

AIRCOOLED MOTORS CORPORATION
SYRACUSE NEW YORK U S A

REPRODUCED FROM THE
NATIONAL ARCHIVES



OPERATORS HANDBOOK & PARTS CATALOG



AIRCRAFT ENGINE MODEL 4AC-176

This handbook is intended as a practical working manual for the guidance of owners and mechanics in operating, servicing and maintaining Franklin aircraft engines.

Obviously, it is impossible to cover every operating eventuality in detail. However, should any problem arise which presents the need for special handling, or which requires special information, contact the nearest Franklin Parts and Service Station, or the factory for instructions. Your inquiry will receive prompt, courteous attention and an immediate reply. A list of Franklin Parts and Service Stations appears on the opposite page.

When you contact your Franklin Service Station or factory concerning parts or service, please give the engine number. THIS IS IMPORTANT. It will insure prompt, accurate service and prevent undue delay.

When returning parts to your Franklin Service Station or the factory, attach tag to EACH PART, with your name, address and ENGINE NUMBER from which the part was removed, together with the date of your original letter in reference to the part in question. This will assure the speedier handling of your service request. Also, when shipping parts to the factory, be sure they are shipped prepaid.

In the event of failure of any engine part, do not attempt repairs without factory permission if any adjustment is expected.

We suggest that you study this handbook thoroughly. Strict adherence to the instructions and recommendations it contains will assure you a high degree of satisfaction with the performance of your Franklin aircraft engine.

NOTE: The publication date of this operator's handbook is Apr. 25, 1945. Its contents supersede all previous instructions, clearance data, and parts prices which may have been issued on Franklin Aircraft Engine, Model 4AC-176. When and if changes are made in the data contained in this handbook, currently dated replacement sheets for insertion in your manual will be made available.

WARRANTY

Aircooled Motors Corporation warrants each new Franklin engine or part to be free from defects in material and workmanship, when properly installed, serviced and used under normal conditions, for ninety (90) days, but in no case to exceed fifty (50) hours of operation, after the shipment of each engine or part from its factory.

This warranty is limited to replacing or repairing at its factory, any part or parts which have been returned to its factory with transportation charges prepaid and which, in the opinion of Aircooled Motors, are defective.

This warranty is expressly in lieu of all other warranties and representations, expressed or implied, and all other obligations or liabilities on the part of the Aircooled Motors Corporation.

This warranty does not cover any labor charges for replacement of parts, adjustments, repairs or any other work done on Franklin aircraft engines or parts.

This warranty shall not apply to any engine or part which shall have been repaired or altered outside of its factory in any way so as, in its judgment, to affect its operation, or which has been subject to misuse, negligence or accident, or which shall have been operated at a speed exceeding the factory rated speed.

Aircooled Motors Corporation makes no warranty with respect to ignition apparatus, carbureters, instruments or other trade accessories, - inasmuch as these are usually warranted specially by their respective manufacturers.

Aircooled Motors Corporation reserves the right to make any changes in prices or specifications of engine or parts, without notice and without incurring any responsibility with regard to engines or parts previously sold or replaced.

AIRCOOLED MOTORS CORPORATION

Syracuse, New York

SPECIAL NOTICE

MODEL DESIGNATIONS ARE AS FOLLOWS

4AC-176-B2	65 H.P. at 2200 RPM Comp. Ratio 6.3 to 1 dual ignition
4AC-176-BA2	65 H.P. at 2300 RPM Comp. Ratio 6 to 1 dual ignition
4AC-176-C2	75 H.P. at 2500 RPM Comp. Ratio 6.3 to 1 dual ignition
4AC-176-C3	Comp. Ratio 6.3 to 1 dual ignition with starter and generator
4AC-176-D2	80 H.P. at 2650 RPM Comp. Ratio 6.3 to 1 dual ignition
4AC-176-D3	Comp. Ratio 6.3 to 1 dual ignition with starter and generator
4AC-176-E2	75 H.P. at 2350 RPM Comp. Ratio 7 to 1 dual ignition
4AC-176-E3	Comp. Ratio 7 to 1 dual ignition with starter and generator
4AC-176-F2	80 H.P. at 2500 RPM Comp. Ratio 7 to 1 dual ignition
4AC-176-F3	Comp. Ratio 7 to 1 dual ignition with starter and generator

At the factory an accurate record is kept of every engine shipped. It is essential that the operator or service station send us all of the symbols as well as the serial number of the engine in question, when ordering parts, or requesting information. From these symbols and the serial number, we can readily determine the horse power, compression ratio, type of pistons and capacity of the oil pan, as well as other pertinent information, and permits us to render fast, accurate service.

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SPECIFICATIONS

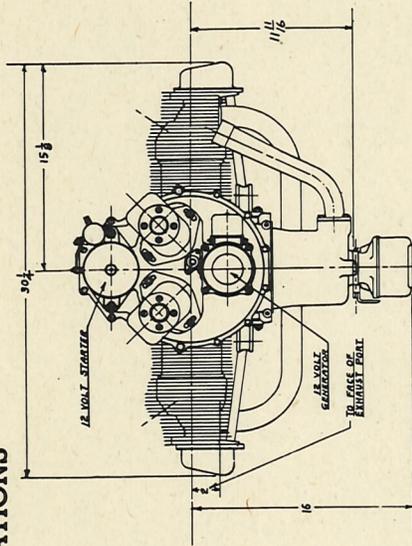
Franklin Model 4AC-176 Aircraft Engine

TYPE: Four-cylinder, overhead valve,
direct drive, horizontally opposed,
air cooled.

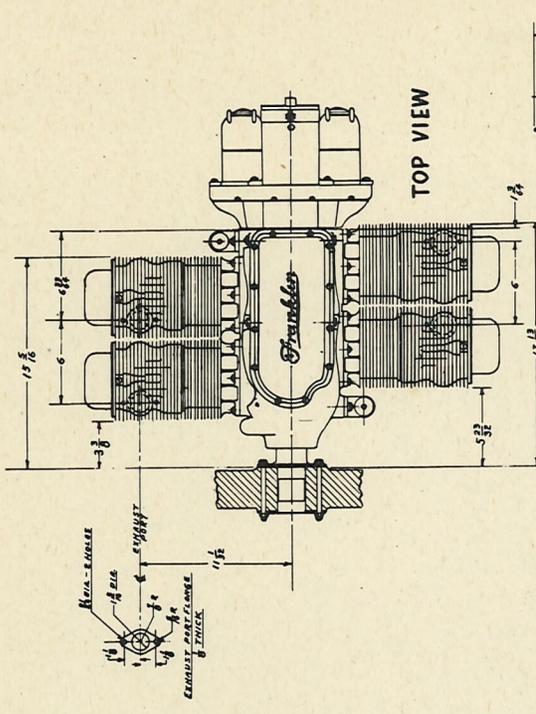
APPROVED TYPE CERTIFICATE No. 221

<u>SYMBOL</u>	<u>RATING</u>
4AC-176-B2	65 HP @ 2200 RPM
4AC-176-BA2	65 HP @ 2300 RPM
4AC-176-C2-C3	75 HP @ 2500 RPM
4AC-176-D2-D3	80 HP @ 2650 RPM
4AC-176-E2-E3	75 HP @ 2350 RPM
4AC-176-F2-F3	80 HP @ 2500 RPM
BORE	4"
STROKE	3 $\frac{1}{8}$ "
COMPRESSION RATIO.	6.3 to 1, 6 to 1, or 7 to 1
PISTON DISPLACEMENT.	176 Cu. In.
FUEL (recommended)	(6.3: 1 or 6:1 Ratio, 73 octane or better except for 80 HP when 80 octane is to be used - 7:1 Ratio, 80 octane or better. (AFD Method Aviation Gasoline containing not more than 1 c.c. of lead per gallon).
OIL RECOMMENDED.	SAE 20
OIL PRESSURE.	35 to 45 pounds
OIL TEMPERATURE (Safe Maximum)	240
OIL CONSUMPTION (Rated Power).	1.6 oz. per hour
OIL SUMP CAPACITY.	2 sizes of pans are furnished, of 5 and 8 quarts capacity
CRANKSHAFT ROTATION.	Counter-clockwise, facing propeller
VALVE CLEARANCE.040 (no oil in lifter, fully depressed)
FIRING ORDER.	1 - 4 - 2 - 3
MAGNETO	Eisemann
SPARK ADVANCE	28°
SPARK PLUGS	Champion J-10
CARBURETOR	Marvel-Schebler, MA-3F

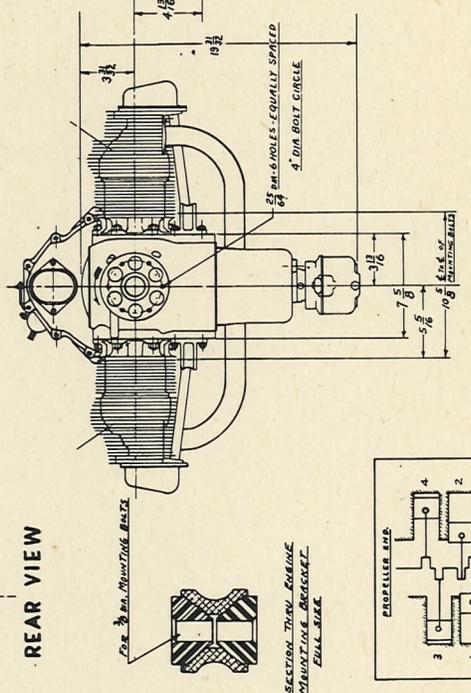
INSTALLATION AND MOUNTING SPECIFICATIONS



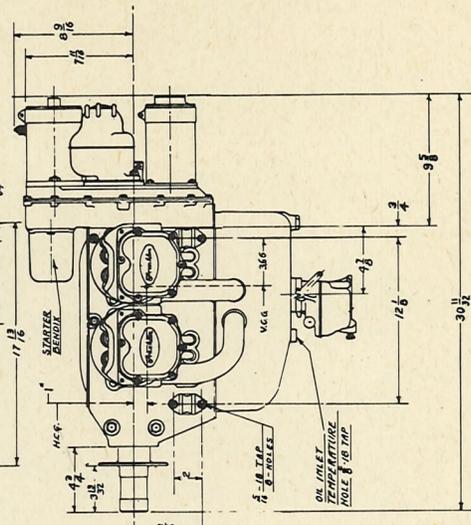
REAR VIEW



TOP VIEW



VIEW OF PROPELLER END



SIDE VIEW

Compression Ratio 7 to 1
Fuel Used 80 octane
Oil viscosity S. A. E. 20
Results corrected to:
60° F. carburetor air
29.92 in. hg. barometer
10 mm. hg. vapor pressure

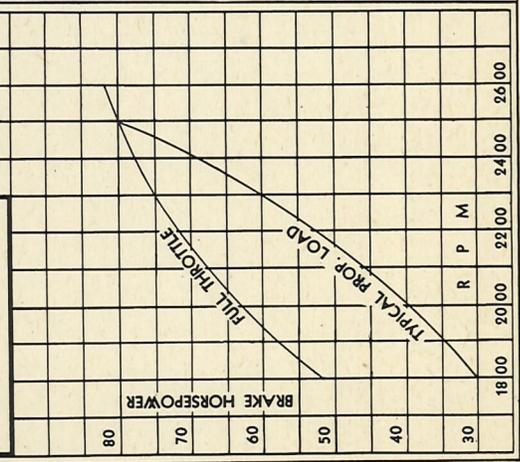


FIG. 2
4AC-176-F-3
AIRCOOLED MOTORS CORP.

POWER AND PROPELLER LOAD CURVES
FRANKLIN MODEL 4AC-176-F-3

PART I

ENGINE DESCRIPTION

MODEL 4AC-176

CRANKCASE: The crankcase is a two-piece casting of high strength aluminum alloy, with removable top cover and oil pan, allowing ready inspection of, and access to connecting rods, connecting rod bearings and other internal working parts.

The crankcase has five main bearings, the front ones being extra wide.

Both camshaft and main bearings are of the interchangeable, steel back, precision type. Camshaft bearings are babbitt lined while crankshaft bearings are copper lead lined.

Propeller thrust is taken by washers on both sides of the front main bearing saddle so design permits either tractor or pusher operation.

Cast on the crankcase are four bosses, designed to allow various types of mounting brackets to be bolted on the case. This arrangement allows the plane manufacturer considerable latitude in his installation design, and insures a light yet extremely rigid mounting, permitting removal of engine without dismantling.

CRANKSHAFT: The one piece, alloy steel forging, four throw, three bearing crankshaft is counterweighted as well as statically and dynamically balanced. It is drilled for lightness and to provide pressure lubrication of all bearings. Furthermore, the propeller hub inner flange is forged as an integral part of the shaft, which extends $3-21/32$ " beyond the inner flange, so as to provide full bearing support for the propeller.

This type of construction eliminates many propeller hub assembly parts, and propeller trackage difficulties.

CAMSHAFT AND TIMING GEARS: The camshaft is a one-piece steel forging. The eight hardened cams provide a firing order which insures maximum smoothness.

The camshaft gear is of "Celeron" with an aluminum rim while the crankshaft gear is of steel.

CONNECTING RODS: Alloy steel, drop forged connecting rods are of conventional design with a bronze bushing pressed in the piston pin end. The big end is fitted with a steel back precision type copper lead bearing, and is drilled to throw oil spray on the cylinder wall and piston pin. In order that oil spray may properly lubricate the piston pin, three holes have been drilled

through the bosses and bronze bushing.

PISTONS: The pistons used in the Franklin 4AC-176 series engines have recently been developed by the ever progressive Franklin Engineering Department. These pistons are cast of carefully selected, aircraft quality, aluminum alloy, and contain an alloy steel strut that controls expansion of pistons within extremely narrow limits, permitting piston clearances of .003 of an inch, without the slightest danger of pistons seizing. This feature gives Franklin engines greater efficiency, longer cylinder, piston and ring life and eliminates piston slap.

Piston pins are of the full floating type. Perfect Circle Piston Rings are used as follows:- one type "200" in the upper groove, one type "70" in the middle groove and one type "85" in the lower groove.

VALVE MECHANISM ASSEMBLY: Each cylinder is equipped with two alloy steel overhead valves, steel or iron valve seats, and alloy iron valve guides.

Valve springs are made of the best grade Swedish wire, 100% magna-fluxed.

Valve rockers are force-feed lubricated; oil spray in the cover lubricates the valve stems, guides and springs.

CYLINDERS: Cylinder heads are aluminum alloy, screwed and shrunk on iron alloy barrels. Heads and barrels have generous cooling fins.

OIL RESERVOIR: The oil reservoir is an aluminum pan, held to the bottom of the engine with 21 cap screws, and may be either 5 or 8 quarts capacity. Being a wet sump engine, it requires no extra tanks or plumbing for the oil system.

HYDRAULIC VALVE LIFTERS: Wilcox-Rich hydraulic valve lifters operate automatically and eliminate valve adjustments between top overhauls. They are controlled by engine oil pressure and compensate for the expansion of cylinder and valve gear up to .200 backlash.

LUBRICATION SYSTEM: The oil pump is of the unit-gear type, incorporating unusually wide gears. The oil pump cover incorporates the oil pressure relief unit. The spring is so calibrated as to give the required oil pump pressure without adjustment.

Oil is pressure-fed to the hydraulic valve lifters, main bearings, connecting rod bearings and valve rocker mechanisms. Valve stems, guides and springs are lubricated by spray, from rockers. Cylinder walls and piston pins are lubricated by oil spray from holes drilled in the big end bearing of the connecting rods. Timing and accessory drive gears are continuously bathed in oil,

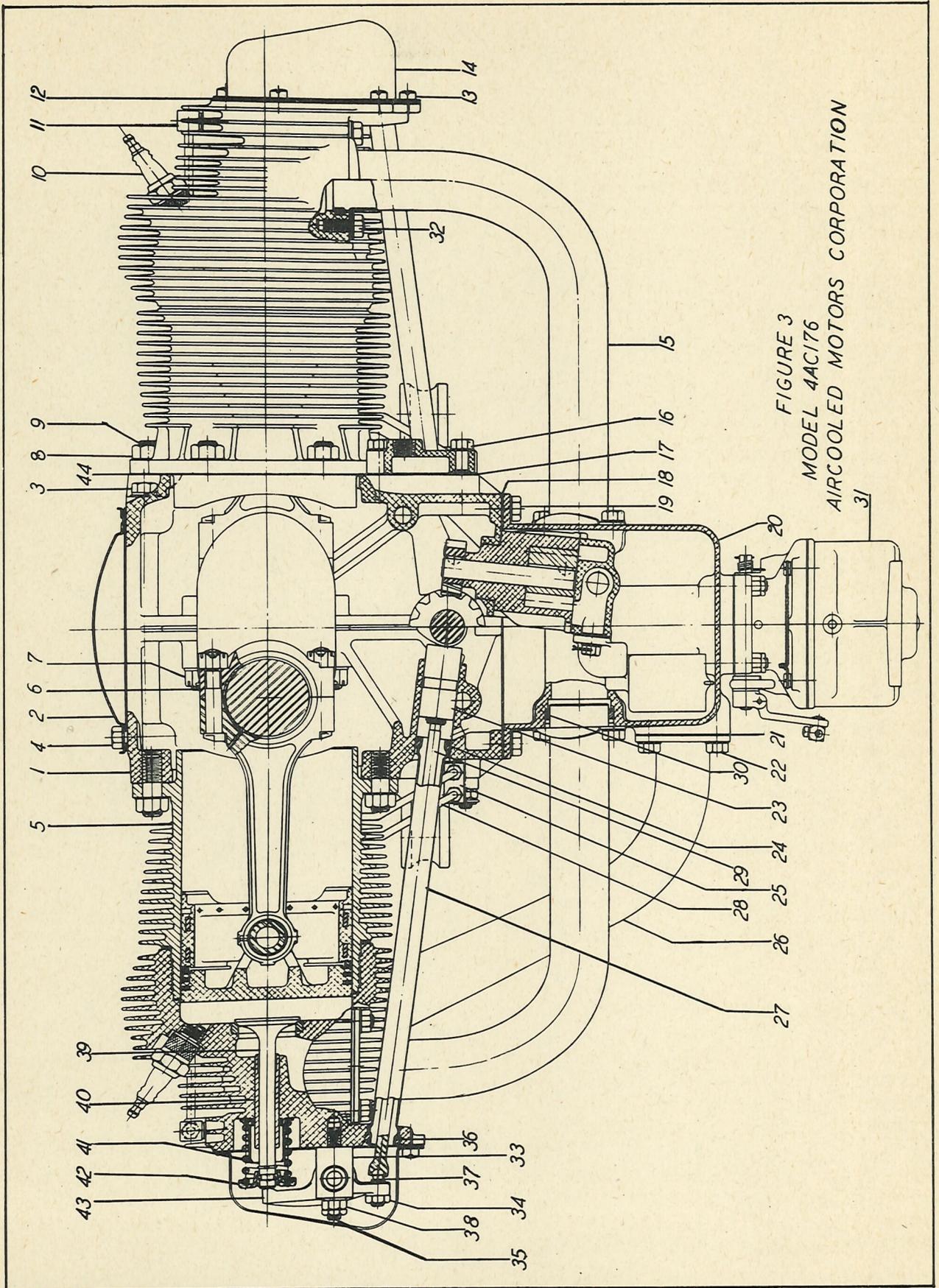


FIGURE 3
 MODEL 4AC176
 AIRCOOLED MOTORS CORPORATION

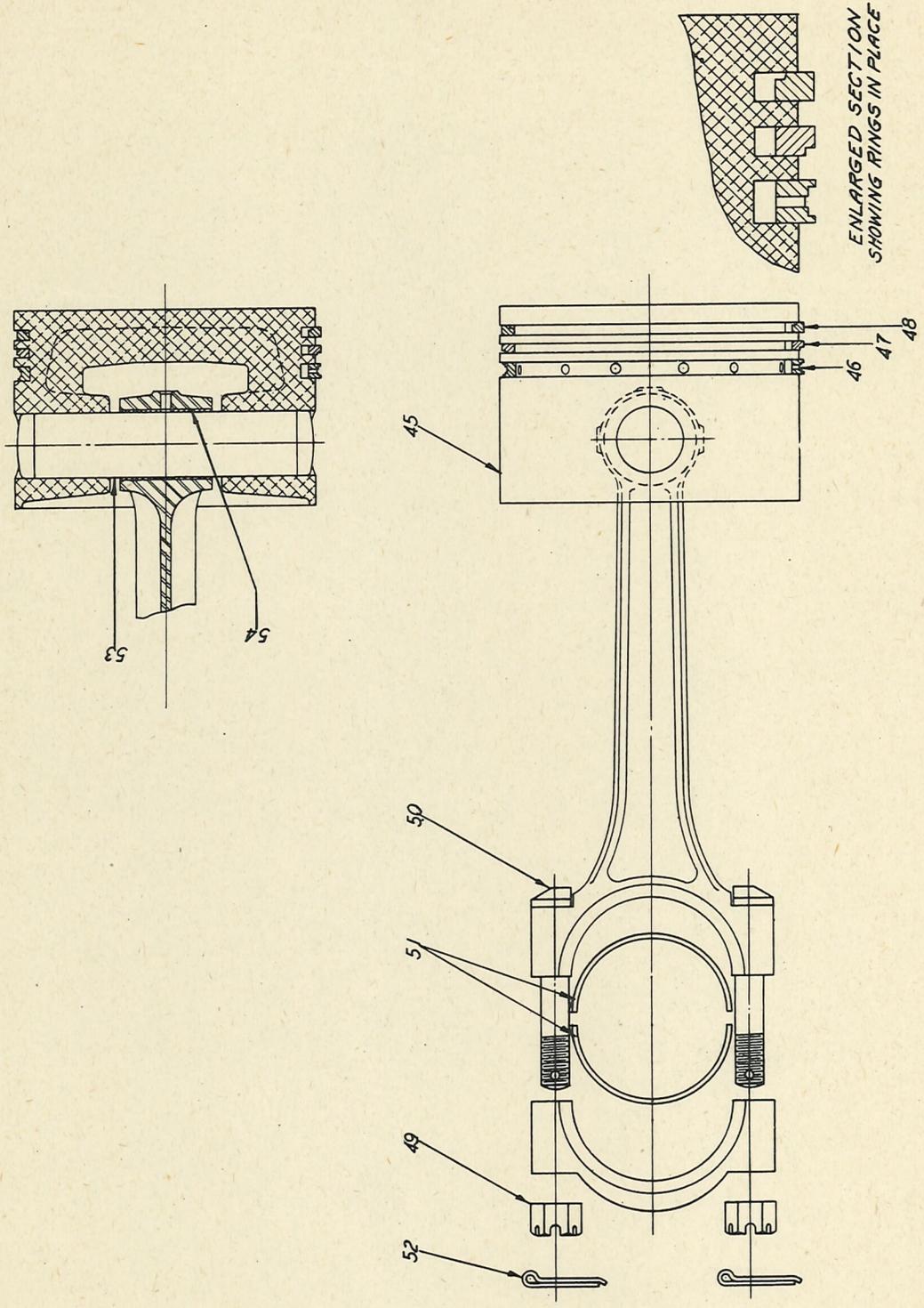


FIGURE 4
 FOR 4AC-176 ENGINES
 AIRCOOLED MOTORS CORPORATION
 SYRACUSE N.Y.

