeller end that does not carry any load but serves merely to pass oil into the crankshaft.

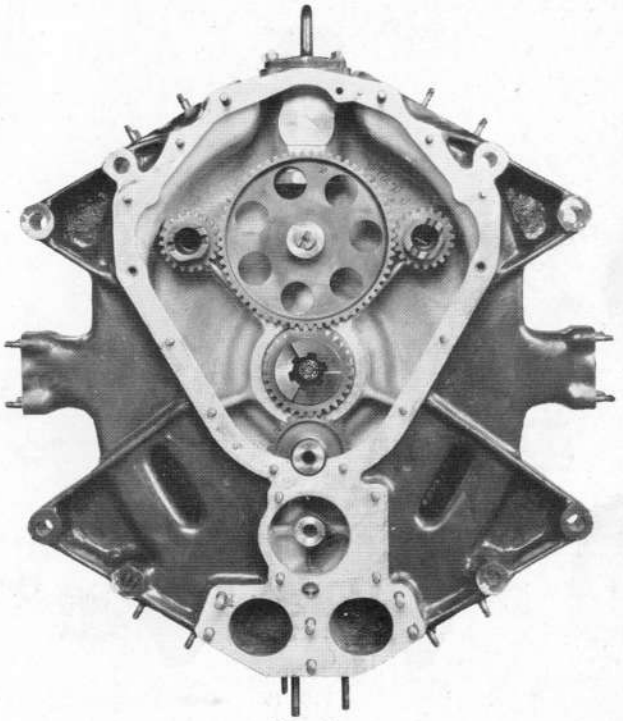


FIG. 15

CURTISS CHALLENGER—CRANKCASE, SHOWING ACCESSORY DRIVE TRAIN

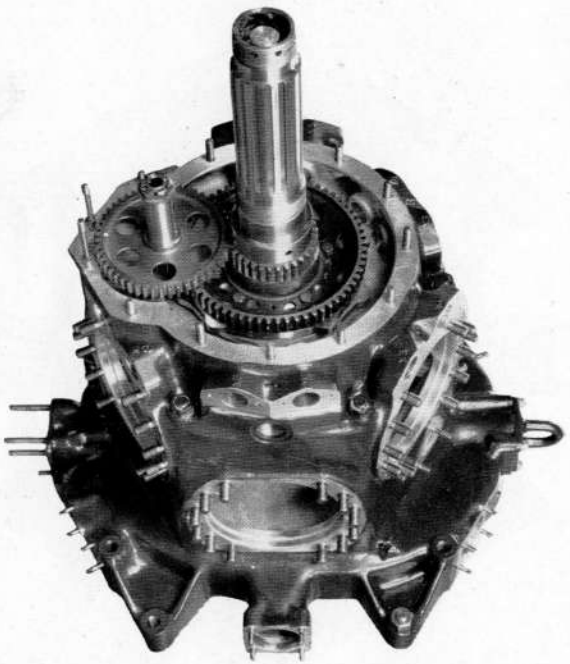


FIG. 16

CURTISS CHALLENGER—SHOWING CRANKCASE AND CAM DRIVE TRAIN

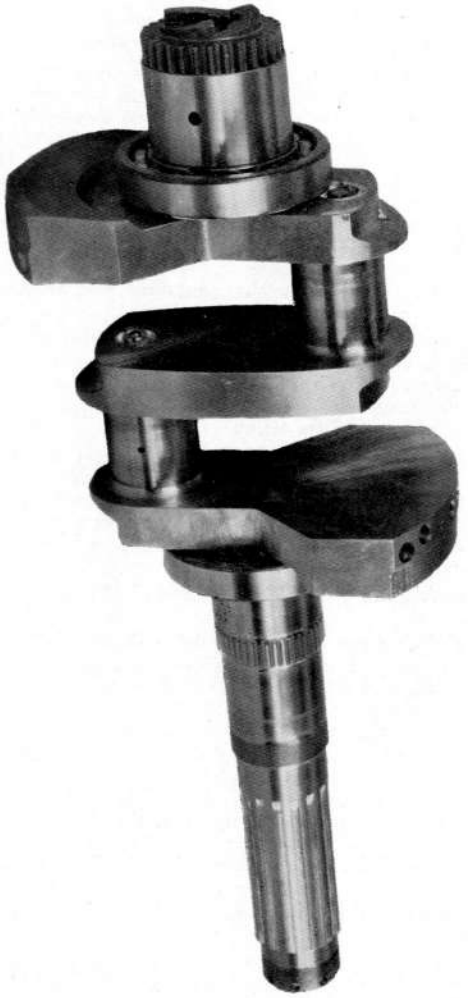


FIG. 17

CURTISS CHALLENGER—CRANKSHAFT

Assemble the oil retaining plugs back in the positions from which they came. Be sure all cotter pins are in place tight enough to prevent them from moving.

Assemble the crankshaft gear on the crankshaft. Cotter the nut holding the gear in place. **Be sure the cotter is tight.**

For assembling the engine, it is much more convenient to have the engine on a tilting stand although the work can be done on a fixed stand. Turn the engine to a position where the crankshaft will be vertical, and carefully lower the crankshaft assembly into place in the anti-propeller end section. Then slip the propeller end section on over the nose of the crankshaft. Put "Heldite," or similar gasket liquid on the joint between the two sections of the crankcase, and assemble the crankcase together, drawing down on the nuts carefully and slowly so that there will be no danger of springing the case. Be sure to cotter pin the nut of the stud inside the propeller end section at the bottom.

Next, the spacer C-10123 should be assembled on the shaft. Measurements should be taken of the bearing surface on which the cam assembly runs. These measurements (diameters) should be taken at right angles, and at both ends of the spacer. At least four measurements should be taken .

Compare these measurements with the bore of the bronze bushing of the cam assembly. If the dimensions show a clearance of not more than .006", and both rubbing surfaces are in good condition, oil the bushing and assemble the cam assembly on the spacer. If the spacer is not in good condition a new one should be provided.

Then assemble the C-10122 shim, and C-10124 gear in place on the shaft.

The remaining gears of the cam drive should next be assembled in the nose-piece. Inspect the bronze bushing to see whether or not it is smooth and not over 1.003" diameter. The adjusting shaft C-10044 has a large integral gear.

If the clearance of the adjusting shaft shows that the bushing should be replaced, the bushing should be pressed out. **Be careful to avoid losing the locking pin for the bushing.** The new bushing (C-10366) should be pressed in. The hole in the bushing for the locking pin must line up with the hole in the nose-piece, so the lock pin can be put in place. Tap the pin into place, and peen the edge of the hole to keep the pin from working out of place.

The bushing can then be reamed, using a fixture similar to that used at the factory.

This fixture must be used to make the adjusting shaft line up properly when in place in the bushing. The bushing should be cut to .999" to 1.000" diameter.

Remove the oil pressure relief valve, and clean all oil passages in the nose-piece, then replace the relief valve.

Oil the adjusting shaft and assemble it in the bushing. The drive shaft assembly C-10204 should be assembled into the adjusting shaft, and locked in place by its nut and washer.

The next step is to assemble the nose-piece on the engine. Be careful in placing the gasket on over the studs to avoid tearing it. To make sure that there is backlash in the gears of the timing train, tighten the nut which holds the timing disc in engagement, and then try to turn the nut with the fingers. If the nut and shaft to which it is attached can be "rocked" enough for the mechanic to feel a slight motion the gears have backlash enough.

The flat deflector (C-10222) should be put in place on the shaft, and then the propeller thrust bearing put in place. Next, the "dished" oil deflector (C-10221) is assembled with the flat surface next to the thrust bearing, the whole being locked in place on the shaft by the C-10354 lock nut. **Be sure to get the latter on tight enough so it cannot loosen.**

The C-10220 cover plate should not be assembled until after the engine has been timed.

The engine will then be ready for assembling the camfollower guides and camfollowers.

Camfollowers and Camfollower Guides

The camfollowers should be cleaned thoroughly and inspected for wear. Pay particular attention to the condition of the rollers and the roller pins. The rollers should be free to turn, but not free enough to have "wobble" on the pins. Note the edges of the rollers to see whether or not they are chipped. If the camfollowers and guides are in good condition, oil them with cylinder oil and assemble on the engine.

If the edge of the rollers are found to be chipped, the rollers can be removed by drilling the pin which holds the rollers in place. Drill this pin with a **center drill** until the portion which is riveted over is removed. Then the pin can be driven out. Replace with a new roller and roller bushing, and rivet the new pin in place just as the old one was riveted. Be very careful when riveting the pin to avoid damaging the camfollower in any way.

The camfollower guide should be measured with a plug gage to see whether or not any wear has taken place. Pay special attention to the ends to make sure that they are not "bell-mouthed". If the measurements taken from the camfollower and the camfollower guide show that there are no clearances greater than that shown in the "allowable" column of the Summary of Clearances the camfollowers and guides can be used again.

Both camfollowers and camfollower guides should show good bearing surfaces. If the bearing surfaces are **not good,** but the clearances are satisfactory, the parts should **not** be used.

It is advisable to use new gaskets under the camfollower guides. After assembling the camfollowers and the guides, make

sure the camfollower slides freely in its guide. Use plenty of oil when assembling.

Accessory Drive

Oil the shaft of the magneto drive idler gear (and its bushing) and assemble the gear in place.

Do not assemble the magneto drive gears, as they should be assembled with the magnetos.

The oil pump idler gear can be assembled at this time. Hold the gear in position and push the shaft through the gear into the bushing.

All shafts should be in good condition.

The backlash of the gears should conform to the "Summary of Clearances".

Assemble the accessory drive cover, using a new gasket. Assemble the tachometer drive assembly after oiling it well.

Oil Pump Assembly

Disassemble the oil pump for inspection. The dural follower gears probably will be scored as will the pump bodies. This scoring is characteristic and unless very deep will not affect the operation of the pump. Clean out all pump passages. If everything is in good condition reassemble the pump DRY and test it by spinning the shaft with the fingers. If it turns freely put some oil into both pumps and assemble the pumps on the engine. If the keys of the shaft and keyways of the pump bodies are in line and the pump is held with the gear down it is possible for the pump shaft to drop out. **Take care that this does not happen.**

Assemble either the fuel pump or the substituting cover, whichever the engine is equipped with.

If the pump should need new gears assemble them in place. Fit them to the clearances noted in the Summary of Clearances. There will be no necessity for replacing the steel gears unless something large enough to wreck the pump gets into the gears. In such a case a whole new pump would be needed. In case a housing was cracked the best procedure would be to get another pump.

Connecting Rod Assemblies

The master rod bearing should be measured and compared with its corresponding crankpin diameter. If the average diametrical clearance is not more than .005", and the bearing material has a good appearance, **do not disturb the bearing.** If the bearings need replacing, the old shells may be removed by cutting off the "headed over" portion of the rivets, and driving the rivets out. New shells should be riveted in place. **Be sure the rivets are tight.** The "pinch" or "draw" of the shells in the rod should be from .007" to .009" to insure their seating tightly in the rod.

The "draw" may be fitted as follows, using a C-10039T1 clamp to hold the shell tightly in place.

The draw may be fitted either on the shell in the rod, or on the shell in the cap. As a rule, it will be found easier to fit the draw on the shell in the rod itself, as the studs are somewhat in the way when fitting the other shell. File the ends of the shell so that they hold the cap away from the rod from .007" to .009", making sure that the clearances are the same at all four corners of the shell. The end of the shell itself should be plane (flat) to make certain of even pressure all around, when the rod is clamped together. In finishing up the shells to this clearance, better results will be obtained by filing to a point where the clearance is about .001" to .002" greater than that desired, and finishing by rubbing the shell on emery cloth which is supported on a surface plate. When the correct draw is fitted, the rod should be clamped tightly together for boring the shells.

The diameter to which the shells should be bored can be determined from the measurements taken from the crankpin upon which the bearing is to run. The bearing diameter should be of such a dimension as to give a maximum of .0025" and a minimum of .002". When the bearing size is determined, the rod should be assembled in a Curtiss fixture for boring. The bearing should be cut with a fly cutter and a boring bar. **Reaming is not recommended.**

If the connecting rod bearing has been replaced, it is recommended that the bronze bushings for the piston pin and for the link pin be also replaced. These can be easily pressed out of the rod, and new ones pressed in. These should be cut in the grinder by mounting the rod on a fixture or jig that may be obtained from the Curtiss Aeroplane & Motor Co., Inc. This fixture will insure the correct center distance between the bushing and the connecting rod bearing. These bushings should be ground and **not reamed.** The bushings should be measured, after grinding, by plug gages which are the correct dimensions. After the cutting and grinding operation, the rods should be very carefully cleaned to make sure that no abrasive is left on the rod or in the bearings.

After this, the wax which has been put in the oil passages to keep chips from entering, should be cleaned out with a small wire, or be removed by heating the rod enough to cause the wax to melt.

The alignment of the piston pin hole and the connecting rod bearing bore should be checked by using a mandrel in the piston pin hole, and another in the connecting rod bearing. Support the mandrel of the connecting rod bearing in Vee blocks so that the rod can be rotated in a vertical plane thru an arc of 90°. Using measuring blocks and a dial indicator, measure the difference in height, when the rod is vertical, between the two ends of the mandrel in the piston pin hole. Then swing the rod down to a horizontal position, and get the difference between the two ends with the same mandrel. The greatest difference should not

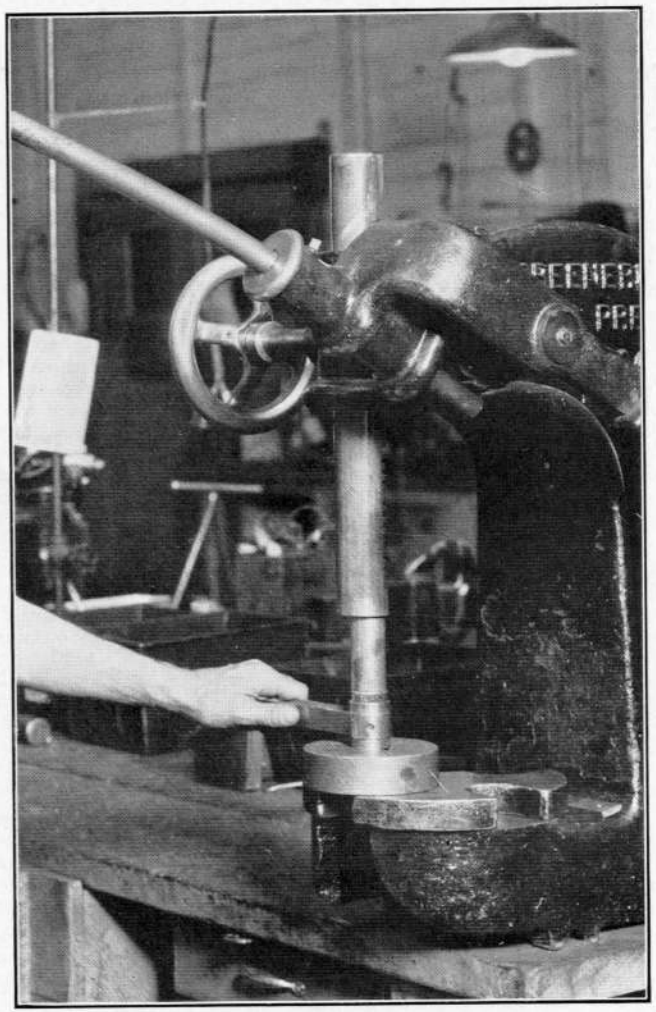


FIG. 18

REMOVING PISTON PIN BUSHING

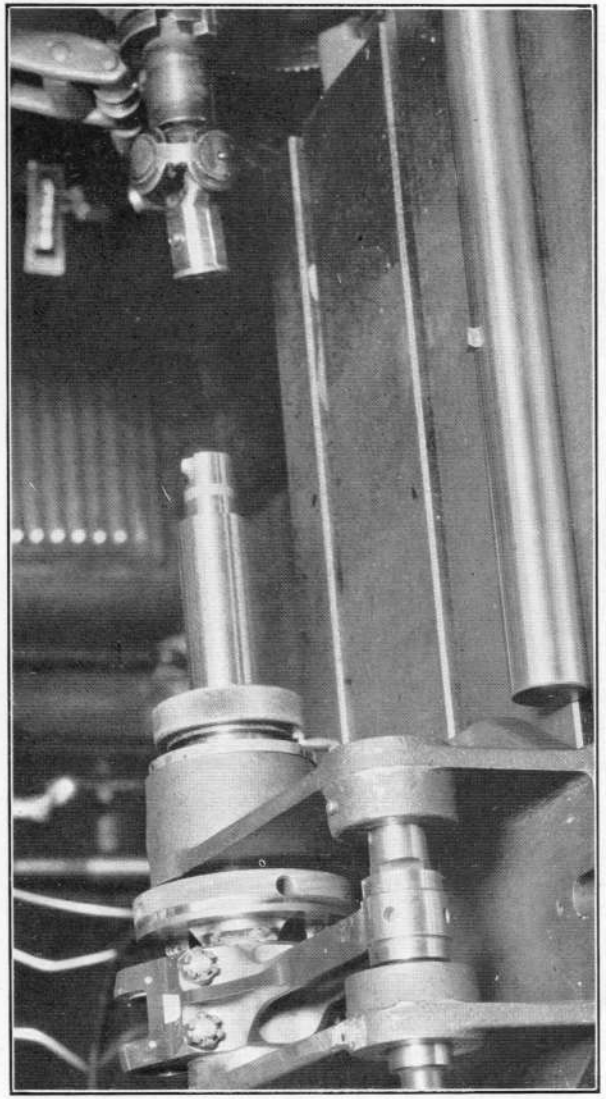


FIG. 19

BORING CONNECTING ROD BEARING

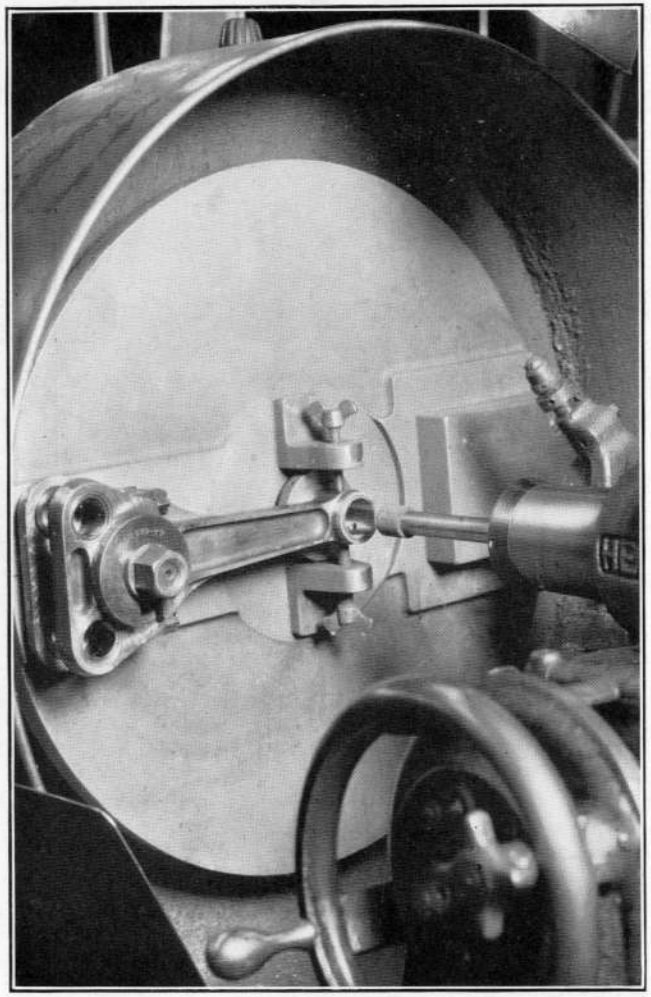


FIG. 20

GRINDING PISTON PIN BUSHING

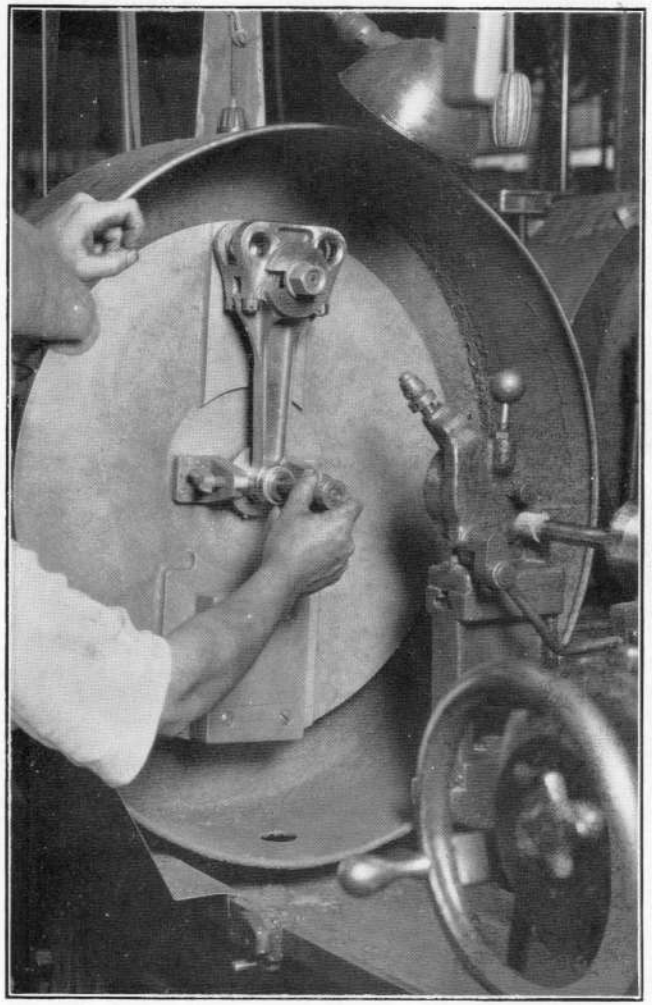


FIG. 21

GUAGING PISTON PIN BUSHING

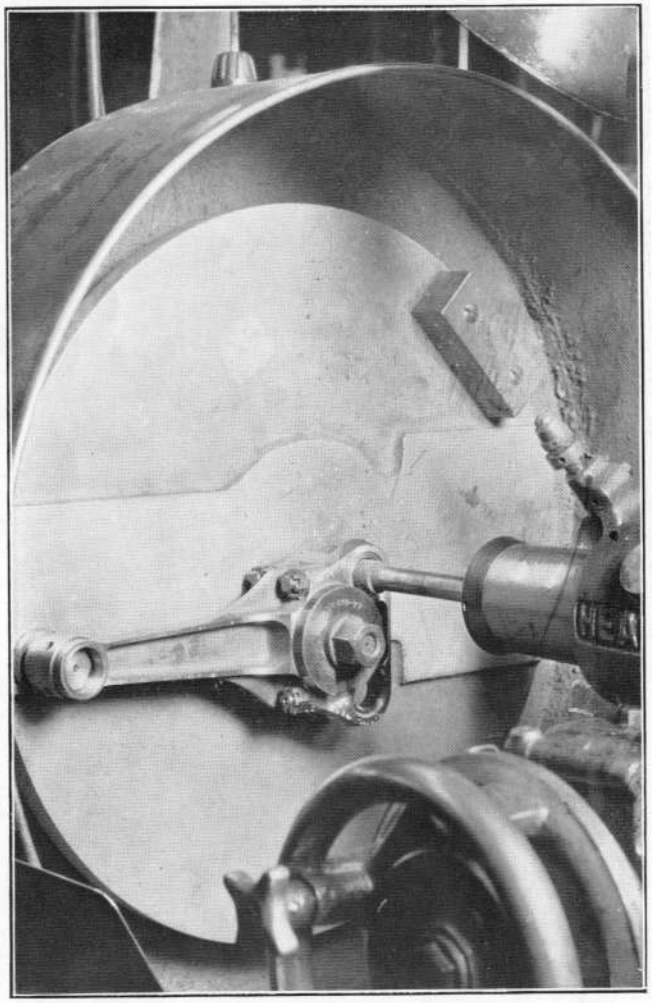


FIG. 22

GRINDING WRIST PIN BUSHINGS

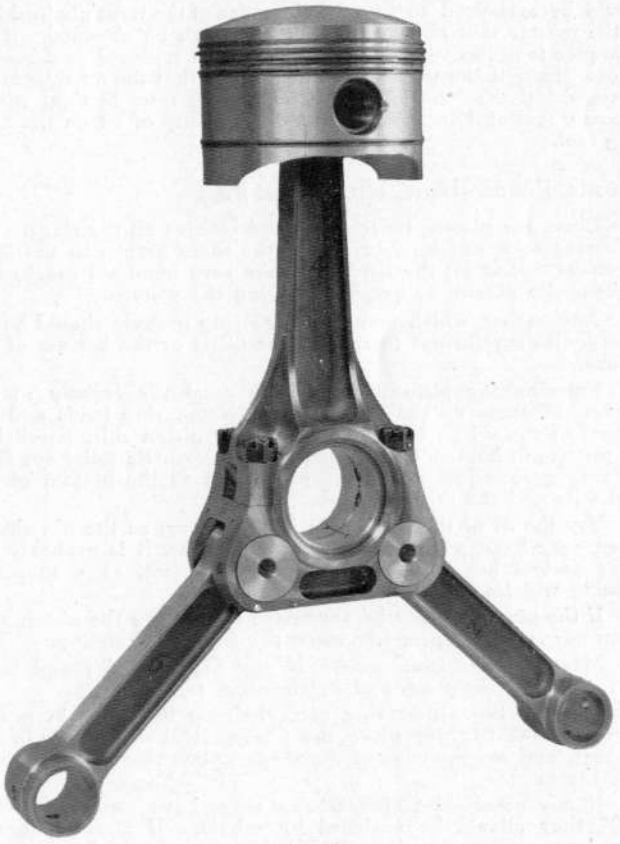


FIG. 23

CONNECTING ROD AND PISTON ASSEMBLY

be over .006″ for a mandrel 12 inches long. If the rod passes this test, it is ready to assemble in the engine. The short rods are tested in the same manner.

The wrist pins should be inspected to see that the bronze or aluminum in the end is not cracked. The wrist pin diameter should be measured so that the clearance of the wrist pin bushings in the master rods and in the short rods can be obtained. If the clearance is excessive the bushing should be replaced as described before. Inspect the wrist pin to make sure that the oil tube is not loosened. If the tube is loose, it should be spun in tight with a spinning tool and an electric drill. Use plenty of oil on the spinning tool.