The oil pump pressure relief valve is located in the pump casting and is set at the factory to give correct oil pressure of 35 to 45 pounds.

The oil strainer is located inside the oil reservoir at the inlet to the oil pump. The oil level gauge is combined with the oil filler and is located at the lower right rear side of the engine.

CARBURETION: The carbureter is of the up-draft type. The gasoline vapor mixture from the carbureter passes through the distributing zone which is cast in the oil pan. The distributing zone is bathed in oil; vapor mixture is thus warmed, and at the same time the oil temperature is decreased.

Individual intake pipes connect the intake ports with the distributing zone. Primer connections are provided to facilitate cold weather starting.

IGNITION: The engine is equipped with dual magnetos fitted with impulse starter couplings, assuring easy starting under all conditions.

TEST: Each engine is carefully run-in, inspected and thoroughly tested at full throttle - under full load, before being shipped. When shipped from the factory, it is ready for installation and operation.



PART II

INSTALLATION

SECTION 1. - UNPACKING FRANKLIN ENGINE

Franklin aircraft engines are shipped in standard Franklin crates, except for the carburetor, which is detached and packed separately in the crate. Each engine is equipped with all accessories ready to install in the airplane. Each engine is fastened in the crate by means of bolts through the regular mounting lugs.

After taking off the top lid of the crate, the engine is removed by simply loosening the four bolts which hold it to the bottom of the crate.

The oil sump has been drained and the various oil holes plugged before shipment. Naturally, a certain amount of oil will remain in the oil galleries and in the hydraulic lifters, because it is impossible to remove all of the oil unless the engine is totally dismantled.

SECTION 2. - MOUNTING

The engine installation diagram (Fig. 1) shows a typical engine mounting. It applies to the model covered in this handbook. It will be noted that the engine is bolted to the mounting at four points. Eight rubber biscuits are supplied to insulate the engine from the mount at these four points.

If, for any reason, it is necessary to remove the engine from the ship, care must be taken when replacing it, to see that the rubber biscuits are in good condition at each mounting point, in order to insure proper alignment of the mounting lugs and even tension on the crankcase.

SECTION 3. - FUEL SYSTEM

The Marvel-Schebler MA-3-A aircraft carburetor is used on Franklin 6AC-264 and 6AC-298 Aircraft Engines.

The gasoline inlet boss on the carburetor carries 1/4" pipe tap. To eliminate any possibility of foreign matter entering the carburetor, a commercial type gasoline strainer should be used between the gasoline tank and the carburetor.

The gasoline line is supplied by the plane maker. However, in special installations care should be taken that a pipe of at least 1/4 inch inside diameter be used. Copper tubing is not recommended because of possible fatigue failure.

The shut-off cock should be installed as close to the carburetor as possible to eliminate any possibility of vapor-lock troubles during hot weather.

SECTION 4. - OILING SYSTEM

A 5/8" - 18 SAE thread-tapped hole is provided at the bottom of the oil pan alongside the carburetor for connecting the oil temperature gauge bulb.

Oil pressure gauge connection is located on the by-pass plate at the left front of the crankcase and is 1/8 inch pipe thread.

SECTION 5. - IGNITION SYSTEM

The Eisemann Magneto is standard equipment.

It is recommended that extreme care be used when installing the magneto grounding wire which runs from the magneto breaker cap through the switch to the engine mount. This is to prevent any premature starting of the engine, which might occur should the wiring be faulty. The magneto is shorted through this wire when the ignition switch is in the "off" position.

The Eisemann magneto is equipped with an impulse coupling which retards and intensifies the spark. This assures easy starting as the crankshaft is turned slowly.

The magnetos should be removed and thoroughly inspected at each top and major overhaul period, special attention being given to the weight pins in the impulse couplings.

SECTION 6. - MOUNTING THE PROPELLER

An unusual feature of the Franklin aircraft engine, is the fact that the propeller hub is an integral part of the crankshaft. This design eliminates many hub assembly parts, permits of easy mounting and removal of propeller, and assures proper propeller tracking.

The propeller is mounted by simply backing the propeller on to the crankshaft up to the rear propeller flange, which is forged on to the shaft, affixing the front duralumin plate, passing the six bolts through the front plate, propeller and rear flange and tightening the bolts in place. It will be noted that the crankshaft extension is long enough to act as a full bearing surface for the propeller and, if care is used to tighten the six bolts evenly, proper trackage will result. The tips of the propeller should track within 1/8".

To remove the propeller, simply remove the six propeller hub bolts and pull the propeller off.

Another precaution to observe when installing the propeller is to locate it relative to a particular cylinder, so that a man starting the engine will be able to pull it through compression in a normal manner.

Any propeller of approved design may be used on Franklin aircraft engines. It should load the engine sufficiently so that the full throttle RPM do not exceed the CAB rated speed during take-off and climb.

However, a propeller should never be used that overloads the engine excessively as then the engine would not be able to deliver rated power.

If a wooden propeller is used and for no apparent reason the engine does not turn up to rated power, the propeller should be checked for warpage. If warped, the propeller should be replaced by a new one of the same design.

Engine must not be operated at any time above rated speed even though in level flight full throttle speed might exceed rated speed by as much as 350 R. P. M. on some types of airplanes. If the engine speed rises above rated speed, PULL BACK THROTTLE UNTIL IT DOES NOT EXCEED RATED SPEED.



PART III

GENERAL OPERATION

For all-around satisfactory operation, it is essential that the engine be correctly installed in the airplane and properly maintained, and - as with all engines, it is of utmost importance that a good quality fuel and lubricating oil be used at all times. To insure trouble-free operation, it is essential that both gasoline and lubricating oil be free of dirt, grit, dust or foreign matter of any kind.

SECTION 1. - FUEL

A good quality of gasoline should be used and care should be taken that the fuel contains no water or foreign matter. If there is any doubt about the purity of the gasoline, it is advisable to strain it through a fine gasoline screen or chamois before using it.

SECTION 2. - LUBRICATION

A good quality of gasoline should be used and care should be taken that the fuel contains no water or foreign matter. If there is any doubt about the cleanliness of the gasoline, it is advisable to strain it through a fine gasoline screen or chamois before using it.

It is essential that the oil be of the correct viscosity, SAE 20, that it be free from corrosive constituents which might cause pitting of the bearings and other important parts; and that it have the proper low pour-point so that starting and warming up will be easier on the engine in cold weather.

The proper oil level should be maintained at all times. (See "Specifications")

When necessary to measure the oil, simply unlock the filler cap (bayonet gauge is integral with cap). When replacing the filler cap, be sure to lock it down tightly.

The use of improper oil may result in high oil temperatures and oil consumption, low oil pressure and the formation of considerable carbon and sludge. Excessive carbon is usually the cause of sticking valves and rings, scored pistons, clogged oil lines and strainers. It will also clog hydraulic lifters, rocker arms, etc.

No particular brand of lubricating oil is recommended by Air-cooled Motors Corporation. We do recommend that a high grade S.A.E. 20 oil be used.

B. RECOMMENDED OIL CHANGES

While any number of Franklin engines have operated over 100 hours satisfactorily without the oil being changed, it is not recommended as a general practice. It is suggested that for the average operator the oil be changed every 25 hours unless service experience indicates otherwise.

To drain the oil, simply remove the plug at the rear end of the oil pan.

To clean the oil strainer, remove the oil pan and take out the two cap screws which attach the oil pump inlet elbow to the oil pump proper.

NOTE On later type oil pan, an oil pump screen inspection plate has been incorporated so that it is unnecessary to remove oil pan to inspect oil pump screen.

The oil pan should be drained while hot, as more of the oil will then drain out of the system. Clean oil cans should be used when filling the engine with fresh oil. The oil should not be left standing uncovered because foreign matter may thus get into the engine and cause considerable damage.

The oil pump and screen should be cleaned at intervals of approximately 100 hours. This is best done as follows:-

1. Warm the oil thoroughly in flight.
2. Drain the oil from the engine.
3. Remove all the screws from the oil pan and remove the pan. This exposes the oil pump for inspection and permits the removal of the oil screen elbow, to which oil pump screen is attached. SEE ABOVE NOTE.

When the oil pan has been removed, the interior of the engine should be inspected for sludge. If this inspection shows an undue amount of sludge on the walls of the crankcase, it is recommended that the pump be installed, pan put in place again, and the engine run for 20 or 30 minutes with a low viscosity oil, such as SAE 10; then drained while hot, followed by another inspection of the interior of the engine.

The cleanliness of the interior of the engine is a very important factor in prolonging its life. It is impossible to prevent the formation of some sludge and grit after many hours of operation. However, it should be removed as often as practical in order to prevent serious engine wear.

C. TOP CYLINDER LUBRICATION MAY BE USED

The chief purpose of top cylinder lubrication is to prevent excessive wear on the contact surfaces of the upper portion of the cylinder walls, rings, pistons, valve guides and stems.

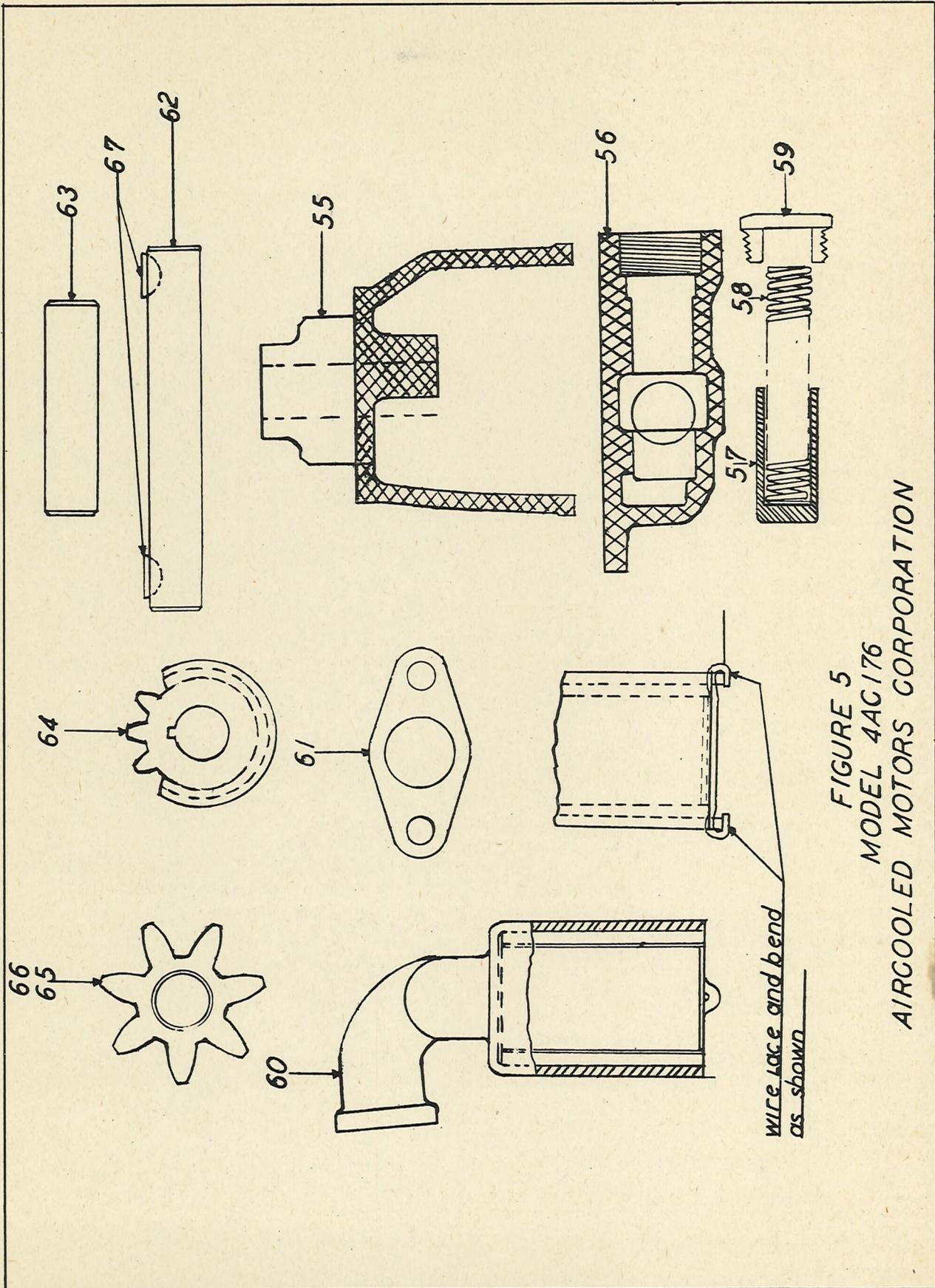


FIGURE 5
MODEL 4AC176
AIRCOOLED MOTORS CORPORATION

Franklin engines as a general rule do not require the use of top cylinder lubricants inasmuch as they are equipped with a positive pressure lubrication system to the entire valve mechanism. However, the occasional use of a top cylinder lubricant will tend to prevent the accumulation of sludge on the internal parts of the cylinder assemblies and, therefore, prolongs the proper functioning of the component parts.

The simplest method of applying top cylinder lubricant is to mix it with the gasoline in proportions recommended by the makers of the lubricant.

D. MAGNETO LUBRICATION

EISEMANN MAGNETO: The 15 m/m open-type ball bearing at each end of magnet rotor and oilless type bronze bearing on distributor shaft are packed with a high-melting acid-free grease. The factory application should last for at least 500 hours under normal operating conditions. This oilless bearing should not be washed in any type of cleaning fluid as it destroys the lubricant value impregnated in bronze bushing.

Apply one drop of medium grade crankcase oil to breaker cam wick after each 500 hours of operation.

SECTION 3. - STARTING

FRANKLIN ENGINES ARE EQUIPPED WITH MARVEL CARBURETERS and are easy to start when the correct procedure is used.

In hot summer weather, priming is unnecessary. The engine will ordinarily start after being pulled through two or three revolutions with the throttle cracked slightly - just off idle.

Furthermore, in the fall and spring when the engine has been running for less than an hour, previous to the time of starting, it will also start without any priming.

If the engine fails to start in hot weather, it is usually due to overloading. In other words, there may be too much raw gasoline in the cylinders. This can be detected by a dull, hollow explosion, - or by a considerable amount of gasoline dripping from the carbureter drain. This can be remedied by turning the switch to the "off" position, opening the throttle wide and cranking the engine backward six or seven revolutions. Then crack the throttle, turn ignition switch to "on" and start the engine.

If the engine has any tendency to kick or start while being pulled through with the switch in the "off" position, it is an indication that the wiring has failed somewhere in the switch circuit of the magneto; i. e., primary connection, switch or switch to ground.

Whenever it is necessary to prime the engine, regardless of the type of carbureter, the number of priming strokes required is governed by temperature, the type of gasoline, and whether or not the engine has been recently run. In other words, the extent of priming should be governed by experience and varies somewhat with different engines.

In extremely cold weather, it is advisable to drain the oil from the crankcase at the end of the day's operations. Before starting the engine, the oil should be heated, then poured into the engine, and the engine started immediately, before the oil has a chance to become cold.

SECTION 4. - HARD STARTING

An engine in good condition should start promptly, regardless of the air temperature, provided the preceding instructions are carefully followed. If, however, the engine fails to start, check the following: All controls for proper functioning, carbureter strainer and fuel line for dirt and water, wiring for loose connections, broken insulation and cleanliness and spark plugs and breaker points for condition and gap settings, (See Part IV, Section 2, "25 Hour Inspection.") The improper functioning of one or more of these items is usually the cause of the difficulty.

If the engine has seen considerable service, and all of these items function properly, it is an indication that a top overhaul is needed. (See Part V, "Top Overhaul")

SECTION 5. - WARMING UP THE ENGINE

After starting, run the engine slowly (600 to 1000 RPM) in order to warm it up gradually until the oil temperature has reached 90 to 100 degrees F. In extremely cold weather it may not be possible to reach this temperature. The oil pressure is also a good indication of operating temperature of the engine. In other words, if the pressure is 40 to 45 pounds maximum, it is safe to fly the ship.

Do not operate the engine at full throttle on the ground any longer than necessary. Continued running under these conditions may overheat the engine. Revolving propellers do not cool aircraft engines adequately while running on the ground for long periods at full throttle.

SECTION 5A. - PROPER USE OF CARBURETOR ALTITUDE CONTROL

The engine should be thoroughly warmed with the altitude mixture control in the "Full Rich" position. It should remain in this position during take-off and climb and at all times during flight when the ship is below an altitude of 3,000 feet. Upon reaching an altitude of 3,000 feet, and if it is desirable to gain more altitude, the throttle should be placed in the "Full Open" position and the altitude mixture control manipulated slowly and left at that position at which the engine reaches its maximum R. P. M. Then the throttle may be closed sufficiently to bring the engine back to the normal R. P. M. for this particular maneuver or cruising. During the descent, the mixture control should be closed or placed at the "Full Rich" position.

We wish to stress the importance of the judicious use of the altitude control. The improper use of this device may well cause burned and warped valves, piston failure and combustion chamber corrosion or even power plant failure.

SECTION 6.- OIL PRESSURE

Oil pressure should register immediately after starting. If there is no indication on the oil pressure gauge after 15 to 20 seconds, stop the engine and check the oil supply. Do not continue to run the engine unless normal oil pressure is obtained. The normal oil pressure may be slightly higher in cold weather, though it should not change much more than 20% from the normal (35 - 45 pounds). In other words, it should not drop or increase more than 7 to 9 pounds in continued flight. If the oil pump does not deliver proper pressure, either the oil pump relief valve plunger is sticking or the clearance on the main bearings is excessive.

SECTION 7.- STOPPING ENGINE

Always allow the engine to idle for a short time after running at full throttle before turning off the ignition switch, in order that the "cooling off" may not be too rapid.

SECTION 8.- IDLE ADJUSTMENT

The engine should idle between 500 and 600 RPM. Slower idling speeds may permit the engine to stall in long glides in cold weather. This idling speed should be obtained by adjusting the adjusting lever stop screw on the carbureter, not by turning the idling mixture adjustment screw on the carbureter.

However, if the engine still will not idle properly, an adjustment of the idle mixture screw may be necessary. Turning the idle screw clockwise makes the mixture leaner.

For easier starting in cold weather, it may be necessary to enrich this idle adjustment by turning it counter-clockwise.

SECTION 9.- TREATMENT OF NEW ENGINE

Careful treatment of a new engine will prolong its life. Every Franklin aircraft engine is run in for approximately seven hours after it has been assembled at the factory, but in order to insure long life, it is suggested that during the next 25 hours of operation, it not be run at full throttle any longer than is necessary.

If the engine is inclined to be stiff, it is advisable to use top cylinder lubricant in the gasoline during the first 25 hour period. Some owners prefer to change their oil frequently during the first 25 hours. This procedure has the effect of flushing the engine which is desirable. Under no circumstances use oil having a SAE number in excess of 20 in a new engine.

IMPORTANT: - The first 25 to 30 hours of service are the most important in the life of an engine. When an engine is carefully run in during this period, it will invariably operate longer without requiring major service work.

PART IV

MAINTENANCE & INSPECTION

Franklin engine design incorporates the most modern features of engineering and construction. Each engine is sturdily built of high quality materials and workmanship. Like any other well built piece of machinery, it will repay proper treatment and attention with the utmost satisfaction in performance and operating economies. To obtain this satisfaction, it should be properly operated, maintained and inspected. That is the owner's responsibility.

SECTION 1. - TEN HOUR INSPECTION

Remove and clean gasoline strainer. When replacing the glass bowl, be sure to get all the air out of the gas line by first fastening the glass bowl loosely, so that when the gas is turned on it will leak out. This flow of gasoline will force all of the air out through the gascolator and obviate air lock. As the gasoline begins to overflow, tighten the bowl so as to stop the gasoline leak.

Wipe off spark plugs and ignition cables at frequent intervals, removing dirt and soot which might well cause a short circuit.

Inspect ignition cable terminals at both the spark plug and magneto to see that they are clean and tight.