Pistons, Piston Rings, and Piston Pins

Clean the pistons thoroughly, and remove all the rings. Tag each ring so it can be returned to the same groove in the same piston. Look at all the lands to make sure none are cracked or broken. Be careful to avoid scratching the pistons.

Any carbon which may be in the ring grooves should be removed. Be careful not to scratch the fillets or the bottom of the groove.

Examine the pistons closely for cracks, especially at the bosses. Measure up the piston at the piston ring lands and the bottom of the skirt . Do not measure the piston skirt parallel to the piston pin hole as each piston has an eccentric relief cut from the ring groove just above the piston pin to the bottom of the skirt. Record the measurements.

Try the fit of the piston pin in the piston, as the pin should be an easy hand push fit. If the pin is tight, it is probably because carbon has formed in the piston bosses, so a thorough cleaning will free the pin.

If the pin can easily be assembled by heating the piston with hot water it will fit properly when the engine is running.

Measure the piston pins. If any are out of round more than .002″, or show signs of overheating, replace them.

Measure the piston ring gaps, holding the rings in a ring gage (C-6648-T1), or place the piston (without rings) in the cylinder, and use the ends of the skirts to line the ring up square with the bore.

If any scarf joint compression rings have gaps more than .040″ they should be replaced by others. If any oil control rings have gaps more than .035″, they too should be replaced. Any engines that have step joint rings should have these removed, and scarf joint rings put in their places.

Special care must be given to make certain that the rings which are to be assembled on the piston are the correct ones for the engine. In each ring groove where the Simplex rings are to be used there is $\frac{1}{16}$″ diameter hole in line with the piston pin boss. This hole is to locate the expander properly. To assemble

these rings, first put the expander in place making sure the locating pin is in this hole. Be sure that the expander fits evenly all around in the groove, then assemble the piston ring on over the expander. Place the rings on the piston as shown on figure 24.

Cylinder Assemblies

The cylinders should be inspected thoroughly after the combustion chamber has been cleaned. Watch the head closely for cracks, and the barrel for spots or streaks, indicating heavy rubbing. Test the valves with gasoline, and if they do not leak do not grind them. They should be removed from the cylinder head so that the seats may be inspected. Unless any valve looks as if it needed a slight touching up, do not grind it.

If the bronze valve seats appear pitted, but the valves do not leak, do not recut them as this pitted appearance is characteristic of the aluminum bronze seats after the engine has been used for a short time. If the valve seat is pitted, and the valve leaks, try "lapping the valve in" and if a short grinding does not stop the leaking, reface the seat. Do not cut any more than is absolutely necessary off the seat, and then touch the valve up using grinding compound.

If the valve seat is recut the valve should be refaced on a grinder to a 45° angle. Do not cut more than is absolutely necessary.

Measure the cylinders to determine the piston clearances. If the cylinder is not more than .005″ out of round, or the clearance is not greater than .050″ at the top of the piston, and .042″ at the bottom, the cylinder and piston need not be replaced. Practically all wear takes place on the piston. Reassemble the valves in the cylinder head. **Be sure to put the safety lock** ring on each valve stem. Put the valve springs back on the valves, and lock the split bushing holding the valve spring washer in place. This bushing should be screwed down until the locking pin is just flush with the top of the valve spring washer.

After cleaning and inspecting the rocker arms and their bearings, assemble them on the cylinder.

It is well to overhaul cylinders No. 1 and No. 4 first.

As soon as a cylinder is ready to assemble on the engine, oil the piston pin, and put the piston for that cylinder on its connecting rod. **Each piston should be assembled in the engine so that the piston boss which has the number stamped on it, is next to the propeller.**

Be sure BOTH piston pin locking rings are tight in place in EACH piston.

Slip the cylinder packing in place over the sleeve. It is advisable to use new packing rings during an overhaul.

Compress the rings in place with the clamp furnished in the tool kit, oil the cylinder walls, and slip the cylinder on over the piston. Cylinder No. 1 should be assembled first. Put each cyl-

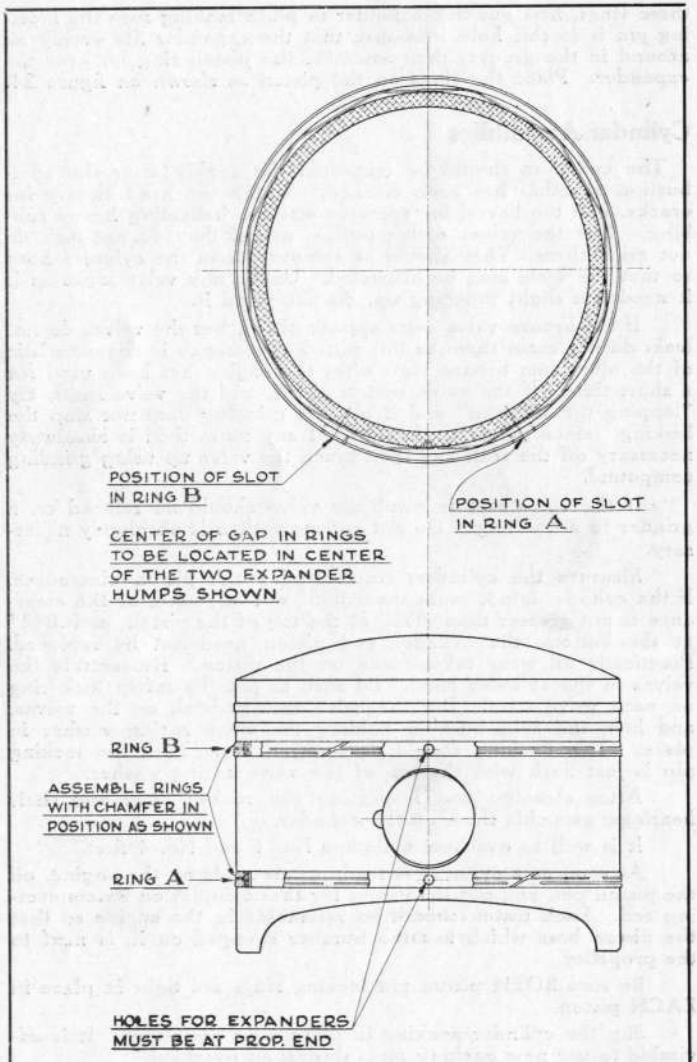


FIG. 24
LOCATION OF GAPS WHEN ASSEMBLING SIMPLEX RINGS

inder on and tighten all the nuts. Make sure all the hold down nuts are tight on each cylinder.

Next, assemble the intake pipes. Put the clamp ring and rubber packing on the intake pipe, and assemble the pipe on the engine. Tighten the cap screws holding the pipe to the cylinder, before tightening the rubber packing and its gland in place. **Do not attempt to pull the packing gland down enough to seat it on the crankcase casting, as it is not supposed to be drawn down so far.**

Push Rods and Push Rod Housings

All push rods should be tested for straightness. Use an indicator and "Vee" blocks, rotating each rod in the "Vee" blocks taking an indicator reading at the center. If the indicator shows a "bow" of more than .006", straighten the rod.

There are three (3) sets of push rods. The push rods for cylinder No. 1 are the longest and comprise one set. The rods for cylinders No. 3 and No. 5 comprise the second set (4 push rods) and are of intermediate length. The third set consists of six (6) rods and is the shortest set. These are for cylinders No. 2, 4 and 6. **Make sure each rod is assembled in its proper place.**

The packing gland on the rocker arm housing should be loosened so the push rod housing tube can be moved in and out of the rocker arm housing. Put the push rod in its proper housing and assemble all on the engine. There should be some oil on each ball end of the rod. It will be necessary to loosen the adjusting screw as much as possible and open the valve somewhat, in order to get the push rod in place. It is advisable to use new gaskets under the lower end of the push rod housings, and between the rocker arm housing and the cylinder head, during each overhaul. Fasten the housings to the engine and tighten the tappet adjusting screws to give .005" clearance for the intake valves and .010" for the exhaust valves. **Be sure to tighten the locking screws.**

Turn the crankshaft in the direction of rotation until the EXHAUST valve of cylinder No. 5 just starts to open.

Loosen the nut of the adjusting shaft (in nose piece) of the timing gear train.

Remove the plug in the crankcase just ahead of cylinder No. 1, and turn the crankshaft in the direction of rotation until the line marked "IGN. 1" and "EX opens 5" lines up with the line on the side of the hole. Turning to the line puts the crankpin of No. 1 cylinder 36° B.T.C., and in the correct position for timing the **magnetos**. The magnetos are timed on cylinder No. 1, and the valves on cylinder No. 5. The line on the counterweight lines up with the line in the hole, when No. 1 piston is in firing position, and when piston No. 5 is 96° B.B.C., the point where the exhaust valve of cylinder No. 5 starts to open.

Tighten the nut of the adjusting shaft of the cam drive train.

Magnetos

If the magnetos have given indications of needing overhauling they should be sent to magneto specialists (preferably the manufacturer) for reconditioning. If they do not need an overhauling they should be inspected according to the section of this book which deals with magnetos.

Assemble the magneto couplings on the magneto shaft (if they have been removed). The best way to assemble the magnetos is to take each one, and its drive gear, holding the drive gear in position with the coupling and assemble the whole as a unit. The magneto shaft should be turned just before the teeth of the magneto drive gear mesh with the magneto drive intermediate gear to a position which approximates the firing position. To do this it is necessary to have the crankshaft in its proper position, i.e., the mark on the counterweight of the crankshaft should line up with the line scribed on the inside of the hole provided for timing. The distributor of the magneto must be in position to furnish a spark **for No. 1 cylinder.** When in this position, the distributor gear marks line up with the marks on the magneto frame. By timing this way it is possible to get the exact timing by shifting the magnetos slightly on the case. When the magnetos are assembled the engine is ready for timing.

Magneto and Valve Timing

The following precautions should be followed when timing the magnetos.

1. Make sure the breaker gap is correct (.012″ for Scintilla magnetos).
2. Have the spark advance lever in the full advance position.
3. Be sure the timing marks on the crankshaft counterweight and on the crankcase line up.
4. Have all backlash "taken up".

Tighten the magneto mounting nuts, just enough to provide friction, so the magneto can be turned by tapping it with the hand.

Tap the magneto to a retard position. If "feelers" are to be used for setting the magneto, separate the breaker points and insert a .0015″ or .002″ thickness gage or "feeler". Tap the magneto in the direction opposite to the rotation of the shaft until the points barely release the "feeler". Tighten the magneto in this position. Then rotate the crankshaft backwards about 20°, and put the "feeler" between the points again. Turn the crankshaft in the direction of rotation until the "feeler" is released. See if the line on the counterweight, and the line on the hole, line up. If they do not, shift the magneto to make them line up when the points start to separate. Repeat with the other magneto. **Be sure the spark advance lever of the magneto is in the FULL ADVANCE position when timing.**

If a small light is to be used in timing, put a piece of insulating material between the bronze arm carrying the breaker points and the springs making contact with this arm. Connect the light,

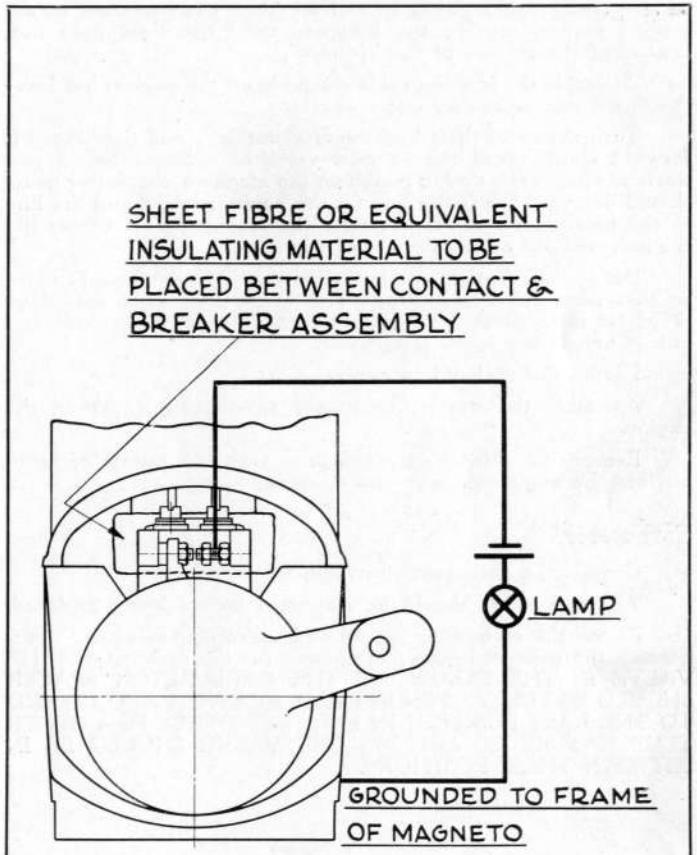


FIG. 25

WIRING DIAGRAM FOR CHECKING IGNITION TIMING OF SCINTILLA MAGNETO

battery and breaker points in series. Time the magnetos as described before, moving the magneto until the light goes out, instead of the release of the "feelers".

Assemble the ignition cable assembly on the engine, but leave the distributor blocks off one magneto.

Turn the crankshaft backwards about 20°, and then move it forward slowly until the exhaust valve of cylinder No. 5 just starts to open. The timing marks on the magneto distributor gears should line up. See if the line on the counterweight and the line in the hole match up. If not time the engine again. Cotter pin the nut, and put on the thrust bearing cover.

Put the spark plugs in the cylinders. Tighten them in place so that they will not loosen. The spark plug gaps should be .015" for B. G. plugs. All plugs should be clean both inside and out. Connect the spark plug wires.

Put on the rocker box covers.

Assemble the starter, or starter substituting cover on the engine.

Remove the lifting eye, and pour two (2) quarts of clean oil into the engine through the opening.

Carburetor

Consult the carburetor instructions.

The carburetor should be inspected before being replaced.

Fasten the carburetor spacer and carburetor in place. Connect up the exhaust heating equipment for the carburetor. THE VALVE IN THE ELBOW AT THE CARBURETOR SPACER SHOULD BE FULLY OPEN IN COLD WEATHER AND CLOSED TO THE LAST POSITION IN HOT WEATHER. FOR OTHER TEMPERATURE CONDITIONS THE VALVE SHOULD BE IN BETWEEN THESE POSITIONS.

FOREWORD FOR PARTS LIST

These lists are made up primarily for use in ordering replacements, not for assembly lists.

All orders for replacement parts should include the MANUFACTURER'S ENGINE NUMBER. This will expedite the delivery of parts.

These lists show all the LATEST parts that have been used in production for these engines. BE SURE TO INCLUDE THE MANUFACTURER'S ENGINE NUMBER IN THE ORDER.

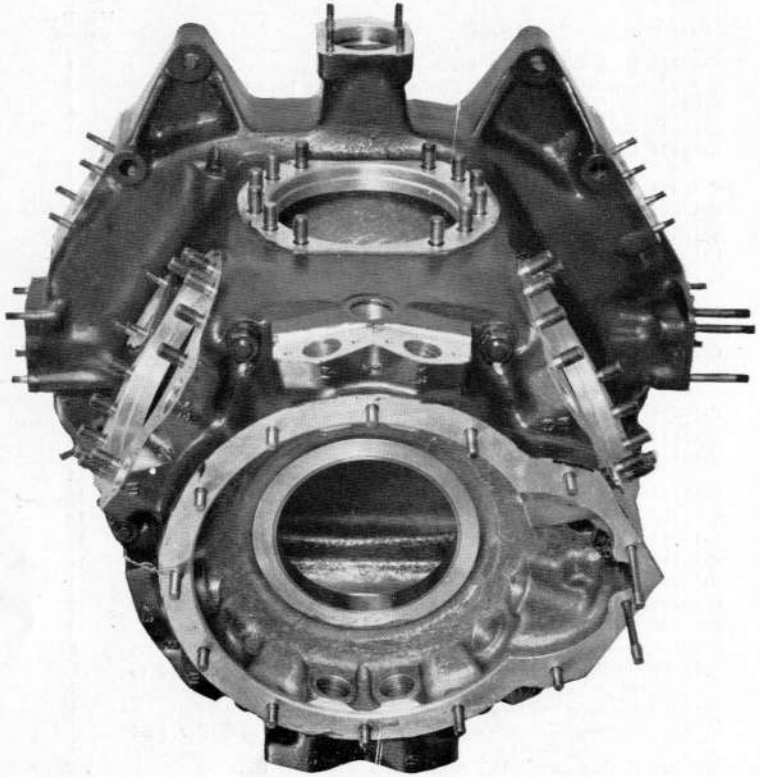
INDEX FOR GROUPED PARTS LIST

LIST OF GASKETS FOR CHALLENGER ENGINE

LIST NO. C-10595

Part No.	Name	No. Required
C-2311	Gasket—Electric Starter	1
C-4092	Gasket—Gear Gas Pump Driveshaft Housing	1
C-8251	Gasket—Breather Flange to Crankcase	1
C-10045	Gasket—Generator Substituting Cover	1
C-10058	Gasket—Crankcase Center Section to Crankcase Propeller End	1
C-10059	Gasket—Oil Sump Housing to Oil Sump Housing Cover	2
C-10061	Gasket—Crankcase Propeller End to Oil Sump Housing	1
C-10083	Gasket—Carburetor Spacer to Carburetor	1
C-10092	Gasket—Pressure Oil Strainer Cover	1
C-10096	Gasket—Crankcase Center Section Anti-Propeller End to Oil Pump	1
C-10142	Gasket—Gun Synchronizer Substituting Cover and Lifting Eye	1
C-10168	Gasket—Cylinder Head Cover to Cylinder Head	12
C-10223	Gasket—Crankcase Propeller End to Crankcase Propeller End Cover	1
C-10235	Packing—Intake Manifold	6
C-10242	Gasket—Manifold to Cylinder Head Intake	6
C-10250	Gasket—Oil Sump Housing to Crankcase Center Section Anti-Propeller End	1
C-10271	Gasket—Push Rod Enclosing Tube to Camfollower Guide	12
C-10277	Packing—Push Rod Enclosing Tube	12
C-10278	Gasket—Rocker Arm Housing to Cylinder Head	12
C-10279	Gasket—Camfollower Guide to Crankcase	12
C-10283	Gasket—Carburetor Spacer	1
C-10284	Gasket—Exhaust Gas Heated Carburetor Intake Elbow	1
C-10316	Gasket—Carburetor Exhaust Heated Outlet Flange	1
C-10377	Gasket—Manifold to Cylinder Head Exhaust	6
C-10458	Gasket—Stromberg Carburetor Air Scoop Manifold to Carburetor (NA-U4J)	1
C-10470	Packing—Cylinder Sleeve	6
C-10499	Gasket—Crankcase Center Section Anti-Propeller End to Cover	1
C-10505	Gasket—Propeller End Bearing Clamp Bolt	2
C-10519	Gasket—Magneto	2
C-10567	Gasket—Scintilla Magneto MN6-D-F3 Oil Deflector	2
23-D-2	Gasket—1 1/8 x 1 3/8 x 1/16 Copper Asbestos	2
23-D-7	Gasket—33/64 x 31/64 x 3/32 Copper Asbestos	12
23-D-16	Gasket—5/8 x 13/16 x 1/16 Copper Asbestos	2
37-D-10	Washer—7/16 x 11/16 x 1/16 Fibre	2
37-D-63	Washer—7/8 x 1 1/8 x 1/32 Vellumoid	1
129-D-8	Gasket—Two Bolt Type for 1/2 O.D. Tube	2
129-D-23	Gasket—Two Bolt Type	1

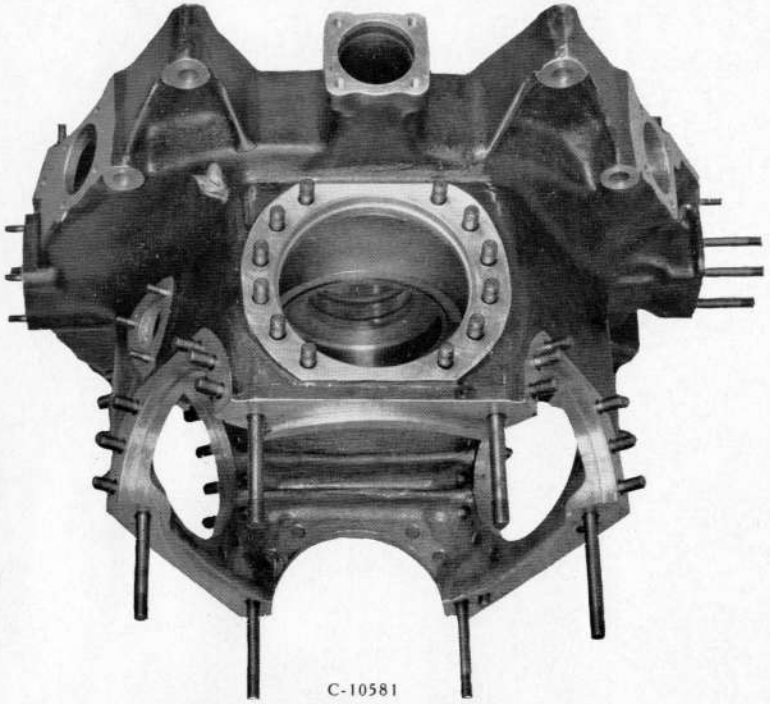
CRANKCASE CENTER SECTION



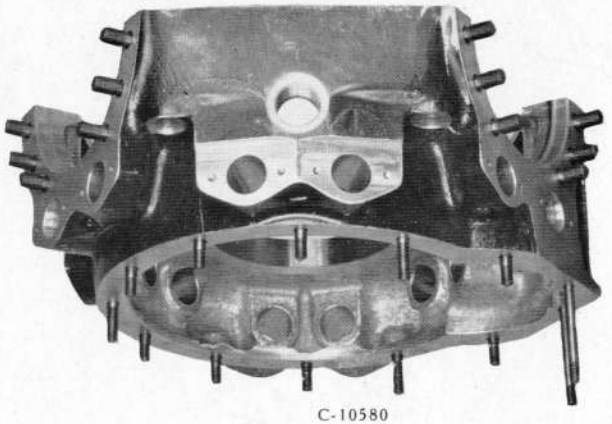
C-10497

JUNE 1929

CRANKCASE CENTER SECTION STUDDING ASSEMBLIES



C-10581



C-10580

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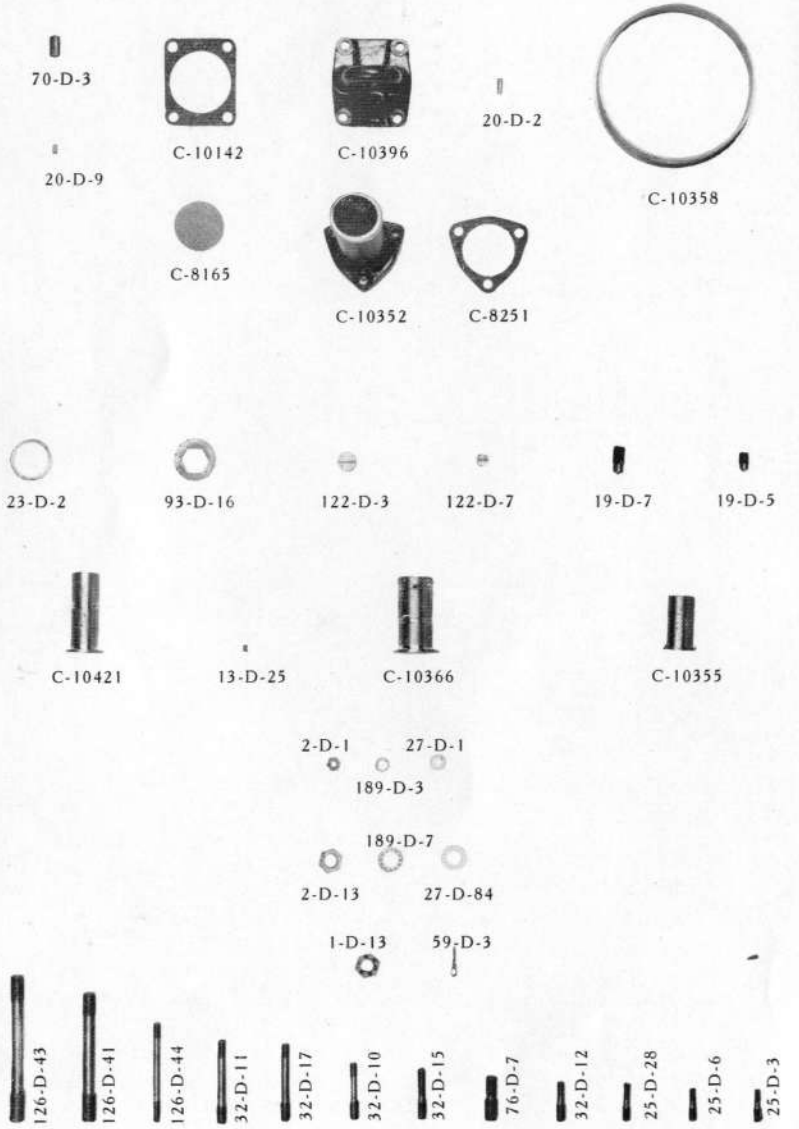
CRANKCASE CENTER SECTION GROUP



GROUPED PARTS LIST

CRANKCASE CENTER SECTION GROUP

The crankcase center section assembly is made up of two halves, the crankcase propeller end and the crankcase anti-propeller end. The crankcase propeller end is the same for all engines. The crankcase anti-propeller end may be the type with four (4) engine mounting bolt hole bosses, or the type with eight (8) engine mounting bolt hole bosses. The crankcase center section with the eight (8) engine mounting bolt hole bosses is a later type, and is provided with the four (4) extra inner bolt hole bosses so that it may be used to replace the four bolt type case.

When ordering spare parts for the crankcase center section it is very important for servicing to know which type crankcase is to be serviced.