SECTION 2. - TWENTY-FIVE HOUR INSPECTION

Many owners prefer to drain the oil every 25 hours, which is good practice and is recommended.

We suggest that the oil, after being drained from the crankcase, be strained through a 20 mesh, or finer screen, to make certain that no metallic particles are present. The presence of metallic particles serves as a warning that some part in the interior of the engine requires attention and possible replacement.

Check and lubricate controls in order to make certain that they operate through the full range without binding.

Check and clean spark plugs. Gaps should be set to approximately .020 for the J-10 Champion plugs. Standard specifications of Franklin aircraft engines call for the use of Champion J-10 spark plugs.

Extreme care should be exercised to prevent the possibility of stripping the thread in the aluminum alloy cylinder head when the spark plug is tightened in position. In other words, do not tighten the spark plugs excessively.

Check all high-tension cables and terminals. If either terminal is corroded, the cable assembly should be replaced. It is also very important that the insulation on the cable be in good condition, otherwise a high tension spark might jump from the cable to the engine, thus causing it to misfire.

Check propeller track.

Check the breaker points in the magneto every 25 hours.

Apply small amount of grease on breaker arm cam.

SECTION 3. - ONE HUNDRED HOUR INSPECTION

At this point, after making the customary 25 hour inspection, the following additional inspection is recommended.

Remove the valve covers and check the valve guides for wear. This is done by pressing over on the side of the spring with a screw driver to see how much they move back and forth. Excess clearance on the guides means that the valves cannot seat properly, because the action of the rocker arm will push the valve sidewise in the guide. Furthermore, the excess clearance around the exhaust valve stem will permit the exhaust gas to push off the lubrication on the stem and result in excessive wear.

Excessive clearance on the intake stem means that the engine will receive excess air at this point. This will cause too lean a mixture and will result in increased cylinder head temperature, warped valves, etc. (See Part VII, "Table of Fits and Clearances").

Remove, dismantle and clean the carbureter thoroughly. Dirt in the carbureter may prevent the engine from turning up properly or might cause a forced landing.

It is recommended that this work be done by an experienced carbureter man. However, the average mechanic, if he is careful, can do a satisfactory job. It is extremely important to remember that in cleaning the carbureter jets, they should be blown out with air - not cleaned with wire - as the jets may be made oversize, with the result that the carbureter would not meter properly.

Clean out all gas lines, strainer, etc. It is desirable to remove the gas tank shut-off in the tank and clean the small strainer which is attached. The gas tank should be washed out with clean gasoline in order to remove any trace of sediment.

Remove and thoroughly clean the oil screen.



PART V

TOP OVERHAUL

SECTION 1. - NEED FOR TOP OVERHAUL

While in many cases top overhaul may not be required between major overhaul periods, good practice indicates that a top overhaul every 250 hours will insure continued maximum performance and operating economy.

The following inspection and adjustment should be made before "revving up" the engine to full throttle on the ground in order to determine the possible need for a top overhaul:

- A. See that spark is set at the correct position. Settings are given with specifications in front of book and on the name plate attached to the engine.
- B. Check over the various items covered in the 10, 25, and 100 hour checks.
- C. See if the carbureter throttle lever opens the throttle valve all of the way when against the forward stop.
- D. While the engine is cool and ignition switch is off, test the compression of each cylinder. A good plan is to have one person turn the propeller slowly, while another listens for blowing valves in the exhaust ports and through the carbureter inlet. This test should be made with the throttle wide open.
- E. After checking as above, and making any necessary adjustments, start the engine and warm it up until the temperature of the oil is approximately 100 degrees F., - then open the throttle (spark fully advanced) and note the maximum RPM. *If the engine does not turn up to required minimum speed with proper propeller attached, it is possible that a top overhaul is necessary.

* Tachometers should be checked for accuracy from time to time.

SECTION 2. - TOP OVERHAUL

The top overhaul of the Franklin aircraft engine is easily accomplished without removing the engine from the ship.

First, place the ship in a clean, protected spot free from dust and dirt. Take off the cowling over the engine and then remove the air housings. The engine should then be dusted off with compressed air, if possible, then washed completely with gasoline and a brush.

After taking out the spark plugs, remove the cylinders from the engine. This is more easily accomplished by first removing the valve lifter rod tubes with special puller listed in parts catalog. The cylinder will probably require a gentle rap with a wooden hammer in order to break the gasket loose from the crankcase.

The cylinder should then be slightly raised from the crankcase, taking care to see that the piston, as it emerges from the cylinder, does not drop down and hit the crankcase, causing possible injury to the crankcase or pistons. Immediately after removing cylinders, it is advisable to remove the propeller. Otherwise, if the propeller is turned while the cylinders are off, the pistons or crankcase may be damaged.

Scrape all carbon from the interior of the cylinder head while the valves are still in place. This will protect the valve seats, thus eliminating the possibility of damage to the surface of the seat.

To remove a valve, place a block of wood, 7" long, under the cylinder, with the cylinder resting on a bench. Press down on the valve cap until the split cone is removable (using special tool, part #11258). This will allow removal of valve spring, washers and valve. Each part should be tagged so that it will be put back in same place when reassembling the engine.

Clean all parts with gasoline and inspect the valves and magnaflu for cracks, burning and stem wear. Also examine the valve seats carefully for cracks and burning.

Do not re-face the valve seats unless absolutely necessary as a re-facing operation sometimes removes more material from the seat than is required. However, in the case of badly burned seats, re-facing is essential. It may even be necessary to install new seats. If so, the cylinder should be returned to the factory because these valve seats are shrunk into position, - an operation requiring tools which are seldom available in the field. (See Part VI, Section 2F, last paragraph, for cylinder exchange. Also refer to Parts Price List.)

Before re-seating the valve, the valve guide should be inspected. If more than .004 wear is found, the valve guide should be replaced because it is impossible to properly seat the valve if the valve guide has excessive clearance.

For the method of changing guides, see instructions in Part VI, Section 2F, "Cylinder Assembly".

If it is absolutely necessary to reface the valve seats, two reseating cutters must be used - a 30° x 1-15/16" cutter for the intake seats and a 45° x 1-1/2" cutter for the exhaust seats. The pilot bar should be of 3/8" diameter for both intake and exhaust valves.

If cutters are employed, remember that they should be used sparingly. If extreme care is not used, they will remove an excessive amount of metal. Furthermore, care must be taken to see that they cut evenly. Otherwise, the seat will be wavy and will require an excessive amount of hand-lapping to remove the wave.

As previously mentioned, the re-seating operation of the valve seats is one which must be done with a great deal of care, because an extra wide valve seat means that the aluminum which is rolled over to help hold the seat in position is cut away. This means that the seat has nothing but a shrink fit to hold it in position. If the aluminum is cut away, it will be necessary to install new valve seats.

The carbon should be carefully removed from the valves taking care not to damage the valve face. Do not use emery cloth on the valve stems since this removes the gloss obtained through many hours of operation.

If the valves are burned, pitted or grained, intake valves should be refaced to a 30 degree angle, and exhaust valves to a 45 degree angle.

After refacing the valves and seats, they should be lapped-in by using a very fine grinding compound: A final check for leaks should be made by pouring gasoline in the ports - or with air pressure directed to the combustion chamber.

VALVE SPRINGS

Valve springs should be carefully examined for cracks after they have been thoroughly cleaned with gasoline. After they have been installed, they should be checked for loading.

The valve springs, when assembled to the cylinders, should support 50 to 60 pounds when the valve is on its seat. If the spring weight does not support at least 48 pounds, the spring should be removed and washers placed under the spring in sufficient numbers to bring tension up to the required limits. A weak spring tends to cause uneven firing under part throttle operation, while more than 60 pounds tends to overload the hydraulic unit. If a thickness of more than two 1/16" washers is

needed to bring the spring to the necessary tension, it means that the spring has weakened to a point where it must be replaced.

For cylinders machined with $1/8$ " deeper valve spring recess and equipped with $3/32$ " longer valve springs, the valve springs should support 50 to 60 pounds when the valve is on its seat. Old recesses are $25/32$ " deep and the new are $27/32$ " deep.

Dampers in the older valve springs ($1-27/32$ " long) should be $31/32$ " long. If any are found to be longer, they should be ground off to proper length. Dampers in the later type springs ($1-15/16$ " long) should be $1-1/8$ " long.

Rusty springs should all be replaced because they are apt to crack through and break. NOTE SEE BULLETIN NO. 23.

CYLINDERS

The cylinders should be checked for taper and out-of roundness by using an inside micrometer.

A cylinder which is worn more than .002 or .003 should be returned to the factory and exchanged for a cylinder of normal size; that is, 4.000 to 4.001. Measurements should be taken upward to a distance of approximately five inches (5") from the lowest edge of the cylinder skirt. Above that point an inward taper will probably be noted - that is normal.

This method of handling excess clearance is less costly to the operator than it is to re-grind the cylinders and use oversize pistons, because, under the exchange cylinder plan, it is customary to use the original pistons as they seldom wear out.

Before assembly, be sure that all parts are absolutely clean and in first-class condition. As the parts are being put together, oil all bearings and other contact surfaces in order to avoid the possibility of scuffing when the engine is first started.

If the valve leak test (see Part V, Section 2, "Top Overhaul") shows the valves to be right, - and if the cylinder has normal clearance, the valve mechanism can be reassembled to the unit.

Make sure that the oil hole in the rocker pin bearing is directed toward the cylinder.

Do not install the valve rocker caps on the cylinder until the cylinders have been installed on the crankcase. Otherwise it will be impossible to see whether the lifter rods are lining up properly at the ball end of the valve adjusting screws.

Do not tighten cylinder hold-down cap screws until cylinder tie plate has been installed across both cylinders to allow proper alignment of cylinders with crankcase. Cap screws should be tightened down evenly to insure an even pressure of cylinder to crankcase. Failure to do this often causes cracking of cylinder base flange.

ASSEMBLY OF CYLINDERS TO CRANKCASE

Before assembling the cylinders to the crankcase, the interior of the crankcase and cylinders should be inspected and cleaned.

New gaskets should always be used. The possible saving in using an old cylinder gasket may be more than offset by the added cost of an oil leak.

Cover the piston rings and the cylinder walls with a liberal coating of lubricating oil.

Use a band type of ring clamp over the piston rings before attempting to pilot the cylinder over the piston, then push very carefully. Otherwise the rings may be cocked and broken

Draw up evenly at each of the six points where the cylinder is fastened to the crankcase.

The next important step is to properly adjust the valve clearance. With the No. 1 cylinder at the firing position and using special tool No. 10687, (See Parts Price List), PULL BACK ON THE ROCKER ARM UNTIL ALL THE OIL IS FORCED OUT OF THE HYDRAULIC LIFTER. This condition will be apparent when continued pressure no longer alters the gap between the valve stem and the rocker arm. At the time measurement is made make sure pressure is not applied severely enough to spring the rocker and obtain a false reading.

With the rocker arm in this position, it is a simple matter to adjust the screw on the push rod end to a point where a .040 gap is measurable between the top of the valve and the rocker arm.

If the engine has been totally dismantled and the hydraulic lifters cleaned and washed out, it will be unnecessary, of course, to squeeze the oil out of the lifter inasmuch as there will be no oil beneath the piston of the hydraulic lifter unit.

Clean all the spark plugs and check the gaps to see that they are .020 for the Champion J-10 plugs. Care should be taken that there are no burrs on the threads of the spark plugs. This can be noticed if the plugs go in hard. In other words, if a plug cannot readily be screwed into position with the fingers, it is evident that there is a burr in the plug which is preventing its entrance. In this event, the plug should be carefully removed and the burr filed off. Also, extreme care should be taken to see that the plug is started straight, - as experience has shown that cylinders have been ruined because the plug was started in cocked, and forced in with a wrench.

Installing the exhaust stacks and air housings on the engine, be sure that the nuts on the studs, which hold the exhaust stacks in position, are not tightened excessively. Bring the nuts up to a snug position without forcing.

It is recommended that the engine be run in on the following schedule:

1000 R.P.M. - 30 minutes	1500 R.P.M. - 20 minutes
1100 " " "	1600 " " "
1200 " " "	1700 " " "
1300 " " "	1800 " " "
1400 " " "	1900 " " "

PISTON RINGS

At the time of top overhaul, install new piston rings. The average piston ring begins to lose its effectiveness at about the same time as the valves. Remove the old rings and thoroughly clean the ring grooves before new rings are installed. The top of the piston should be cleaned with Crocus cloth dipped in kerosene.

It is not necessary to remove the piston from the rod in order to install new piston rings.

Should it be desirable to remove a 4AC-176 piston from the connecting rod, simply push out the piston pin. If the piston is badly scratched, it can usually be re-finished with Crocus cloth. However, if the scratches are very deep and numerous, it is best to replace it with a new piston.

To install the piston pin, it is necessary only to push the pin through the piston and connecting rod.

If a new 4AC-176 piston is required, it should be purchased with the pin fitted, insuring proper clearance between the piston and the piston pin.

Perfect Circle Piston Rings are standard equipment on Franklin 4AC-176 engines. Three different types of rings are used, a 3/32" type "200" is used in the top groove, a 3/32" type "70" in the middle groove and a 3/16" type "85" oil ring in the groove immediately above the piston pin.

It will be noticed that there is an oil ring groove below the pin in which no ring was installed. This oil ring groove was incorporated in the design to permit the installation of an added oil ring if it is impossible to properly control the oil with the regular ring combination, due to excessive clearance between piston and cylinder.

UNDER NO CIRCUMSTANCES SHOULD THIS ADDED OIL RING BE USED WITHOUT FIRST CONTACTING OUR SERVICE DEPARTMENT FOR INSTRUCTIONS.

NOTE Later type pistons have no lower oil ring groove below piston pin.

Before installing rings, it will usually be noticed that there is a highly glazed finish in the cylinder barrel. This glaze should be broken by a spring loaded cylinder hone such as manufactured by the Automotive Maintenance Machine Co., of North Chicago, Illinois.

Be sure that the hone used is of the Spring loaded type and not of the Positive type.

After honing, the cylinders should be steam cleaned if possible. In any event, extreme care should be taken to see that all abrasive is removed from cylinders.

When the glaze is broken, the new rings will quickly find their seats. But, if the glaze is not broken, they will require several hundred hours to seat. In the meantime, excessive blow-by may damage the rings.

PART VI

COMPLETE OVERHAUL

A complete overhaul should not be required before 500 hours, - the recommended point.

However, unusual operating conditions may cause excessive wear resulting in high oil consumption. The appearance of metal particles in the oil, or erratic operation in flight, may make a complete overhaul advisable before that time.

SECTION 1. - COMPLETE DISASSEMBLY

To dismantle an engine completely, it must be first removed from the plane.

Remove the propeller by simply taking out the six bolts which hold it to the hub and crankshaft. Remove the exhaust pipes, throttle controls, gasoline line, engine bolts, etc. Then the engine may be easily lifted out of the plane by two persons.

The engine should be dismantled on a bench or on an assembly stand.

Because it is obviously impossible to do a first-class job unless all parts are thoroughly cleaned, the exterior of the engine should be thoroughly washed with gasoline before any work is undertaken. It is usually a good plan to have several clean boxes or cans available in which to place the parts as they are removed from the engine. Each part should be thoroughly washed with gasoline.

CAUTION: To prevent damage to parts, always use a fibre drift or mallet whenever it is necessary to separate or drive parts together.

A. REMOVING CYLINDERS

Remove the cylinders and dismantle assemblies, as explained in Part V "Top Overhaul".

B. REMOVING PISTONS

See Part V "Top Overhaul"

C. REMOVING ACCESSORIES

Remove the magneto, carbureter, crankcase cover, oil pan and timing gear case cover. To remove the crankshaft, it will be necessary to take off the three nuts on the top side of the case; next back-off the main bearing stud nuts

and the camshaft bearing stud nuts. The two halves of the crankcase will now come apart and the crankshaft, as well as the camshaft, can be lifted out. Care should be taken in separating the halves of the crankcase as they are piloted on dowels. It may be necessary to tap lightly with a wooden mallet.

To remove the oil pump, proceed as outlined in Part III, Section 2B, "Top Overhaul". (Also see Figs. 2 and 3.)

SECTION 2. - INSPECTION & REPLACEMENT OF PARTS

After disassembly, all parts should be cleaned and laid out in groups for inspection. As they are examined, make a list of all parts to be replaced. The correct fits and clearances for the parts are shown in Part VII "Table of Fits and Clearances".

A. HYDRAULIC LIFTER ASSEMBLY

The cam followers should slide freely in the guide bosses in the crankcase.

These cam followers seldom have to be replaced for wear. However, they may require replacement due to "parking"; that is, where they have not been rotating in the guide bosses, with the result that the cam marks a straight line across the faces.

The hydraulic valve lifter units usually last indefinitely. However, if they appear weak or incapable of holding pressure, they should be replaced.

B. VALVE LIFTER ACTUATING UNIT

To properly assemble the hydraulic valve lifter unit, use a short piece of lacing wire, preferably copper, and insert it in the small hole at the bottom of the lifter cylinder. This will raise the ball check from its seat and allow the unit to compress easily. After the unit has been pushed together, the spring should be snapped into the cylinder by pushing and twisting, in a clockwise direction, on the spring. This clockwise twisting motion should be used on both assembly and disassembly.

C. PUSH RODS

The ball end of the valve rocker adjusting screw must fit tightly to the inside of the push rod. Otherwise it will work up and down and cause erratic valve operation. If the ball end and cup end are not smooth and free from wear, they should be replaced. Push rods should also be checked for straightness. If bent, they should be replaced.

Care must be taken to make certain that the push rod fits into the hydraulic valve lifter unit.

D. CAMSHAFT ASSEMBLY

The camshaft should be examined for wear on the bearing and cam surfaces. If the edges of the cams are worn or chipped, the camshaft should be replaced.

Inasmuch as the camshaft bearings are of the interchangeable precision type, these bearings should be replaced when replacing crankshaft bearings.

E. CAMSHAFT GEARS

It will seldom be necessary to replace the crankshaft gear. However, it may be necessary to replace the Celeron camshaft gear if the edges of the teeth look flat, or if there is excessive back-lash between the crankshaft and camshaft gear teeth.

It is recommended that on 65 HP engines the gear be changed after each 1000 hours operation. On 80 HP engines the gear should be changed to the aluminum rim type after 500 hours operation.

F. CYCLINDER ASSEMBLY

Examine all cylinder parts following the instructions given in Part V, "Top Overhaul".

As a rule it is not necessary to replace valve guides until after 450 to 550 hours of service. However, if it should be necessary to replace them, all cylinders requiring new valve guides should be returned to the factory for guide replacement.

We recommend this because the guides are shrunk into the aluminum cylinder under heat at definite limits. When this work is done at the factory, the guide and the cylinder hole are carefully checked and oversize valve guides selected to give the proper fit.

However, because of time limitations, some operators will desire to make the guide replacement themselves. The best method of removing valve guides is to heat the cylinder head to 450° - 500° F. Drive guide into the cylinder, using a 3/8" pilot with shoulder to fit top edge of guide. It is imperative that this method be used to push out the guide, because, if it is pushed out the other way, the lower part of the guide will tend to make the guide hole in the cylinder oversize. While cylinder is still hot, cover the new guide with white lead and drive into cylinder head. After cylinder has cooled, the guide will have shrunk in place and is ready for valve installation, having been finished to size at the factory.

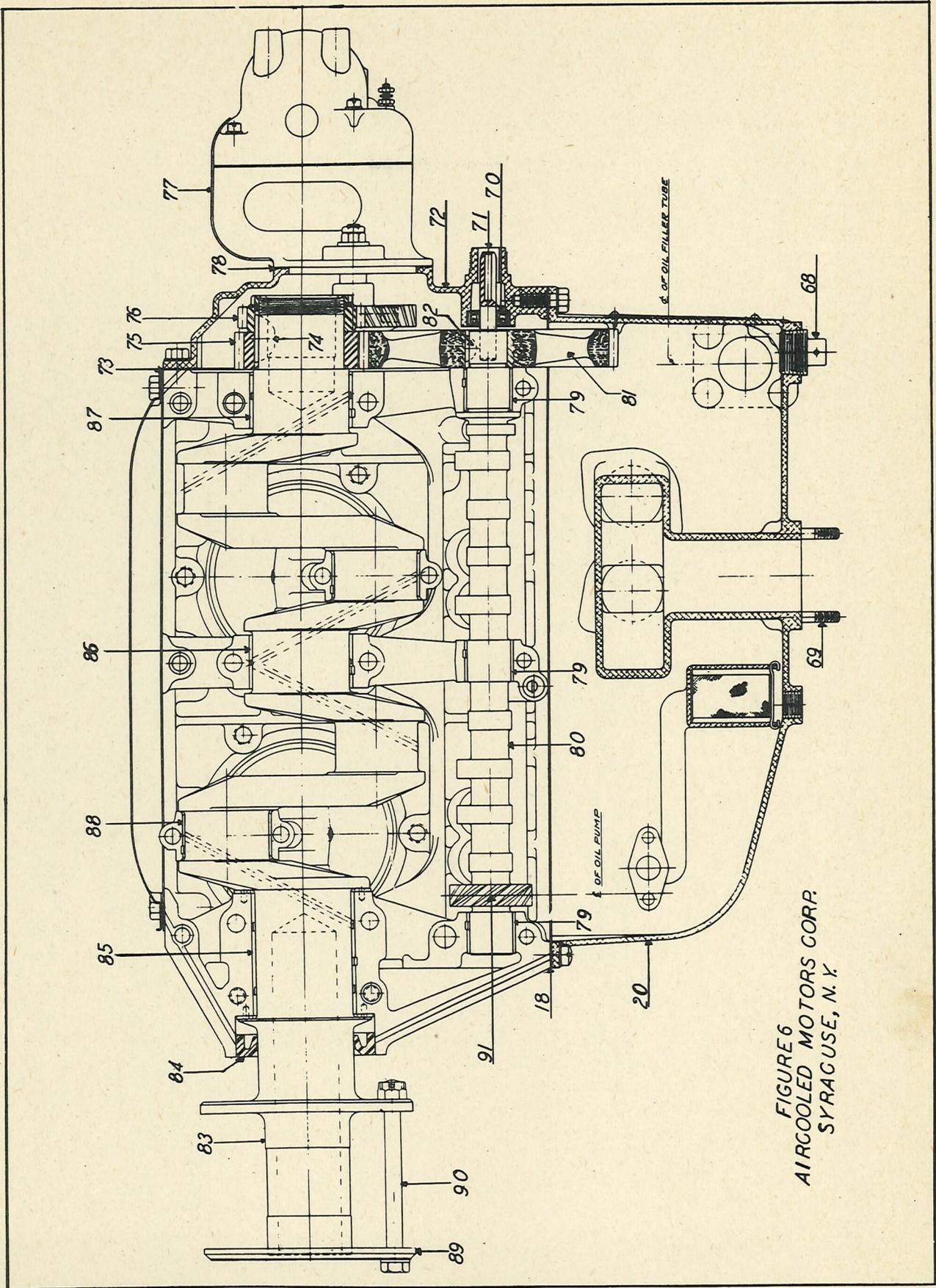


FIGURE 6
 AIR-COOLED MOTORS CORP.
 SYRACUSE, N. Y.