Part No.	Name	No. Required
C-8164	Cover—Breather Tube	1
C-8165	Screen—Breather Tube Cover	1
C-8251	Gasket—Breather Flange to Crankcase	1
C-10142	Gasket—Gun Synchronizer Housing or Substituting Cover	1
C-10352	Breather Assembly	1
*C-10355	Bushing—Oil Pump Intermediate Gear Shaft For replacement order C-10559 bushing	1
C-10358	Ring—Crankcase Main Bearing Sold and serviced at factory only.	2
*C-10366	Bushing—Magneto Drive Intermediate Gear For replacement order C-10558 bushing.	1
C-10396	Cover—Gun Synchronizer Substituting and Lifting Eye	1
*C-10421	Bushing—Magneto Drive Gear For replacement order C-10557 bushing.	2
*C-10497	Crankcase—Studding Assembly Center Section Propeller and Anti-Propeller End (This type has eight (8) engine mounting bolt hole bosses.) Includes: All studs, bushings, main bearing rings and pins, screw bushings, dowel pins, washers and nuts. Engines No. 12 to 195 inclusive were factory equipped with a crankcase center section which has but four (4) engine mounting bole hole bosses. This type crankcase has been discontinued, and all replacements will be made with the crankcase which has eight (8) engine mounting bolt hole bosses . It is very important when replacing a crankcase which has four (4) engine mounting bolt hole bosses, to replace the crankcase center section anti-propeller end cover C-10155 (See Anti-Propeller End Cover Group), and Oil Pump to Strainer Tube Assembly C-10282 (See Oil Pump Group). Further it will be necessary to change the ignition cable tubes installation, or replace it with the type ignition cable tubes assembly C-10512 (See Ignition Cable Tubes Group). Servicing at an authorized Curtiss Flying Service station or at the factory is recommended. **If the crankcase on engine No. 13 is to be replaced it is necessary to consult the Motor Engineering Department.**	1

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
C-10580	Crankcase—Studding Assembly Center Section Propeller End Includes: All studs, main bearing ring and pin and nuts. Sold and serviced at the factory only.	1
C-10581	Crankcase—Studding Assembly Center Section Anti-Propeller End (This type has eight (8) engine mounting bolt hole bosses) Includes: All studs, bushings, main bearing ring and pin, screw bushings and dowel pins. Sold and serviced at the factory only. Conditions noted above under part No. C-10497 which affect engines No. 12 to 195 inclusive apply here.	1
1-D-13	Nut—$\frac{1}{2}$-20 U. S. F. Slotted Hex. Crankcase Center Section Propeller to Anti-Propeller End Attaching Long Stud.	1
2-D-1	Nut—$\frac{1}{4}$-28 U. S. F. Plain Hex. (3) Breather to Crankcase Attaching Stud (4) Gun Synchronizer Housing, or Substituting Cover Attaching Stud.	7
2-D-13	Nut—$\frac{1}{2}$-20 U.S.F. Plain Hex. Crankcase Center Section Propeller to Anti-Propeller Attaching Short Stud.	5
* 13-D-25	Pin—$\frac{1}{8}$ x $\frac{1}{4}$ (2) Magneto Drive Gear Bushing Locking (1) Magneto Drive Intermediate Gear Bushing Locking (1) Oil Pump Intermediate Gear Drive Shaft Bushing Locking	4
19-D-5	Bushing—No. 12-24 A.S.M.E. & $\frac{3}{8}$-24 U.S.F. Blind Screw Ignition Cable Tube Clamp to Crankcase Center Section Attaching Screw. For replacement order 19-S-5 bushing This bushing is used only on engines equipped with the type crankcase anti-propeller end which has but four (4) engine mounting bolt hole bosses. Engines Nos. 12 to 195 inclusive were factory equipped with a crankcase anti-propeller end section having but four (4) engine mounting bolt hole bosses.	4
19-D-7	Bushing—$\frac{5}{16}$-24 U.S.F. & $\frac{7}{16}$-20 U.S.F. Blind Screw Magneto to Crankcase Center Section Anti-Propeller End Cover Attaching Screw. This bushing is used only on engines equipped with type crankcase C-10497. For replacements order 19-S-7 bushing Engines Nos. 196 and those following were factory equipped with crankcase C-10497.	2
20-D-2	Pin—$\frac{5}{16}$ x $\frac{1}{2}$ Crankcase Main Bearing Ring to Crankcase Center Section Propeller and Anti-Propeller End Dowel. Servicing at authorized Curtiss Flying Service Station or at factory is recommended.	6
* 20-D-9	Pin—$\frac{5}{16}$ x $\frac{3}{8}$ Crankcase Center Section Anti-Propeller End Cover to Crankcase Center Section Anti-Propeller End Dowel.	2

* This part requires special assembling, see instructions under "Complete Overhaul"

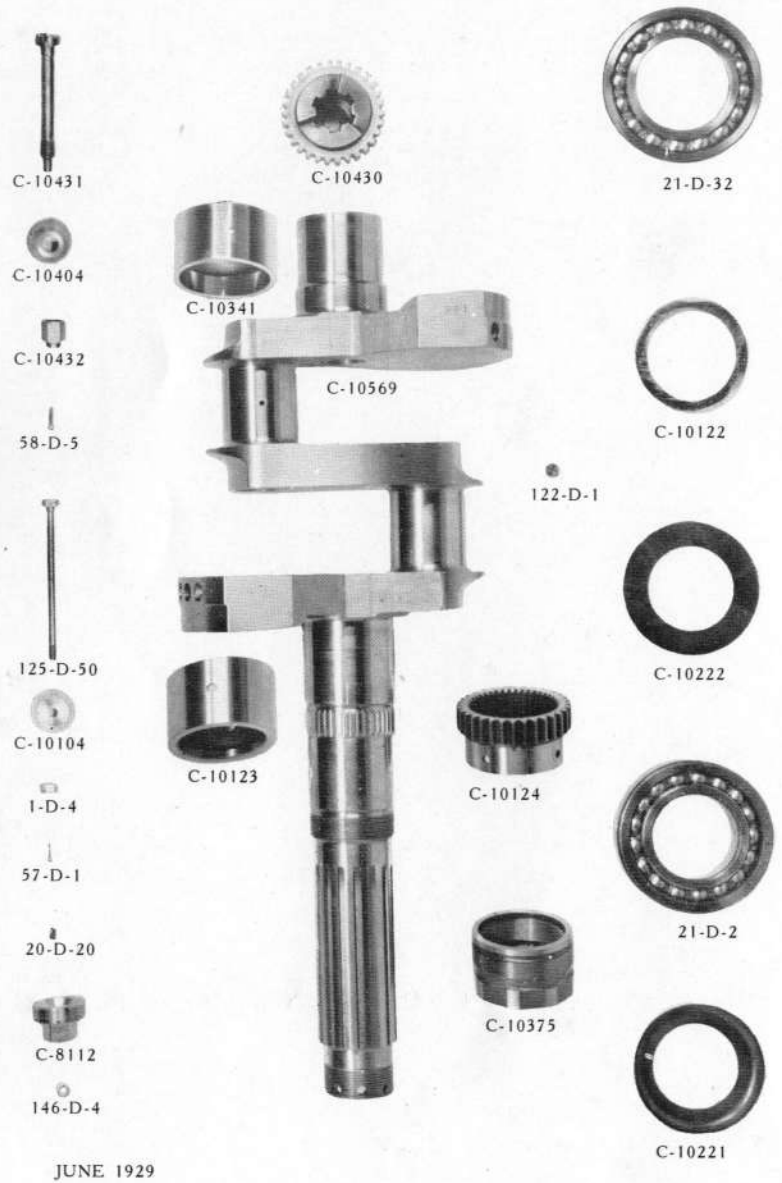
Part No.	Name	No. Required
23-D-2	Gasket—$1\frac{1}{8}$ x $1\frac{3}{8}$ x $\frac{1}{16}$ Copper Asbestos—Crankcase Center Section Propeller End Plug. (Used for Timing purposes.)	1
25-D-3	Stud—$\frac{1}{4}$-28 U.S.F. and $\frac{5}{16}$-24 U.S.F. x $1\frac{1}{8}$ Plain Shoulder For replacement order 25-S-3 stud. (3) Breather Flange to Crankcase Attaching (10) Crankcase Center Section Anti-Propeller End Cover Attaching Small (4) Gun Synchronizer Housing, or Substituting Cover and Lifting Eye, to Crankcase Center Section Anti-Propeller End Attaching.	17
25-D-6	Stud—$\frac{1}{4}$-28 U.S.F. & $\frac{5}{16}$-24 U.S.F. x $1\frac{5}{16}$ Plain Shoulder For replacements order 25-S-6 stud. Intake Manifold Flange to Crankcase Center Section Anti Propeller End Attaching.	24
25-D-28	Stud—$\frac{1}{4}$-28 U.S.F. x $\frac{5}{16}$-24 U.S.F. x $1\frac{9}{32}$ Plain Shoulder For replacements order 25-S-28 stud (4) Oil Pump to Crankcase Center Section Anti-Propeller End Attaching. (2) Oil Sump Housing to Crankcase Center Section Anti-Propeller.	6
27-D-1	Washer—$\frac{17}{64}$ x $\frac{1}{2}$ x $\frac{1}{32}$ Plain (3) Breather Flange to Crankcase Attaching Stud Nut (4) Gun Synchronizer Housing, or Substituting Cover and Lifting Eye, to Crankcase Center Section Anti-Propeller End Attaching Stud Nut.	7
27-D-84	Washer—$\frac{33}{64}$ x $\frac{7}{8}$ x $\frac{1}{16}$ Plain Crankcase Center Section Propeller End to Anti-Propeller End Attaching Stud Nut.	6
32-D-10	Stud—$\frac{5}{16}$-24 U.S.F. & $\frac{3}{8}$-24 U.S.F. x $1\frac{13}{16}$ Plain Shoulder For replacements order 32-S-10 stud Carburetor Spacer to Crankcase Center Section Anti-Propeller End Attaching Long	3
32-D-11	Stud—$\frac{5}{16}$-24 U.S.F. & $\frac{3}{8}$-24 U.S.F. x $2\frac{13}{16}$ Plain Shoulder For replacements order 32-S-11 stud Magneto to Crankcase Center Section Anti-Propeller End Cover Attaching Long This stud is used only on engines equipped with the type crankcase center section anti-propeller end which has but four (4) engine mounting bolt hole bosses. Engines Nos. 12 to 195 inclusive were factory equipped with the type crankcase center section anti-propeller end with four (4) engine mounting bolt hole bosses.	2
32-D-12	Stud—$\frac{5}{16}$-24 U.S.F. & $\frac{3}{8}$-24 U.S.F. x $1\frac{3}{8}$ Plain Shoulder For replacements order 32-S-12 stud. (3) Carburetor Spacer to Crankcase Center Section Anti-Propeller End Attaching Short. (8) Crankcase Propeller End to Crankcase Center Section Propeller End Attaching Short.	11
32-D-15	Stud—$\frac{5}{16}$-24 U.S.F. & $\frac{3}{8}$-24 U.S.F. x $1\frac{33}{64}$ Plain Shoulder For replacements order 32-S-15 stud (2) Crankcase Center Section Anti-Propeller End Cover Attaching Large. (3) Crankcase Propeller End to Crankcase Center Section Propeller End Attaching Medium.	5

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
32-D-17	Stud—$\frac{5}{16}$-24 U.S.F. & $\frac{3}{8}$-24 U.S.F. x $2\frac{49}{64}$ Plain Shoulder For replacements order 32-S-17 stud Oil Sump Housing to Crankcase Center Section Anti-Propeller End Attaching Large.	3
59-D-3	Cotter Pin—$\frac{1}{8}$ x $\frac{3}{4}$ Crankcase Center Section Propeller to Anti-Propeller End Attaching Long Stud Nut	1
70-D-3	Pin—$\frac{3}{8}$ x $\frac{3}{4}$ Straight Crankcase Center Section Propeller End Anti-Propeller End to Anti-Propeller End Dowel.	1
76-D-7	Stud—$\frac{1}{2}$-20 U.S.F. & $\frac{7}{16}$-20 U.S.F. x $1\frac{15}{32}$ Plain Shoulder For replacements order 76-S-7 stud Cylinder Sleeve to Crankcase Center Section Attaching	72
93-D-16	Plug—$1\frac{1}{8}$-18 Hex. U.S.F. Head Drilled for Lockwire Used for timing purposes. Crankcase Center Section Propeller End	1
122-D-3	Pipe Plug—$\frac{3}{8}$-18 Headless Used when oil overflow tube is not used Crankcase Center Section Anti-Propeller End	1
122-D-7	Pipe Plug—$\frac{1}{8}$-27 Headless (1) Crankcase Center Section Anti-Propeller End Main Bearing Oil Hole (1() Crankcase Center Section Anti-Propeller End Oil Hole	2
126-D-41	Stud—$\frac{9}{16}$-18 U.S.F. & $\frac{1}{2}$-20 U.S.F. x $4\frac{3}{8}$ U.S.F. Special Necked Plain Shoulder For replacements order 126-S-41 stud Crankcase Center Section Propeller to Anti-Propeller End	5
126-D-43	Stud—$\frac{9}{16}$-18 U.S.F. & $\frac{1}{2}$-20 U.S.F. x $4\frac{15}{16}$ Special Necked and Drilled for Slotted Nut For replacements order 126-S-43 stud Crankcase Center Section Propeller to Anti-Propeller End Attaching Long	1
126-D-44	Stud—$\frac{5}{16}$-24 U.S.F. x $\frac{5}{16}$-24 U.S.F. x $3\frac{11}{32}$ Special Necked Plain Shoulder For replacements order 126-S-44 stud Crankcase Propeller End to Crankcase Center Section Propeller End	2
189-D-3	Lockwasher—$\frac{17}{64}$ x $\frac{1}{2}$ x .024 Shakeproof (3) Breather Flange to Crankcase Attaching Stud Nut (4) Gun Synchronizer, or Substituting Cover and Lifting Eye Attaching Stud Nut	7
189-D-7	Lockwasher—$\frac{33}{64}$ x $\frac{7}{8}$ x .040 Shakeproof Crankcase Center Section Propeller to Anti-Propeller End Attaching Short Stud.	5

* This part requires special assembling, see instructions under "Complete Overhaul"

CRANKSHAFT GROUP



CRANKSHAFT GROUP

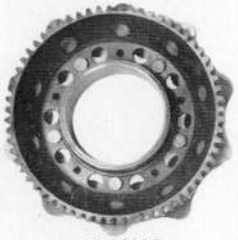
Part No.	Name	No. Required
*C-8112	Plug—Crankshaft Propeller End	1
C-10104	Plug—Crankshaft Crank Pin Oil Retaining	4
C-10122	Shim—Crankshaft Gear	1
C-10123	Spacer—Cam	1
*C-10124	Gear—Crankshaft Propeller End	1
C-10221	Deflector—Crankshaft Thrust Bearing Propeller End Oil	1
C-10222	Deflector—Crankshaft Thrust Bearing Anti-Propeller End Oil	1
C-10341	Spacer—Crankshaft Anti-Propeller End	1
C-10369	Crankshaft—Complete Assembly includes: (2) Crankshaft Main Bearings (1) Crankshaft Anti-Propeller End Gear and Spacer All plugs, nuts, and cotter pins Engines No. 12 to 89 inclusive were factory equipped with a crankshaft which has a 2-⅛-12 thread for the propeller hub nut. This type shaft has been discontinued and all replacements will be made with a shaft which has a 2-$\frac{1}{16}$-12 thread for propeller hub nut. The following note applies to engines using a metal propeller: If the shaft has a 2-⅛-12 thread and is to be replaced, it is very important to replace the propeller shaft ring and propeller hub shaft nut. (See Propeller Hub Group). The following note applies to engines using a wooden propeller: If the shaft has a 2-⅛-12 thread and is to be replaced, it is very important to replace the propeller hub nut. (See Propeller Hub Group).	1
C-10375	Nut—Crankshaft Thrust Bearing Lock	1
C-10404	Plug—Crankshaft Anti-Propeller End Oil Retaining	1
C-10430	Gear—Crankshaft Anti-Propeller End	1
C-10431	Bolt—Crankshaft Anti-Propeller End Gear Retaining	1
C-10432	Nut—Crankshaft Anti-Propeller End Gear Retaining Bolt	1
C-10569	Crankshaft—Plug Assembly includes: (3) Crankshaft Crank Pin Oil Retaining Pipe Plugs (1) Crankshaft Propeller End Plug and Pin (1) Propeller Hub Locating Pin This assembly is listed for use as an alternate assembly in ordering replacements only. The above note under Part No. C-10369 affecting Engines No. 12 to 89 inclusive applies here.	1
1-D-4	Nut—$\frac{5}{16}$-24 U.S.F. Slotted Hex. Crankshaft Crank Pin Plug Attaching Bolt	2
* 20-D-20	Pin—$\frac{3}{16}$ x ⅜ Crankshaft Propeller End Plug Retaining	1

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
21-D-2	Bearing—Radial Ball Crankshaft Propeller End Thrust	1
21-D-32	Bearing—Special Radial Ball Crankshaft Main	2
57-D-1	Cotter Pin—$\frac{1}{16}$ x $\frac{1}{2}$ Crankshaft Crank Pin Plug Attaching Bolt Nut	2
58-D-5	Cotter Pin—$\frac{5}{32}$ x $\frac{1}{2}$ Main Journal Plug to Crankshaft Gear Attaching Bolt Nut	1
122-D-1	Pipe Plug—$\frac{1}{8}$-27 Headless Crankshaft Crank Pin Oil Retaining	3
125-D-50	Bolt—$\frac{5}{16}$-24 U.S.F. x 4$\frac{3}{4}$ Special Necked for Slotted Nut Crankshaft Crank Pin Plug Attaching	2
146-D-4	Pin—$\frac{5}{16}$ x $\frac{7}{32}$ Propeller Hub Locating	1

* This part requires special assembling, see instructions under "Complete Overhaul"

CAMFOLLOWER GUIDES AND CAM GEAR GROUP



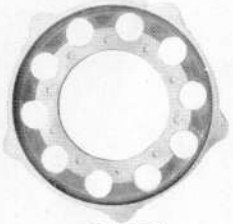
C-10225

1-D-1

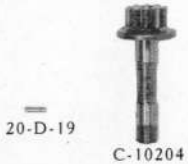
57-D-11 125-D-52

C-10279

C-10017



C-10218

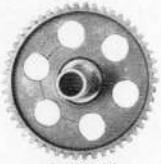


20-D-19

C-10204

C-10217

C-10232



C-10044

C-10117

27-D-88

C-10231

1-D-26

C-10020

C-10116

59-D-6

C-10019

C-10021

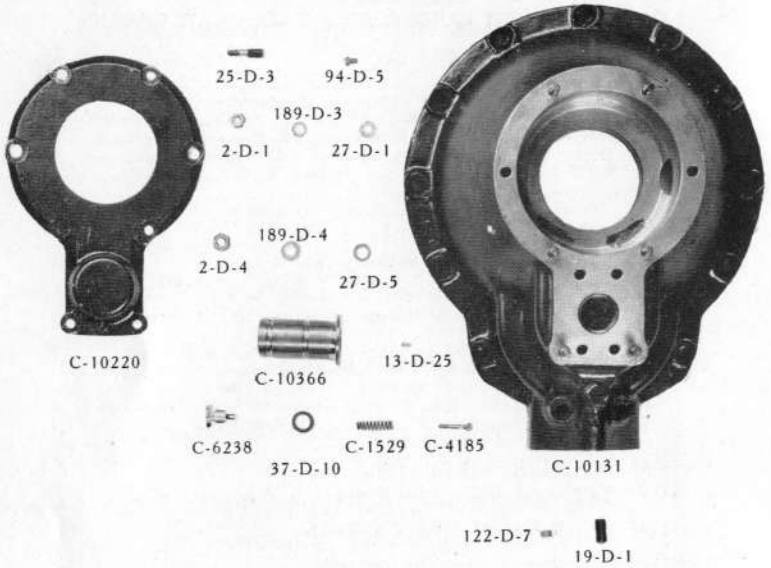
JUNE 1929

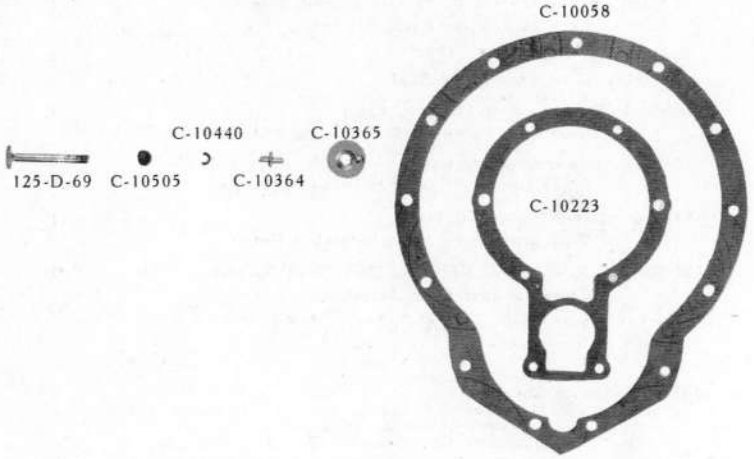
CAMFOLLOWER GUIDES AND CAM GEAR GROUP

Part No.	Name	No. Required
C-10017	Guide—Propeller End Cylinders Camfollower	6
C-10019	Bushing—Camfollower Roller	12
C-10020	Roller—Camfollower	12
*C-10021	Pin—Camfollower Roller	12
C-10044	Shaft—Cam Gear Drive Shaft Adjusting	1
*C-10116	Bushing—Intake and Exhaust Cam Gear	1
C-10117	Gear—Assembly Intake and Exhaust Cam includes: Bushing	1
C-10204	Shaft—Assembly Cam Gear Drive includes: Pin	1
C-10217	Guide—Anti-Propeller End Cylinders Camfollower	6
C-10218	Cam—Intake and Exhaust	2
C-10225	Gear—Assembly Complete Intake and Exhaust Cam	1
C-10231	Camfollower—Machining Assembly	12
C-10232	Camfollower—Complete Assembly	12
C-10279	Gasket—Camfollower Guide to Crankcase	12
1-D-1	Nut—$\frac{1}{4}$-28 U.S.F. Slotted Hex. Cams to Cam Gear Attaching Bolt	5
1-D-26	Nut—$\frac{3}{4}$-16 U.S.F. Special Slotted Hex. Cam Gear Drive Shaft Retaining	1
20-D-19	Pin—$\frac{3}{16}$ x $1\frac{1}{16}$ Cam Gear Drive Shaft	1
27-D-88	Washer—$\frac{13}{64}$ x $1\frac{3}{8}$ x $\frac{5}{32}$ Plain Cam Gear Drive Shaft Retaining Nut	1
57-D-11	Cotter Pin—$\frac{1}{16}$ x $\frac{7}{16}$ Cams to Cam Gear Attaching Bolt Nut	5
59-D-6	Cotter Pin—$\frac{1}{8}$ x $1\frac{1}{8}$ Cam Gear Drive Shaft Retaining Nut	1
125-D-52	Bolt—$\frac{1}{4}$-28 U.S.F. x $\frac{13}{16}$ Hex. Head Special Cams to Cam Gear Attaching	5

* This part requires special assembling, see instructions under "Complete Overhaul"

CRANKCASE PROPELLER END GROUP





CRANKCASE PROPELLER END GROUP

Part No.	Name	No. Required
C-1529	Spring—Propeller End Crankcase Oil Pressure Regulator	1
C-4185	Valve—Propeller End Crankcase Oil Pressure Regulator	1
C-6238	Screw—Propeller End Crankcase Oil Pressure Regulator	1
C-10058	Gasket—Crankcase Center Section to Crankcase Propeller End	1
C-10131	Crankcase—Studding Assembly Propeller End includes: All studs, bushings, pins and oil pressure regulator	1
C-10220	Cover—Crankcase Propeller End	1
C-10223	Gasket—Crankcase Propeller End to Crankcase Propeller End Cover	1
C-10364	Pin—Propeller End Bearing Clamping Bolt Washer Retaining	2
C-10365	Washer—Propeller End Bearing Clamping Bolt Inner	2
*C-10366	Bushing—Cam Gear Drive Shaft Adjusting Shaft For replacements order C-10558 bushing	1
C-10440	Ring—Propeller End Bearing Clamping Bolt Retaining	2
C-10505	Gasket—Propeller End Bearing Clamping Bolt	2
2-D-1	Nut—¼-28 U.S.F. Plain Hex. Propeller End Crankcase Cover to Propeller End Crankcase Attaching Stud.	6
2-D-4	Nut—$\frac{5}{16}$-24 U.S.F. Plain Hex. (13) Crankcase Propeller End to Crankcase Center Section Attaching Stud (2) Propeller End Bearing Clamping Bolt	15
13-D-25	Pin—⅛ x ¼ Cam Gear Drive Shaft Adjusting Shaft Bushing to Propeller End Crankcase Dowel	1
19-D-1	Bushing—¼-28 U.S.F. x ⅜-24 U.S.F. Blind Screw For replacements order 19-S-1 bushing Oil Sump Housing to Propeller End Crankcase Attaching Screw	3
25-D-3	Stud—¼-28 x $\frac{3}{16}$-24 x 1⅛ Plain Shoulder For replacements order 25-S-3 stud Propeller End Crankcase Cover to Propeller End Crankcase Attaching	6
27-D-1	Washer—$\frac{17}{64}$ x ½ x $\frac{1}{32}$ Plain Propeller End Crankcase Cover to Propeller End Crankcase Attaching Stud Nut	6
27-D-5	Washer—$\frac{21}{64}$ x $\frac{9}{16}$ x $\frac{3}{32}$ Plain (13) Crankcase Propeller End to Crankcase Center Section Attaching Stud Nut (2) Propeller End Bearing Clamping Bolt Nut	15
37-D-10	Washer—$\frac{7}{16}$ x $\frac{11}{16}$ x $\frac{1}{16}$ Fibre Propeller End Crankcase Oil Pressure Regulator Screw	1
94-D-5	Screw—No. 10-32 A.S.M.E. x ¼ Oval Fillister Head Machine Name Plate to Crankcase Attaching	4
122-D-7	Pipe Plug—⅛-27 Headless Propeller End Crankcase Oil Hole	1
125-D-69	Bolt—$\frac{7}{16}$-24 U.S.F. x 2⅜ Special Necked Propeller End Bearing Clamping	2
189-D-3	Lockwasher—$\frac{17}{64}$ x ½ x .024 Shakeproof Propeller End Crankcase Cover to Propeller End Crankcase Attaching Stud Nut	6
189-D-4	Lockwasher—$\frac{21}{64}$ x $\frac{19}{32}$ x .030 Shakeproof (13) Crankcase Propeller End to Crankcase Center Section Attaching Stud Nut (2) Propeller End Bearing Clamping Bolt Nut	15