When installing new guides, use a special replacement part which is .001 oversize. If the guide hole becomes damaged, we can supply .002 and .005 oversize guide, which may be used after reaming the guide hole oversize.

Scored or worn cylinders are usually rebored and fitted with oversize pistons. In Franklin aircraft engines, however, it is recommended that the cylinder assemblies be returned to the factory and exchanged for cylinders with new cylinder barrels, ground and honed to standard size, new valve seats, new valve guides and new valves. This exchange is offered because the pistons usually last indefinitely. If dirt has gotten into the engine, the ring groove wear may necessitate piston replacement.

Under this plan of cylinder exchange (see Parts Price List), the operator receives cylinder assemblies capable of giving exactly the same service as new cylinders. In the long run this is much more economical than to attempt to re-grind the cylinders and install oversize pistons.

G. ROCKER ARMS

The rocker arms usually operate indefinitely, provided they have all been adequately lubricated. However, if the rocker arm bushing is badly worn, it should be replaced. Also, if the barrel end of the rocker arm is worn, the rocker arm assembly should be replaced.

However, in case only the rocker arm bushing needs to be replaced, this should be done at the factory where the bushings are precision-bored to the correct diameter.

H. PISTON & RINGS

The pistons on the 4AC-176 should be carefully examined and cleaned. The piston pin should be a push fit at a temperature of 120° F. When the engine was originally built at the factory, the pin was snug-push fit into the piston. If the pin is looser than .0006 in the piston, it should be replaced with a .001 oversize pin. If the pistons are badly scratched, or the ring grooves worn, a new piston should be used. If the ring grooves are in good condition and the piston only slightly scratched, rub with a Crocus cloth, dipped in kerosene, or a fine oil stone.

Use new piston rings when top or major overhauling the engine. The new rings should fit freely into the ring grooves of the piston. Otherwise there may be a tendency for the rings to stick when the engine is again placed in operation.

I. PISTON PINS

The piston pin should be carefully examined to see that the aluminum plugs fit tightly in the pin proper. If they do not fit tightly, it will be necessary to replace the entire pin assembly. Marking of the cylinder walls by the aluminum piston pin plugs in no way interferes with the proper functioning of the piston.

J. CRANKCASE

The crankcase is cast in two pieces of high-strength aluminum alloy, divided through the center line of the camshaft and crankshaft. Each half is piloted to the other with hollow dowels through which the bearing studs pass. There are eight main bearing studs and three camshaft bearing studs. In addition, there are two through bolts and one stud at top of case.

On the propeller end of the castings are packing grooves in which are laid part number 24x31, a synthetic rubber packing. There is also a short groove at the top of magneto end of case. Ten inches of this material is furnished when ordering service packing. This packing prevents oil seepage through the ends of the case.

At this point it is advisable to see that the crankshaft oil seal is in perfect condition. Scratches in the material may cause annoying oil leaks. If any scratches are evident, a new seal should be installed. Installation of crankshaft oil seal should be done carefully. Apply permatex to the surface of the seal coming in contact with the crankcase. The seal should be pushed into the crankcase so as to be flush with outer surface of the snout. If pushed in too far, it will seal the oil drain which may cause serious leakage.

After the crankshaft and camshaft have been installed and the two halves of the case bolted together, care should be taken to see that crankshaft and camshaft turn freely without any binding.

K. TIMING GEAR CASE

The timing gear case should be thoroughly examined, - primarily with the idea of detecting checks or cracks. Also be sure the tachometer drive leather oil seal is in serviceable condition. If the leather is backed up by the

spring and appears torn, or incapable of sealing the tachometer drive shaft properly, it will be necessary to replace the old seal. This should be done very carefully as the seal is quite fragile and easily damaged.

The best way to do this is to use an arbor press, if one is available. If not, the old seal can be driven out and the new seal tapped in position with a wooden block. Install the seal so that the spring is toward the camshaft gear.

Engines equipped with starters and generators are furnished with a different type of tachometer drive and should be serviced as follows: If the rubber seal appears torn or, incapable of sealing the tachometer drive shaft properly, it will be necessary to replace the old seal. The best way to do this is, pick out the old seal with a sharp pointed tool and tap the new seal into position with a small wooden block.

L. CRANKCASE COVER

Examine the crankcase cover for checks or cracks. It is always best to use a new gasket when replacing cover.

M. EXTERNAL OIL LINES

Clean out all fittings. Make certain they are clear; otherwise the valve mechanism will not receive the proper amount of oil. As a safety precaution, it is our recommendation that these oil lines be replaced with new lines at time of overhaul. Also supports and clamps should be installed to prevent breakage from vibration.

N. OIL PUMP ASSEMBLY

The oil pump should be carefully examined to see that the gears are not worn, or the pump scored. Though it will rarely be necessary, we recommend that a new pump be installed if there is any indication that it is not in first-class condition.

O. INTAKE PIPES

Examine the intake pipes for cracks, giving special attention to the elbow flanges at the cylinder end and rubber packings at each end.

P. CONNECTING ROD ASSEMBLY

All connecting rods should be carefully examined and magnafluxed for cracks. The cap bolts and nuts should be thoroughly inspected to see that the threads are in good condition. Otherwise they should be replaced.

The small bushing in the upper end of the rod should be examined to see that it is not turned out of position. This condition can be corrected by lining up the oil holes in the connecting rod with the holes in the bushing. It should also be examined for wear. If it is larger than .861, the rod should be returned to the factory where new bushing, precision-bored to the right dimension, will be installed.

After 450 to 550 hours of operation, we recommend that new connecting rod bushings be installed; however, before ordering bushings, measure the diameter of the crank pins to see that they are not worn excessively. See Crankshaft below for permissible wear measurement.

Q. CRANKSHAFT

If the crank pin journals have worn .001 or .0015 out of round, and are more than .001 tapered, it will be necessary to have the crankshaft re-ground to one of the standard undersizes. This re-grinding should be done only where proper facilities are available. It is important in re-grinding that all fillets be carefully ground to .125 - .135 radius and be free from grinding marks. After re-grinding, the shaft should be checked for balance and magnafluxed.

The main journals should be measured for wear. If such inspection shows the diameter to be less than 2.248, or tapered in excess of .0015 or out of round more than .001, the shaft should be re-ground .010 undersize or 2.2395 - 2.2400.

Main bearing bushings should be examined carefully for wear or cracks. Also examine the thrust faces on the front main bushing.

ELECTRICAL EQUIPMENT

Aircooled Motors Corporation has adapted high production automotive electrical equipment for use on Franklin aircraft engines, bringing for the first time electrically equipped aircraft to the airport operator and private owner at a price he can afford to pay.

By using automotive electrical equipment, the airport operator and private owner has available the service of many hundreds of automotive electrical equipment stores throughout the nation. The reliability of present day automotive equipment is known to every automobile driver. With reasonable care the electrical equipment on Franklin aircraft engines should give hundreds of hours of trouble-free service.

W A R N I N G

BEFORE WORKING ON ELECTRICAL EQUIPMENT, DISCONNECT ONE OF THE BATTERY LEADS TO PREVENT INADVERTENTLY TURNING PROPELLER.

ALWAYS BE SURE PROPELLER IS CLEAR BEFORE STARTING ENGINE.

GENERATOR

The generator on your Franklin engine has a three brush, fused, positive ground circuit, equipped with two-stage regulator that needs no adjustment. If for any reason the generator does not charge, inspect the fuse and replace if burned out.

If the fuse has burned out, it indicates an overload or an open circuit in the electrical system, and the cause of overload or open circuit should be determined. The generator must not be run if the circuit is open.

When the airplane is used for short flights and frequent starts, the third brush should be set to generate not more than eight (8) amperes. If the airplane is used for long flights, the third brush should be set to generate four (4) amperes. To generate more current, move the third brush in direction of rotation.

The generator should be oiled at each 100 hour check and the brushes should be examined at each 50 hour check. If the brushes are worn near the brush holders, they should be replaced or damage to the commutator may occur. At this point, it is advisable to have your nearest Auto-Lite distributor turn down the commutator. Never use sandpaper, or emery cloth on the commutators.

Your generator is driven by a special shock absorbing gear. This gear should be examined at each top overhaul period, the gear removed from the driving hub and the rubber shock absorbers replaced.

See "S" for generator gear backlash.

R. STARTER

Your starter is controlled by a solenoid starter switch mounted on the starting motor with push button control mounted on the dash. The starting unit will require little attention.

Check the brushes and commutator at each major overhaul period, following same instructions as for generator.

Check all wiring on both starter, generator and battery for possible shorts and loose connections at each 100 hour check.

If any evidence of oil is found in starter, remove starter and replace oil seal at drive end.

S. ACCESSORY CASE

Your starter, generator, tachometer drive and both magnetos are carried on one accessory case. The alignment of all the gears depends upon the proper alignment of this case. Care should be taken to use factory gaskets of the proper thickness and material.

Also be careful not to distort case or dowels upon removal or replacement.

The recommended procedure for removing and reassembling starter, generator and magneto gears is as follows:

1. Remove starter, generator, and both magnetos.
2. Remove timing gear case.
3. Fasten block portion of gear puller (using special tool, part #10688) to generator and magneto drive gear hub with two 5/16 inch cap screws.
4. Hook gear puller jaws over end of puller block and pull the gear and hub.
5. Remove starter gear lock.
6. Fasten gear puller jaws in the two larger divisions of the starter gear webbing and pull the gear.
7. To reassemble the starter gear. Heat gear in oven to 300°F. White lead should be applied on starter gear hub and the gear dropped on crankshaft, care being taken that the slot in the gear lines up with the key in the shaft. This method prevents scoring or feathering of gear hub which is liable to occur when pressed on cold. Then install the lock and lock ring.
8. Line up the slot in the magneto and generator drive gear assembly with the key in the shaft and drive up tight to the shaft. Drive only on the hub. If pressure is put on the gear it will be thrown out of alignment.

When replacing the accessories, replace the generator first, allowing approximately .004 backlash. This can be determined through the magneto openings in the case. Next, replace the tachometer drive allowing approximately .006 backlash to be checked through magneto opening. Magnetos should now be timed and drive gears should be allowed approximately .002 backlash. Magneto gear backlash may be checked through starter opening. The starter Bendix Drive will not require backlash check.

In extreme instances: If the proper backlash cannot be secured, it is possible to scrape the openings in the accessory case, thus allowing the accessory in question to shift enough to secure proper backlash.

RE-ASSEMBLY AFTER COMPLETE OVERHAUL

Before starting re-assembly of the engine, all steel parts should be magnafluxed for checks and cracks. This should be done by an operator well versed in the use of magnafluxing equipment.

The use of new gaskets throughout is recommended. We do not recommend the use of any gasket paste or liquid except in connection with crankshaft oil seal. When used, this material often gets into the engine and may cause considerable damage by plugging oil passages.

It is important that assembly of the engine be undertaken in a clean, light place, free from drafts which would tend to blow dirt on or into the engine. The crankcase should first be carefully washed with clean gasoline and blown out with compressed air. Wipe out the camshaft and crankshaft bearing seats carefully. Install bearing shells, with special attention that oil holes in shells line up with drilled holes in case; now oil liberally. Install oil seal on crankshaft. Lay crankshaft and camshaft in one half of the case, being sure that gear marks on both shafts coincide.

Make certain that hollow dowels are replaced if they were removed. Next put the synthetic rubber packing in the grooves at front and back.

Place other half of case in position; put flat washers and nuts on all the bearing studs and draw all nuts up snugly. Next put the two long tie bolts through top of case with flat washers under nuts. If crankshaft turns freely, nut should be tightened and safetied. Again check crankshaft to see that it does not bind.

It is also necessary to check the oil seal at propeller end of case before drawing the cases together.

The next operation concerns the installation of the connecting rods. Wash them carefully and install bushings. Care should be used in the assembly of connecting rods to the crankshaft. It is important that the parting surfaces be in good condition because the life of the bearing is greatly dependent upon the amount of crush imparted to it by the cap. Be sure that the oil holes in the shell, which are used in the connecting rod, line up with the squirt holes drilled in the rod. Oil the crank pins before installing the rod. After rods are in place, check them for freedom and proper fit. If the rod is tight, it is probably because the bearing is riding the fillet. This condition can be corrected by removing the connecting rod and cutting a radius on both edges of the bearing insert. After rods are properly installed, mount the pistons and proceed with installation of cylinders as outlined on Page 18.

Next install the timing gear case. We recommend the use of a new gasket. It is important that great care be used in slipping the oil seal over the tachometer drive spigot because rough handling may damage the oil seal. Make sure that all dowel pins are in place before tightening timing gear case to the block as these dowels control the alignment of the magnetos with the crankshaft.

CAUTION: Be sure that engine is set on No. 1 center. This can be determined by pressing in on the two valve tappets on No. 1 cylinder and rotating the crankshaft several degrees in each direction to make sure that they do not move. If either valve lifter moves, the crankshaft must be turned over one full revolution to be in proper time. This position is indicated by the mark on the propeller hub flange on the crankshaft.

In addition to the top center mark on the flange, there is another mark on the flange 28° before top center. When setting magnetos, the 28° timing mark should coincide with the parting line of the crankcase.

The right hand magneto, viewed from the pilot's seat, fires the spark plugs over the exhaust ports and the left hand magneto fires the plugs over the intake ports.

The most accurate way to time the magneto is as follows:

Remove the distributor cap from the magneto. Turn shaft until impulse clicks on No. 1 cylinder. Then turn backwards until points are nearly closed. Put a piece of .001 shim stock between points and turn backwards until shim stock is tight between points. Install magneto on timing gear case but do not tighten nuts. Rock magneto until shim stock is just free and tighten nuts, safety with palnuts.

If .001 shim stock is not available, a piece of cellophane may be used; however, if cellophane is used, care should be taken to remove any wax that may have been deposited on the points from the cellophane.

Installation of piston rings, see Part V, "Top Overhaul".

Installation of cylinders, see Part V, "Top Overhaul".

Installation of high tension wires, Firing Order 1-4-2-3.

After the assembly has been completed, run the engine in, in accordance with the instructions given in Part V, Section 2, "Top Overhaul".

Three special tools: A gear puller, inlet manifold packing assembly tool, and valve lifter rod tube puller and setting tool.



PART VII

TABLE OF FITS AND CLEARANCES

MODEL 4AC-176

	Min.	Desired	Max.	Max. Per- missible After Wear
1. Crankshaft bearings center and gear end	.0015	.002	.0035	.006
2. Crankshaft bearings propeller end	.0015	.002	.0035	.006
3. Crankshaft thrust bearings and clearance	.004	.008	.012	.014
4. Connecting rod and crank pin	.001	.0015	.0025	.006
5. Piston pin and rod	.0005	.0007	.0009	.002
6. Piston and piston pin	.0000	.0001 tight	.0002 tight	.002
7. Cylinder and piston	.0025	.0030	.0035	.007
8. Camshaft small bearing	.001	.002	.0025	.004
9. Camshaft end movement	.002	.004	.006	.010
10. Valve rockers and pins	.002	.003	.0035	.006
11. Valve lifters and crankcase	.001	.001	.002	.004
12. Valve stems and guides	.0025	.0034	.0043	.006
13. Oil pump drive shaft and pump body	.001	.0015	.0025	.004
14. Oil pump driven gear and shaft	.001	.0015	.002	.004
15. Oil pump gears, pump body and cover	.0035	.004	.0075	.009
16. Backlash - camshaft and crankshaft gears	.000	.001	.002	.006
17. Piston ring and groove - top - Perfect Circle	.0055	.0062	.007	.009
18. Piston rings and groove - second - Perfect Circle	.0035	.0042	.005	.007
19. Piston ring and groove - third - Perfect Circle	.002	.00275	.0035	.0055
20. Piston ring - butt clearance	.025	.029	.035	.050
21. Side clearance - connecting rod and crankshaft	.006	.009	.012	.014
22. Push rod and crankcase (Fuel Pump)	.002	.002	.006	.008

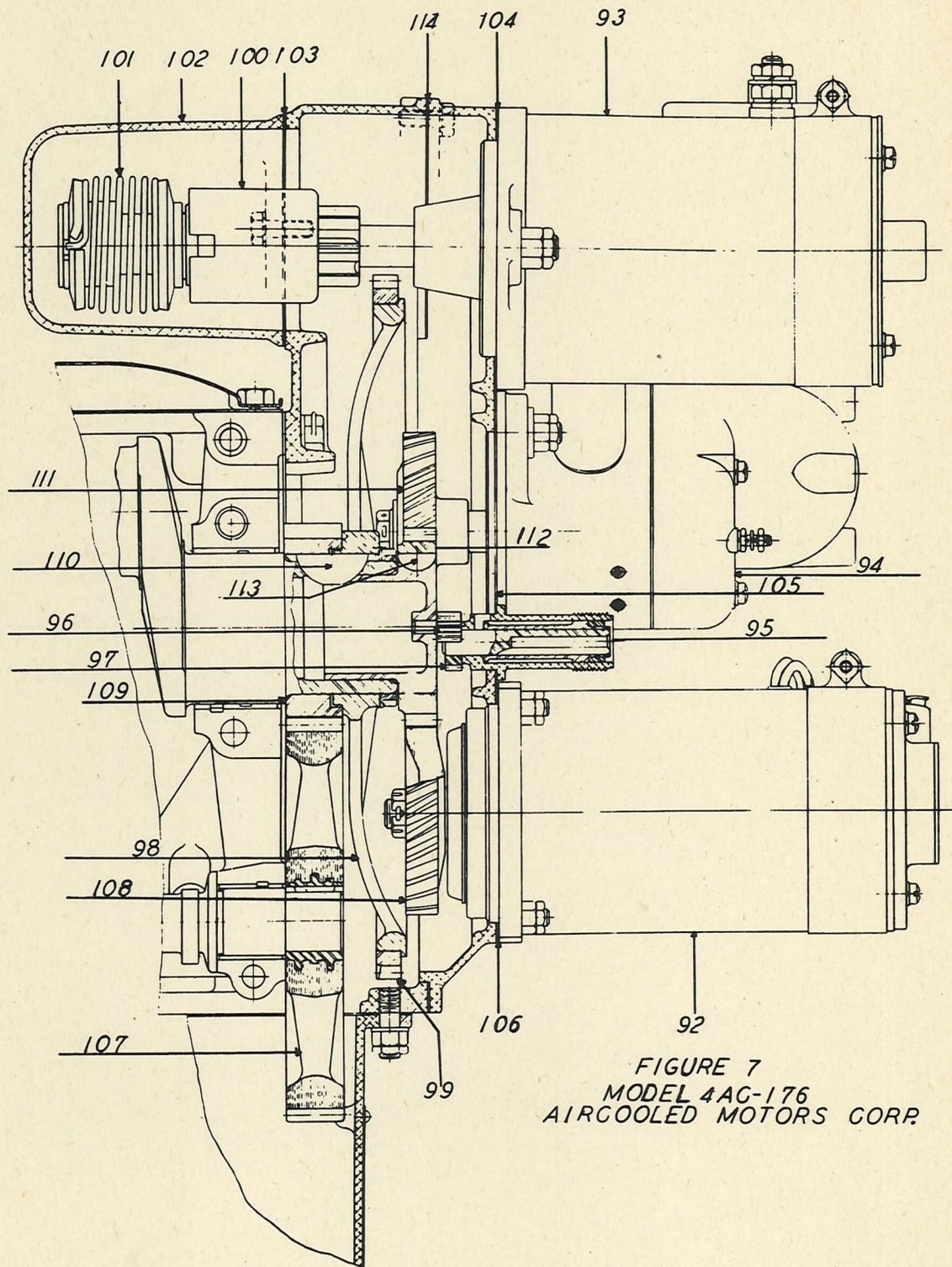


FIGURE 7
 MODEL 4AC-176
 AIRCOOLED MOTORS CORP.