* This part requires special assembling, see instructions under "Complete Overhaul"

ENGINE MOUNTING BEAM GROUP

203-D-1

34-D-17

1-D-16

59-D-5

C-10506

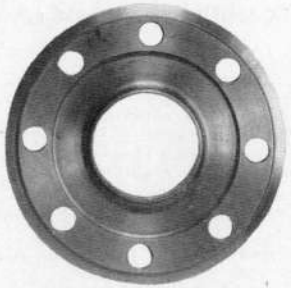
ENGINE MOUNTING BEAM GROUP

Part No.	Name	No. Required
C-10506	Beam—Engine Mounting Supplied for use on engines equipped with type Crankcase Center Section C-10497 only.	2
1-D-16	Nut—$\frac{9}{16}$-18 U.S.F. Slotted Hex. Engine Mounting Beam to Engine Attaching Bolt	4
34-D-17	Washer—$\frac{37}{64}$ x $1\frac{1}{16}$ x $\frac{3}{32}$ Plain Engine Mounting Beam to Engine Attaching Bolt	8
59-D-5	Cotter Pin—$\frac{1}{8}$ x $\frac{7}{8}$ Engine Mounting Beam to Engine Attaching Bolt Nut	4
203-D-1	Bolt—$\frac{9}{16}$-18 U.S.F. x $4\frac{5}{16}$ Hex Head Engine Mounting Beam to Engine Attaching	4

* This part requires special assembling, see instructions under "Complete Overhaul"

PROPELLER HUB GROUP


C-10572


C-10409


C-10459


C-10560

59-D-3


124-D-7


C-10434


C-10538

C-4220


C-10410

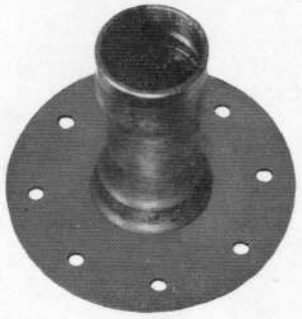

C-10354


C-10297


C-10492

C-1322


C-10363


C-10408

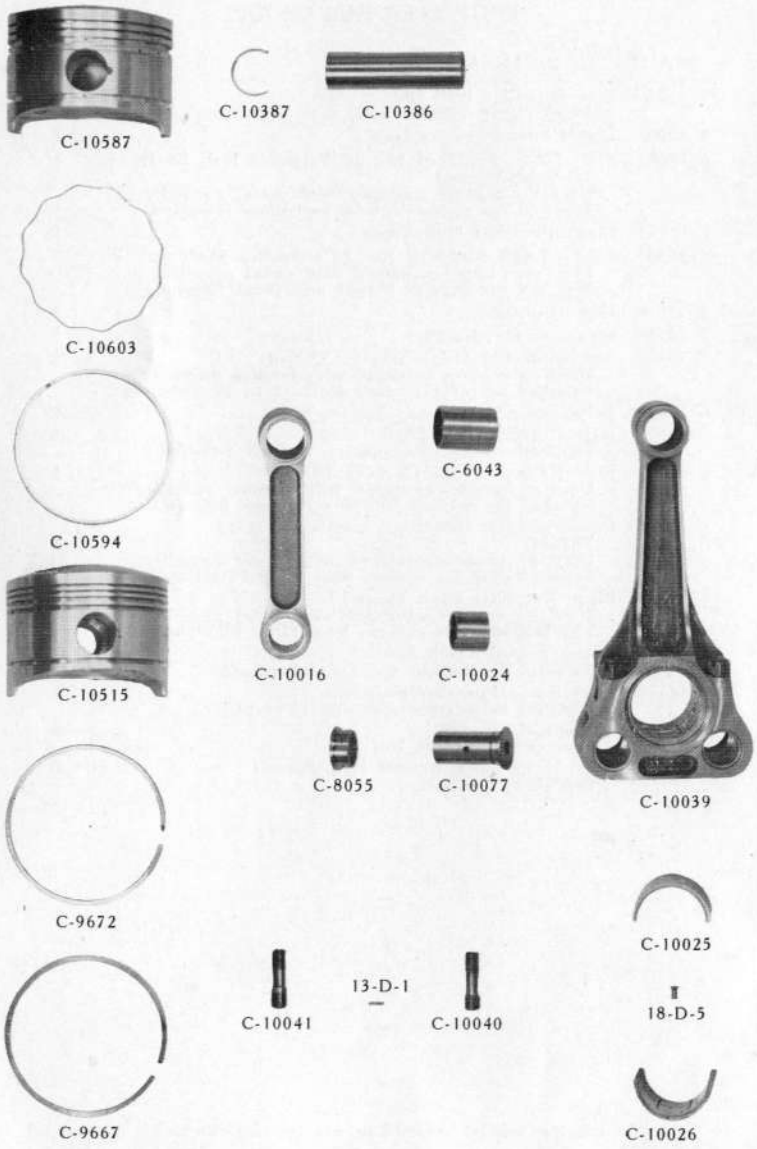
JUNE 1929

PROPELLER HUB GROUP

Part No.	Name	No. Required
C-1322	Pin—Propeller Hub Nut Supplied for engines using a wooden propeller	1
C-4220	Dowel Pin—Propeller Hub	1
C-10297	Nut—S.A.E. Standard No. 20 Propeller Hub Shaft (2-$\frac{1}{16}$-12 Thread) Used on engines equipped with metal propeller Supplied for engines No. 90 and those following	1
C-10354	Ring—Propeller Hub Taper	1
C-10363	Ring—S.A.E. Standard No. 20 Propeller Shaft Used on engines equipped with metal propeller Supplied for engines No. 90 and those following	1
C-10408	Hub—Propeller	1
C-10409	Flange—Propeller Hub	1
C-10410	Nut—Propeller Hub (2-$\frac{1}{16}$-12 Thread) Used on engines equipped with wooden propeller Supplied only for engines Nos. 12 to 89 inclusive	1
C-10434	Bolt—Propeller Hub	8
C-10459	Nut—Propeller Hub Lock Supplied for engines using a wooden propeller	1
C-10492	Nut—Propeller Hub (2-$\frac{1}{16}$-12 Thread) Used on engines equipped with wooden propeller Supplied for engines No. 90 and those following	1
C-10538	Nut—Propelelr Hub Shaft Special (2-$\frac{1}{8}$-12 Thread) Used on engines equipped with metal propeller Supplied only for engines Nos. 12 to 89 inclusive	1
C-10539	Ring—Propeller Shaft Special Used on engines equipped with metal propeller Supplied only for engines Nos. 12 to 89 inclusive	1
C-10560	Ring—Propeller Hub Snap Supplied for engines using metal propeller	1
C-10572	Lock Ring—Propeller Hub Nut Supplied for engines using metal propeller	1
59-D-3	Cotter Pin—$\frac{1}{8}$ x $\frac{3}{4}$ Propeller Hub Bolt Nut	8
124-D-7	Nut—$\frac{1}{2}$-20 U.S.F. Slotted Hex. Special Propeller Hub Bolt	8

* This part requires special assembling, see instructions under "Complete Overhaul"

CONNECTING ROD AND PISTON GROUP



JUNE 1929

CONNECTING ROD AND PISTON GROUP

Consult Motor Engineering Department for Oversize Rings and Pistons

Part No.	Name	No. Required
*C-6043	Bushing—Connecting Rod Upper End (4) Articulated Connecting Rod Upper End (Piston Pin End) (2) Master Connecting Rod Upper End (Piston Pin End)	6
*C-8055	Bushing—Master Connecting Rod Lower End (Wrist Pin End)	8
*C-9667	Ring—5 1/8 x 5/32 Piston Lower This ring is supplied only for engines equipped with C-10451 or C-10515 pistons. Also see ring C-10594 Replacements made only at authorized Curtiss Flying Service Station or at the factory.	18
*C-9672	Ring—5 1/8 x 5/32 Piston Upper Replacements made only at authorized Curtiss Flying Service Station or at the factory.	12
C-10016	Connecting Rod—Assembly Articulated Includes: Bushings	4
*C-10024	Bushing—Wrist Pin (In articulated rod)	4
*C-10025	Bearing Shell—Master Connecting Rod Upper Half	2
*C-10026	Bearing Shell—Master Connecting Rod Lower Half	2
C-10039	Connecting Rod—Bearing Assembly Master Includes: Bushings, shells, nuts and studs.	2
*C-10040	Stud—Master Connecting Rod Cap (Plain) Not stocked: sold on special request only. Replacements made only at authorized Curtiss Flying Service Station or at the factory.	4
*C-10041	Stud—Master Connecting Rod Cap (Dowel Type) Not stocked: sold on special request only. Replacements made only at authorized Curtiss Flying Service Station or at the factory.	4
C-10077	Wrist Pin—Assembly Includes: Guide and oil tube	4
C-10386	Piston Pin	6
C-10387	Ring—Piston Pin Retaining	12
*C-10515	Piston—5 1/8 x 1.813 (Standard Compression Ratio 5.2 to 1) This piston is readily recognized as it is machined to take five (5) rings. Single piston replacement on engines equipped with this piston will be supplied. When it is necessary to replace the complete set of pistons, the replacement must be made with C-10587 piston and must also include a new set of piston rings C-9672 and C-10594 See also pistons C-10587 and C-10599 to determine the correct piston required for replacements. When pistons are ordered for replacements they must be supplied with fitted rings.	6
*C-10587	Piston—5 1/8 x 1.813 (Standard Compression Ratio 5.2 to 1) This piston is readily recognized as it is machined to take four (4) rings. See also pistons C-10515 and C-10599 to determine	6

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
	the correct piston required for replacements. When pistons are ordered for replacements they must be supplied with fitted rings.	
*C-10594	Ring—5 1/8 x 3/16 Piston Oil (Simplex) This ring is supplied only for engines equipped with piston C-10587 or C-10599. Also see ring C-9667. Replacements made only at authorized Curtiss Flying Service Station or at the factory must include the piston ring expander C-10603 (one expander required per ring).	12
*C-10599	Piston—5 1/8 x 1.813 (Low Compression 4.9 to 1) This piston is readily recognized as it is machined to take four (4) rings. All low compression piston replacements will be made with this piston. The following engines were factory equipped with low compression pistons which are machined to take five (5) rings. Engines No. 72, 89, 103, 104, 105, 112, 142, 167 to 176 inclusive, 188, 189, 201, 202, 203, 247, 248, 249, 264, 265, 266, 268, 286, 304 to 313 inclusive and 316 to 372 inclusive. Single piston replacements on engines equipped with low compression five (5) ring piston type will not be supplied but will be supplied in complete sets. When pistons are ordered for replacements they must be supplied with fitted rings and expanders. Also see Piston C-10515 and C-10587 to determine the correct piston required for replacements.	6
*C-10603	Expander—Piston Ring (Simplex) This expander is supplied only for use in conjunction with Simplex piston ring C-10594.	12
1-D-13	Nut—1/2-20 U.S.F. Slotted Hex. Master Connecting Rod Stud	8
* 13-D-1	Pin—1/8 x 1/2 Master Connecting Rod Stud Locking Not stocked; sold on special request only. Replacements made only at authorized Curtiss Flying Service Station or at the factory.	8
18-D-5	Rivet—3/16 x 1/2 Flat Countersunk Head Master Connecting Rod Shell Retaining	8
59-D-3	Cotter Pin—1/8 x 3/4 Master Connecting Rod Stud Nut	8

* This part requires special assembling, see instructions under "Complete Overhaul"

CYLINDER HEAD GROUP

CYLINDER HEAD GROUP

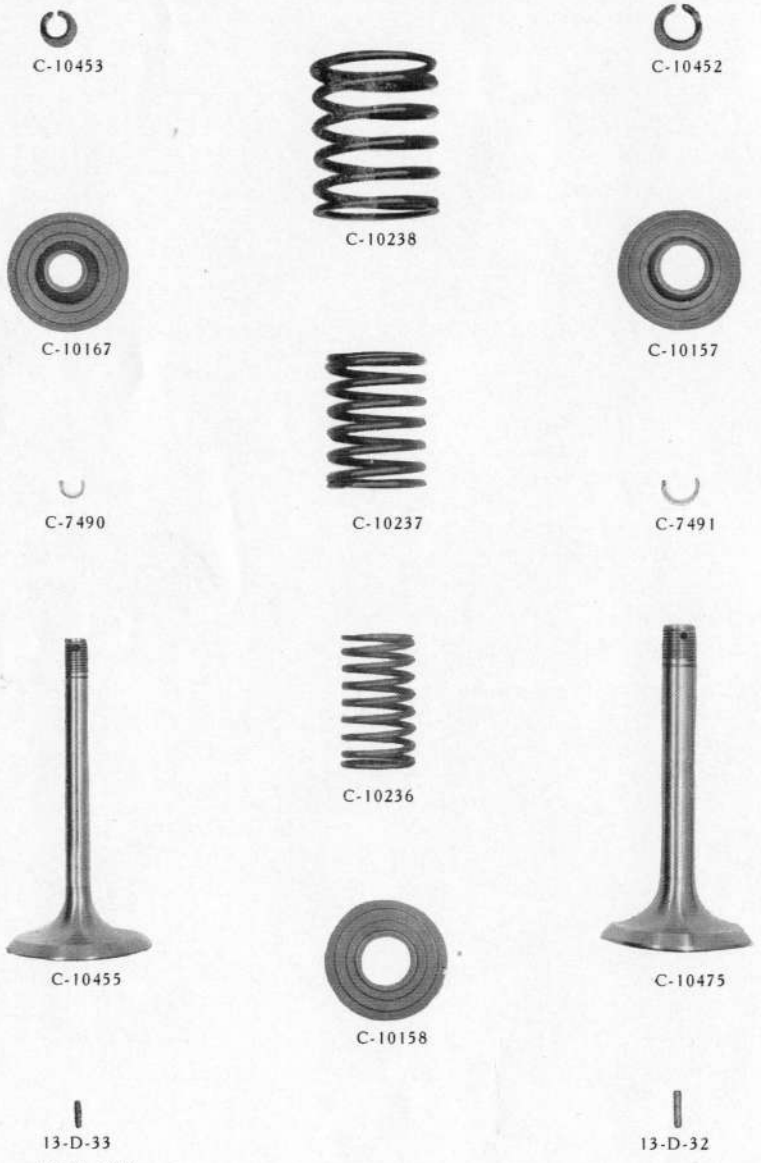
Part No.	Name	No. Required
*C-10159	Guide—Exhaust Valve For replacements order C-10563 guide	6
C-10168	Gasket—Cylinder Head Cover to Cylinder Head	12
*C-10171	Guide—Intake Valve For replacements order C-10562 guide	6
C-10179	Cover—Cylinder Head	12
*C-10244	Seat—Valve Not stocked, sold on special request only. Recommend replacing at the factory only.	12
C-10470	Packing—Cylinder Sleeve	6
*C-10472	Cylinder Head to Sleeve Assembly (Standard) Includes: Valve guides, valve seats, all bushings and studs. Additional machining is required when replacements are made for engines using an air starter. One each per cylinder head must also be supplied: C-10514 gasket, C-10544 bushing and 93-D-15 plug. The following engines were modified at factory for air starter use: Engines No. 45, 46, 68, 69, 70, 183, 190, 191, 192, 205 and 206.	6
C-10473	Cylinder Assembly Complete (Standard) Includes: Valves, valve seats, valve springs and washers, complete rocker arm assemblies with mounting parts, valve guides, all bushings and studs. Additional machining is required when replacements are made for engines using an air starter. One each per cylinder head must also be supplied: C-10514 gasket, C-10544 bushing and 93-D-15 plug. The following engines were modified at factory for air starter use: Engines No. 45, 46, 68, 69, 70, 183, 190, 191, 192, 205 and 206.	6
C-10514	Gasket—$\frac{1}{2}$ x $\frac{11}{32}$ x $\frac{3}{32}$ Soft Copper Air Starter Bushing Plug Factory equipped on engines No. 45, 46, 68, 69, 70, 183, 190, 191, 192, 205 and 206.	6
C-10544	Bushing—Air Starter Factory equipped on engines No. 45, 46, 68, 69, 70, 183, 190, 191, 192, 205 and 206.	6
*C-10574	Bushing—Spark Plug	12
2-D-10	Nut—$\frac{7}{16}$-20 U.S.F. Plain Hex. Cylinder Sleeve to Crankcase Attaching Stud.	72
4-D-5	Bushing—$\frac{1}{4}$-28 U.S.F. & $\frac{3}{8}$-24 U.S.F. x $\frac{1}{2}$ Screw Intake Manifold to Cylinder Head Attaching For replacements order 4-S-5 bushing.	18
4-D-9	Bushing—No. 12-24 A.S.M.E. & $\frac{5}{16}$-24 U.S.F. x $\frac{3}{8}$ Screw (18) Ignition Cable Tube Clips Attaching (24) Cylinder Head Cover to Cylinder Head Attaching. For replacements order 4-S-9 bushing.	42

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
27-D-33	Washer—$\frac{7}{32}$ x $\frac{3}{8}$ x $\frac{1}{32}$ Plain Cylinder Head Cover to Cylinder Head Attaching Screw	24
28-D-7	Lockwasher—$\frac{7}{32}$ x $\frac{11}{32}$ x $\frac{5}{64}$ Standard Cylinder Head Cover to Cylinder Head Attaching	24
93-D-15	Plug—$\frac{1}{2}$-13 U.S.F. Hex. Head Air Starter Bushing Used when air starter connection is not used	6
96-D-2	Screw—No. 12-24 A.S.M.E. x $\frac{5}{8}$ Oval Fillister Head Cylinder Head Cover to Cylinder Head Attaching	24
126-D-48	Stud—$\frac{3}{8}$-24 U.S.F. x $1\frac{3}{8}$ Straight Exhaust Manifold to Cylinder Head Attaching For replacements order 126-S-48 stud.	18
189-D-6	Lockwasher—$\frac{33}{64}$ x $\frac{53}{64}$ x .035 Shakeproof Cylinder Sleeve to Crankcase Attaching Stud Nut.	72

* This part requires special assembling, see instructions under "Complete Overhaul"

INTAKE AND EXHAUST VALVE GROUP



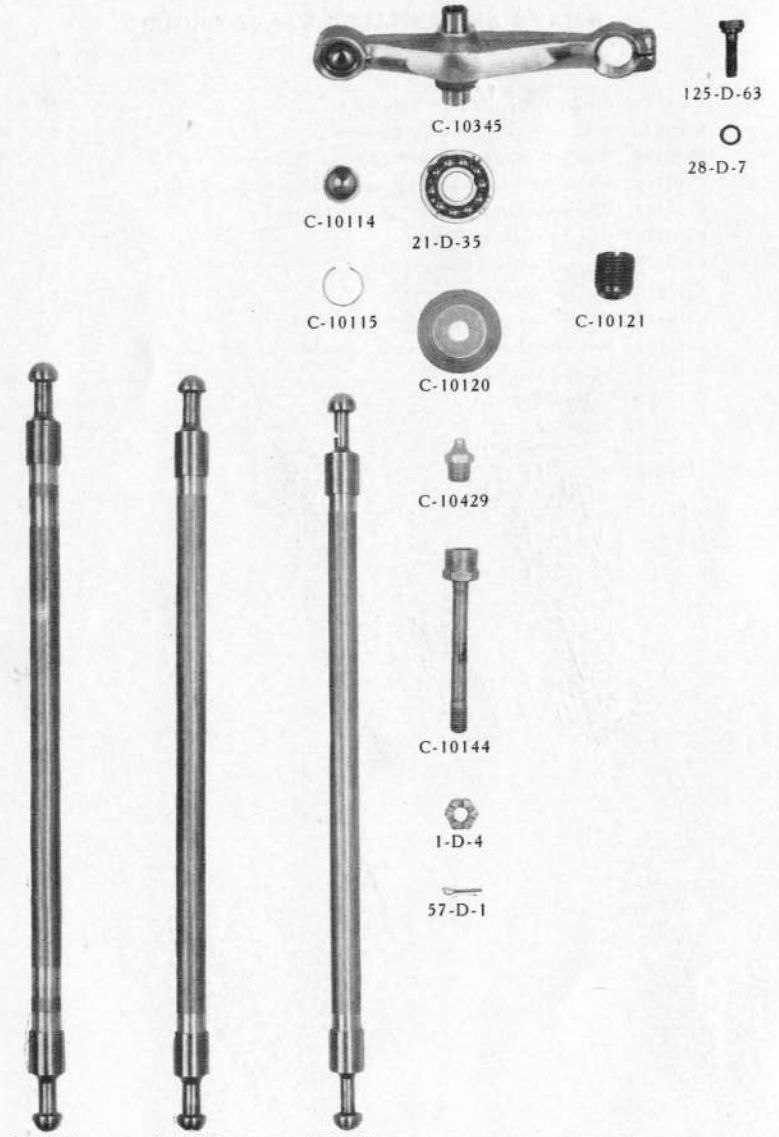
JUNE 1929

INTAKE AND EXHAUST VALVE GROUP

Part No.	Name	No. Required
C-7490	Ring—Intake Valve Retaining	6
C-7491	Ring—Exhaust Valve Retaining	6
C-10157	Washer—Exhaust Valve Spring Upper	6
C-10158	Washer—Intake and Exhaust Valve Spring Lower	12
C-10167	Washer—Intake Valve Spring Upper	6
C-10236	Spring—Valve Inner	12
C-10237	Spring—Valve Intermediate	12
C-10238	Spring—Valve Outer	12
C-10452	Nut—Exhaust Valve Spring Washer	6
C-10453	Nut—Intake Valve Spring Washer	6
C-10455	Valve—Intake	6
C-10475	Valve—Exhaust	6
13-D-32	Pin—$\frac{1}{8}$ x $\frac{43}{64}$ Exhaust Valve	6
13-D-33	Pin—$\frac{1}{8}$ x $\frac{31}{64}$ Intake Valve	6

* This part requires special assembling, see instructions under "Complete Overhaul"

PUSH RODS AND ROCKER ARM GROUP



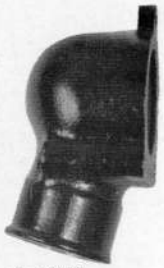
JUNE 1929

PUSH RODS AND ROCKER ARM GROUP

Part No.	Name	No. Required
C-10036	Push Rod—Assembly No. 2, 4 and 6 Cylinders Valve	6
C-10037	Push Rod—Assembly No. 3 and 5 Cylinders Valve	4
C-10114	Socket—Valve Push Rod	12
C-10115	Ring—Valve Push Rod Socket Retaining	12
C-10120	Cover—Rocker Arm Bearing Retaining	24
C-10121	Screw—Assembly Valve Rocker Arm Adjusting	12
C-10125	Rocker Arm—Complete Assembly Valve Includes: Rocker arm pin, adjusting screw assembly, push rod socket and retaining ring, and adjusting screw lock screw and washer.	12
C-10144	Bolt—Rocker Arm Bearing Retaining Cover	12
C-10345	Rocker Arm—Assembly Valve Includes: Rocker arm with pin	12
C-10347	Push Rod—Assembly No. 1 Cylinder Valve	2
C-10429	Nipple—Vacuum Gun Zerk Type Rocker Arm Bearing Retaining Cover Bolt	12
1-D-4	Nut—$\frac{5}{16}$-24 U.S.F. Slotted Hex. Rocker Arm Bearing Retaining Cover Bolt	12
21-D-35	Bearing—Radial Ball Valve Rocker Arm	24
28-D-7	Lockwasher—$\frac{7}{32}$ x $\frac{11}{32}$ x $\frac{3}{64}$ Standard Valve Rocker Arm Adjusting Screw Lock Screw	12
57-D-1	Cotter Pin—$\frac{1}{16}$ x $\frac{1}{2}$ Rocker Arm Retaining Cover Bolt Nut	12
125-D-63	Screw—No. 12-24 A.S.M.E. x $\frac{3}{4}$ Special Hex. Head Valve Rocker Arm Adjusting Screw Lock.	12

* This part requires special assembling, see instructions under "Complete Overhaul"

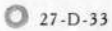
PUSH ROD HOUSING GROUP



C-10257

96-D-2

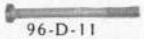
189-D-2



27-D-33

C-10278

C-10258



96-D-11

C-10277

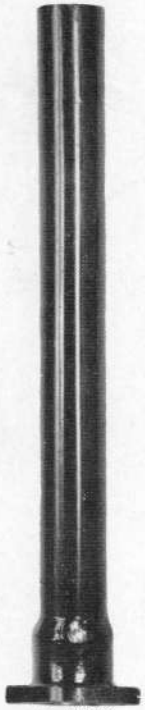
C-10272

125-D-65

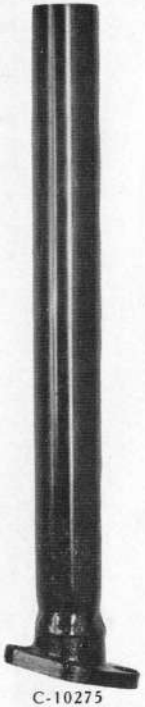
28-D-7

27-D-33

C-10271



C-10276



C-10275

JUNE 1929

PUSH ROD HOUSING GROUP

Part No.	Name	No. Required
C-10257	Housing—Anti-Propeller End Cylinders Rocker Arm	6
C-10258	Housing—Propeller End Cylinders Rocker Arm	6
C-10271	Gasket—Push Rod Enclosing Tube to Camfollower Guide	12
C-10272	Nut—Push Rod Enclosing Tube Packing	12
C-10275	Tube—Assembly Propeller End Cylinders Valve Push Rod Enclosing	6
C-10276	Tube—Assembly Anti-Propeller End Cylinders Valve Push Rod Enclosing	6
C-10277	Packing—Push Rod Enclosing Tube	12
C-10278	Gasket—Rocker Arm Housing to Cylinder Head	12
27-D-33	Washer—$\frac{7}{32}$ x $\frac{3}{8}$ x $\frac{1}{32}$ Plain (36) Rocker Arm Housing to Cylinder Head Attaching Screw (24) Camfollower Guide and Enclosing Tube Attaching Screw	60
28-D-7	Lockwasher—$\frac{7}{32}$ x $\frac{11}{32}$ x $\frac{3}{64}$ Standard Camfollower Guide and Enclosing Tube Attaching Screw	24
96-D-2	Screw—No. 12-24 A.S.M.E. x $\frac{5}{8}$ Oval Fillister Head Machine Rocker Arm Housing to Cylinder Head Attaching Short	12
96-D-11	Screw—No. 12-24 A.S.M.E. x $2\frac{3}{32}$ Oval Fillister Head Machine Rocker Arm Housing to Cylinder Head Attaching Long	24
125-D-65	Screw—No. 12-24 A.S.M.E. x $1\frac{1}{16}$ Special Hex. Head Camfollower Guide and Enclosing Tube Attaching	24
189-D-2	Lockwasher—$\frac{13}{64}$ x $\frac{23}{64}$ x .021 Shakeproof Rocker Arm Housing to Cylinder Head Attaching Screw	36