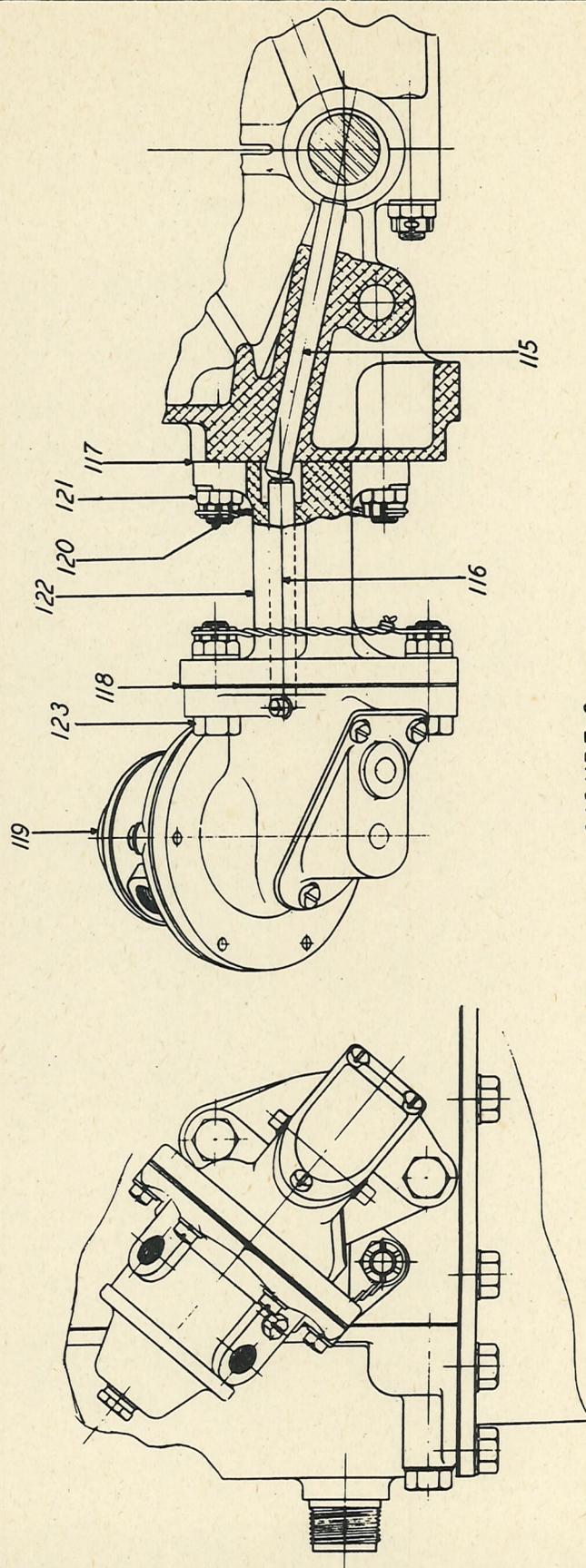


FIGURE 8
MODEL 4AC-176
AIRCOOLED MOTORS CORP.

PART VIII

TORQUE WRENCH SPECIFICATIONS

MODEL 4AC-176

	<u>Size</u>	<u>Ft. Lbs.</u>	<u>Inch Lbs.</u>
Connecting rod bolt nuts	3/8-24	25-30	300-360
Cylinder hold-down nuts & cap screws	3/8-24	33	395
Cylinder hold-down nuts & cap screws	7/16-20	40	480
Main crankshaft bearing stud nuts	3/8-24	30	360
Camshaft bearing stud nuts	5/16-24	20	240
Long through crankcase bolt nuts	5/16-24	20	240
Oil pump by-pass plate cap screws	5/16-18	15	180
Rocker support stud nuts	5/16-24	10-12	120-145
Oil pan fillister head screws	5/16-18	5-6	60-75
Crankcase cover cap screws	5/16-18	5-6	60-75
Rocker adj. screw nuts	5/16-24	10-12	120-145
Spark plugs in cyl. heads	14 m.m.	15	180
Magneto flange stud nuts	5/16-24	7-8	85-95
Starter flange stud nuts	3/8-24	20	240
Generator flange stud nuts	1/4-28	5	60
Oil pump to crankcase cap screw	1/4-20	5-6	60-75
Gear case to crankcase cap screws	5/16-18	10-12	120-145
Gear case to cover cap screws	1/4-20	5-6	60-75
Inlet pipe flange to cyl. head cap screw	5/16-18	15	180
Inlet pipe flange to oil pan cap screw	5/16-18	15	180
Motor mount to crankcase stud nuts	5/16-24	20	240



PARTS and SERVICE

IMPORTANT!

Save time and shipping expense by ordering all parts from the Distributor in your territory. Send your order directly to him. Be sure to specify model and serial number of engine for which parts are ordered.

AUTHORIZED FRANKLIN PARTS & SERVICE STATIONS

ALABAMA

Southern Airways Sales Co., Inc.
Municipal Airport, Birmingham, Ala.
Telephone: 9-2142

CALIFORNIA

Hagelin Aircraft Motors Co.
933 Airway, Glendale 1, Calif.
Telephone: Cltrus 1-1651

Stinson Flying Corporation
Belmont Airport, Belmont, Calif.
Telephone:

CANADA

Cub Aircraft Co., Ltd.
Hamilton, Ontario, Canada
Telephone: 5-1133

Leavens Bros. Air Services, Ltd.
Barker Airport, Toronto, Canada
Telephone: MELrose 5791-2

FLORIDA

D. H. Wallace
Municipal Airport, Clarcona, Fla.
Telephone: Orlando County 31R14

Palm Beach Aero Corporation
Lantana, Florida
Telephone: 9892

GEORGIA

Aviation Supply Corporation
Atlanta Municipal Airport
Hapeville, Georgia
Telephone: Calhoun 1107-8

Blevins Aircraft Corporation
Atlanta Municipal Airport
Hapeville, Georgia
Telephone: CA 1672

ILLINOIS

Snyder Aircraft Corporation
Municipal Airport, Chicago, Ill.
Telephone: Portsmouth 5900

Tufts-Edgcombe, Inc.
Pal-Waukee Airport, Des Plaines, Ill.
Telephone: Wheeling 33-34-35

INDIANA

Muncie Aviation Corporation
Muncie Airport, Muncie, Indiana
Telephone: 2-2236

IOWA

Hunter Flying Service
Municipal Airport, Cedar Rapids, Iowa
Telephone: 3-1436

Beacon Airmotive Equipment Co.
LeMars, Iowa
Telephone: 351

KANSAS

Harte Flying Service
Municipal Airport, Wichita, Kansas
Telephone: 6-6114

KENTUCKY

Louisville Flying Service, Inc.
Bowman Field, Louisville 5, Ky.
Telephone: Highland 0070

MAINE

Airways, Inc.
Municipal Airport, Waterville, Maine
Telephone: 2300

MARYLAND

Baltimore School of Aeronautics, Inc.
Curtiss-Wright Airport
Baltimore, Maryland
Telephone: FOrest 3377

MASSACHUSETTS

E. W. Wiggins Airways, Inc.
Metropolitan Airport,
Norwood, Mass.
Telephone: CANton 0770

Jennings Bros. Air Service
Worcester Airport,
North Grafton, Mass.
Telephone: 768

MICHIGAN

Barr Aviation Company
Detroit City Airport, Detroit, Mich.
Telephone: ARLington 9584

Michigan Central Airlines, Inc.
Bishop Airport, Flint, Michigan
Telephone: 4-2621

MINNESOTA

Van Dusen Aircraft Supplies
2004 Lyndale Avenue, South
Minneapolis 5, Minnesota
Telephone: Kenwood 1852

MISSOURI

Ong Aircraft Corporation
Ong Airport, Kansas City, Mo.
Telephone: Republic 1123

Springfield Flying Service, Inc.
Municipal Airport, Springfield, Mo.
Telephone: 2418

St. Louis School of Aeronautics
Lambert Airport, Robertson, Mo.
Telephone: Terryhill 53130

Supply Division, Inc.
Lambert Airport, Robertson, Mo.
Phone: Terryhill 5-3880 (St. Louis)

SPECIFY MODEL and SERIAL NUMBER of ENGINE

NEW YORK

F & G Engine Company
105 Jericho Turnpike,
Mineola, L. I., N. Y.
Telephone: Garden City 1532

Buffalo Aeronautical Corporation
Buffalo Airport, Buffalo 11, N. Y.
Telephone: HUmboldt 5302

Niagara From The Air, Inc.
Bell Aircraft Airport,
Tonawanda, N. Y.
Telephone:

Ithaca Flying Service, Inc.
Ithaca, New York
Telephone: 8-625

Standard Aviation, Inc.
Walden, New York
Telephone:

NORTH CAROLINA

Piedmont Aviation, Inc.
Smith Reynolds Airport
Winston-Salem 1, North Carolina
Telephone: 3-2444

Carolina Aircraft Sales
Brockenbrough Field
Charlotte, North Carolina
Telephone: 4-7862

OHIO

Philip A. Meinke
Municipal Airport, Willoughby, Ohio
Telephone: 831

Midwest Aviation Corporation
Norton Field, Columbus, Ohio
Telephone: EV-4921

Tri-State Aviation Corporation
Cincinnati Airport, Sharonville, Ohio
Telephone: Sycamore 8500

Tuscarawas County Aviation, Inc.
Municipal Airport
New Philadelphia, Ohio
Telephone: 22031

OKLAHOMA

J. H. Burke Aviation Service
Wiley Post Airport
Oklahoma City, Oklahoma
Telephone: 8-2136

OREGON

A. W. Whitaker
5001 N. E. Union Avenue
Portland, Oregon
Telephone: Garfield 2317

PENNSYLVANIA

Krantz Aeronautical Corp.
Port Erie Airport, Erie, Pa.
Telephone: 32-198

SOUTH CAROLINA

Hawthorne Aero Supply
Orangeburg, South Carolina
Telephone: 1128

TENNESSEE

Southern Air Service
Municipal Airport, Memphis, Tenn.
Telephone: Long Distance, Station
No. 2, Glover, Miss.

TEXAS

Lou Foote Flying Service
Lancaster, Texas
Telephone: W-1131

Hangar Six, Inc.
Stinson Field, San Antonio, Texas
Telephone:

Southwest Aircraft
Meacham Field, Fort Worth 6, Texas
Telephone: 61179

Aircraft Sales Company
Meachem Field, Fort Worth, Texas
Telephone: 6-5491

VIRGINIA

Richmond Air Transport & Sales Corp.
R. E. Byrd Municipal Airport
Richmond, Virginia
Telephone:

Virginia Cub Distributors
Shadwell, Virginia
Telephone: RURAL 7131

WASHINGTON

Northwest Aircraft Distributor Co.
Vancouver, Washington
Telephone: 1960-W

WEST VIRGINIA

Glenn T. Clark
Clark Field, Winfield, W. Va.
Telephone: St. Albans 912W2

WISCONSIN

Stanislaw's, Inc.
Municipal Airport, Kenosha, Wis.
Telephone:

SOUTH AMERICA

Mesbla S/A, Rio de Janeiro, Brazil

PART IX

PARTS PRICE LIST

FRANKLIN AIRCRAFT ENGINES

MODEL 4AC-176

Revised July 1, 1943

PART IX
PARTS PRICE LIST
FRANKLIN AIRCRAFT ENGINES
MODEL 4AC-176

Revised July 1, 1943

REMEMBER: When you contact your distributor or the factory for parts or service, please give the engine number and the approximate date of its delivery to you.

<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>No. Per Engine</u>	<u>Price Each</u>
<u>I</u>				
<u>AIR HOUSING</u>				
10379	Cylinder Air Housing Assembly 4AC-176-B2-B3		1	20.00
10493	Cylinder Air Housing Apron)		1	3.00
10464	Cylinder Air Housing Support)		4	.10
10469	Spark Plug Hole Cover) #10379		2	.25
<u>II</u>				
<u>CAMSHAFT</u>				
10725	Gear - Camshaft - 4AC-176-F2-F3-D2-D3	81	1	14.09
10219	Camshaft & Tachometer Drive Assembly	80	1	23.79
10068	Gear - Camshaft - 4AC-176-B2-B3	81	1	7.92
10064	Bushing - Camshaft #1 & 3 Half	79	3	.27
10065	Bushing - Camshaft #2 & 4 Half	79	3	.24
5449	Connector - Tachometer	71	1	.32
6x15	Camshaft Gear to Shaft Woodruff Key		1	.03
<u>III</u>				
<u>CARBURETOR</u>				
11244	Carburetor - 4AC-176-BA2-BA3	31	1	29.25*
10154	Carburetor 4AC-176-C2-C3-D2-D3 E2-E3-F2-F3	31	1	24.75*
10223	Carburetor 4AC-176-B2-B3	31	1	24.75*
10586	Carburetor (With Altitude Control) 4AC-176-D2-D3-F2-F3		1	27.25*
5452	Carburetor Gasket		1	.03
5137	Carburetor Stud	69	4	.24

Part No.	Description	Ref. No.	No. Per Engine	Price Each
3x211	Hex Nut) Carburetor		4	2.00 Per C
) to			
23x14	Palnut) Crankcase		4	.86 Per C
32x13	Lacing Wire, Carburetor Throttle		1	.85 Per C
	Lever (4")			Ft.

IV

CONNECTING RODS

10051	Connecting Rod (Includes Piston Pin Bushing, Bolts and Nuts and Cap)		4	16.60
10037	Connecting Rod Bushing	88-51	8	.63
10381	Connecting Rod Bushing .010 undersize)	Crank-	8	.92
10382	Connecting Rod Bushing .020 undersize)	shaft End	8	1.05
10003	Connecting Rod Bolt	50	8	1.14
23x21	Connecting Rod Bolt Nut	49	8	.27
10018	Connecting Rod Bushing (Piston End)	54	4	.18

NOTE: See Instruction Book on Piston Pins

8x112	Cotter Pin	52	8	.22 Per C
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V

CRANKCASE

10567	Crankcase Assembly (For use without fuel pump - 65 HP)		1	175.00
10477	Crankcase Assembly (For use without fuel pump - 80 HP)		1	175.00
10497	Crankcase Assembly (For use with fuel pump - 80 HP)		1	180.00

NOTE: Oil By-Pass Plate & Gasket must be purchased with crankcase

10167	Stud - Crankcase (Front Tie Stud)		1	.96
10111	Stud - Crankshaft Bearing (Front with Dowel)	6	1	.82
10109	Stud - Crankshaft Bearing (Upper Front)	6	2	.82
2x412	Crankcase Tie Bolt	3	2	.43
10108	Stud - Crankshaft Bearing (Center & Front) (To Eng. No.)		4	.79
10872	Stud - Crankshaft Bearing (Center & Front) (After Eng. No.)		4	.79
10107	Stud - Camshaft Bearing		3	.69
10371	Crankcase Bearing Stud Packing		2	.07
10106	Dowel - Crankcase		2	.19
10192	Stud - Cylinder Hold Down - 80 HP)	9	24	.55
28x83	Dowel - 1/4 x 3/4 (Timing Case)		2	.06
10483	Stud - Crankshaft Bearing (Upper Rear)		1	.82
10482	Stud - Crankshaft Bearing (Lower Rear)		1	.79
5095	Washer - Crankshaft Bearing Stud		8	.10

<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>No. Per Engine</u>	<u>Price Each</u>
24x31	Packing - Synthetic Rubber			.09
17x11	Bushing - 1/4 x 1/8 Pipe in By-Pass Plate		1	.10
8x18	Pin - Cotter 1/16 x 3/4 (Crankcase tie Bolt)		3	.15 Per C
7x32	Plug - 1/4 Slotted Headless Pipe		3	.05
10105	Packing - Crankcase Tie Bolt & Oil Header		4	.10
10075	Plate - Oil By-Pass	16	1	3.41
10074	Gasket - Oil By-Pass	17	1	.01
	(4AC-176B Engines up to #100799 4AC-176F Engines up to #125113)			
10472	Plate - Oil By-Pass		1	4.40
10489	Gasket - Oil By-Pass		1	.02
	(4AC-176B Engine #100800 and up 4AC-176F Engine #125116 and up)			
10368	Oil Pan Stud (In crankcase over inlet opening) - For 8 qt. Pan		4	.60
10106	Engine Mounting Bracket - Dowel		4	.19
10168	Engine Mounting Bracket		4	2.96
10193	Engine Mounting Bracket Stud		8	.34
10246	Engine Mounting Bracket Rubber Bushing		8	.10
10501	Engine Mounting Washer - 7/16 I.D.		8	.04
2x171	Oil By-Pass Plate Cap Screw		4	2.00 Per C
8x112	Cotter Pin - 3/32 x 3/4 - Crankshaft Bearing Stud		4	.22 Per C

VI

CRANKCASE COVER

10170	Crankcase Cover (With Oil Filler Hole)		1	5.62
10070	Crankcase Cover (Without Oil Filler Hole)	2	1	.72
10071	Crankcase Cover Gasket		1	.33
2x169	Crankcase Cover Screw	4	12	1.00 Per C
19x17	Crankcase Cover Screw Washer		12	2.50 Per C
8x118	Cotter Pin - 1/16 x 5/8 - Camshaft Bearing Stud		3	.18 Per C

VII

CRANKSHAFT, GEAR, BUSHINGS

10458	Crankshaft	83	1	90.20
10063	Crankshaft Thrust Washer		4	.90
28x811	Crankshaft Thrust Washer Dowel		8	.03
10061	Crankshaft Bushing (Gear End - Cyl. 1 & 3)	87	1	.96
10391	Crankshaft Bushing (Gear End - Cyl. 1 & 3) .010 undersize	87	1	2.08
10392	Crankshaft Bushing (Gear End - Cyl. 1 & 3) .020 undersize	87	1	2.16
10062	Crankshaft Bushing (Gear End - cyl. 2 & 4)	87	1	.79
10393	Crankshaft Bushing (Gear End - cyl. 2 & 4) .010 undersize	87	1	1.95

<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>No. Per Engine</u>	<u>Price Each</u>
10394	Crankshaft Bushing (Gear end -Cyl. 2 & 4) .020 undersize	87	1	1.80
10059	Crankshaft Bushing (Center - Cyl. 1 & 3)	86	1	.96
10387	Crankshaft Bushing (Center - Cyl. 1 & 3) .010 undersize	86	1	1.95
10388	Crankshaft Bushing (Center - Cyl. 1 & 3) .020 undersize	86	1	1.80
10060	Crankshaft Bushing (Center - Cyl. 2 & 4)	86	1	.82
10389	Crankshaft Bushing (Center - Cyl. 2 & 4) .010 undersize	86	1	1.95
10390	Crankshaft Bushing (Center - Cyl. 2 & 4) .020 undersize	86	1	1.80
10057	Crankshaft Bushing (Prop. End-Cyl. 1 & 3)	85	1	1.33
10383	Crankshaft Bushing (Prop. End-Cyl. 1 & 3) .010 undersize	85	1	2.86
10384	Crankshaft Bushing (Prop. End-Cyl. 1 & 3) .020 undersize	85	1	2.65
10058	Crankshaft Bushing (Prop. End-Cyl. 2 & 4)	85	1	1.33
10385	Crankshaft Bushing (Prop. End-Cyl. 2 & 4) .010 undersize	85	1	2.38
10386	Crankshaft Bushing (Prop. End-Cyl. 2 & 4) .020 undersize	85	1	2.41
10040	Crankshaft Oil Seal	84	1	4.03
10249	Crankshaft Gear (Engines with Gen. & Starter)	107 109	1	4.80
10248	Crankshaft Gear (Engines without Gen. & Starter)	75	1	4.80
6x110	Crankshaft Gear Key		1	.09

VIII

CYLINDER ASSEMBLY

10865	Cylinder Assembly	5	4	75.00
10034	Cylinder Gasket		4	.04
2x163	Cylinder to Crankcase Cap Screw		24	5.00 Per C
19x18	Cylinder Cap Screw Washers (65 HP engines only)		24	1.00 Per C
3x92	Nuts - Cylinder Hold Down Stud 7/16-20 Hex		24	6.00 Per C
23x12	Palnut - Cylinder Hold Down Stud 7/16-20 75 & 80 HP Engines only)		24	1.50 Per C
5167	Spark Plug Gasket		8	.02
5546	Spark Plug	10	8	.65*
10542	Spark Plug - Shielded		8	1.30*

<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>Per Engine</u>	<u>Price Each</u>
<u>CYLINDER EXCHANGE POLICY:</u> Upon return to the Factory, transportation prepaid, of old cylinder in usable condition, <u>subject to inspection at the factory, including valves, guides, seats, springs & rocker assemblies complete, we will exchange identical factory conditioned cylinder assemblies.</u>				PRICE ON REQUEST

IX

MAGNETOS

11049	Magneto - Cyl. #2 & 4) Shielded	94	1	80.00
11048	Magneto - Cyl. #1 & 3) Includes High Tension Wires	94	1	80.00
10533	Magneto - 65 HP	77	2	41.00
10225	Magneto - 80 HP		2	46.50
11667	Magneto and Tachometer Drive Gear Assembly (with starter or generator)	112	1	12.87
5103	Crankshaft Gear Nut		1	.84
5104	Crankshaft Gear Nut Lockwasher		1	.21
5255	Spark Plug Wrench (short)		1	.65 Net
10649	Spark Plug Wrench (long)		1	.97 Net
5256	Magneto Stud		4	.40
10952	Magneto Driven Gear	76	2	5.28
5057	Magneto Drive Gear (Without Starter or Generator)		1	4.80
5512	Magneto Gasket	78	2	.12
10397	High Tension Wire Assembly - Cyl. #1 & 3		1	1.81
10398	High Tension Wire Assembly - Cyl. #2 & 4		1	1.81
10721	High Tension Wire Assembly - Cyl. #1 & 3)		1	1.81
10722	High Tension Wire Assembly - Cyl. #2 & 4) (Taylorcraft & Porterfield)		1	1.81