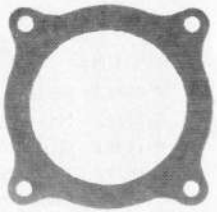
* This part requires special assembling, see instructions under "Complete Overhaul"

JUNE 1929

ACCESSORY DRIVE GROUP

C-10098

C-10107

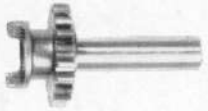


C-6429

20-D-13

102-D-14

C-10374



C-10420

10-D-9

C-10094

C-10353

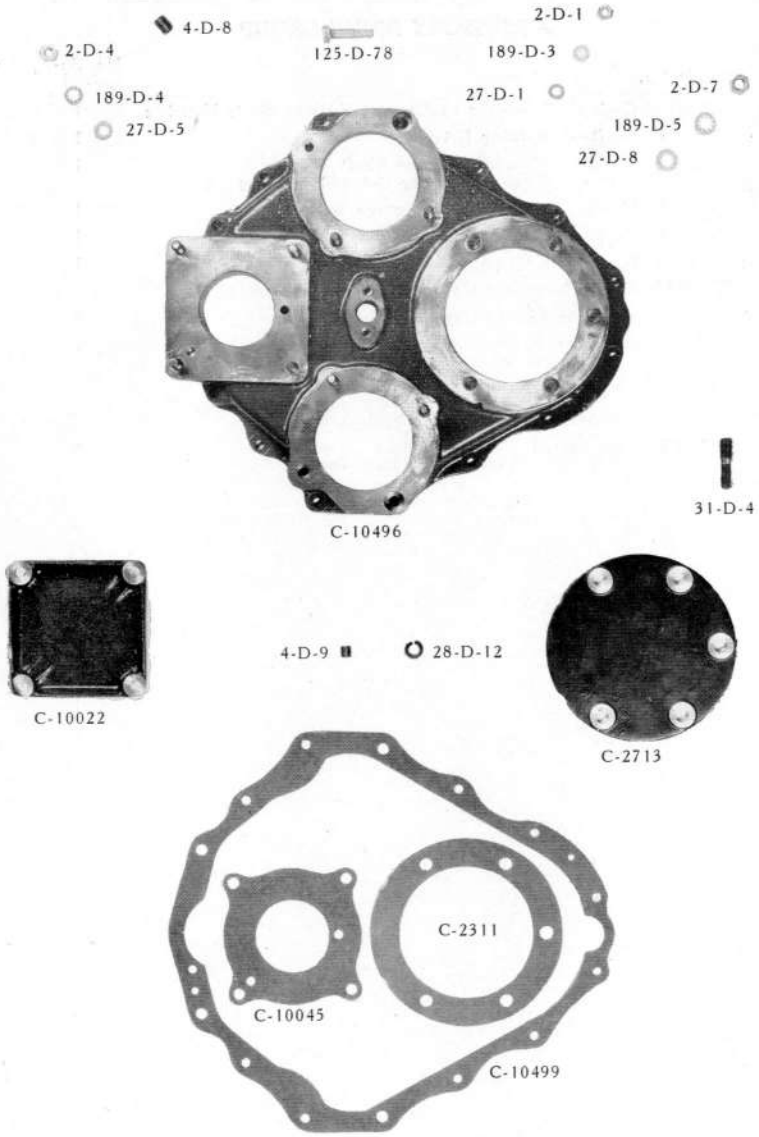
C-10356

ACCESSORY DRIVE GROUP

Part No.	Name	No. Required
C-6429	Gasket—Generator to Generator Drive Shaft Housing	1
C-10094	Shaft—Generator Drive	1
*C-10098	Bushing—Generator Drive Shaft For replacements order C-10588 bushing	1
C-10107	Housing—Assembly Generator Drive Shaft	1
C-10353	Gear—Oil Pump Intermediate	1
C-10356	Shaft—Oil Pump Intermediate Gear	1
C-10374	Gear—Assembly Magneto Drive Intermediate	1
C-10420	Gear—Magneto Drive	2
10-D-9	Key—No. 5 Woodruff Oil Pump Intermediate Gear	1
20-D-13	Pin—$\frac{3}{16}$ x $\frac{7}{32}$ Generator Drive Shaft Housing to Crankcase Center Section Anti-Propeller End Cover Dowel	1
*102-D-14	Plug—$\frac{7}{16}$-20 U.S.F. Headless Magneto Drive Intermediate Gear	1

* This part requires special assembling, see instructions under "Complete Overhaul"

CRANKCASE CENTER SECTION ANTI-PROPELLER END COVER



CRANKCASE CENTER SECTION ANTI-PROPELLER END COVER GROUP

Part No.	Name	No. Required
	Covers are supplied in two (2) types but are not interchangeable. The difference in types can readily be recognized. One type has a two (2) stud magneto attaching flange pad. The other type has a four (4) hole magneto attaching flange pad, two (2) holes are for studs and two (2) for screws.	
	When ordering cover for replacements, it is very important for servicing to know which type cover is required.	
C-2311	Gasket—Electric Starter or Starter Substituting Cover	1
C-2713	Cover—Starter Substituting	1
C-10022	Cover—Generator Substituting	1
C-10045	Gasket—Generator Drive Shaft Housing or Generator Substituting Cover	1 1
C-10135	Gasket—Crankcase Center Section Anti-Propeller End Cover Used with type C-10155 cover only Engines Nos. 12 to 195 inclusive were factory equipped with C-10155 cover	1
C-10155	Cover—Studding Assembly Crankcase Center Section Anti-Propeller End Includes: All studs, screw bushings, and oil overflow tube substituting plug This cover is the two (2) stud magneto attaching flange pad type, and was factory equipped on engines Nos. 12 to 195 inclusive. This type cover should be ordered for replacements on engines equipped only with a crankcase center section anti-propeller end which has but four (4) engine mounting bolt hole bosses. Engines Nos. 12 to 195 inclusive were factory equipped with this type crankcase.	1
*C-10496	Cover—Studding Assembly Crankcase Center Section Anti-Propeller End Includes: All studs and screw bushings. This cover is the four (4) hole magneto attaching flange pad type, and is factory equipped on engine No. 196 and those following. This type cover should be ordered for replacements on engines equipped only with type crankcase center section No. C-10497 (See Crankcase Group). Replacement of cover C-10155 with cover C-10496 is necessary when replacements are made with crankcase C-10497 or C-10581. (See Crankcase Group) When these replacements are made it is very important for servicing to know how the magnetos are to be installed, whether in the upward or downward position. It is necessary to use the following additional parts if the magnetos are to be installed in the downward position: Two(2) parts of each: 27-D-5 Washer 28-D-12 Lockwasher 125-D-78 Bolt instead of 45-4-12 Bolt (Magneto Attaching) 45-D-7 Bolt (Magneto Attaching) Recommend that replacements be made at authorized Curtiss Flying Service Station or at factory.	1

* This part requires special assembling, see instructions under "Complete Overhaul"

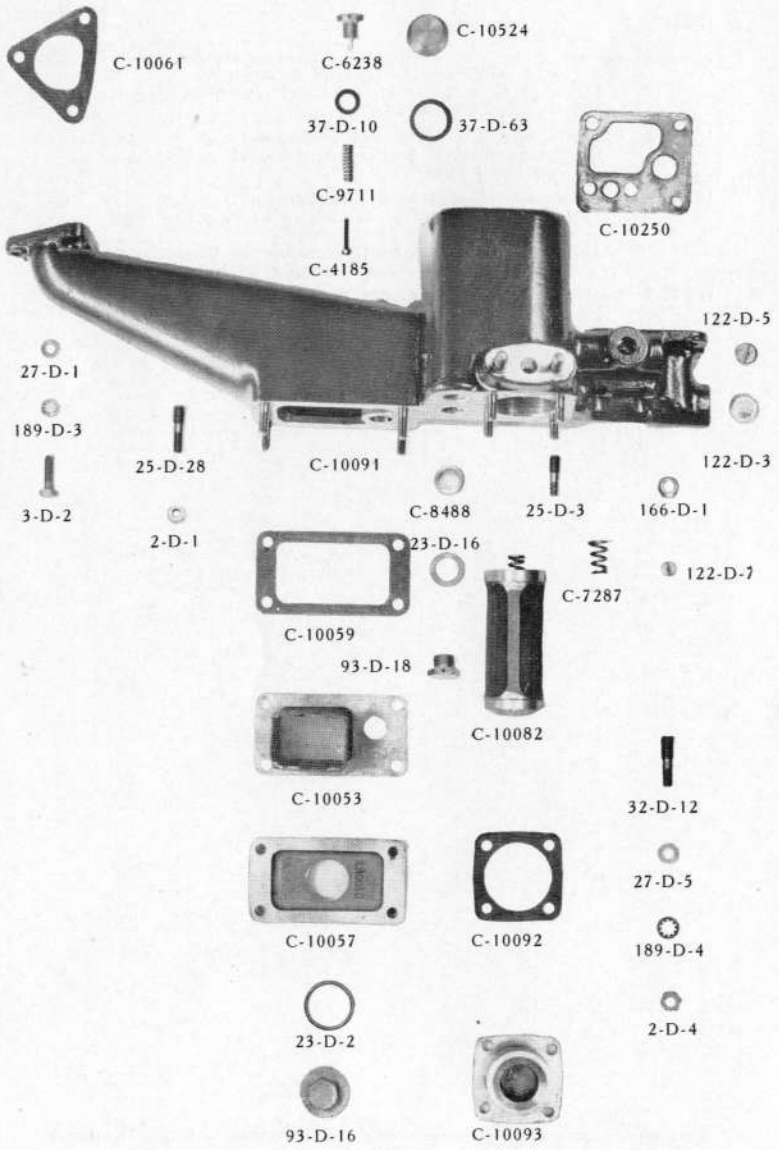
Part No.	Name	No. Required
C-10499	Gasket—Crankcase Center Sectioin Anti-Propeller End Cover Used with type C-10496 cover only. Engine No. 196 and those following were factory equipped with C-10496 cover.	1
2-D-1	Nut—¼-28 U.S.F. Plain Hex. Crankcase Center Section Anti-Propeller End Cover Attaching Small Stud	10
2-D-4	Nut—5/16-24 U.S.F. Plain Hex. (2) Crankcase Center Section Anti-Propeller End Cover Attaching Large Stud. (4) Generator Drive Shaft Housing or Generator Substituting Cover Attaching Stud.	6
2-D-7	Nut—⅜-24 U.S.F. Plain Hex Electric Starter, or Starter Substituting Cover Attaching Stud Nut	5
4-D-8	Bushing—5/16-24 U.S.F. x 7/16-20 U.S.F. x ½ Screw For replacements order 4-S-8 bushing Magnetos Attaching Bolt Used on type cover C-10496 only Factory equipped on engines No. 196 and those following.	2
4-D-9	Bushing—No. 12-24A.S.M.E. & 5/16 U.S.F. x ⅜ Screw For replacements order 4-S-9 bushing Tachometer Drive Shaft Housing Attaching Screw	2
27-D-1	Washer—17/64 x ½ x 1/32 Plain Crankcase Center Section Anti-Propeller End Cover Attaching Small Stud Nut	10
27-D-5	Washer—21/64 x 9/16 x 1/32 Plain (2) Crankcase Center Section Anti-Propeller End Cover Attaching Large Stud Nut (4) Generator Drive Shaft Housing, or Generator Substituting Cover Attaching Stud Nut (2) Magneto Attaching Long Bolt Substituting Screw Used only on type cover C-10496 when magnetos are installed downward.	8
27-D-8	Washer—33/64 x 11/16 x 1/32 Plain Electric Starter, or Starter Substituting Cover Attaching Stud Nut	5
28-D-12	Lockwasher—11/32 x 19/32 x 3/32 Standard Magneto Attaching Long Bolt Substituting Screw Used on type cover C-10496 only when magnetos are installed downward	2
31-D-4	Stud—⅜-24 U.S.F. & 7/16-20 U.S.F. x 1⅝ Plain Shoulder Electric Starter or Starter Substituting Cover Attaching For replacements order 31-S-4 stud	5
32-D-15	Stud—5/16-24 U.S.F. & ⅜-24 U.S.F. x 1 23/32 Plain Shoulder For replacements order 32-S-15 stud (4) Generator Drive Shaft Housing or Generator Substituting Cover Attaching Magneto Attaching The number required depends on the type cover on which replacement is to be made. Cover C-10155 requires 2 studs (Engines Nos. 12 to 195 inclusive) Cover C-10496 requires 4 studs (Engine No. 196 and those following)	

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
125-D-78	Screw—5/16-24 U.S.F. x 1⅜ Flat Fillister Head Special Magneto Attaching Long Bolt Substituting Used on type Cover C-10496 only, when magnetos are installed downward	2
189-D-3	Lockwasher—17/64 x ½ x .024 Shakeproof Crankcase Center Section Anti-Propeller End Attaching Small Stud Nut	10
189-D-4	Lockwasher—21/64 x 19/32 x .030 Shakeproof (2) Crankcase Center Section Anti-Propeller End Attaching Large Stud Nut (4) Generator Drive Shaft Housing, or Generator Substituting Cover Attaching Stud Nut	6
189-D-5	Lockwasher—33/64 x 11/16 x .035 Shakeproof Electric Starter, or Starter Substituting Cover Attaching Stud Nut	5

* This part requires special assembling, see instructions under "Complete Overhaul"

OIL SUMP GROUP



OIL SUMP GROUP

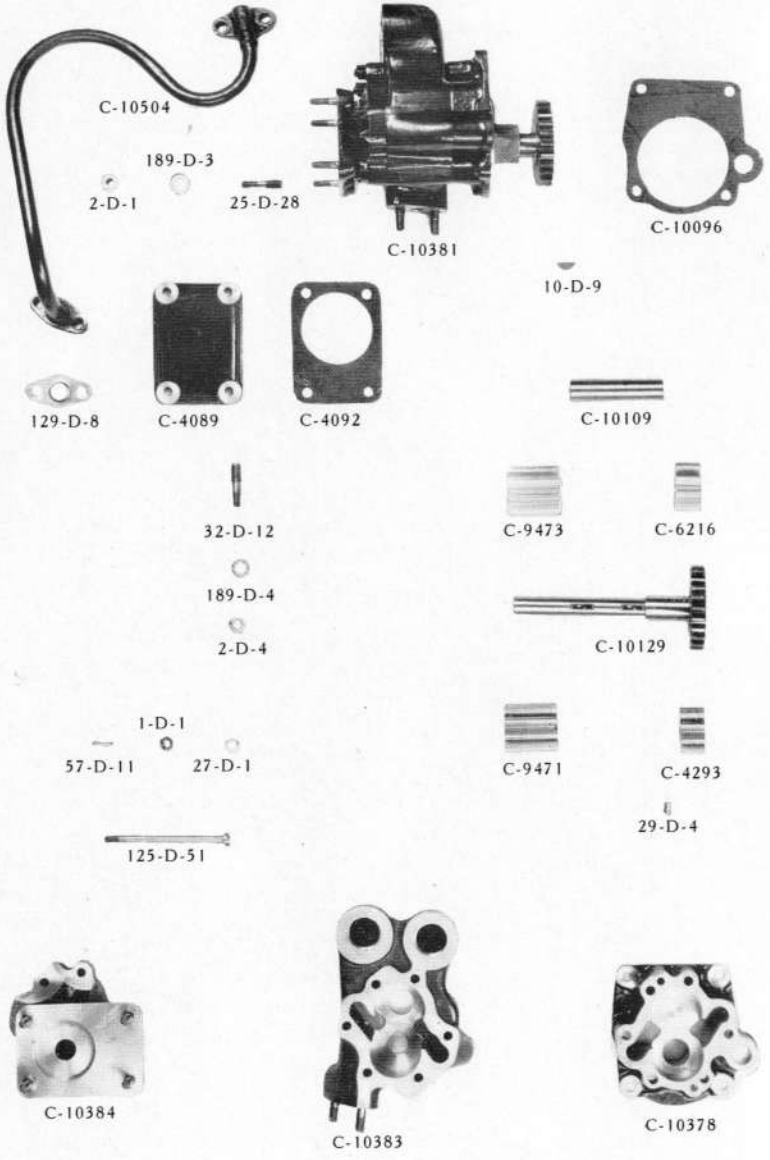
Part No.	Name	No. Required
X-865	Tube—Oil Strainer Guide Used only on engines Nos, 12 to 141 inclusive Not necessary to use if sump has been replaced with sump which has full length strainer guide webs.	1
C-4185	Valve—Oil Sump Housing Oil Pressure Regulator	1
C-6238	Screw—Oil Sump Housing Oil Pressure Regulator	1
C-7287	Spring—Pressure Oil Strainer Head	1
C-8488	Bushing—Oil Thermometer to Oil Sump Housing	2
C-9711	Spring—Oil Sump Housing Oil Pressure Regulator	1
C-10053	Screen—Assembly Crankcase Oil Drain	1
C-10057	Cover—Oil Sump	1
C-10059	Gasket—Oil Sump Housing to Oil Sump Housing and Screen	2
C-10061	Gasket—Crankcase Propeller End to Oil Sump Housing	1
C-10082	Strainer—Assembly Pressure Oil (Standard) Do not order for replacement of strainer on engines Nos. 12 to 141 inclusive unless the oil sump housing has full length strainer guide webs in sump. This type sump is factory equipped on engine No. 142 and those following. (See also part C-10082-A listed below)	1
C-10082-A	Strainer—Assembly Pressure Oil (Special) Can be used for replacements on all engines, but recommend ordering standard strainer C-10082 providing the oil sump has full length strainer guide webs. This type sump is factory equipped on engine No. 142 and those following Strainer C-10082-A was factory equipped on engines Nos 12 to 144 inclusive.	1
C-10091	Housing—Studding Assembly Oil Sump Includes: All plugs, studs, bushings and complete relief valve It is not necessary to use the oil strainer guide tube X-865 if the oil sump housing is replaced on the following engines: engines Nos. 12 to 141 inclusive.	1
C-10092	Gasket—Pressure Oil Strainer Cover	1
C-10093	Cover—Presure Oil Strainer	1
C-10250	Gasket—Oil Sump Housing to Crankcase Center Section Anti-Propeller End	1
C-10524	Plug—Oil Sump Housing (Top)	1
2-D-1	Nut—¼-28 U.S.F. Plain Hex. (4) Oil Sump Cover to Oil Sump Housing Attaching Stud (2) Oil Sump Housing to Crankcase Center Section Anti-Propeller End Attaching Small Stud (4) Pressure Oil Strainer Cover Attaching Stud	10
2-D-4	Nut—$\frac{5}{16}$-24 U.S.F. Plain Hex. Oil Sump Housing to Crankcase Center Section Anti-Propeller End Attaching Large Stud	18
3-D-2	Bolt—¼-28 U.S.F. x $\frac{3}{8}$ Plain Hex. Head Oil Sump Housing to Crankcase Propeller End Attaching	3
23-D-2	Gasket—1⅛ x 1⅜ x $\frac{1}{16}$ Copper Asbestos Oil Sump Drain Plug	1

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
23-D-16	Gasket—5/8 x 13/16 x 1/16 Copper Asbestos Oil Thermometer Substituting Plug	2
25-D-3	Stud—1/4-28 U.S.F. & 5/16-24 U.S.F. x 1 1/8 Plain Shoulder For replacements order 25-S-3 stud Pressure Oil Strainer Cover Attaching	
25-D-28	Stud—1/4-28 U.S.F. & 5/16-24 U.S.F. x 1 9/32 Plain Shoulder For replacements order 25-S-28 stud Oil Sump Cover Attaching	
27-D-1	Washer—17/64 x 1/2 x 3/32 Plain (4) Oil Sump Cover Attaching Stud Nut (2) Oil Sump Housing to Crankcase Center Section Anti-Propeller End Attaching Small Stud Nut. (3) Oil Sump Housing Attaching Bolt (4) Pressure Oil Strainer Cover Attaching Stud Nut	13
27-D-5	Washer—21/64 x 9/16 x 1/32 Plain Oil Sump Housing Attaching Large Stud	3
32-D-12	Stud—5/16-24 U.S.F. & 3/8-24 U.S.F. x 1 3/8 Plain Shoulder Oil Pump to Oil Strainer Oil Tube Attaching For replacements order 32-S-12 Stud	2
37-D-10	Washer—7/16 x 11/16 x 1/16 Fibre Oil Sump Housing Oil Pressure Regulator Screw.	1
37-D-63	Washer—7/8 x 1 1/8 x 1/32 Vellumoid Oil Sump Housing (Top) Plug	1
93-D-16	Plug—1 1/8-18 U.S.F. Hex. Head Oil Sump Drain	1
93-D-18	Plug—5/8-18 U.S.F. Hex. Head Oil Thermometer Substituting	2
122-D-3	Pipe Plug—3/8-18 Headless Oil Sump Housing Anti-Propeller End Large	1
122-D-5	Pipe Plug—1/4-18 Headless Oil Sump Housing Anti-Propeller End Small	1
122-D-7	Pipe Plug—1/8-27 Headless Oil Sump Housing (Side) Bushing (used when oil pressure gage is not used)	1
166-D-1	Bushing—1/8 Pipe Thread & 1/4 Pipe Thread x 11/32 Screw Oil Sump Housing (Side)	1
189-D-3	Lockwasher—17/64 x 1/2 x .024 Shakeproof (4) Oil Sump Cover Attaching Stud Nut (2) Oil Sump Housing to Crankcase Center Section Anti-Propeller End Attaching Small Stud Nut (3) Oil Sump Housing to Crankcase Propeller End Attaching Bolt (4) Pressure Oil Strainer Cover Attaching Stud Nut	13
189-D-4	Lockwasher—21/64 x 13/32 x .030 Shakeproof Oil Sump Housing to Crankcase Attaching Large Stud Nut	3

* This part requires special assembling, see instructions under "Complete Overhaul"

OIL PUMP GROUP



OIL PUMP GROUP

Part No.	Name	No. Required
C-4089	Cover—Gear Gas Pump Substituting Used when gas pump is not used	1
C-4092	Gasket—Gear Gas Pump Drive Shaft Housing or Substituting Cover	1
C-4293	Gear—Oil Pressure Pump Keyed	1
C-6216	Gear—Oil Pressure Pump Idler	1
C-9471	Gear—Oil Scavenger Pump Keyed	1
C-9473	Gear—Oil Scavenger Pump Idler	1
C-10096	Gasket—Oil Pump to Crankcase	1
C-10109	Shaft—Oil Pump Idler	1
C-10129	Shaft—Oil Pump Drive	1
C-10282	Tube—Assembly Oil Pump to Oil Strainer Oil Oil tubes are supplied in two (2) types—C-10282 or C-10504. The C-10282 tube can be used only on engines equipped with crankcase center section anti-propeller end type case which has but four (4) engine mounting bolt hole bosses. Engines No. 12 to 195 inclusive were factory equipped with this type crankcase The other type tube C-10504 was designed for use with type crankcase anti-propeller end C-10497, or C-10581 (See Crankcase Center Section Group). This type crankcase is factory equipped on engine No. 196 and those following. Type tube C-10504 can be used for replacements on engines Nos. 12 to 195 inclusive, providing the engine installation in ship will permit its use.	1
C-10378	Body—Oil Pump Pressure Cover replacements made at factory only, the complete pump shoult be sent to factory for cover replacements.	1
C-10381	Oil Pump—Complete Assembly	1
C-10383	Body—Studding Assembly Oil Pump Scavengner Body replacements made at factory only, the complete pump should be sent to factory for body replacements.	1
C-10384	Cover—Studding Assembly Oil Pump Cover replacements made at factory only, the complete pump should be sent to factory for cover replacements.	1
C-10504	Tube—Assembly Oil Pump to Oil Strainer Oil See Part C-10282 listed elsewhere in this group	1
C-10586	Bodies and Cover—Assembly Oil Pump Includes: All bodies, cover, dowel pins and studs. This assembly can be ordered as an alternate for body replacements when the remaining parts of the pump do not have to be serviced.	1
1-D1	Nut—1/4-28 U.S.F. Slotted Hex. Oil Pump Bodies to Cover Attaching Bolt	6

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
2-D-1	Nut—$\frac{1}{4}$-28 U.S.F. Plain Hex. (4) Gear Gas Pump Drive Shaft Housing, or Substituting Cover Attaching Stud. (4) Oil Pump to Crankcase Attaching Stud.	8
2-D-4	Nut—$\frac{5}{16}$-24 U.S.F. Plain Hex. Oil Pump to Oil Strainer Oil Tube Attaching Stud.	4
10-D-9	Key—No. 5 Woodruff Oil Pump Keyed Gears Driving	2
25-D-28	Stud—$\frac{1}{4}$-28 U.S.F. & $\frac{5}{16}$-24 U.S.F. x $1\frac{9}{32}$ Plain Shoulder Gear Gas Pump Drive Shaft Housing, or Substituting Cover Attaching. For replacements order 25-S-28 stud.	4
27-D-1	Washer—$\frac{17}{64}$ x $\frac{1}{2}$ x $\frac{1}{32}$ Plain (4) Gear Gas Pump Drive Shaft Housing, or Substituting Cover Attaching Stud Nut (12) Oil Pump Bodies to Cover Attaching Bolt Nut (4) Oil Pump to Crankcase Attaching Stud Nut	20
29-D-4	Pin—$\frac{1}{4}$ x $\frac{3}{8}$ Oil Pump Bodies Dowel	4
32-D-12	Stud—$\frac{5}{16}$-24 U.S.F. x $\frac{3}{8}$-24 U.S.F. x $1\frac{3}{8}$ Plain Shoulder Oil Pump to Oil Strainer Oil Tube to Oil Pump Attaching. For replacements order 32-S-12 stud.	2
57-D-11	Cotter Pin—$\frac{1}{16}$ x $\frac{7}{16}$ Oil Pump Bodies to Cover Attaching Bolt Nut	6
125-D-51	Bolt—$\frac{1}{4}$-28 U.S.F. x $3\frac{11}{16}$ Oval Fillister Head Oil Pump Bodies to Cover Attaching.	6
129-D-8	Gasket—Two Bolt Type for $\frac{1}{2}$ O. D. Tube Oil Pump to Oil Strainer Oil Tube	2
189-D-3	Lockwasher—$\frac{17}{64}$ x $\frac{1}{2}$ x .024 Shakeproof (4) Gear Gas Pump Drive Shaft Housing or Substituting Cover Attaching Stud Nut (4) Oil Pump to Crankcase Attaching Stud Nut	8
189-D-4	Lockwasher—$\frac{21}{64}$ x $\frac{19}{32}$ x .030 Shakeproof Oil Pump to Oil Strainer Oil Tube Attaching Stud Nut.	4