X

MANIFOLDS

7354	Inlet Pipe Packing	30	8	.12
10101	Inlet Manifold Pipe Flange		8	.07
10150	Exhaust Pipe Flange		4	.18
10151	Exhaust Pipe Gasket		4	.05
10191	Exhaust Pipe Flange Stud		8	.35
2x169	Inlet Pipe Cap Screw	32	16	1.00 Per C
3x93	Exhaust Flange Nuts		8	4.00 Per C
19x17	Exhaust Pipe Shakeproof Washers		24	2.50 Per C

Following four inlet pipes used with 5 quart oil pan:

10098	Inlet Pipe - Cyl. #1 & 2	15	2	.72
10099	Inlet Pipe - Cyl. #3	15	1	1.00

<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>No. Per Engine</u>	<u>Price Each</u>
10100	Inlet Pipe - Cyl. #4	15	1	1.00
	Following four inlet pipes used with 8 quart oil pan:			
10210	Inlet Pipe - Cyl. #1 & 2	15	2	.81
10211	Inlet Pipe - Cyl. #3	15	1	1.12
10212	Inlet Pipe - Cyl. #4	15	1	1.12

XI

OIL PUMP

10998	Oil Pump Assembly - 4AC-176-D2-D3-F2-F3		1	43.00	
10396	Oil Pump Assembly - 4AC-176-B2-B3 -BA2 (Includes next 11 items)		1	40.00	
5033	Relief Valve Spring Nut	59	1	.24	
10048	Oil Pump Body	55	1	9.25	
10055	Oil Pump Cover		1	10.78	
10672	Oil Pump Drive Gear	} 4AC-176-B2-B3	1	4.08	
10050	Oil Pump Driven Gear		1	.48	
6x114	Woodruff Key #212 - Gears to Shaft	67	2	.03	
10672	Oil Pump Drive Gear	} 4AC-176-D2-D3-F2-F3	1	4.08	
10673	Oil Pump Driven Gear		1	4.00	
10997	Relief Valve Spring	58	1	.38	
10056	Relief Valve Plunger	57	1	.84	
10066	Oil Pump Shaft Gear	64	1	2.38	
10067	Oil Pump Drive Shaft	62	1	.85	
10114	Oil Pump Stationary Shaft	63	1	.26	
2x315	Elbow to Body Screw 1/4-20x3/4		2	17.00	Per C
2x316	Pump to Case Screw 1/4-20x3-3/8		4	22.00	Per C
5x21	Washers		6	.60	Per C
32x11	Lacing Wire 13"		1	.85	Per 100 Ft.
32x12	Lacing Wire 2-1/2"		1	.85	Per 100 Ft.
10095	Oil Pump Inlet Screen Assembly	60	1	.84	
10091	Oil Pump Inlet Elbow Gasket	61	1	.03	
10093	Oil Pump Inlet Elbow Assembly		1	3.60	

<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>Per</u>	<u>Price</u>
		<u>No.</u>	<u>Engine</u>	<u>Each</u>
<u>XII</u>				
<u>OIL LINES, GAUGE, FILLER PIPE</u>				
<u>& CAP</u>				
11080	Crankcase Breather Flexible Tube - (On Starter Cover Only)		1	1.05
5305	Crankcase Breather Flexible Tube (For Engines without Starter)		1	1.10
5364	Crankcase Breather Flexible Tube (Taylorcraft)		1	1.02
5573	Crankcase Breather Rigid Tube		1	.61
10214	Oil Filler Tube		1	3.22
10498	Oil Filler Tube (Aeronca)		1	4.03
10395	Oil Filler Tube Support		1	.08
10236	Oil Filler Tube Gasket	21	1	.03
10237	Oil Level Gauge (With Oil Filler on oil Pan) (Specify Engine Number)	26	1	1.54
10814	Oil Level Gauge Assembly (Aeronca)		1	1.90
10590	Oil Level Gauge (With Oil Filler in Crankcase Cover) (Specify engine number)		1	1.90
10681	Oil Filler Cap (On Crankcase Cover) - 4 qt.		1	.67
10683	Oil Filler Cap (On Crankcase Cover) - 8 qt.		1	.67
10682	Oil Filler Cap (On Crankcase Cover) - 5 qt.		1	.67
2x167	Filler Tube to Oil Pan Cap Screw	22	4	3.00 Per C
19x17	Filler Tube to Oil Pan Cap Screw Washers		4	2.50 Per C
8x17	Breather Tube to Crankcase Cotter Pin		1	.19 Per C
8x115	Flexible Tube to Rigid Tube Cotter Pin		1	.30 Per C
10205	Valve Oiler Double Elbow (In Crankcase)	25	2	.24
13x42	Flared Tube Elbow 3/16 (In Cylinder)		4	.17
2x218	Hex Head Screw)		1	1.00 Per C
3x211	Hex Nut) Oil Filler Tube		1	2.00 Per C
19x14	Lock Washer) to Support		1	2.00 Per C
5x111	Plain Washer)		1	.36 Per C
11805	Valve Case Oil Pipe Support		2	.39
11690	Valve Case Oil Pipe Assembly		4	.67
11676	Valve Case Oil Pipe Sleeve		4	.05
11677	Valve Case Oil Pipe Clamp		4	.29
12x18	Round Head Screw) Valve Case		2	1.00 Per C
19x15	Shakeproof Lock Washer) Oil Pipe Clamp		2	1.00 Per C
3x32	Hex Nut) to Support		2	1.00 Per C

<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>No. Per Engine</u>	<u>Price Each</u>
<u>XIII</u>				
<u>PISTONS, PINS AND RINGS</u>				
10871	Piston - 6 to 1 Compression Ratio	45	4	6.48
10222	Piston - 7 to 1 Compression Ratio	45	4	6.53
10221	Piston - 6.3 to 1 Compression Ratio	45	4	6.48
10218	Piston Pin Assembly	53	4	2.22
10399	Piston Pin Assembly .001 oversize		4	6.25
10173	Piston Ring (3rd Groove)	46	4	.65
10172	Piston Ring (2nd Groove)	47	4	.40
10171	Piston Ring (Top Groove)	48	4	.40

<u>XIV</u>				
<u>PROPELLER PLATE</u>				
5038	Propeller Hub Front Plate	89	1	4.85
5094	Propeller Hub Bolt	90	6	.25
5517	Propeller Hub Name Plate		1	.60
3x81	Propeller Hub Bolt Nut		6	5.00 Per C
5x23	Propeller Hub Bolt Nut Washer		6	2.00 Per C

<u>XV</u>				
<u>TIMING GEAR CASE</u>				
10085	Timing Gear Case Gasket) Without	73	1	.10
) Starter or			
10084	Timing Gear Case) Generator	72	1	22.20
10123	Timing Gear Case - Crankcase End		1	30.58
10124	Timing Gear Case - Accessory End		1	27.70
10120	Timing Gear Case Gasket (outer)	114	1	.48
10085	Timing Gear Case Gasket (inner)	114	1	.10
	(Used with Starter & Generator)			
10206	Oil Pan Stud (In Gear Case)	19	3	.44
2x149	Timing Case Screws 1/4-20x5/8		12	2.40 Per C
2x168	Timing Case to Crankcase Screw 5/16-18x2-3/8"		2	5.00 Per C
2x170	Timing Case Screws 3/8-16x1"		2	5.00 Per C
2x318	Timing Case to Crankcase Screw 5/16-18x7/8"		8	13.00 Per C
3x93	Oil Pan Stud Nut		3	4.00 Per C
5x22	Washers for 2/318 and 10206		11	.40 Per C
19x14	Shakeproof Washers for 2x149		12	2.00 Per C
19x113	Shakeproof Washers for 2x170		2	1.10 Per C
19x17	Shakeproof Washers for Oil Pan, Gear Case & Crankcase Cover		34	2.50 Per C

<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>No. Per Engine</u>	<u>Price Each</u>
28x71	Timing Gear Case Oil Retainer	70	1	.48
28x83	Timing Gear Case Dowel		2	.20
32x11	Timing Gear Case Screw Lacing Wire 46"		1	.85 Per C Ft.

XVI

VALVE MECHANISM

10007	Valves - Exhaust	39	4	1.59
10008	Valves - Inlet	39	4	1.13
10450	Valve Guides - .001 oversize	40	8	.72
10451	Valve Guides - .002 oversize	40	8	.72
10452	Valve Guides - .005 oversize	40	8	.72
10032	Valve Spring Washer Retaining Key		16	.03
10188	Valve Spring (1-27/32" Long) (Can be used on cylinders having both shallow and deep recesses. Use necessary shims under spring to get proper spring tension.)	41	8	.93
10824	Valve Spring (1-15/16" Long) (To be used only on cylinders having 1/8" deeper recess in head for Valve Spring)	41	8	1.00
10189	Valve Spring Washer (Lower)		8	.03
10730	Valve Spring Washer (Upper) (For Spring #10188)	42	8	.16
10825	Valve Spring Washer (Upper) (For Spring #10824)	42	8	.24
10201	Valve Retaining Ring		8	.03
10202	Washer-Valve Spring Lower (Shim) 1/32"			.03
10770	Washer-Valve Spring Lower (Shim) 1/64" (Use only one per spring as required)			.03
10014	Valve Rocker Adj. Screws	37	8	.61
3x214	Valve Rocker Adj. Screw Lock Nut	34	8	2.00 Per C
10021	Valve Rocker Shaft Stud	35	12	.35
*10799	Valve Rocker Support (Center)	33	4	2.16
10025	Valve Rocker Support (Outer)	33	8	2.42
*10798	Valve Rocker Pin		4	1.25
10031	Valve Cover	14	4	.55
10035	Valve Cover Gasket	12	4	.10
10052	Exhaust Valve Rocker Assembly (Includes next two items)	43	4	3.30
10015	Exhaust Valve Rocker		4	} Not sold } separa- } tely - See } Foot Note
10017	Exhaust Valve Rocker Bushing			

<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>No. Per Engine</u>	<u>Price Each</u>
10053	Inlet Valve Rocker Assembly (Includes next two items)	43	4	3.00
10016	Inlet Valve Rocker	}	}	Not sold separa- tely. See foot note.
10017	Inlet Valve Rocker Bushing			
10194	Cylinder Tie Plate		2	.28
10213	Cylinder Tie Plate Gasket		4	.08

*IMPORTANT - When valve rocker pin #10798 is used with old style valve rocker support #10024, the portions of the support separating the small oil holes from the large center hole should be filed or cut away approximately $3/32''$ x $3/32''$ to allow oil to flow to the valve rocker pin. See Bulletin No. 15 -

3x93	Rocker pin to Cyl. Nut 5/16-24		12	4.00Per C
5x22	Rocker pin to Cyl. Washer		12	.40Per C
23x15	Rocker pin to Cyl. Palnut		12	1.00Per C
12x24	Valve Cover & Tie Plate to Cyl. Screw	13	32	3.00Per C
19x14	Valve Cover & Tie Plate to Cyl. Washer		32	2.00Per C
19x18	Cylinder to Crankcase Washer		24	1.00Per C
27x18	Rocker Pin Expansion Plug		4	.03
10026	Valve Lifter	23	8	2.92
10771	Valve Lifter Unit		8	1.39
10772	Valve Lifter Body		8	1.53
10027	Valve Lifter Rod	29	8	.44
10028	Valve Lifter Rod Tube	27	8	.72
10029	Valve Lifter Rod Tube Packing	24	16	.10

NOTE: It is essential that axis of valve rocker bushing and barrel end of rocker arm be parallel; otherwise the valve rocker contacts valve stem off center, causing excessive guide wear, ultimately bad valve seat condition. As this work should be done on precision machinery, Aircooled Motors Corporation will exchange valve rockers at their factory List Price of \$.80 each.

<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>No. Per Engine</u>	<u>Price Each</u>
<u>XVII</u>				
<u>STARTER & GENERATOR GROUP</u>				
11220	Starter Drive Shaft Cover Assembly - (With Breather Tube)			6.25
10118	Starting Motor (12 Volt)	93	1	25.00
10119	Generator (12 Volt)	92	1	40.00
5136	Generator Stud		4	.24
5632	Starter Gasket	104	1	.15
5633	Starter Drive Shaft Cover (Without Breather Tube)	102	1	3.40
5634	Starter Drive Shaft Cover Gasket	103	1	.05
5637	Generator Gasket	106	1	.08
10591	Generator Gear Assembly	108	1	16.40
10135	Tachometer Drive Housing Gasket		1	.03
10140	Tachometer Drive Gear	96	1	1.35
10141	Tachometer Driven Gear	97	1	1.29
10142	Tachometer Drive Connector	95	1	.99
10143	Tachometer Connector Sleeve		1	2.28
10144	Tachometer Drive Housing		1	7.51
10207	Starting Motor Stud		2	.55
10208	Tachometer Drive Packing		1	.24
	Starter Bendix Drive (Secure Locally)	100		
	Starter Bendix Drive Spring (Secure Locally)	101		
17183	Starter Ring Gear & Hub Assembly		1	26.88
2x150	Starter Cover to Timing Case Screw 1/4-20x3/4"		2	2.40 Per C
2x166	Tachometer Housing to Timing Case Screw 1/4-20x1/2"		2	1.00 Per C
3x211	Generator to Timing Case Nut 1/4-20		4	2.00 Per C
3x94	Starter to Timing Case Nut 3/8-16		2	4.00 Per C
19x14	Starter Cover & Tachometer Housing Washers 1/4 Shakeproof		4	2.00 Per C
23x11	Starter to Case Palnut 3/8-16		2	1.32 Per C
10598	Generator Gear Shock Absorber		6	.09
23x14	Generator to Case Palnut 1/4-20		4	.86 Per C
5103	Crankshaft Gear Nut		1	.84
5104	Crankshaft Bear Nut Lock Washer		1	.21

<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>No. Per Engine</u>	<u>Price Each</u>
<u>XVIII</u>				
<u>OIL PAN</u>				
11069	Oil Pan Assembly - 8 Qt. (Without Filler Hole)		1	59.00
11065	Oil Pan Assembly - 5 Qt. (Without Filler Hole)		1	49.75
11064	Oil Pan Assembly - 5 Qt. (With Filler Hole)	20	1	50.31
11068	Oil Pan Assembly - 8 Qt. (With Filler Hole)	20	1	75.48
10087	Oil Pan Gasket	18	1	.32
10239	Oil Pan Drain Plug	68	1	.11
5x22	Oil Pan Stud Washers		14	.40 Per C
3x93	Oil Pan Stud Nut	19	7	4.00 Per C
12x29	Oil Pan Fillister Head Screw		18	6.00 Per C
23x15	Oil Pan Stud Palnut	19	3	1.00 Per C
32x11	Oil Pan Drain Plug Lacing Wire 50"		1	.85 Per Ft
19x17	Oil Pan Screw Washer		18	2.50 Per C
10751	Oil Filler Tube Hole Cover		1	2.12
10719	Oil Pan Screen Hole Cover		1	1.89
10718	Oil Pan Screen Hole Cover Gasket		1	.05
5113	Oil Pan Screen Hole Cover Stud		4	.22
3x211	Hex Nut - 1/4-28) Cover to		4	2.00 Per C
23x14	Palnut - 1/4-28) Pan		4	.86 Per C
5x21	Plain Washer - 1/4)		4	.60 Per C

SEE TIMING GEAR CASE GROUP FOR
ADDITIONAL FASTENINGS.

XIX

FUEL PUMP

10361	Push Rod - Cam End	115	1	.38
10362	Push Rod - Pump End	116	1	.38
10359	Gasket	117	1	.10
10360	Fuel Pump Gasket	118	1	.08
10551	Fuel Pump	119	1	6.00
10193	Stud, Crankcase to Support	120	1	.19
3x84	Stud Nut	121	2	4.00 Per C
10358	Fuel Pump Bracket	122	1	5.76
2x410	Fuel Pump Support Cap Screw	123	2	4.00 Per C
5x22	Plain Washer - Pump to Bracket		4	.40 Per C
32x13	Lacing Wire - Pump to Bracket		9"	.02 Per Ft

<u>Part No.</u>	<u>Description</u>	<u>Ref. No.</u>	<u>No. Per Engine</u>	<u>Price Each</u>
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TOOLS

10688	Gear Puller			\$10.00 NET
10738	Inlet Manifold Packing Assembly Tool			1.00 NET
11258	Valve Lifter Rod Tube Puller & Setting Tool			5.00 NET

All Prices subject to change without notice.
 Prices shown in this handbook are for the
 United States only. All prices are F. O. B.
 Syracuse, New York.

PARTS PRICE LIST IN NUMERICAL ORDER

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>PRICE EACH</u>
2x149	1/4" - 20 x 5/8"	Cap Screw 2.40 per C
2x150	1/4" - 20 x 3/4"	Cap Screw 2.40 per C
2x163	7/16" - 14 x 1 1/16"	Cap Screw 5.00 per C
2x166	1/4" - 20 x 1/2"	Cap Screw 1.00 per C
2x167	5/16" - 18 x 3/4"	Cap Screw 3.00 per C
2x168	5/16" - 18 x 2 3/8"	Cap Screw 5.00 per C
2x169	5/16" - 18 x 5/8"	Cap Screw 1.00 per C
2x170	3/8" - 16 x 1"	Cap Screw 5.00 per C
2x171	5/16" - 18 x 1 1/8"	Cap Screw 2.00 per C
2x218	1/4" - 28 x 3/8"	Cap Screw 1.00 per C
2x315	1/4" - 20 x 3/4"	Cap Screw 17.00 per C
2x316	1/4" - 20 x 3 3/8"	Cap Screw 22.00 per C
2x318	5/16" - 18 x 7/8"	Cap Screw 13.00 per C
2x410	5/16" - 24 x 1 1/8"	Cap Screw 4.00 per C
2x412	5/16" - 24 x 7 3/16"	Thru Bolt .43
3x32	10 - 32	Hex Nut 1.00 per C
3x81	3/8" - 24	Hex Nut 5.00 per C
3x84	5/16" - 24	Hex Nut 4.00 per C
3x92	7/16" - 20	Hex Nut 6.00 per C
3x93	5/16" - 24	Hex Nut 4.00 per C
3x94	3/8" - 24	Hex Nut 4.00 per C
3x211	1/4" - 28	Hex Nut 2.00 per C
3x214	5/16" - 24	Hex Nut 2.00 per C
5x19	5/16"	Plain Washer 1.00 per C
5x111	1/4"	Flat Washer .36 per C
5x21	1/4"	Flat Washer .60 per C
5x22	5/16"	Flat Washer .40 per C
5x23	3/8"	Flat Washer 2.00 per C
6x15	Woodruff Key	.03
6x19	Woodruff Key	.04
6x110	Woodruff Key	.09
6x114	Woodruff Key	.03
7x32	Pipe Plug	.05
8x11	Cotter Pins	.25 per C
8x18	Cotter Pins	.15 per C
8x112	Cotter Pins	.22 per C
8x115	Cotter Pins	.30 per C
8x118	Cotter Pins	.18 per C
12x18	10 - 32 x 5/8"	1.00 per C
12x24	1/4" - 20 Fillister Head Screws	3.00 per C
12x29	5/16" - 18 Fillister Head Screws	6.00 per C
13x42	Flared Tube Elbow	.17
17x11	Bushing	.10
19x14	Shakeproof Washers	2.00 per C
19x15	Shakeproof Washers	1.00 per C
19x17	Shakeproof Washers	2.50 per C
19x18	Shakeproof Washers	1.00 per C
19x113	Shakeproof Washers	1.10 per C
23x11	Palnut	1.32 per C
23x12	Palnut	1.50 per C
23x14	Palnut	.86 per C

PART NO.DESCRIPTIONPRICE EACH

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>PRICE EACH</u>
23x15	Palnut	1.00 per C
23x21	Connecting Rod Bolt Nut	.27
24x31	Synthetic Packing	.09
27x18	Expansion Plug	.03
28x71	Gear Case Oil Retainer	.48
28x83	Gear Case Dowel	.20
28x811	Crankshaft Thrust Washer Dowel	.03
32x11	Lacing Wire	.85 per 100'
32x12	Lacing Wire	.85 per 100'
32x13	Lacing Wire	.02 per Ft.
5033	Relief Valve Spring Nut	.24
5038	Propeller Hub Front Plate	4.85
5057	Magneto Drive Gear (Without Starter or Generator)	4.80
5094	Propeller Hub Bolt	.25
5095	Crankshaft Bearing Stud Washer	.10
5103	Crankshaft Gear Nut	.84
5104	Crankshaft Gear Nut Lock	.21
5113	Oil Pan Screen Hole Cover Stud	.22
5136	Generator Stud	.24
5137	Carburetor Stud	.24
5167	Spark Plug Gasket	.02
5255	Spark Plug Wrench	.65 Net
5256	Magneto Stud	.40
5305	Crankcase Breather Flexible Tube - To Eng. #	1.10
5364	Crankcase Breather Flexible Tube (Taylorcraft)	1.02
5449	Connector	.32
5452	Gasket	.03
5512	Magneto Gasket	.12
5517	Propeller Hub Name Plate	.60
5546	Spark Plug	.65*
5573	Crankcase Breather Rigid Tube	.61
5632	Starter Gasket	.15
5633	Starter Cover - Without Breather Tube	3.40
5634	Starter Cover Gasket	.05
5637	Generator Gasket	.08
7354	Inlet Pipe Packing	.12
10003	Connecting Rod Bolt	1.14
10007	Exhaust Valve	1.59
10008	Intake Valve	1.13
10014	Valve Rocker Adjusting Screws	..61
10018	Connecting Rod Bushing Pin End	.18
10021	Valve Rocker Shaft Stud	.35
10025	Valve Rocker Support	2.42
10026	Valve Lifter	2.92
10027	Valve Lifter Rod	.44
10028	Valve Lifter Rod Tube	.72
10029	Valve Lifter Rod Tube Packing	.10
10031	Valve Cover	.55
10032	Valve Spring Washer Retaining Key	.03
10034	Cylinder Gasket	.04
10035	Valve Cover Gasket	.10
10037	Connecting Rod Bushing	.63

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>PRICE EACH</u>
10040	Crankshaft Oil Seal	4.03
10048	Oil Pump Body	9.25
10050	Oil Pump Driven Gear	.48
10051	Connecting Rod Assembly	16.60
10052	Valve Rocker Assembly Exhaust	3.30
10053	Valve Rocker Assembly Inlet	3.00
10055	Oil Pump Cover	10.78
10056	Oil Pump Relief Valve Plunger	.84
10057	Crankshaft Bushing Propeller End 1 & 3	1.33
10058	Crankshaft Bushing Propeller End 2 & 4	1.33
10059	Crankshaft Bushing Center 1 & 3	.96
10060	Crankshaft Bushing Center 2 & 4	.82
10061	Crankshaft Bushing Gear End 1 & 3	.96
10062	Crankshaft Bushing Gear End 2 & 4	.79
10063	Crankshaft Thrust Washer	.90
10064	Camshaft Bushing 1 & 3	.27
10065	Camshaft Bushing 2 & 4	.24
10066	Oil Pump Shaft Gear	2.38
10067	Oil Pump Drive Shaft	.85
10068	Camshaft Gear	7.92
10070	Crankcase Cover	.72
10071	Crankcase Cover Gasket	.33
10074	Oil By Pass Plate Gasket	.01
10075	Oil By Pass Plate	3.41
10084	Timing Gear Case	22.20
10085	Timing Gear Case Gasket	.10
10087	Oil Pan Gasket	.32
10091	Oil Inlet Elbow Gasket	.03
10093	Oil Inlet Elbow Assembly	3.60
10095	Oil Inlet Screen Assembly	.84
10098	Inlet Pipe	.72
10099	Inlet Pipe	1.00
10100	Inlet Pipe	1.00
10101	Inlet Pipe Flange	.07
10105	Crankcase Tie Bolt Packing	.10
10106	Crankcase Dowel	.19
10107	Stud - Camshaft Bearing	.69
10108	Stud - Crankshaft Bearing	.79
10109	Stud - Crankshaft Bearing	.82
10111	Stud - Crankshaft	.82
10114	Oil Pump Stationary Shaft	.26
10118	Starting Motor (12 Volt)	25.00
10119	Generator (12 Volt)	40.00
10120	Timing Gear Case Gasket (outer)	.48
10123	Timing Gear Case	30.58
10124	Timing Gear Case	27.70
10135	Tachometer Drive Housing Gasket	.03
10140	Tachometer Drive Gear	1.35
10141	Tachometer Driven Gear	1.29
10142	Tachometer Drive Connector	.99

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>PRICE EACH</u>
10143	Tachometer Connector Sleeve	2.28
10144	Tachometer Drive Housing	7.51
10150	Exhaust Pipe Flange	.18
10151	Exhaust Pipe Gasket	.05
10154	Carburetor 4AC-176-C2-C3-D2-D3-E2-E3-F2-F3 80 H. P.	24.75*
10167	Crankcase Front Tie Stud	.96
10168	Engine Mounting Bracket	2.96
10170	Crankcase Cover	5.62
10171	Piston Ring	.40
10172	Piston Ring	.40
10173	Piston Ring	.65
10188	Valve Spring	.93
10189	Valve Spring Washer (Lower)	.03
10191	Exhaust Pipe Flange Stud	.35
10192	Cylinder Hold Down Stud	.55
10193	Engine Mounting Bracket Stud	.34
10194	Cylinder Tie Plate	.28
10201	Valve Retaining Ring	.03
10202	Valve Spring Shim	.03
10205	Valve Oiler Double Elbow	.24
10206	Oil Pan Stud	.44
10207	Starting Motor Stud	.55
10208	Tachometer Drive Packing	.24
17183	Starter Ring Gear & Hub Assembly	26.88
10210	Inlet Pipe	.81
10211	Inlet Pipe	1.12
10212	Inlet Pipe	1.12
10213	Cylinder Tie Plate Gasket	.08
10214	Oil Filler Tube	3.22
10218	Piston Pin Assembly	2.22
10219	Camshaft & Tachometer Drive Assembly	23.79
10221	Piston 6.3 to 1 Compression Ratio	6.48
10222	Piston 7 to 1 Compression Ratio	6.53
10223	Carburetor 4AC-176-B2-B3	24.75*
10225	Magneto	46.50
11048	Magneto Shielded 80 H. P. Cyl. 2 & 4	80.00
11049	Magneto Shielded 80 H. P. Cyl. 1 & 3	80.00
10236	Oil Filler Tube Gasket	.03
10237	Oil Level Gauge Assembly	1.54
10239	Oil Pan Drain Plug	.11
10246	Engine Mounting Rubber Bushing	.10
10248	Crankshaft Gear	4.80
10249	Crankshaft Gear Generator & Starter	4.80
10358	Fuel Pump Bracket	5.76
10359	Fuel Pump Bracket Gasket	.10
10360	Fuel Pump Gasket	.08
10361	Fuel Pump Push Rod (Inner)	.38
10362	Fuel Pump Push Rod (Outer)	.38
10368	Oil Pan Stud	.60
10371	Crankcase Bearing Stud Packing	.07
10379	Cylinder Air Housing	20.00

Part No.DESCRIPTIONPRICE EACH

<u>Part No.</u>	<u>DESCRIPTION</u>	<u>PRICE EACH</u>
10381	Connecting rod Bushing .010 U. S.	.92
10382	Connecting Rod Bushing .020 U. S.	1.05
10383	Crankshaft Bushing (Prop. End .010 U. S.)	2.86
10384	Crankshaft Bushing (Prop. End .020 U. S.)	2.65
10385	Crankshaft Bushing (Prop. End .010 U. S.)	2.38
10386	Crankshaft Bushing (Prop. End .010 U. S.)	2.41
10387	Crankshaft Bushing (Center .010 U. S.)	1.95
10388	Crankshaft Bushing (Center .020 U. S.)	1.80
10389	Crankshaft Bushing (Center .010 U. S.)	1.95
10390	Crankshaft Bushing (Center .020 U. S.)	1.80
10391	Crankshaft Bushing (Gear End .010 U. S.)	2.08
10392	Crankshaft Bushing (Gear End .020 U. S.)	2.16
10393	Crankshaft Bushing (Gear End .010 U. S.)	1.95
10394	Crankshaft Bushing (Gear End .020 U. S.)	1.80
10395	Oil Filler Tube Support	.08
10396	Oil Pump Assembly (4AC-176-B2, 4AC-176)	40.00
10397	High Tension Wire Assembly Cyl. 1 & 3	1.81
10398	High Tension Wire Assembly Cyl. 2 & 4	1.81
10399	Piston Pin Assembly .001 Oversize	6.25
10450	Valve Guide .001 Oversize	.72
10451	Valve Guide .002 Oversize	.72
10452	Valve Guide .005 Oversize	.72
10458	Crankshaft	90.20
10464	Cylinder Air Housing Support	.10
10469	Spark Plug Hole Cover (Air Housing)	.25
10472	Oil By-Pass Plate	4.40
10477	Crankcase Assembly (For use without fuel pump) 80 H. P.	175.00
10482	Crankshaft Bearing Stud	.79
10483	Crankshaft Bearing Stud	.82
10489	Oil By *pass Plate Gasket	.02
10493	Cylinder Air Housing Apron	3.00
10497	Crankcase Assembly (For use with fuel pump) 80 H. P.	180.00
10498	Oil Filler Tube (Aeronca)	4.03
10501	Engine Mounting Washer	.04
10533	Magneto	41.00
10542	Spark Plug (Shielded)	1.30*
10551	Fuel Pump	6.00
10567	Crankcase Assembly	175.00
10586	Carburetor (Altitude Control)	27.25*
10590	Oil Level Gauge	1.90
10591	Generator Gear Assembly	16.40
10598	Generator Gear Shock Absorber	.09
10649	Spark Plug Wrench (long)	.97 Net
10672	Oil Pump Drive Gear	4.08
10673	Oil Pump Driven Gear	4.00
10681	Oil Filler Cap	.67
10682	Oil Filler Cap	.67
10683	Oil Filler Cap	.67
10688	Gear Puller	10.00 Net
10718	Oil Pan Screen Hole Cover Gasket	.05
10719	Oil Pan Screen Hole Cover	1.89
10721	High Tension Wire Assembly	1.81

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>PRICE EACH</u>
10722	High Tension Wire Assembly	1.81
10725	Camshaft Gear	14.09
10730	Valve Spring Washer (Upper)	.16
10738	Inlet Manifold Packing Assembly Tool	1.00 Net
10751	Oil Filler Tube Hole Cover	2.12
10770	Valve Spring Washer (Lower - Shim)	.03
10771	Valve Lifter Unit	1.39
10772	Valve Lifter Body	1.53
10798	Valve Rocker Pin	1.25
10799	Valve Rocker Support (Center)	2.16
10824	Valve Spring (1-15/16" Long)	1.00
10825	Valve Spring Washer (Upper) - For #10824	.24
10865	Cylinder Assembly	75.00
10871	Piston - 6:1 Compression Ratio	6.48
10872	Crankshaft Bearing Stud	.79
10952	Magneto Driven Gear	5.28
10997	Oil Pump Relief Valve Spring	.38
10998	Oil Pump Assembly (4AC-176-D2-D3-F2-F3)	43.00
11064	Oil Pan Assembly 5 quart (With Filler Hole)	50.31
11065	Oil Pan Assembly 5 quart (Without Filler Hole)	49.75
11068	Oil Pan Assembly 8 quart (With Filler Hole)	75.48
11069	Oil Pan Assembly 8 quart (Without Filler Hole)	59.00
11080	Crankcase Breather Tube	1.05
11220	Starter Drive Shaft Cover Assembly (With Breather Tube)	6.25
11244	Carburetor - 4AC-176-BA2	29.25*
11258	Valve Lifter Rod Tube Puller & Setting Tool	5.00 Net
11667	Magneto & Tachometer Drive Gear Assembly	12.84
11676	Valve Case Oil Pipe Sleeve	.05
11677	Valve Case Oil Pipe Clamp	.29
11690	Valve Case Oil Pipe Assembly	.67
11805	Valve Case Oil Pipe Support	.39

June 19, 1940

SERVICE BULLETIN NO. 5

Franklin Aircraft Engines

PREVENTIVE MAINTENANCE

The whole-hearted response of Franklin owners to our questionnaire of May 1st and their overwhelming expression of confidence in our product is extremely gratifying.

Complete analysis of the questionnaires, both from the standpoint of improvements to future products and the servicing and maintenance of engines in the field has been instructive. Wherever practical, owner suggestions will always be incorporated in current and future models.

From the standpoint of service it is especially noted that most engines are being operated well beyond the recommended period for major overhaul and with comparatively few and minor adjustments.

PREVENTIVE MAINTENANCE rather than correction after trouble best serves the interests of economy and safety in all types of flying operation, especially student training.

The fact that most of our engines have been used in student training operations, which service admittedly is more gruelling for obvious reasons, coupled with the occasional disregard of instructions in our service manual recommending major overhaul at the 500 hour period, may well account for a few isolated cases of crankcase and crankshaft failure. We recommend that all engines used in training programs be preferably major overhauled at the 400 hour point in the interest of longer engine life generally, economy and safety.

You can help yourself and help us by adhering to the following recommendations:

- (1) Engines should not be operated at speeds in excess of those recommended. It is common knowledge that diving a plane with full open throttle subjects the entire aircraft to excessive strains. What is not generally known is that a plane maneuvered into a steep dive with the throttle fully closed puts undue stress on the engine due to the wide unbalance of power impulses with respect to inertia forces, and for that reason this maneuver should be avoided.
- (2) Engines should be lubricated with a standard brand of good quality oil of the recommended viscosity.
- (3) Engines should be operated with fuel having a sufficiently high octane number to obviate the possibility of detonation; i. e., 4AC-150 - 70 octane, 4AC-150A - 73 octane.

- (4) Excessive spark advance, too lean a mixture, improper use of hot air stove also tend to make an engine detonate and may eventually cause serious trouble or even part failure.
- (5) Propellers should be checked for track and balance at frequent intervals. A propeller that does not track properly or is out of balance puts terrific loads on the entire engine structure, especially at the front end of the crankcase and thrust bearing as well as excessive stresses on the engine mount.
- (6) The crankcase should also be carefully examined for fatigue checks or cracks. In order to simplify this operation, all paint should be removed from the exterior of the case. The four vertical corner surfaces of the crankcase, the lower portion of the forward end of the crankcase supporting the thrust bearing and the webs forming the central portion of the crankcase supporting the middle main bearing, should all be especially scrutinized. Any crankcase showing evidence of fatigue should be returned to the factory for examination and replacement, if necessary. Failure to do so may cause crankshaft failure.
- (7) When you major overhaul an engine, the following procedure is recommended with respect to inspection: The crankshaft, camshaft, connecting rods, and wrist pins should be magnafluxed to determine the presence of possible fatigue checks or cracks. Crankshafts should be particularly scrutinized at the journal fillets. If there is any doubt as to the structural soundness of the part, it should be replaced.
- (8) Only standard Franklin parts should be used as replacement parts. This recommendation includes spark plugs - use only those brands specified; i.e., Champion J10 or Bendix 14 AB.
- (9) The major overhaul procedure to be followed is set forth in the Operators Handbook under Part IV beginning on page 23 with final reassembling instructions on page 30.

If the foregoing recommendations and the instructions in the Operators Handbook suggest the need for additional information concerning the operation and maintenance of Franklin engines, you are sincerely urged to write our Service Department. Your requests will receive our prompt and careful attention.

AIRCOOLED MOTORS CORPORATION,

Service Department.

November 7, 1940

SERVICE BULLETIN NO. 7

Franklin Aircraft Engines

THE ECONOMY OF PREVENTIVE MAINTENANCE

Now that the winter season is approaching, a few suggestions on preventive maintenance may be in order. Many owners will avail themselves of this opportune time for giving their Franklin engines an overhaul and it is believed the following recommendations will be helpful in this connection.

OIL CHANNELS IN CRANKCASE

All oil channels should be thoroughly flushed to clean out sediment or sludge that may have become lodged, especially the dead ends of the hydraulic valve lifter oil channels. These channels should be cleaned whenever it is found necessary to remove any of the valve lifters.

CELORON GEARS

It is recommended that Celoron magneto driven gears be replaced at each major overhaul period (500 hours) and the Celoron camshaft gear at each second major overhaul (1000 hours).

MAGNAFLUXING

One of the most effective means for preventing engine repairs between overhauls and making sure that vital parts have not developed flaws is the magnafluxing of crankshaft, connecting rods, piston pins and valve rockers at each overhaul period.

MISCELLANEOUS

Check the carbureter heater valve for proper operation. The use of heat for the prevention of ice formation in the carbureter should be given careful consideration.

Check the flexible crankcase breather tube frequently for ice formation. If this tube becomes clogged, crankcase pressure and oil leakage may result.

Thoroughly clean sludge out of valve cases.

To facilitate easy starting, special attention should be given to magneto breaker point adjustment, primer for proper functioning, primer connections for tightness and high tension wires for insulation cracks.

Cover the hole in cowling just ahead of the crankcase to restrict the flow of cold air to the crankcase.

Change to SAE 20 oil of good quality for Models 4AC-150, 4AC-150A and 4AC-171. For Model 4AC-176 SAE 20 oil is specified for all-year use.

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A

April 10, 1941



SERVICE BULLETIN NO. 10

Franklin Aircraft Engines

EXHAUST VALVES

A very few exhaust valve failures have been reported by Franklin operators, which prompts us to issue this bulletin to assist in preventing such failures. From the information obtainable it is apparent that the cause can be traced to incorrect valve clearance, incorrect magneto setting, low grade fuel, excessively worn valve guides, or hydraulic valve lifters which are not functioning. All of these items are covered in the Operator's Handbook furnished with each engine, but we desire to call particular attention to the following important recommendations:

Valve Clearance: .040" is the proper clearance between valve rocker and valve stem with piston in firing position and all oil forced out of hydraulic valve lifter by pulling back on valve rocker with a valve setting tool until continued pressure no longer alters the gap between valve rocker and valve stem. Improper setting will result in damage to valves and seats.

Valve Guides: All valve guides should be measured at time of top and major overhauls. If excessive clearance is found between valve stem and guide, the guide should be replaced. Too much clearance will cause the valve to seat improperly and eventually result in valve failure.

Magneto Setting: Check magneto settings frequently. Under certain operating conditions the spark setting sometimes advances automatically due to breaker lever fibre wear. In the Operator's Handbook, under Maintenance & Inspection, it is recommended that breaker points in the magnetos be checked every 25 hours. This means the spark setting should also be checked. Great care should be taken to note whether detonation is present -- If it is, the setting should be retarded until it disappears. Excessive spark advance should be avoided -- The settings recommended in Operator's Handbooks were determined by exhaustive engineering tests.

Fuel: For Models 4AC-150 (50 H. P.) and 4AC-171 (60 H. P.) the recommended aviation fuel is 70 octane or better with not more than 1 cc of lead.

For Models 4AC-150A (60 H. P.) and later models having 6.3:1 compression ratio, the recommended aviation fuel is 73 octane or better with not more than 1 cc of lead.

For all models having 7:1 compression ratio, the recommended aviation fuel is 80 octane or better with not more than 1 cc of lead.

Many operators are finding that most satisfactory and economical results are obtained by using 80 octane gasoline in engines having 6.9:1 and 6.3:1 compression ratios. There is apparently more or less confusion regarding gasoline knock ratings and it is therefore urged that only aviation gasoline rated by the new AFD method be used. This approximates the ASTM method. A gasoline rated by the AFD method is usually lower in octane rating than that rated by the CFR or the Motor method. A 73 octane fuel AFD is usually found to be 80 octane CFR.

Several of the gasoline manufacturers are making changes due to the National Defense Program, which, no doubt will cause some confusion. If in doubt about the octane number, always use a fuel on the high side of rating rather than on the low side.

It takes but a few minutes of operation with a low octane grade of gasoline, to cause serious trouble, such as warped valves, corrosion in the cylinder heads and pistons.

Hydraulic Valve Lifters: If a lifter fails to function, the clearance between valve stem and valve rocker will be approximately .100" which results in the valve striking the valve seat at very high velocity. This will produce a noise that is easily distinguished and the valve lifter should be corrected or replaced immediately to prevent damage to valve and seat.

Valve Springs: The valve springs on your engine have been designed and selected with utmost care. For that reason it is most important that the spring weight be kept within the range specified in your Operator's Handbook. A spring with insufficient tension will permit the valve to bounce with erratic closing, where a spring with excessive tension will over-load and many times cause the valve to fail.

Only the highest grade material and best quality workmanship obtainable go to make up Franklin valves. Strict adherence to the above recommendations will eliminate delayed flight programs and unnecessary expense.

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A

SERVICE BULLETIN NO. 11FRANKLIN ENGINES

Models	4AC-176-F2 and F3
4AC-199-E2 and E3, 6AC-264-F2 and F3, 6AC-298-F2 and F3	

The gasoline specifications of the aviation industry have been and still are passing through stages of evolution. The National Emergency has done much toward establishing a universally acceptable method of rating fuels for octane value, but has created a new condition having a serious bearing on the specifications of fuels.

Heretofore manufacturers of gasolines in most cases used a clear base stock having an octane value of 73 for aviation fuels. By the addition of 1/2 cc tetraethyl lead, the octane value of this fuel was lifted to 80 octane and 2½ cc's of lead brought it to 87 octane. It has been brought to our attention recently that in some cases clear base stocks, having an octane value of 65, were being used requiring 1 cc of lead to raise the octane value of the fuel to 73. These base fuels required approximately 2 cc's of lead to produce a value of 80 octane and 4 cc's is required to develop a fuel having an octane number of 91. All octane values mentioned herein are based on the new AFD Method which now has national acceptance. (Approximately equal octane values are arrived at with ASTM and AFD Methods.)

PLEASE NOTE:

Inasmuch as the above listed Franklin models were designed and built and must, for reasons beyond our control, continue to be built to operate on 80 octane fuel having a lead content of not more than 1 cc per gallon, we, therefore, call your attention to the fact that these engines will not function satisfactorily with fuels containing tetraethyl lead in excess of 1 cc per gallon, nor with fuels having an octane value, AFD Method, of less than 80.

Our Models 4AC-150, 4AC-171 require aviation fuel having an octane value of at least 70, containing not more than 1 cc of tetraethyl lead. Model 150A requires aviation fuel having an octane value of 73, containing not more than 1 cc of lead.

Furthermore, we will not be responsible for the damage to an engine or mal-function of an engine caused by the use of fuels not conforming to our recommendations.

For restrictions imposed in connection with the purchase of materials for commercial aviation purposes, due to the National Emergency, precludes our obtaining special metals for certain engine parts having high lead resistance characteristics. It is hoped that the increased production in certain branches of the steel industry will alleviate existing conditions.

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A



SERVICE BULLETIN NO. 12

OPERATING RECOMMENDATIONS FOR FRANKLIN ENGINES

PROPER USE OF ALTITUDE CONTROL CARBURETERS

1. FUEL

Franklin engines should be operated only on fuels meeting general specifications recently issued, which essentially specify that the fuel must be of aviation grade having an octane value of 80 AFD Method and containing not more than 1 cc tetraethyl lead per gallon.