* This part requires special assembling, see instructions under "Complete Overhaul"

INTAKE AND EXHAUST MANIFOLD GROUP


C-10241


C-10242


C-10284

3-D-2


C-10264


C-10240


3-D-10


C-10248

39-D-21


C-10291


C-10288


C-10234


189-D-3

27-D-33

2-D-7

96-D-2

27-D-1

189-D-2


C-10235


C-10376


C-10377


2-D-1

INTAKE AND EXHAUST MANIFOLD GROUP

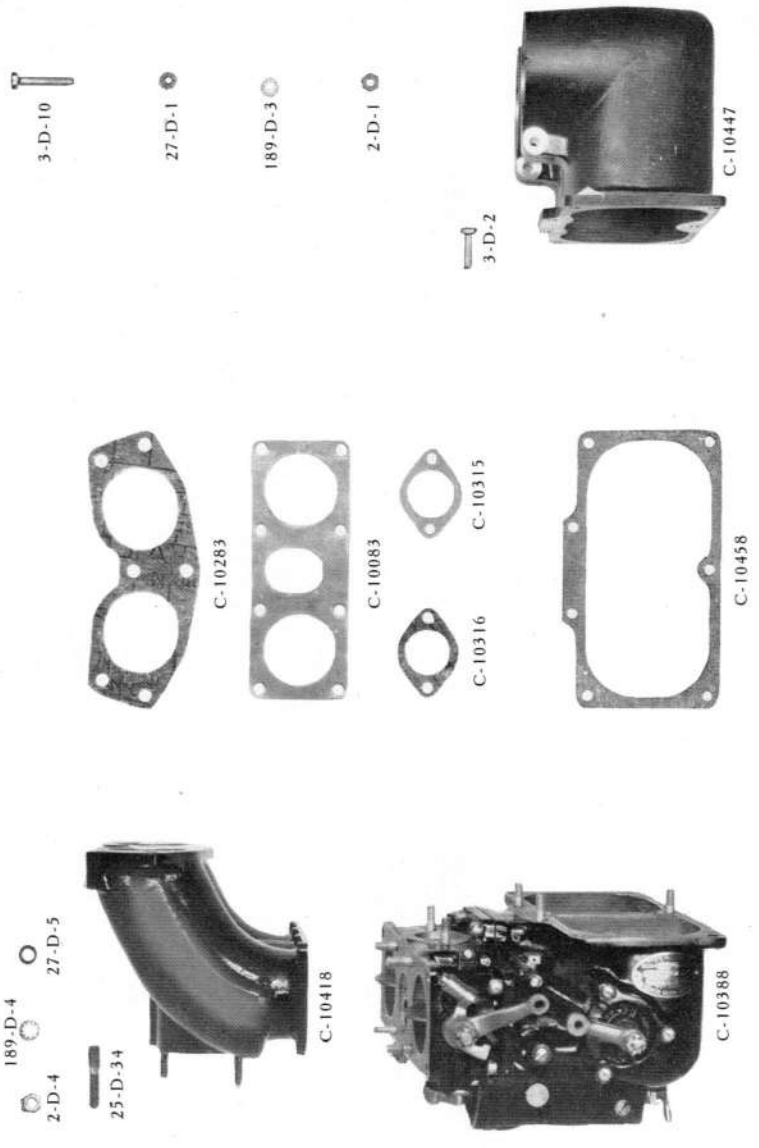
Part No.	Name	No. Required
C-10234	Flange—Intake Manifold	6
C-10235	Packing—Intake Manifold	6
C-10240	Manifold—Intake Long	3
C-10241	Manifold—Intake Short	3
C-10242	Gasket—Intake Manifold to Cylinder Head	6
C-10248	Elbow—Exhaust Gas Heated Carburetor Intake	1
C-10264	Elbow—Assembly Exhaust Gas Heated Carburetor Intake Includes: Valve, clamping bolt and shaft assembly.	1
C-10284	Gasket—Exhaust Gas Heated Carburetor Intake Elbow	1
C-10288	Shaft—Assembly - Exhaust Gas Heated Carburetor Intake Elbow	1
C-10291	Valve—Exhaust Gas Heated Carburetor Intake Elbow	1
C-10376	Flange—Exhaust Manifold	6
C-10377	Gasket—Exhaust Manifold to Cylinder Head	6
C-10541	Tube—Assembly Exhaust Tube to Exhaust Gas Heated Carburetor Intake Elbow	1
2-D-1	Nut—$\frac{1}{4}$-28 U.S.F. Plain Hex. (1) Exhaust Gas Heated Carburetor Intake Elbow Clamping Bolt (2) Exhaust Gas Heated Carburetor Intake Elbow Attaching Stud (24) Intake Manifold Flange to Crankcase Attaching Stud	27
2-D-7	Nut—$\frac{3}{8}$-24 U.S.F. Plain Hex. Exhaust Manifold to Cylinder Head Attaching Stud	18
3-D-2	Bolt—$\frac{1}{4}$-28 U.S.F. x $\frac{13}{16}$ Plain Hex. Head Intake Manifold to Cylinder Head Attaching	18
3-D-10	Bolt—$\frac{1}{4}$-28 U.S.F. x $1\frac{9}{16}$ Plain Hex. Head Exhaust Gas Heated Carburetor Intake Elbow Clamping	1
27-D-1	Washer—$\frac{7}{64}$ x $\frac{1}{2}$ x $\frac{1}{32}$ Plain (1) Exhaust Gas Heated Carburetor Intake Elbow Clamping Bolt (2) Exhaust Gas Heated Carburetor Intake Elbow Attaching Stud Nut (24) Intake Manifold Flange to Crankcase Attaching Stud Nut (18) Intake Manifold to Cylinder Head Attaching Bolt	45
27-D-33	Washer—$\frac{7}{32}$ x $\frac{3}{8}$ x $\frac{1}{32}$ Plain Exhaust Gas Heated Caburetor Intake Elbow Lever Locking Screw	1
33-D-21	Nut—No. 12-24 A.S.M.E. Plain Hex. Exhaust Gas Heated Carburetor Intake Elbow Lever Locking	1

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
39-D-21	Screw—No. 12-24 A.S.M.E. x 3/8 Oval Head Counter Sunk Exhaust Gas Heated Carburetor Intake Elbow Valve to Shaft Attaching	2
96-D-2	Screw—No. 12-24 A.S.M.E. x 5/8 Oval Fillister Head Machine Exhaust Gas Heated Carburetor Intake Elbow Lever Locking	1
189-D-2	Lockwasher—17/64 x 31/64 x .021 Shakeproof Exhaust Gas Heated Carburetor Intake Elbow Lever Locking Screw	1
189-D-3	Lockwasher—17/64 x 1/2 x .024 Shakeproof	45
	(1) Exhaust Gas Heated Carburetor Intake Elbow Clamping Bolt	
	(2) Exhaust Gas Heated Carburetor Intake Elbow Attaching Stud Nut	
	(24) Intake Manifold Flange to Crankcase Attaching Stud Nut	
	(18) Intake Manifold to Cylinder Head Attaching Bolt	
2000-D-2	Lockwasher—5/16-24 Thread Pal-Nut Standard Exhaust Manifold Flange to Cylinder Head Attaching	18

* This part requires special assembling, see instructions under "Complete Overhaul"

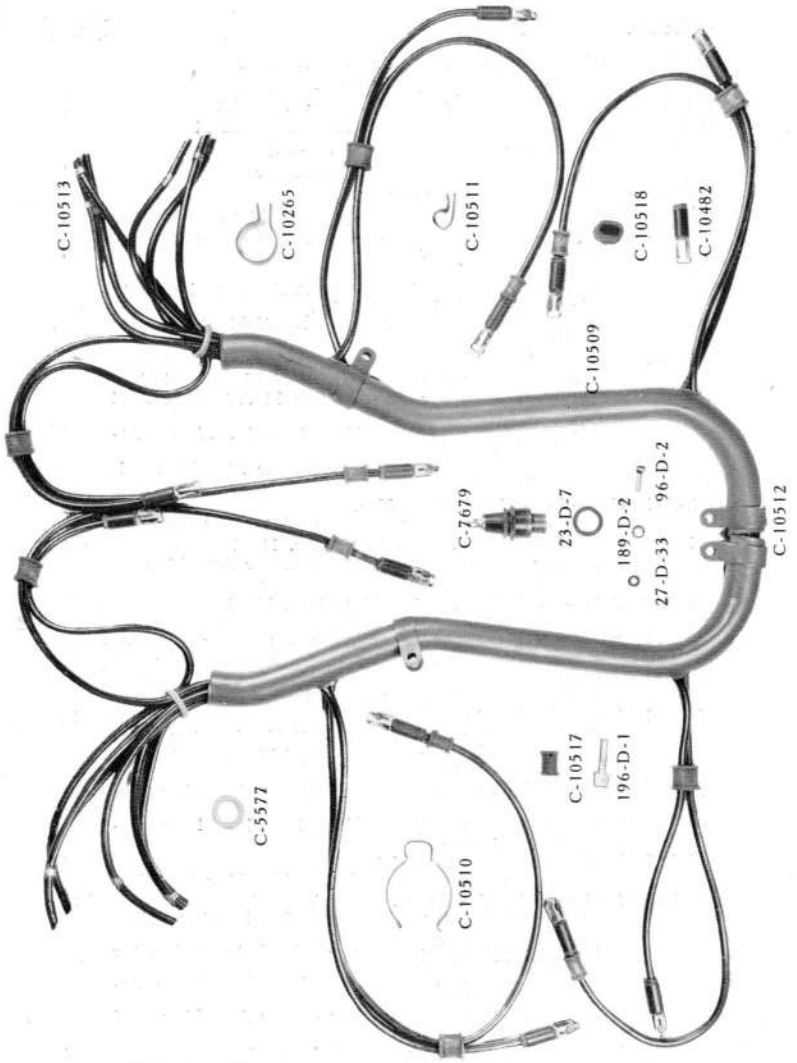
CARBURETOR AND CARBURETOR SPACER GROUP



CARBURETOR AND CARBURETOR SPACER GROUP

Part No.	Name	No. Required
C-10083	Gasket—Carburetor Spacer to Carburetor	1
C-10283	Gasket—Carburetor Spacer to Crankcase	1
C-10315	Flange—Carburetor Exhaust Heated Outlet	1
C-10316	Gasket—Carburetor Exhaust Heated Outlet Flange	1
C-10388	Carburetor—Stromberg Model NA-U4J	1
C-10418	Spacer—Studding Assembly Carburetor	1
C-10447	Manifold—Carburetor Air Scoop	1
C-10458	Gasket—Carburetor Air Scoop Manifold to Carburetor	1
C-10479	Carburetion—Complete Assembly with Stromberg NA-U4J Carburetor includes: Carburetor exhaust heated outlet flange and gasket Air scoop manifold and gasket All carburetor and air scoop manifold studs, nuts and washers.	1
2-D-1	Nut—¼-28 Plain Hex (2) Carburetor Air Scoop Manifold Clamping Bolt (7) Carburetor Air Scoop Manifold Attaching Stud and Bolt (2) Carburetor Exhaust Heated Outlet Flange Attaching Stud (8) Carburetor to Carburetor Spacer Attaching Bolt and Stud	19
2-D-4	Nut—5/16-24 U.S.F. Plain Hex. Carburetor Spacer to Crankcase Attaching Stud	6
3-D-2	Bolt—¼-28 U.S.F. x 1/8 Plain Hex. Head (4) Air Scoop Manifold to Carburetor Attaching (4) Carburetor to Carburetor Spacer Attaching	8
3-D-10	Bolt—¼-28 U.S.F. x 1 5/16 Plain Hex. Head Carburetor Air Scoop Manifold Clamping	2
25-D-34	Stud—¼-28 U.S.F. & 5/16-24 U.S.F. x 1 3/8 Plain Shoulder Exhaust Gas Heated Carburetor Intake Elbow Attaching For replacements order 25-S-34 Stud	2
27-D-1	Washer—17/64 x ½ x 3/32 Plain (2) Carburetor Air Scoop Manifold Clamping Bolt (7) Carburetor Air Scoop Manifold to Carburetor Attaching Stud and Bolt (8) Carburetor to Carburetor Spacer Attaching Stud and Bolt Nut (2) Carburetor Exhaust Heated Outlet Flange Attaching Stud Nut	19
27-D-5	Washer—21/64 x 9/16 x 1/32 Plain Carburetor Spacer to Crankcase Attaching Stud Nut	6
189-D-3	Lockwasher—17/64 x ½ x .024 Shakeproof (2) Carburetor Air Scoop Manifold Clamping Bolt Nut (7) Carburetor Air Scoop Manifold to Carburetor Attaching Stud and Bolt (2) Carburetor Exhaust Heated Outlet Flange Attaching Stud Nut (8) Carburetor to Carburetor Spacer Attaching Stud and Bolt Nut	19
189-D-4	Lockwasher—21/64 x 19/32 x .030 Shakeproof Carburetor Spacer to Crankcase Attaching Stud Nut	6

* This part requires special assembling, see instructions under "Complete Overhaul"



IGNITION CABLES AND TUBES GROUP

Part No.	Name	No. Required

Engines are equipped with one of two (2) types of ignition cable tubes assemblies. One type has the cables leading to the spark plugs inclosed in a metal tube. The other type has no inclosing tube for the cables leading to the spark plugs.

It is very important for servicing to know which type ignition cables tubes assembly is to be serviced.

C-5577	Ring—Ignition Cable Fastening for 6 Cables	2
C-7679	Spark Plug—Model BG-1XA Aviation	12
**C-8157	Clip—Ignition Cable Tube (Spark Plug Cable Tube Small End)	6
**C-10178	Tube—Ignition Cable Long (Spark Plug Cable)	3
**C-10182	Tube—Ignition Cable Large Right Hand	1
**C-10183	Tube—Ignition Cable Large Left Hand	1
**C-10184	Cable—Ignition (set)	1
**C-10251	Tube—Ignition Cable Short (Spark Plug Cable)	3
C-10265	Clip—Ignition Cable Large Tube	4
**C-10266	Clip—Ignition Cable Tube Right Hand (Spark Plug Cable)	3
**C-10267	Clip—Ignition Cable Tube Left Hand (Spark Plug Cable)	3
C-10482	Terminal—Spark Plug Safety Lock	12
***C-10509	Tube—Ignition Cable Large	2
***C-10510	Clamp—Ignition Cable (Large)	6
***C-10511	Clip—Ignition Cable (Single Cable Bushing)	6
*C-10512	Tubes—Assembly Complete Ignition Cable This is the type tubes assembly which has no metal tube inclosing the cables leading to the spark plugs and is factory equipped on engine No. 196 and those following. All complete tubes assembly replacements will be supplied with this type assembly. Engines Nos. 12 to 195 inclusive were factory equipped with type complete ignition cable tubes assembly, which has the cables leading to spark plugs inclosed in a metal tube. When replacements are made on engines equipped with this type assembly it is necessary to order the additional part C-10510 Clamp - (6) required. If the installation of this type assembly is to be changed, as referred to under part No. C-10497, listed in Crankcase Center Section Group, the following additional parts should be ordered, six (6) of each, C-10511 clips, C-10517 bushings, C-10518 bushings, and C-10510 clamps.	1
***C-10513	Cable—Ignition (set)	1
C-10517	Bushing—Ignition Cable Single Clip	6
C-10518	Bushing—Ignition Cable Double Clamp	6
23-D-7	Gasket—$\frac{33}{64}$ x $\frac{31}{32}$ x $\frac{1}{32}$ Copper Asbestos Spark Plug	12

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	quired No. Re-
27-D-33	Washer—$\frac{7}{32}$ x $\frac{3}{8}$ x $\frac{1}{32}$ Plain	10
	**(4) Ignition Cable Tube Clip to Crankcase Anti-Propeller End Cover Attaching Screw	
	(6) Ignition Cable Tube Clip to Cylinder Head Attaching Screw	
96-D-2	Screw—No. 12-24 A.S.M.E. x $\frac{5}{8}$ Oval Fillister Head Machine	10
	**(4) Ignition Cable Tube Clip to Crankcase Anti-Propeller End Cover Attaching	
	(6) Ignition Cable Tube Clip to Cylinder Head Attaching	
189-D-2	Lockwasher—$\frac{13}{64}$ x $\frac{27}{64}$ x .021 Shakeproof	6
	**(4) Ignition Cable Tube Clip to Crankcase Anti-Propeller End Cover Attaching	
	(6) Ignition Cable Tube Clip to Cylinder Head Attaching	
196-D-1	Tag—No. 1 Ignition Cable	1
196-D-2	Tag—No. 2 Ignition Cable	1
196-D-3	Tag—No. 3 Ignition Cable	1
196-D-4	Tag—No. 4 Ignition Cable	1
196-D-5	Tag—No. 5 Ignition Cable	1
196-D-6	Tag—No. 6 Ignition Cable	1

**Supplied for use on engines equipped with the type ignition cable tubes assembly which has the cables leading to the spark plugs inclosed in a metal tube.

Engines No. 12 to 195 inclusive were factory equipped with this type ignition cable tubes assembly.

***Supplied for use on engines equipped with type C-10512 ignition cables tubes assembly.

Engines No. 196 and those following were factory equipped with this type ignition cable tubes assembly.

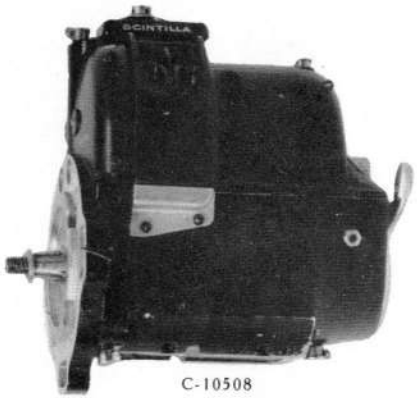
* This part requires special assembling, see instructions under "Complete Overhaul"

MAGNETO AND MAGNETOS DRIVE GROUP


C-10567


C-10566


C-10519



C-10508


C-9591

58-D-3


124-D-34


27-D-87


C-10484


C-10486


45-D-7


45-D-12


34-D-4


28-D-12


2-D-4


C-10207


C-10520

94-D-3

57-D-3


183-D-2


86-D-5


C-10205

33-D-19


194-D-1

27-D-30

JUNE 1929

MAGNETO AND MAGNETO DRIVE GROUP

Part No.	Name	No. Required
C-9591	Ring—Magneto Oldham Coupling This ring is supplied for PN6 Magnetos only Engine Nos 12 to 199 inclusive were factory equipped with one (1) PN6 Magneto	1
C-10205	Rod—Magnetos Connecting	1
C-10207	Rod—Assembly Magnetos Connecting	1
C-10484	Ring—Magneto Oldham Coupling This ring is supplied for MN6 Magnetos only. Each magneto requires one (1) ring. Engines Nos. 12 to 199 inclusive were factory equipped with one (1) MN6 Magneto. Engine No. 200 and those following were factory equipped with (2) MN6 Magnetos.	2
C-10486	Flange—Magneto Drive Coupling All replacements will be made with this single piece flange. When making replacements on engines equipped with two piece flanges, the old flanges and flange attaching nut washer should be discarded.	2
C-10508	Magneto—Scintilla Model MN6-D-F3 All replacements will be made with MN6-D-F3 Magnetos, and should include the following additional parts: One (1) each per magneto: C-10566 Magneto Oil Deflector C-10567 Magneto Oil Deflector Gasket four (4) each per magneto: 86-D-5 Magneto Oil Deflector Attaching Screw 27-D-30 Magneto Oil Deflector Attaching Screw Washer The above additional parts do not have to be replaced unless necessary on engines previously using magneto MN6-D-F3 which are to be repaired. It is very important when replacing PN6 magnetos to replace the Oldham coupling ring C-9591 with Oldham coupling ring C-10484, since ring C-9591 cannot be used with MN6 magnetos.	1
C-10519	Gasket—Magneto All replacements will be made with this type (three magneto attaching bolt) Gasket.	2
C-10520	Coupling—Magnetos Connecting Rod Clevis Pin	1
C-10566	Deflector—Magneto Oil	2
C-10567	Gasket—Magneto Oil Deflector	2
2-D-4	Nut—$\frac{5}{16}$-24 U.S.F. Plain Hex. Magneto Attaching Stud	4
27-D-30	Washer—$\frac{13}{64}$ x $\frac{5}{16}$ x $\frac{1}{32}$ Plain Magneto Oil Deflector Attaching Screw	8
27-D-87	Washer—$\frac{33}{64}$ x $1\frac{1}{8}$ x $\frac{1}{8}$ Plain Magneto Drive Coupling Attaching This washer is supplied for engines equipped with two (2) piece coupling flange only.	2

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
28-D-12	Lockwasher—11/32 x 1/2 x 3/32 Standard (4) Magneto Attaching Stud †(2) Magneto Attaching Bolt Nut	6
33-D-19	Nut—No. 10-32 Plain Hex. Magnetos Connecting Rod End Lock	2
34-D-4	Washer—21/64 x 3/4 x 3/32 Plain (4) Magneto Attaching Stud Nut †(2) Magneto Attaching Bolt	6
45-D-7	Bolt—5/16-24 U.S.F. x 1 1/4 Plain Hex. Head Magneto Attaching Short Supplied on engines equipped only with type Crankcase C-10497 (See Crankcase Center Section Group) This bolt is used only when magnetos are installed in the downward position. One (1) bolt required for each magneto.	2
45-D-12	Bolt—5/16-24 U.S.F. x 2 15/16 Plain Hex. Head Magneto Attaching Long	2
57-D-3	Cotter Pin—1/16 x 3/8 Magnetos Connecting Rod Attaching	2
58-D-3	Cotter Pin—3/32 x 5/8 Magneto Drive Coupling Flange Attaching Nut	2
86-D-5	Screw—No. 10-32 A.S.M.E. x 1/4 Oval Fillister Head Magneto Oil Deflector Attaching	8
94-D-3	Screw—No. 10-32 A.S.M.E. x 7/16 Oval Fillister Head Machine Magneto Clevis Pin Coupling	1
124-D-34	Nut—3/8-16 U.S.S. Special Slotted Hex. Magneto Drive Coupling Flange to Magneto Attaching	2
183-D-2	Pin—3/16 x 31/32 Magnetos Connecting Rod Attaching Clevis	1
194-D-1	Rod End—Magnetos Connecting Rod—Adjustable Yoke	2

†Supplied on engines equipped with type Crankcase C-10497 (See Crankcase Center Section Group) Factory equipped on Engines No. 196 and those following.

* This part requires special assembling, see instructions under "Complete Overhaul"

SINGLE AND DOUBLE TACHOMETER DRIVE GROUP


C-10468


96-D-4


96-D-12


C-10465

17-D-1


C-10477


13-D-31


C-10469


C-10467


C-10462


C-10463


C-10466


C-10372


129-D-23


C-10373

189-D-2


27-D-33


96-D-2


C-10371


C-7221

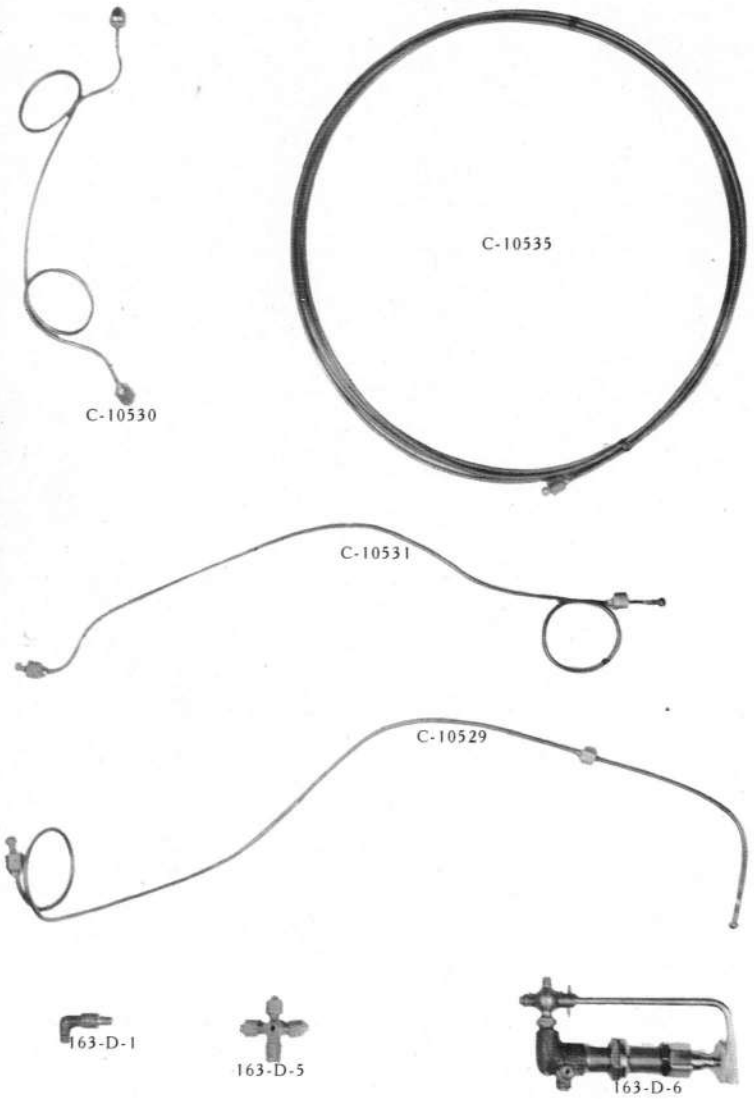
SINGLE AND DOUBLE TACHOMETER DRIVE GROUP

Part No.	Name	No. Required
C-7221	Ring—Tachometer Drive Shaft Retaining Ring (Single Tachometer)	1
C-10371	Shaft—Tachometer Drive (Single Tachometer)	1
C-10372	Housing—Tachometer Drive Shaft (Single Tachometer)	1
C-10373	Housing—Assembly Tachometer Drive Shaft (Single Tachometer) The single tachometer drive is standard equipment on all standard engines, but is interchangeable with the double tachometer with the following exception: The double tachometer drive attaching screws are longer than the screws used for single tachometer drive (See 96-D-12 screw listed elsewhere in this group). The single tachometer drive is factory equipped on all engines, except those listed under Part C-10468 double tachometer drive.	1
C-10462	Shaft—Tachometer Driving (Double Tachometer)	1
C-10463	Gear—Tachometer Driving Shaft (Double Tachometer)	1
C-10465	Sleeve—Tachometer Threaded (Double Tachometer)	2
C-10466	Shaft—Tachometer Driven (Double Tachometer)	2
C-10467	Cap—Assembly Tachometer Drive Housing (Double Tachometer)	1
C-10468	Housing—Complete Assembly Tachometer Drive (Double Tachometer) The double tachometer drive is interchangeable with the single tachometer, except the attaching screws which are too long for the single tachometer drive. (See 96-D-2 listed elsewhere in this group). The double tachometer was factory equipped on the following engines No. 72, 89, 103, 104, 105, 112, 142 167 to 176 inclusive, 188, 189, 201, 202, 203, 247, 248, 249, 264 to 267 inclusive, 286, 304 to 313 inclusive, and 316 to 372 inclusive.	1
C-10469	Gasket—Tachometer Drive Housing to Drive Housing Cap (Double Tachometer)	1
C-10477	Housing—Assembly Tachometer Drive (Double Tachometer)	1
13-D-31	Pin—$\frac{1}{8}$ x $\frac{3}{8}$ Tachometer Drive Housing Cap to Tachometer Housing Dowel (Double Tachometer)	2
17-D-1	Pin—$\frac{3}{32}$ x $\frac{5}{16}$ Tachometer Threaded Sleeve Locking (Double Tachometer)	2
27-D-33	Washer—$\frac{7}{32}$ x $\frac{3}{8}$ x $\frac{1}{32}$ Plain (2) Tachometer Drive Shaft Housing to Crankcase Cover Attaching (1) Tachometer Drive Housing Cap Attaching (Double Tachometer)	3

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
96-D-2	Screw—No. 12-24 A.S.M.E. x 5/8 Oval Fillister Head Machine Tachometer Drive Shaft Housing Attaching (Single Tachometer)	2
96-D-4	Screw—No. 12-24 A.S.M.E. x 3/4 Oval Fillister Head Machine Tachometer Drive Housing Cap Attaching (Double Tachometer)	1
96-D-12	Screw—No. 12-24 A.S.M.E. x 1 3/16 Oval Fillister Head Machine Tachometer Drive Housing to Crankcase Cover Attaching (Double Tachometer)	2
129-D-23	Gasket—Two Bolt Type Tachometer Drive Housing to Crankcase Cover	1
189-D-2	Lockwasher—17/64 x 27/64 x .021 Shakeproof (2) Tachometer Drive Housing to Crankcase Cover Attaching Screw (1) Tachometer Drive Housing Cap Attaching Screw (Double Tachometer)	3

* This part requires special assembling, see instructions under "Complete Overhaul"



PRIMING SYSTEM GROUP

Part No.	Name	No. Required
C-10527	Priming System	1
C-10529	Tube—Assembly Cylinder No. 1 Priming	1
C-10530	Tube—Assembly Cylinder No. 2 Priming	1
C-10531	Tube—Assembly Cylinder No. 3 Priming	1
C-10535	Tube—Assembly Gas Primer Pump Outlet	1
C-10545	Clamp—Priming Tube Used on engines equipped with type ignition cable tubes which have the cables leading to spark plugs enclosed in a metal tube. Engines No. 12 to 195 inclusive were factory equipped with this type ignition cable tubes.	3
163-D-1	Elbow—Gasoline Primer ⅛" Tube Discharge	3
163-D-5	Cross-Side Outlet—Primer Discharge	1
163-D-6	Primer Pump—With shut-off cock	1

* This part requires special assembling, see instructions under "Complete Overhaul"

NUMERICAL PARTS LIST

Part No.	Name	No. Required
X-865	Tube—Oil Strainer Guide	1
C-1322	Pin—Propeller Hub	1
C-1529	Spring—Oil Pressure Regulator	1
C-2311	Gasket—Electric Starter or Starter Substituting Cover	1
C-2713	Cover—Starter Substituting	1
C-4089	Cover—Gear Gas Pump Substituting	1
C-4092	Gasket—Gear Gas Pump Drive Shaft Housing, or Substituting Cover	1
C-4167	Bushing—Spark Plug	12
C-4185	Valve—Oil Pressure Regulator	2
C-4220	Dowel Pin—Propeller Hub	1
C-4293	Gear—Oil Pressure Pump Keyed	1
C-5577	Ring—Ignition Cable Fastening for 6 Cables	2
C-6043	Bushing—Connecting Rod Upper End	6
C-6216	Gear—Oil Pressure Pump Idler	1
C-6238	Screw—Oil Pressure Regulator	2
C-6429	Gasket—Generator to Generator Drive Shaft Housing	1
C-7221	Ring—Tachometer Drive Shaft Retaining	1
C-7287	Spring—Pressure Oil Strainer Head	1
C-7490	Ring—Intake Valve Retaining	6
C-7491	Ring—Exhaust Valve Retaining	6
C-7679	Spark Plug—Model BG-1XA Aviation	12
C-8055	Bushing—Master Connecting Rod Lower End	8
C-8112	Plug—Crankshaft Propeller End	1
C-8157	Clip—Ignition Cable Tube (Spark Plug Cable Tube Small End)	6
C-8164	Cover—Breather Tube	1
C-8165	Screen—Breather Tube Cover	1
C-8251	Gasket—Breather Flange to Crankcase	1
C-8488	Bushing—Oil Thermometer to Oil Sump Housing	2
C-9471	Gear—Oil Scavenger Pump Keyed	1
C-9473	Gear—Oil Scavenger Pump Idler	1
C-9591	Ring—Magneto Oldham Coupling	1
C-9667	Ring—5 1/8 x 5/32 Piston Lower	18
C-9672	Ring—5 1/8 x 5/32 Piston Upper	12
C-9711	Spring—Oil Pressure Regulator	1
C-10016	Connecting Rod—Assembly Articulated	4
C-10017	Guide—Propeller End Cylinders Camfollower	6
C-10019	Bushing—Camfollower Roller	12
C-10020	Roller—Camfollower	12
C-10021	Pin—Camfollower Roller	12
C-10022	Cover—Generator Substituting	1
C-10024	Bushing—Wrist Pin	4
C-10025	Bearing Shell—Master Connecting Rod Upper Half	2
C-10026	Bearing Shell—Master Connecting Rod Lower Half	2

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
C-10036	Push Rod—Assembly No. 2, 4 and 6 Cylinders Valve	6
C-10037	Push Rod—Assembly No. 3 and 5 Cylinders Valve	4
C-10039	Connecting Rod—Bearing Assembly Master	2
C-10040	Stud—Master Connecting Rod Cap (Plain)	4
C-10041	Stud—Master Connecting Rod Cap (Dowel Type)	4
C-10044	Shaft—Cam Gear Drive Shaft Adjusting	1
C-10045	Gasket—Generator Drive Shaft Housing or Generator Substituting Cover	1
C-10053	Screen—Assembly Crankcase Oil Drain	1
C-10057	Cover—Oil Sump	1
C-10058	Gasket—Crankcase Center Section to Crankcase Propeller End	1
C-10059	Gasket—Oil Sump Housing to Oil Sump Housing and Screen	2
C-10061	Gasket—Crankcase Propeller End to Oil Sump Housing	1
C-10077	Wrist Pin—Assembly	4
C-10082	Strainer—Assembly Pressure Oil (Standard)	1
C-10082-A	Strainer—Assembly Pressure Oil (Special)	1
C-10083	Gasket—Carburetor Spacer to Carburetor	1
C-10091	Housing—Studding Assembly Oil Sump	1
C-10092	Gasket—Pressure Oil Strainer Cover	1
C-10093	Cover—Pressure Oil Strainer	1
C-10094	Shaft—Generator Drive (For replacements order C-10588 bushing)	1
C-10096	Gasket—Oil Pump to Crankcase	1
C-10098	Bushing—Generator Drive Shaft	1
C-10104	Plug—Crankshaft Crank Pin Oil Retaining	4
C-10107	Housing—Assembly Generator Drive Shaft	1
C-10109	Shaft—Oil Pump Idler	1
C-10111	Tubes—Assembly Complete Ignition Cable	1
C-10114	Socket—Valve Push Rod	12
C-10115	Ring—Valve Push Rod Socket Retaining	12
C-10116	Bushing—Intake and Exhaust Cam Gear	1
C-10117	Gear—Assembly Intake and Exhaust Cam	1
C-10120	Cover—Rocker Arm Bearing Retaining	24
C-10121	Screw—Assembly Valve Rocker Arm Adjusting	12
C-10122	Shim—Crankshaft Gear	1
C-10123	Spacer—Cam	1
C-10125	Rocker Arm—Complete Assembly Valve	12
C-10129	Shaft—Oil Pump Drive	1
C-10131	Crankcase—Studding Assembly Propeller End	1
C-10135	Gasket—Crankcase Center Section Anti-Propeller End Cover	1
C-10142	Gasket—Gun Synchronizer Housing, or Substituting Cover	1
C-10144	Bolt—Rocker Arm Bearing Retaining Cover	12
C-10155	Cover—Studding Assembly Crankcase Center Section Anti-Propeller End	1
C-10157	Washer—Exhaust Valve Spring Upper	6
C-10158	Washer—Intake and Exhaust Valve Spring Lower	12

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
C-10159	Guide—Exhaust Valve (For replacements order C-10563 guide)	6
C-10167	Washer—Intake Valve Spring Upper	6
C-10168	Gasket—Cylinder Head Cover to Cylinder Head	12
C-10171	Guide—Intake Valve (For replacements order C-10562 guide)	6
C-10178	Tube—Ignition Cable Long (Spark Plug Cable)	3
C-10179	Cover—Cylinder Head	12
C-10182	Tube—Ignition Cable Large Right Hand	1
C-10183	Tube—Ignition Cable Large Left Hand	1
C-10184	Cable—Ignition	1 set
C-10204	Shaft—Assembly Cam Gear Drive	1
C-10205	Rod—Magnetos Connecting	1
C-10207	Rod—Assembly Magnetos Connecting	1
C-10217	Guide—Anti-Propeller End Cylinders Camfollowers	6
C-10218	Cam—Intake and Exhaust	2
C-10220	Cover—Crankcase Propeller End	1
C-10221	Deflector—Crankcase Thrust Bearing Propeller End Oil	1
C-10222	Deflector—Crankshaft Thrust Bearing Anti-Propeller End Oil	1
C-10223	Gasket—Crankcase Propeller End to Crankcase Propeller End Cover	1
C-10225	Gear—Assembly Complete Intake and Exhaust Cam	1
C-10231	Camfollower—Machining Assembly	12
C-10232	Camfollower—Complete Assembly	12
C-10234	Flange—Intake Manifold	6
C-10235	Packing—Intake Manifold	6
C-10236	Spring—Valve Inner	12
C-10237	Spring—Valve Intermediate	12
C-10238	Spring—Valve Outer	12
C-10240	Manifold—Intake Long	3
C-10241	Manifold—Intake Short	3
C-10242	Gasket—Intake Manifold to Cylinder Head	6
C-10244	Seat—Valve	12
C-10248	Elbow—Exhaust Gas Heated Carburetor Intake	1
C-10250	Gasket—Oil Sump Housing to Crankcase Center Section Anti-Propeller End	1
C-10251	Tube—Ignition Cable Short (Spark Plug Cable)	3
C-10257	Housing—Anti-Propeller End Cylinders Rocker Arm	6
C-10258	Housing—Propeller End Cylinders Rocker Arm	6
C-10264	Elbow—Assembly Exhaust Gas Heated Carburetor Intake	1
C-10265	Clip—Ignition Cable Iarge Tube	4
C-10266	Clip—Ignition Cable Tube Right Hand (Spark Plug Cable)	3
C-10267	Clip—Ignition Cable Tube Left Hand (Spark Plug Cable)	3
C-10271	Gasket—Push Rod Enclosing Tube to Camfollower Guide	12
C-10272	Nut—Push Rod Enclosing Tube Packing	12

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
C-10275	Tube—Assembly Propeller End Cylinders Valve Push Rod Enclosing	6
C-10276	Tube—Assembly Anti-Propeller End Cylinders Valve Push Rod Enclosing	6
C-10277	Packing—Push Rod Enclosing Tube	12
C-10278	Gasket—Rocker Arm Housing to Cylinder Head	12
C-10279	Gasket—Camfollower Guide to Crankcase	12
C-10282	Tube—Assembly Oil Pump to Oil Strainer Oil	1
C-10283	Gasket—Carburetor Spacer to Crankcase	1
C-10284	Gasket—Exhaust Gas Heated Carburetor Intake Elubow	1
C-10288	Shaft—Assembly Exhaust Gas Heated Carburetor Intake Elbow	1
C-10291	Valve—Exhaust Gas Heated Carburetor Intake Elbow	1
C-10297	Nut—S.A.E. Standard No. 20 Propeller Hub Shaft	1
C-10315	Flange—Carburetor Exhaust Heated Outlet	1
C-10316	Gasket—Carburetor Exhaust Heated Outlet Flange	1
C-10341	Spacer—Crankshaft Anti-Propeller End	1
C-10345	Rocker Arm—Assembly Valve	12
C-10347	Push Rod—Assembly No. 1 Cylinder Valve	2
C-10352	Breather—Assembly	1
C-10353	Gear—Oil Pump Intermediate	1
C-10354	Ring—Propeller Hub Taper	1
C-10355	Bushing—Oil Pump Intermediate Drive Gear Shaft (For replacements order C-10559 bushing)	1
C-10356	Shaft—Oil Pump Intermediate Gear	1
C-10358	Ring—Crankcase Main Bearing	2
C-10363	Ring—S.A.E. Standard No. 20 Propeller Shaft	1
C-10364	Pin—Propeller End Bearing Clamping Bolt Washer Retaining	2
C-10365	Washer—Propeller End Bearing Clamping Bolt Inner	2
C-10366	Bushing—Cam Gear Drive Shaft Adjusting Shaft (For replacements order C-10558 bushing)	2
C-10369	Crankshaft—Complete Assembly	1
C-10371	Shaft—Tachometer Drive	1
C-10372	Housing—Tachometer Drive Shaft	1
C-10373	Housing—Assembly Tachometer Drive Shaft	1
C-10374	Gear—Assembly Magneto Drive Intermediate	1
C-10375	Nut—Crankshaft Thrust Bearing Lock	1
C-10376	Flange—Exhaust Manifold	6
C-10377	Gasket—Exhaust Manifold to Cylinder Head	6
C-10378	Body—Oil Pump Pressure	1
C-10381	Oil Pump—Complete Assembly	1
C-10383	Body—Studding Assembly Oil Pump Scavenger	1
C-10384	Cover—Studding Assembly Oil Pump	1
C-10386	Piston Pin	6
C-10387	Ring—Piston Pin Retaining	12
C-10388	Carburetor—Stromberg Model NA-U4J	1
C-10396	Cover—Gun Synchronizer Substituting and Lifting Eye	1
C-10404	Plug—Crankshaft Anti-Propeller End Oil Retaining	1
C-10408	Hub—Propeller	1

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
C-10409	Flange—Propeller Hub	1
C-10410	Nut—Propeller Hub	1
C-10418	Spacer—Studding Assembly Carburetor	1
C-10420	Gear—Magneto Drive	2
C-10421	Bushing—Magneto Drive Gear (For replacements order C-10557 bushing)	2
C-10429	Nipple—Vacuum Gun—Zerk Type	12
C-10430	Gear—Crankshaft Anti-Propeller End	1
C-10431	Bolt—Crankshaft Anti-Propeller End Gear Retaining	1
C-10432	Nut—Crankshaft Anti-Propeller End Gear Retaining Bolt	1
C-10434	Bolt—Propeller Hub	8
C-10440	Ring—Propeller End Bearing Clamping Bolt Retaining	2
C-10447	Manifold—Carburetor Air Scoop	1
C-10452	Nut—Exhaust Valve Spring Washer	6
C-10453	Nut—Intake Valve Spring Washer	6
C-10455	Valve—Intake	6
C-10458	Gasket—Carburetor Air Scoop Manifold to Carburetor	1
C-10459	Nut—Propeller Hub Lock	1
C-10462	Shaft—Tachometer Driving	1
C-10463	Gear—Tachometer Driving Shaft	1
C-10465	Sleeve—Tachometer Threaded	2
C-10466	Shaft—Tachometer Driven	2
C-10467	Cap—Assembly Tachometer Drive Housing	1
C-10468	Housing—Complete Assembly Tachometer Drive	1
C-10469	Gasket—Tachometer Drive Housing to Drive Housing Cap	1
C-10470	Packing—Cylinder Sleeve	6
C-10472	Cylinder Head to Sleeve Assembly (Standard)	6
C-10473	Cylinder—Assembly Complete (Standard)	6
C-10475	Valve—Exhaust	6
C-10477	Housing—Assembly Tachometer Drive	1
C-10479	Carburetion—Complete Assembly with Stromberg NA-U4J Carburetor	1
C-10482	Terminal—Spark Plug Safety Lock	12
C-10484	Ring—Magneto Oldham Coupling	2
C-10486	Flange—Magneto Drive Coupling	2
C-10492	Nut—Propeller Hub	1
C-10496	Cover—Studding Assembly Crankcase Center Section Anti-Propeller End	1
C-10497	Crankcase—Studding Assembly Center Section Propeller and Anti-Propeller End	1
C-10499	Gasket—Crankcase Center Section Anti-Propeller End Cover	1
C-10504	Tube—Assembly Oil Pump to Oil Strainer Oil	1
C-10505	Gasket—Propeller End Bearing Clamping Bolt	2
C-10506	Beam—Engine Mounting	2
C-10508	Magneto—Scintilla Model MN6-D-F3	2
C-10509	Tube—Ignition Cable (Large)	2
C-10510	Clamp—Ignition Cable (Large)	6

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
C-10511	Clip—Ignition Cable (Single cable bushing)	6
C-10512	Tubes—Assembly Complete Ignition Cable	1
C-10513	Cable—Ignition	1 set
C-10514	Gasket—½ x 11/16 x 5/32 Soft Copper	6
C-10515	Piston—5 1/8 x 1.813 (Standard compression ratio 5.2 to 1)	6
C-10517	Bushing—Ignition Cable Single Clip	6
C-10518	Bushing—Ignition Cable Double Clamp	6
C-10519	Gasket—Magneto	2
C-10520	Coupling—Magneto Connecting Rod Clevis Pin	1
C-10524	Plug—Oil Sump Housing (Top)	1
C-10527	Priming System	1
C-10529	Tube—Assembly Cylinder No. 1 Priming	1
C-10530	Tube—Assembly Cylinder No. 2 Priming	1
C-10531	Tube—Assembly Cylinder No. 3 Priming	1
C-10535	Tube—Assembly Gas Primer Pump Outlet	1
C-10538	Nut—Propeller Hub Shaft Special	1
C-10539	Ring—Propeller Shaft Special	1
C-10541	Tube—Assembly Exhaust Tube to Exhaust Gas Heated Carburetor Intake Elbow	1
C-10544	Bushing—Air Starter	6
C-10545	Clamp—Priming Tube	3
C-10557	Bushing—Magneto Drive Gear (See C-10421)	2
C-10558	Bushing—Cam Gear Drive Shaft Adjusting Shaft (See C-10366)	2
C-10559	Bushing—Oil Pump Intermediate Drive Gear Shaft (See C-10355)	1
C-10560	Ring—Propeller Hub Snap	1
C-10562	Guide—Intake Valve (See C-10171)	6
C-10563	Guide—Exhaust Valve (See C-10159)	6
C-10566	Deflector—Magneto Oil	2
C-10567	Gasket—Magneto Oil Deflector	2
C-10569	Crankshaft—Plug Assembly	1
C-10572	Lock Ring—Propeller Hub Nut	1
C-10580	Crankcase—Studding Assembly Center Section Propeller End	1
C-10581	Crankcase—Studding Assembly Center Section Anti-Propeller End	1
C-10586	Bodies and Cover—Assembly Oil Pump	1
C-10587	Piston—5 1/8 x 1.813 (Standard compression ratio 5.2 to 1)	6
C-10588	Bushing—Generator Drive Shaft (See C-10098)	1
C-10594	Ring—5 1/8 x 1/16 Piston Oil (Simplex)	12
C-10599	Piston—5 1/8 x 1.813 (Low compression ratio 4.9 to 1)	6
C-10603	Expander—Piston Ring (Simplex)	12
1-D-1	Nut—¼-28 U.S.F. Slotted Hex.	11
1-D-4	Nut—5/16-24 U.S.F. Slotted Hex.	14
1-D-13	Nut—½-20 U.S.F. Slotted Hex.	9
1-D-16	Nut—9/16-18 U.S.F. Slotted Hex.	4
1-D-26	Nut—¾-16 U.S.F. Special Slotted Hex .	1

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
2-D-1	Nut—¼-28 U.S.F. Plain Hex.	87
2-D-4	Nut—5/16-24 U.S.F. Plain Hex.	57
2-D-7	Nut—⅜-24 U.S.F. Plain Hex.	23
2-D-10	Nut—7/16-20 U.S.F. Plain Hex.	72
2-D-13	Nut—½-20 U.S.F. Plain Hex.	5
3-D-2	Bolt—¼-28 U.S.F. x 13/16 Plain Hex. Head	29
3-D-10	Bolt—¼-28 U.S.F. x 1 5/16 Plain Hex. Head	3
4-D-5	Bushing—¼-28 U.S.F. & ⅜-24 U.S.F. x ½ Screw (For replacements order 4-S-5 bushing)	18
4-D-8	Bushing—5/16-24 U.S.F. & 7/16-20 U.S.F. x ½ Screw (For replacements order 4-S-8 bushing)	2
4-D-9	Bushing—No. 12-24 A.S.M.E. & 5/16-24 U.S.F. x ⅜ Screw (For replacements order 4-S-9 bushing)	44
10-D-9	Key—No. 5 Woodruff	3
13-D-1	Pin—⅛ x ½	8
13-D-25	Pin—⅛ x ¼	5
13-D-31	Pin—⅛ x ⅜	2
13-D-32	Pin—⅛ x 13/16	6
13-D-33	Pin—⅛ x 21/4	6
17-D-1	Pin—3/32 x 5/16	2
18-D-5	Rivet—5/16 x ½ Flat CounterSunk Head	8
19-D-1	Bushing—¼-28 U.S.F. & ⅜-24 U.S.F. Blind Screw (For replacements order 19-S-1 bushing)	3
19-D-5	Bushing—No. 12-24 A.S.M.E. & ⅜-24 U.S.F. Blind Screw (For replacements order 19-S-5 bushing)	4
19-D-7	Bushing—5/16-24 U.S.F. & 7/16-20 U.S.F. Blind Screw (For replacements order 19-S-7 bushing)	2
20-D-2	Pin—5/16 x ½ Straight	6
20-D-9	Pin—3/16 x ⅜ Straight	2
20-D-13	Pin—5/16 x 3/32 Straight	1
20-D-19	Pin—5/16 x 1 1/8 Straight	1
20-D-20	Pin—5/16 x ⅜ Straight	1
21-D-2	Bearing—Radial Ball	1
21-D-32	Bearing—Special Radial Ball	2
21-D-35	Bearing—Radial Ball	24
23-D-2	Gasket—1 1/8 x 1 3/8 x 1/16 Copper Asbestos	2
23-D-7	Gasket—33/32 x 31/32 x 5/32 Copper Asbestos	12
23-D-16	Gasket—5/8 x 1 1/8 x 1/16 Copper Asbestos	2
25-D-3	Stud—¼-28 U.S.F. & 5/16-24 U.S.F. x 1 1/8 Plain Shoulder (For replacements order 25-S-3 stud)	27
25-D-6	Stud—¼-28 U.S.F. & 5/16-24 U.S.F. x 1 3/16 Plain Shoulder (For replacements order 25-S-6 stud)	24
25-D-28	Stud—¼-28 U.S.F. & 5/16-24 U.S.F. x 1 9/32 Plain Shoulder (For replacements order 25-S-28 stud)	14
25-D-34	Stud—¼-28 U.S.F. & 5/16-24 U.S.F. x 1 3/8 Plain Shoulder (For replacements order 25-S-34 stud)	2
27-D-1	Washer—17/64 x ½ x 1/32 Plain	108
27-D-5	Washer—21/64 x 9/16 x 1/32 Plain	32
27-D-8	Washer—25/64 x 11/16 x 1/32 Plain	5
27-D-30	Washer—13/64 x 5/16 x 1/32 Plain	8

* This part requires special assembling, see instructions under "Complete Overhaul"

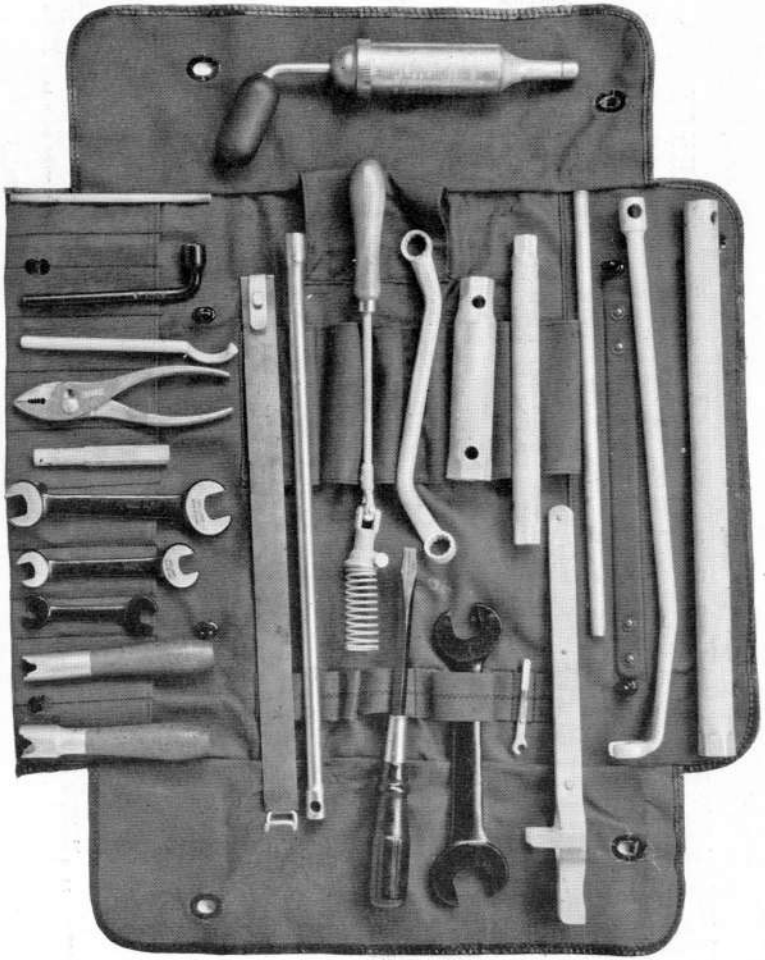
Part No.	Name	No. Required
27-D-33	Washer—$\frac{7}{32}$ x $\frac{3}{8}$ x $\frac{1}{32}$ Plain	98
27-D-84	Washer—$\frac{33}{64}$ x $\frac{7}{8}$ x $\frac{1}{16}$ Plain	6
27-D-87	Washer—$\frac{21}{64}$ x $1\frac{1}{8}$ x $\frac{1}{8}$ Plain	2
27-D-88	Washer—$\frac{21}{64}$ x $1\frac{3}{8}$ x $\frac{3}{32}$ Plain	1
28-D-7	Lockwasher—$\frac{7}{32}$ x $\frac{11}{32}$ x $\frac{3}{64}$ Standard	60
28-D-12	Lockwasher—$\frac{1}{32}$ x $\frac{13}{32}$ x $\frac{3}{32}$ Standard	8
29-D-4	Pin—$\frac{1}{4}$ x $\frac{3}{8}$	4
31-D-4	Stud—$\frac{3}{8}$-24 U.S.F. x $\frac{7}{16}$-20 U.S.F. x $1\frac{5}{8}$ Plain Shoulder (For replacements order 31-S-4 stud)	5
32-D-10	Stud—$\frac{7}{16}$-24 U.S.F. & $\frac{3}{8}$-24 U.S.F. x $1\frac{13}{16}$ Plain Shoulder (For replacements order 32-S-10 stud)	3
32-D-11	Stud—$\frac{7}{16}$-24 U.S.F. & $\frac{3}{8}$-24 U.S.F. x $2\frac{13}{16}$ Plain Shoulder (For replacements order 32-S-11 stud)	2
32-D-12	Stud—$\frac{7}{16}$-24 U.S.F. & $\frac{3}{8}$-24 U.S.F. x $1\frac{3}{8}$ Plain Shoulder (For replacements order 32-S-12 stud)	15
32-D-15	Stud—$\frac{7}{16}$-24 U.S.F. x $\frac{3}{8}$-24 U.S.F. x $1\frac{23}{32}$ Plain Shoulder (For replacements order 32-S-15 stud)	13
32-D-17	Stud—$\frac{7}{16}$-24 U.S.F. x $\frac{3}{8}$-24 U.S.F. x $2\frac{13}{32}$ Plain Shoulder (For replacements order 32-S-17 stud)	3
33-D-19	Nut—No. 10-32 A.S.M.E. Plain Hex.	2
33-D-21	Nut—No. 12-24 A.S.M.E. Plain Hex.	1
34-D-4	Washer—$\frac{21}{64}$ x $\frac{3}{4}$ x $\frac{3}{32}$ Plain	6
34-D-17	Washer—$\frac{21}{64}$ x $1\frac{1}{16}$ x $\frac{3}{32}$ Plain	8
37-D-10	Washer—$\frac{7}{16}$ x $\frac{11}{16}$ x $\frac{1}{16}$ Fibre	2
37-D-63	Washer—$\frac{7}{8}$ x $1\frac{1}{8}$ x $\frac{1}{32}$ Vellumoid	1
39-D-21	Screw—No. 12-24 A.S.M.E. x $\frac{5}{8}$ Oval Fillister Head Machine	1
45-D-7	Bolt—$\frac{5}{16}$-24 U.S.F. x $1\frac{1}{4}$ Plain Hex. Head	2
45-D-12	Bolt—$\frac{7}{16}$-24 U.S.F. x $2\frac{13}{16}$ Plain Hex. Head	2
57-D-1	Cotter Pin—$\frac{1}{16}$ x $\frac{1}{2}$	14
57-D-3	Cotter Pin—$\frac{1}{16}$ x $\frac{3}{8}$	2
57-D-11	Cotter Pin—$\frac{1}{16}$ x $\frac{7}{16}$	11
58-D-3	Cotter Pin—$\frac{3}{32}$ x $\frac{5}{8}$	2
58-D-5	Cotter Pin—$\frac{3}{32}$ x $\frac{1}{2}$	1
59-D-3	Cotter Pin—$\frac{1}{8}$ x $\frac{3}{4}$	17
59-D-5	Cotter Pin—$\frac{1}{8}$ x $\frac{7}{8}$	4
59-D-6	Cotter Pin—$\frac{1}{8}$ x $1\frac{1}{8}$	1
70-D-3	Pin—$\frac{3}{8}$ x $\frac{3}{4}$	1
76-D-7	Stud—$\frac{7}{16}$-20 U.S.F. & $\frac{1}{2}$-20 U.S.F. x $1\frac{13}{16}$ Plain Shoulder (For replacements order 76-S-7 stud)	72
86-D-5	Screw—No. 10-32 A.S.M.E. x $\frac{1}{4}$ Oval Fillister Head	8
93-D-15	Plug—$\frac{1}{2}$-13 U.S.F. Hex. Head	6
93-D-16	Plug—$1\frac{1}{8}$-18 U.S.F. Hex. Head Drilled for Lockwire	2
93-D-18	Plug—$\frac{5}{8}$-18 U.S.F. Hex. Head	2
94-D-3	Screw—No. 10-32 A.S.M.E. x $\frac{7}{16}$ Oval Fillister Head Machine	1
94-D-5	Screw—No. 10-32 A.S.M.E. x $\frac{1}{4}$ Oval Fillister Head Machine	4
96-D-2	Screw—No. 12-24 A.S.M.E. x $\frac{5}{8}$ Oval Fillister Head Machine	48

* This part requires special assembling, see instructions under "Complete Overhaul"

Part No.	Name	No. Required
96-D-4	Screw—No. 12-24 A.S.M.E. x $\frac{3}{4}$ Oval Fillister Head Machine	1
96-D-11	Screw—No. 12-24 A.S.M.E. x $2\frac{3}{32}$ Oval Fillister Head Machine	24
96-D-12	Screw—No. 12-24 A.S.M.E. x $1\frac{3}{16}$ Oval Fillister Head Machine	2
102-D-14	Plug—$\frac{7}{16}$-20 U.S.F. Headless	1
122-D-1	Pipe Plug—$\frac{1}{8}$-27 Headless	3
122-D-3	Pipe Plug—$\frac{3}{8}$-18 Headless	2
122-D-5	Pipe Plug—$\frac{1}{4}$-18 Headless	1
122-D-7	Pipe Plug—$\frac{1}{8}$-27 Headless	4
124-D-7	Nut—$\frac{1}{2}$-20 U.S.F. Slotted Hex. Special	8
124-D-34	Nut—$\frac{3}{8}$-16 U.S.S. Special Slotted Hex.	2
125-D-50	Bolt—$\frac{5}{16}$-24 U.S.F. x $4\frac{3}{4}$ Special Necked and Drilled for Slotted Nut	2
125-D-51	Bolt—$\frac{1}{4}$-28 U.S.F. x $3\frac{1}{16}$ Oval Fillister Head	6
125-D-52	Bolt—$\frac{1}{4}$-28 U.S.F. x $\frac{1}{16}$ Hex. Head Special	5
125-D-63	Screw—No. 12-24 A.S.M.E. x $\frac{3}{4}$ Special Hex. Head	12
125-D-65	Screw—No. 12-24 A.S.M.E. x $1\frac{1}{16}$ Special Hex. Head	24
125-D-69	Bolt—$\frac{5}{16}$-24 U.S.F. x $2\frac{3}{8}$ Special Necked	2
125-D-78	Screw—$\frac{7}{16}$-24 U.S.F. x $1\frac{3}{8}$ Flat Fillister Head Special	2
126-D-41	Stud—$\frac{1}{2}$-20 U.S.F. & $\frac{9}{16}$-18 U.S.F. x $4\frac{3}{8}$ Special Necked Plain Shoulder (For replacements order 126-S-41 stud)	5
126-D-43	Stud—$\frac{1}{2}$-20 U.S.F. & $\frac{9}{16}$-18 U.S.F. x $4\frac{15}{16}$ Special Necked and Drilled for Slotted Nut (For replacements order 126-S-43 stud)	1
126-D-44	Stud—$\frac{5}{16}$-24 U.S.F. & $\frac{7}{16}$-24 U.S.F. x $3\frac{11}{32}$ Special Necked Plain	2
126-D-48	Stud—$\frac{3}{8}$-24 U.S.F. x $1\frac{3}{8}$ Straight (For replacements order 126-S-48 stud)	18
129-D-8	Gasket—Two Bolt Type for $\frac{1}{2}$ O.D. Tube	2
129-D-23	Gasket—Two Bolt Type	1
146-D-4	Pin—$\frac{5}{16}$ x $\frac{7}{32}$	1
163-D-1	Elbow—Gasoline Primer - $\frac{1}{8}$ Tube Discharge	3
163-D-5	Cross—Side Outlet - Primer Discharge	1
163-D-6	Priming Pump—With Shut-off Cock	1
166-D-1	Bushing—$\frac{1}{8}$ Pipe Thread & $\frac{1}{4}$ Pipe Thread x $\frac{11}{32}$ Screw	1
183-D-2	Pin—$\frac{5}{16}$ x $\frac{21}{32}$	1
189-D-2	Lockwasher—$\frac{5}{64}$ x $\frac{27}{64}$ x .021 Shakeproof	14
189-D-3	Lockwasher—$\frac{7}{64}$ x $\frac{1}{2}$ x .024 Shakeproof	108
189-D-4	Lockwasher—$\frac{9}{64}$ x $\frac{13}{32}$ x .030 Shakeproof	34
189-D-5	Lockwasher—$\frac{11}{64}$ x $\frac{15}{32}$ x .035 Shakeproof	5
189-D-6	Lockwasher—$\frac{11}{64}$ x $\frac{25}{64}$ x .035 Shakeproof	72
189-D-7	Lockwasher—$\frac{33}{64}$ x $\frac{7}{8}$ x .040 Shakeproof	5
194-D-1	Rod End—Adjustable Yoke	2
196-D-1	Tag No. 1—Ignition Cable	1
196-D-2	Tag No. 2—Ignition Cable	1
196-D-3	Tag No. 3—Ignition Cable	1
196-D-4	Tag No. 4—Ignition Cable	1
196-D-5	Tag No. 5—Ignition Cable	1
196-D-6	Tag No. 6—Ignition Cable	1
203-D-1	Bolt—$\frac{3}{16}$-18 U.S.F. x $4\frac{1}{16}$ Hex. Head	4
2000-D-2	Lockwasher—$\frac{5}{16}$-24 Thread Pal-Nut Standard	18

* This part requires special assembling, see instructions under "Complete Overhaul"

TOOL KIT FOR CURTISS CHALLENGER ENGINES



C-10343

JUNE 1929

LIST NO. C-10343

TOOL KIT FOR CURTISS CHALLENGER ENGINES

NAME	PART NO.	QUANTITY PER UNIT
Clamp—Assembly Piston Ring	C-10330	1
Gun—Zerk Type Vacuum	C-10426	1
Pin Handle—Connecting Rod Nut Socket Wrench	C-10335	1
Pin Handle—Double End Socket Wrench	C-9626	1
Pin Handle—Spark Plug Wrench	C-10565	1
Pliers—6½ Combination Slip Joint	C-10340	1
Screw Driver—6″	C-4305	1
Tool—Assembly Valve Grinding	C-10551	1
Tool—Assembly Valve Spring Depressing	C-10342	1
Tool Kit—Without Tools	C-4321	1
Wrench—Assembly Exhaust Valve Spring Washer Nut	C-10320	1
Wrench—Assembly Inlet Valve Spring Washer Nut	C-10269	1
Wrench—Camshaft Gear Drive Slotted	C-10444	1
Wrench—Connecting Rod Nut Socket	C-10334	1
Wrench—Cylinder Sleeve to Crankcase Attaching Nut	C-10300	1
Wrench—$\frac{3}{16}$ & $\frac{1}{4}$—15° Double Head	C-2007	1
Wrench—$\frac{5}{16}$ & $\frac{3}{8}$—15° Double Head	C-10337	1
Wrench—$\frac{7}{16}$ & $\frac{1}{2}$—15° Double Head	C-10338	1
Wrench—$\frac{5}{8}$ & $\frac{3}{4}$—15° Double Head	C-10339	1
Wrench—$\frac{5}{16}$ & $\frac{3}{8}$—Hexagonal Double End Socket	C-10346	1
Wrench—$\frac{32}{64}$ Hexagonal Socket	C-4383	1
Wrench—$\frac{7}{16}$ Offset Socket	C-2004	1
Wrench—(1) Push Rod Enclosing Tube Packing Nut	C-8632	1
Wrench—Scintilla Magneto (Furnished with Magneto)	C-5340	1
Wrench—Spark Plug	C-10382	1
Wrench—Starter Stud Attaching Nut	C-10360	1

INSTRUCTIONS ON STROMBERG NA-U4J AIRCRAFT CARBURETOR

INTRODUCTION

The Stromberg NA-U4J carburetor is designed to meet the exacting requirements of air cooled aircraft engines having induction systems so arranged that four or less cylinders draw from one barrel of the carburetor. The principles of operation as described in these instructions are quite similar to those used in all Stromberg aircraft and motor car carburetors. The specification or setting in the carburetor is the result of a great deal of test work conducted by the engine and carburetor manufacturer in the laboratory and in flight, and should not be changed unless it is absolutely certain that a change is necessary to meet unusual operating conditions.

INSTALLATION

The carburetor should be so mounted on the engine that the center line of the float chamber is parallel to the center line of the engine crank shaft. The fuel inlet which is a 3/8" pipe tap connection at the top of the strainer chamber will then be either at the front or rear of the carburetor. This carburetor is installed on the Curtiss challenger engine with the fuel inlet at the front and the air intake toward the rear of the engine. An air intake pipe leads from the carburetor to the top cowling so that clean air is drawn into the engine.

The fuel inlet should be connected to the fuel system of the airplane with provision for a fuel pressure gauge connection near the carburetor. If a fuel pump is used, a pressure of 3 lbs. per square inch at the carburetor is recommended. If a gravity feed system is used, the tanks should be so located that the minimum head of fuel on the carburetor inlet is 24 inches under all normal conditions of flight.

On some carburetors a No. 45 drill size restriction is used on the float needle valve seat and "N.V.R. 45" stamped on the mixture control cover just above the nameplate. THE CARBURETORS WITH THIS RESTRICTION CANNOT BE USED WITH A GRAVITY FUEL SYSTEM and the fuel pressure at the fuel inlet should be maintained at 3 lbs. per square inch.

STARTING

The primer system provided for by the engine manufacturer should be connected up and used whenever starting a cold engine. The exact procedure in starting varies with the type of starting

equipment on the engine, but at low cranking speeds fuel can be drawn out of the idle system provided the throttle is closed or very nearly closed during the cranking operation. As soon as the engine starts to fire, it is usually necessary to open the throttle slightly to keep the engine running and to warm it up sufficiently for normal operation.

ADJUSTMENT

The main metering jets used in the carburetor are of the fixed orifice type and their size as well as the remainder of the carburetor specification have been determined by test work as previously mentioned, so that no adjustment for cruising and full throttle speed is required. An idle adjustment is provided to take care of slight production variations in the carburetors and engines. A small lever at the front of the throttle valve body may be moved to control the richness of the mixture at idling speeds. A quadrant behind this lever indicates by the letters R and L the direction to move it to obtain a rich or lean mixture, and also acts as a locking device to hold the lever in position. A throttle stop is provided on the throttle shaft next to the throttle control lever, which should be adjusted to obtain the desired engine speed. Both the throttle stop and the idle adjustment should be set with the engine hot to obtain the proper idling speed and smooth operation.

SERVICING

Once the carburetor is properly installed and the idle adjustments made, very little attention is required in service. A fuel strainer is located at the front of the carburetor, and may be removed by the removal of the large square head nut at the bottom of the carburetor. A small square head nut is provided as a drain in the bottom of the float chamber. The strainer and drain nut should be removed frequently to get rid of any dirt or water which may have accumulated in the strainer chamber or the float chamber. The entire carburetor should also be inspected to see that all parts are tight and properly safetied.

DESCRIPTION AND FUNCTIONING OF CARBURETOR

Float Mechanism: A conventional hinge type of float mechanism located in a float chamber having ample fuel capacity to operate in all ordinary maneuvers is used. The float, a brass stamping, has been made with a flat top in order to reduce the over-all height of the carburetor. This float mechanism is adjusted at the factory to obtain the proper fuel level, and requires no adjustment in service unless it is necessary after a long period of service to install new parts. For information concerning the proper level see the section of these instructions pertaining to overhaul.

Main Metering System: The metering system used in the carburetor is of the plain tube type with an air bleed to the main discharge nozzle. The main discharge nozzle, of the rose type, located at the center of the venturi, is screwed into a boss projecting into the air intake. The main air bleed and accelerating well is a brass casting (later models a duralumin forging) held in place by the main discharge nozzle. The air bleed arm extends up above the nozzle behind the venturi. The actual metering of the fuel is accomplished by the main "metering jet" located in the passage between the main discharge nozzle and the float chamber. This metering system provides a practically constant mixture ratio over the cruising range of speeds.

Mixture Control: The altitude or mixture control is of the back suction type with a flat disc valve located at one side of the air intake. A suction nozzle located above the throat of the venturi is connected to the mixture control chamber above the valve. A short air bleed passage is provided from the valve to the air intake. The float chamber is connected to the mixture control chamber by several drilled passages and a check valve is provided to prevent fuel from passing out of the float chamber into the mixture when the airplane is upside down.

Idling System: Inasmuch as the main metering system will not function at very low air flows (low engine speed), an idling system is provided. This consists of an idle tube with an idle metering orifice near the bottom and several air bleed holes in the wall, an idle air bleed, and an adjustable idle discharge nozzle. Fuel for the idle system is taken from the annular space around the main discharge nozzle, passes thru the idle metering jet, mixes with air from the idle air bleed in the idle tube, and then passes out the discharge nozzle into the carburetor barrel above the throttle. The idle system operates up to an engine speed of about 900 to 1000 R.P.M.

OVERHAUL

Disassembly: The carburetor should be disassembled for cleaning and inspection each time the engine is given an overhaul. After the carburetor has been removed from the engine and the hot spot and air intake or heater taken off, the halves of the carburetor may be separated by the removal of the fillister head screws at the parting surface. The venturis are held in the lower half by hexagon head screws. Before removing the venturi in the left barrel it is necessary to remove the passage plug and the mixture control suction nozzle located above the mixture control. Remove the main discharge nozzles and the main air bleeder assemblies. Remove the float fulcrum screw and the float and needle valve. Remove the mixture control valve cover assembly by unscrewing the three fillister head screws

holding it to the main body casting, which will allow the removal of the mixture control spring and the upper valve plate. Remove the strainer plug and strainer. Remove the idle tubes which should be done with a pair of thin pliers, care being taken that the top portion of the tube is not damaged. The tube should be gripped as near the parting surface of the main body as possible. The removal of the above parts will permit a thorough inspection and cleaning of the carburetor and unless replacements are necessary further disassembly is not recommended.

Inspection and Cleaning: The bodies and all parts should be thoroughly cleaned in gasoline, and all passages blown out with an air hose. The float needle valve and seat should be inspected for wear, and if the needle valve is badly grooved both parts should be replaced. The needle valve is made of stainless steel hardened and ground, and the seat made of monel metal, so that under ordinary service conditions these parts should last for many hundreds of hours. Check the metering jets, and the float needle seat, to make sure they are tight. See that the throttle fits in the barrel tightly when in the closed position, that the throttle stem and bushings do not have excessive clearance.

Replacements: If due to accident or wear after long service it is necessary to make replacements, the parts should be obtained from the Stromberg Motor Devices Co., Chicago, or an authorized Stromberg aircraft carburetor service organization. Ordering by the part numbers as shown on the attached assembly drawing will greatly facilitate service.

It is recommended that in replacing a "float needle valve" or "needle valve seat," that these two assemblies be installed at the same time, as it is very difficult to fit a new needle valve to an old seat or a new seat with an old needle.

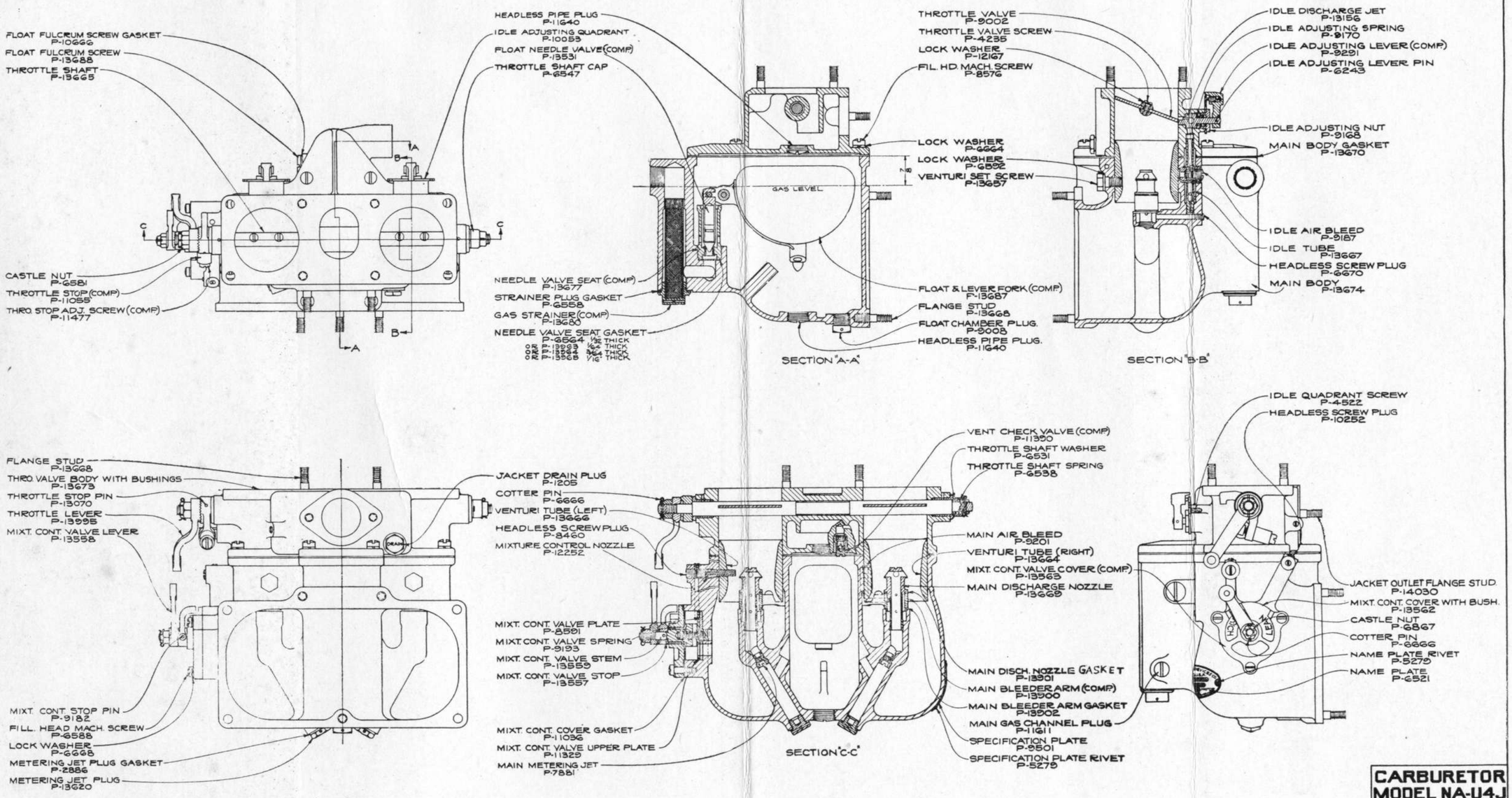
The float level on the NA-U4J should be 7/8" below the parting surface, and is dependent upon the thickness of the gasket under the needle valve seat. The level should be checked under the conditions encountered in service as regards the fuel used and the fuel pressure or head at the carburetor. If a fuel pump is used, a pressure at the carburetor of 3 lb./sq. in. (117" gasoline at .710 gr.) is recommended, and should be used in checking the level. If after fitting new parts the level is not correct, remove the needle valve and put in thicker gaskets to lower the level, or thinner gaskets to raise it. One sixty-fourth inch change in gasket thickness will change the level approximately 5/64".

If it is ever necessary to replace any parts of the mixture control valve cover assembly check the location of the mixture control valve

when the stop is against the full rich stop of the cover. The valve should be wide open in the full rich position and it is best to locate the stop on the pin with all parts in place and then drill and pin these parts.

Assembly: In assembling the carburetor care should be taken to see that all gaskets are properly placed as a missing or leaky gasket may seriously affect the operation of the carburetor. Be sure the mixture control spring is in place and that the mixture control stem engages properly with the mixture control valve.

Form A 524 2500 Sets 5-29 Printed in U. S. A.



CARBURETOR MODEL NA-U4J

SCALE FULL SIZE

DRAWN BY	TRACED BY	ISSUE
R.B.C.	CMW	1
CHECKED	APPROVED	DATE
VJP	GB	2-22-28

A-12894

STROMBERG MOTOR DEVICES COMPANY, CHICAGO, U.S.A.