2. LUBRICATION

Only a good quality of lubricating oil of correct viscosity, SAE 20 for year around operation should be used. The oil should be free from corrosive constituents and foreign matter, which may pit the bearings, score the cylinder walls or cause excessive wear of piston rings. The proper oil level should be maintained at all times. The oil should be changed every 25 hours. It is further recommended that the oil pump and screen be cleaned at intervals of 100 hours.

3. OVERHAUL PERIODS

For long run economy, engines should be top overhauled at 250 hours and major overhauled at 500 hours. Refer to operator's handbook for detailed recommendations.

4. WARMING UP THE ENGINES

Engines should be thoroughly warmed on the ground before take-off is made. (App. 1200 R.P.M.)

5. CRUISING

Engines should not be cruised in excess of the R.P.M. limit designated on the tachometer dial or face by aircraft manufacturers for their respective models conforming to C.A.A. regulations.

6. ON LANDINGS

Engines should be idled from 45 to 60 seconds on the ground before cutting the switches to allow the valves and heads to cool, thereby obviating the possibility of distortion of these parts.

7. PROPER USE OF ALTITUDE CONTROL

PLEASE NOTE:

Several manufacturers are using Franklin engines equipped with manually adjustable altitude carbureters. In some instances this device is labeled "Mixture Control" and "Full Rich" and "Lean" positions indicated. We wish to point out that the mixture control is an altitude mixture adjustment control, the function of which is to lean the mixture for higher altitude operation and that this device can in no way increase the richness of the mixture beyond the point to which the carbureter has been calibrated for sea level operation. In other words, the altitude adjustment does not function as does the choke on an automobile carbureter. Furthermore, the altitude adjustment should not be used below an altitude of 3,000 feet.

The operating procedure is as follows:

The engine should be thoroughly warmed with the altitude mixture control in the "Full Rich" position. It should remain in this position during take-off and climb and at all times during flight when the ship is below an altitude of 3,000 feet. Upon reaching an altitude of 3,000 feet, and if it is desirable to gain more altitude, the throttle should be placed in the "Full Open" position and the altitude mixture control manipulated slowly and left at that position at which the engine reaches its maximum R.P.M. Then the throttle may be closed sufficiently to bring the engine back to the normal R.P.M. for this particular maneuver or cruising. During the descent, the mixture control should be closed or placed at the "Full Rich" position.

We wish to again stress the importance of the judicious use of the altitude control. The improper use of this device may well cause burned and warped valves, piston failure and combustion chamber corrosion or even power plant failure.

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A



June 16, 1941

SERVICE BULLETIN NO. 13

ADDITIONS AND CORRECTIONS

TO

BULLETINS 11 & 12

FUEL

Supplementing bulletins recently issued concerning recommended fuels - 80 octane aviation gasoline produced by THE TEXAS COMPANY and the GULF OIL CORPORATION is satisfactory to use in Franklin aircraft engines. We understand these gasolines are nationally distributed throughout all 48 states.

It has been brought to our attention that there is an error in our bulletins #11 and #12 with reference to Models 4AC-176-B2 and 4AC-176-B3. These models have been approved to operate on aviation gasoline having an octane rating of 73 and containing not more than 1 cc of tetraethyl lead per gallon. Since these bulletins were issued, we have added several new models to our line which also are designed to operate on aviation gasoline having an octane rating of 73 and containing not more than 1 cc of tetraethyl lead per gallon (AFD method). These new models have the following designations: 4AC-199-D2, 4AC-199-D3, 6AC-264-D2, 6AC-264-D3, 6AC-298-D2, 6AC-298-D3.

Under no circumstances should a fuel of lower octane rating than specified be used but when it is impossible to obtain 80 octane fuel, it is permissible to blend 73 octane aviation gasoline containing no tetraethyl lead with 87 octane aviation gasoline in equal proportions.

OIL

It is apparent that gum in lubricating oil has a tendency to hold lead on valve stems and valve seats in engines having 7:1 compression ratio. Therefore, the use of aviation oil is recommended in Franklin aircraft engines of this ratio.

SPARK PLUGS

In view of the difficulty experienced as a result of lead oxide deposits on spark plugs, one of the major spark plug manufacturers suggests that:

"Lead oxide is the most common cause of spark plug failure. This oxide coating forms on the electrodes and insulator from the burning of the fuel, and when hot becomes a conductor of electricity which "shorts" the plug. Certain types of fuel cause these deposits.

Lead oxide may be recognized by the whitish or brownish appearance of the electrodes and insulator. By removing this coating the plugs will function satisfactorily.

Analyzing our spark plug returns, we find that a large percentage of the plugs bear evidence of oxide fouling. Replacing the plugs is NOT the remedy. Cleaning the plugs IS the remedy.

Under present conditions, with the trend to smaller and smaller spark plugs and high octane gasoline, the plugs should be cleaned at least every 25 hours. Then fewer adjustments and replacements will result; better service will be assured."

We thoroughly concur with these statements and call attention to the fact that cleaning spark plugs every 25 hours has always been recommended in our Operator's Handbooks. Hot spark plugs due to oxidation may well be the cause for engines overrunning; that is, operating after the switches have been cut.

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A



RECOMMENDED SPECIFICATIONS FOR AVIATION GASOLINES
FOR FRANKLIN ENGINES

Octane by Method AFD (1C)	80 Min.
Tetraethyl Lead, cc per gal.	1 Max.
<u>Distillation</u>	
10% evaporated, degrees Fahrenheit	158 Max.
50% " " "	212 "
90% " " "	257 "
Sum of 10 plus 50 per cents	307 Min.
Distillation recovery, per cent	97 "
" residue " "	1.5 Max.
" loss " "	1.5 "
Acidity of distillation residue	Neutral
Color	Blue
Vapor Pressure, psi	7.0 Max.
Corrosion:	
Copper strip	No grey or black discoloration
" dish	" " " " " ;
	residue on evaporation of 100 ml.
	not to exceed 5 mg.
Gum, accelerated, mg. per 100 ml.	6. Max.
Sulphur, per cent	.05 "
Freezing Point, degrees Fahrenheit	-76 "

Suppliers desiring complete manufacturing specifications may obtain them upon request to ...



May 1, 1941

Following is a list of companies who have advised us that they are distributing aviation fuel having an octane value of 80, AFD Method, containing not more than 1 cc of lead per gallon:

<u>State</u>	<u>Brand</u>	<u>Distributing Co.</u>
Maine	Esso Aviation Gasoline 80	Colonial Beacon Oil Co.
New Hampshire	" " " "	" " " "
Vermont	" " " "	" " " "
Massachusetts	" " " "	" " " "
Connecticut	" " " "	" " " "
New York	" " " "	" " " "
Pennsylvania	" " " "	Standard Oil Co. of Pa.
New Jersey	" " " "	" " " N. J.
Delaware	" " " "	" " " "
Maryland	" " " "	" " " "
Washington, D. C.	" " " "	" " " "
Virginia	" " " "	" " " "
West Virginia	" " " "	" " " "
North Carolina	" " " "	" " " "
South Carolina	" " " "	" " " "
Ohio	" " " "	Standard Oil Co. (Ohio)
Kentucky	" " " "	Standard Oil Co. (Ky.)
Georgia	" " " "	" " " "
Alabama	" " " "	" " " "
Florida	" " " "	" " " "
Mississippi	" " " "	" " " "
Tennessee	" " " "	Standard Oil Co. of La.
Arkansas	" " " "	" " " "
Louisiana	" " " "	" " " "
Texas	Humble Aviation Gasoline 80	Humble Oil & Refining Co.
Maine	Aero Mobilgas 80	Socony-Vacuum Oil Co. Inc.
New Hampshire	" " " "	" " " "
Vermont	" " " "	" " " "
Massachusetts	" " " "	" " " "
Rhode Island	" " " "	" " " "
Connecticut	" " " "	" " " "
New York	" " " "	" " " "
New Jersey	" " " "	" " " "
Pennsylvania	" " " "	" " " "
Delaware	" " " "	" " " "
West Virginia	" " " "	" " " "
Ohio	" " " "	" " " "
Indiana	" " " "	" " " "
Michigan	" " " "	" " " "
Illinois	" " " "	" " " "
Missouri	" " " "	" " " "
Arkansas	" " " "	" " " "
Louisiana	" " " "	" " " "
Oklahoma	" " " "	" " " "
Texas	" " " "	" " " "
California	Stanavo	Standard Oil Co. of Calif.
Oregon	"	" " " "
Washington	"	" " " "
Arizona	"	" " " "
Nevada	"	" " " "
Utah	"	" " " "
Idaho	"	" " " "
Montana (Western half of state only)	"	" " " "

Shell Oil Company aviation gasoline, we understand, is distributed in all 48 states.

Other manufacturers distributing aviation gasoline conforming to our recommendations will be added from time to time.

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A



July 7, 1941

SERVICE BULLETIN NO. 15

VALVE ROCKER SUPPORTS

To conserve aluminum, it has been found necessary to refinish a number of valve rocker supports, thus making them slightly shorter than standard. Therefore, if it is ever found necessary to replace a support, a set of three of the same length must be installed to prevent damage to the valve rocker pin. No short supports will be carried in stock and it is suggested that sets of three be ordered, using the standard numbers listed in the Operators Handbook. Incidentally, it is seldom found necessary to replace valve rocker supports.

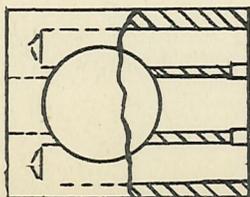
All short supports are stamped with the letter "S" and were installed on the following engines:

- Model 4AC-176-B2 - #100937 to 100992
- Model 4AC-176-F3 - #125149 to 125163,
also #125166 and 125168
- Model 4AC-199 - #200337 to 200470
- Model 6AC-264 - #300110 to 300115
- Model 6AC-298 - #400129 and 400130

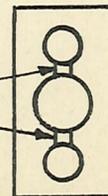
NEW VALVE ROCKER PIN

AND CENTER VALVE ROCKER SUPPORT

A change in design has been made on these parts to eliminate the small center oil holes. To use the new valve rocker pin No. 10798 with the old center support No. 10024, it will be necessary to file or cut away a groove in the portions of the support separating the small oil holes from the large center hole to allow oil to flow to the pin. Only a small cut will be necessary but this is very important. (See sketch). The new center support No. 10799 can be used with either new or old valve rocker pins.



Cut grooves as illustrated approximately $\frac{3}{32}$ " wide and $\frac{3}{32}$ " deep.



The new design support and pin started with the following engines:

Model 4AC-176-B2 - #101003 - 101015 - 101016 -
101027 and up
Model 4AC-176-F3 - #125180 and up
Model 4AC-199 - #200475 and up
Model 6AC-264 - #300116 and up
Model 6AC-298 - #400131 and up

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February 16, 1942

SERVICE BULLETIN NO. 16

CONCERNING THE USE OF GASOLINE WITH HIGH LEAD CONTENT

Gasoline producers advise that in order to provide the necessary high octane gasolines in quantities sufficient to meet the requirements of our armed forces, the amount of tetraethyl lead per gallon will be greatly increased in aviation gasolines of 73 and 80 octane ratings. Amounts have not yet been determined nor have we been advised definitely what octane gasolines will be available.

This increased lead content will not immediately cause detrimental effects but undoubtedly it will be necessary to top overhaul all small aircraft engines more frequently than has been customary in the past in order to remove lead and carbon deposits from valves, valve seats, valve guides, cylinder heads and spark plugs. This must be done to prevent valve sticking, with resultant burning, and to permit engines to operate at top efficiency and full power.

An explanation concerning the purpose of tetraethyl lead and its results, as prepared by a fuel expert, follows: -

"Tetraethyl lead is the trade name given to a special fluid which is added to gasoline for the purpose of suppressing detonation. This fluid consists of approximately 63% tetraethyl lead as such, and 36% ethylene dibromide and ethylene dichloride. A trace of organic dye is added for the purposes of identification. Ethylene dibromide and ethylene dichloride serve to combine with the lead and prevent the deposition of lead in the combustion chamber and upon the valve seat and stem. This reaction, however, is only partially complete, with the result that a portion of the lead is actually deposited on the exhaust equipment. The unreacted bromine and chlorine combines with the hydrogen in the fluid to form hydrobromic and hydrochloric acids. Naturally these acids are extremely corrosive. The presence of these acids with attendant high temperatures is extremely harmful to the life of the valve equipment."

Recommendations contained in previous service bulletins and operators' handbooks should be adhered to insofar as octane ratings are concerned and operators should continue to purchase aviation gasoline with the lowest lead content possible

in the octane ratings specified. Under no circumstances should lower-than-specified ratings be used - a higher rating is preferable.

In view of this unavoidable condition, it will be necessary for all owners and operators to carefully note the performance of their engines and at the first indication of falling off in RPMs or sticking valves, the cylinders should be removed and given a thorough top overhaul. It is impossible for us to recommend a definite period for top overhaul inasmuch as operating conditions vary with each installation, particularly with regard to engine cooling, but under severe operating conditions when using highly leaded gasoline, it may be found necessary to top overhaul as frequently as every 100 hours.

If you have sold your airplane since the original red engine card was mailed to us, kindly advise the name and address of the new owner, together with NC number of the airplane and serial number of the engine so that we can mail him a copy of this bulletin.

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A



February 13, 1942

SERVICE BULLETIN NO. 17

CRANKCASE COVER OIL LEAKS

When reassembling crankcases for Models 4AC-176, 4AC-199, 6AC-264 and 6AC-298, the small round rubber packing should be allowed to protrude approximately 1/16" where the crankcase cover meets the crankcase at the propeller end at the center. The application of Permatex sealer at this point will also assist in eliminating oil leakage.

CAMSHAFT GEAR

All plain Celoron camshaft gears should be replaced with the aluminum rim type gear on Model 4AC-176 (80 HP only) and 4AC-199 engines at the first major overhaul (500 hours).

STICKING VALVES

Valves that have become stuck in their guides as a result of corrosion, usually caused by engines not being operated for some time, can generally be freed by the use of a penetrating oil, such as Keystone #2 manufactured by Keystone Lubricating Co., Philadelphia, Pa., or its equivalent, applied to the valve stems. This precaution may save the unnecessary expense of replacing bent valve rockers, valve lifter rods, etc.

VALVE SPRINGS

A recent change has been made, increasing the length of the valve springs and deepening the recess in the cylinder head. The new length is 1-15/16" as against 1-27/32" for the old spring. The difference in length is so small that care must be exercised to prevent incorrect assembly. The new longer springs cannot be used in cylinders with shallow recesses but old springs may be used in cylinders with deeper recesses by using two #10202 washers (1/32") in the recesses under valve springs. Correct spring weight is 50 to 60 pounds and travel .390" to .410".

DISCARD USED LOCK WASHERS

As a precautionary safety measure, all lock washers must be replaced with new whenever removed after being in use.

TORQUE WRENCH SPECIFICATIONS

	<u>Size</u>	<u>Ft. Lbs.</u>	<u>Inch Lbs.</u>
Connecting rod bolt nuts	3/8-24	25-30	300-360
Cylinder hold-down nuts & cap screws	3/8-24	33	395
Cylinder hold-down nuts & cap screws	7/16-20	40	480
Main crankshaft bearing stud nuts	3/8-24	30	360
Camshaft bearing stud nuts	5/16-24	20	240
Long through crankcase bolt nuts	5/16-24	20	240
Oil pump by-pass plate cap screws	5/16-18	15	180
Rocker support stud nuts	5/16-24	10-12	120-145
Oil pan fillister head screws	5/16-18	5-6	60-75
Crankcase cover cap screws	5/16-18	5-6	60-75
Rocker adj. screw nuts	5/16-24	10-12	120-145
Spark plugs in cyl. heads	14 m.m.	15	180
Magneto flange stud nuts	5/16-24	7-8	85-95
Starter flange stud nuts	3/8-24	20	240
Generator flange stud nuts	1/4-28	5	60
Oil pump to crankcase cap screw	1/4-20	5-6	60-75
Gear case to crankcase cap screws	5/16-18	10-12	120-145
Gear case to cover cap screws	1/4-20	5-6	60-75
Inlet pipe flange to cyl. head cap screw	5/16-18	15	180
Inlet pipe flange to oil pan cap screw	5/16-18	15	180
Motor mount to crankcase stud nuts	5/16-24	20	240

SPARK PLUG INSERTS

Spark plug inserts are now available for all models. The design provides for left hand threads in the cylinder head and installation under heat to insure a tight fit and prevent turning out when spark plug is removed.

Because of special fixtures and tools required, it will be necessary to send cylinders to the factory for spark plug insert installation. However, when necessary, due to time limitations, cylinders may be exchanged. Prices will be furnished on request.

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A



June 23, 1942

SERVICE BULLETIN NO. 18

FOR THE ATTENTION OF ALL WHO ARE STORING AIRPLANES EQUIPPED WITH FRANKLIN ENGINES:

All Franklin aircraft engines are treated with anti-corrosive oil immediately upon conclusion of regular production test procedure and are not, therefore, susceptible to corrosion until again put in operation. However, when an engine is fired, the treatment is nullified and if allowed to stand without being operated, the engine may suffer from corrosion. This is especially true when stored for a long period of time. Even though oil may be left in the crankcase, some parts will become corroded. Parts that come in contact with gasoline containing lead, such as valves and valve guides, are most quickly affected. Therefore, if you find it necessary to store an engine, we recommend the following procedure:

Run the engine for approximately fifteen minutes at 1000 R. P. M. to thoroughly warm the oil, then completely drain the oil from the engine.

Put in one gallon of Colonial Beacon AE603 Corrosion oil, or Houghton Rust Veto, Serial 20C, or R. M. Hollinghead, Serial 70158H.

Run the engine for approximately fifteen minutes at 1000 R. P. M. and then drain oil from engine for two minutes.

Remove valve case covers and spray valve rockers, valve springs and valve stems with one of the above oils. Replace valve case covers.

Spray up into exhaust ports if possible.

Remove spark plugs and spray into cylinder through spark plug holes. Replace plugs.

Remove magneto distributor plates and paint any visible metal parts subject to rust with above mentioned anti-corrosive oils, using a very fine brush.

Remove carburetor from engine. Drain gasoline from carburetor and put one ounce of Ferrocote, manufactured by Quaker Chemical Products Co., in float chamber. Roll carburetor slowly around to make sure the interior is

well flushed and then drain.

When the engine is returned to service, repeat the oiling operation and turn the engine by hand for several revolutions. SPECIAL ATTENTION should be paid to the condition of the valves. If any are found to be sticking they should be treated carefully to loosen before turning the engine. The use of penetrating oil, such as Keystone #2, manufactured by Keystone Lubricating Co., Philadelphia, Pa., may be found necessary. If valves are not free in the guides, valve rockers and valve lifter rods may be damaged.

If it is impossible to follow the above recommendations, the propeller should be pulled through several times at least twice each week to lubricate the engine as much as possible.

Your engine may suddenly be needed for some important service. Keep it in good condition and save unnecessary delay and expense.

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A



August 20, 1942

SERVICE BULLETIN NO. 20

EXTERNAL OIL PIPES

As a precautionary measure, it is recommended that all external oil pipes be replaced with new at each top overhaul. The expense involved is very small when compared to possible engine damage, due to lack of oil resulting from oil pipe breakage.

Vibration usually causes oil pipe failure and we now have available clamps and supports, designed to minimize this vibration. These can be installed without removal of pipes, and it is recommended that the set listed below, applicable to your engine, be purchased at the first opportunity.

<u>Part No.</u>	<u>Name</u>	<u>No. Required Per Engine</u>	<u>Price Each</u>
<u>MODEL 4AC-176 ENGINES</u>			
11677	Valve Case Oil Pipe Clamp	4	\$.29
11805	Valve Case Oil Pipe Support	2	.39
19x15	Shakeproof Lock Washer) Clamp	2	.01
12x18	Round Head Screw) to	2	.01
3x32	Hex Nut) Support	2	.01
11676	Valve Case Oil Pipe Sleeve (Rubber)	4	.05
<u>MODEL 4AC-199 ENGINES</u>			
11677	Valve Case Oil Pipe Clamp	4	.29
11674	Valve Case Oil Pipe Support	2	.39
19x15	Shakeproof Lock Washer) Clamp	2	.01
12x18	Round Head Screw) to	2	.01
3x32	Hex Nut) Support	2	.01
11676	Valve Case Oil Pipe Sleeve (Rubber)	4	.05
<u>MODEL 6AC-298 ENGINES</u>			
11677	Valve Case Oil Pipe Clamp (Double)	4	.29
11675	Valve Case Oil Pipe Clamp (Single)	2	.33

<u>Part No.</u>	<u>Name</u>	<u>No. Required Per Engine</u>	<u>Price Each</u>
<u>MODEL 6AC-298 ENGINES (CONT'D)</u>			
11674	Valve Case Oil Pipe Support	4	.39
19x15	Shakeproof Lock Washer) Clamp	4	.01
12x18	Round Head Screw) to	4	.01
3x32	Hex Nut) Support	4	.01
11676	Valve Case Oil Pipe Sleeve (Rubber)	6	.05

The rubber sleeve, No. 11676, can be installed on oil pipes now on engines by slitting one side of the sleeve lengthwise to permit wrapping around the pipe.

The support should be assembled to the upper cylinder hold-down screw or stud nearest the pipes and clamps placed around rubber sleeves on pipes and fastened to the support.

A SUGGESTION ON THE LEAD PROBLEM

Laboratory tests have shown that varying the speed of an engine in flight helps to prevent lead in gasoline from building up on valves, valve guides, pistons, etc. It is, therefore, suggested that continuous operation of an engine, over long periods of time, at a certain RPM be avoided. Also, after landing, idling the engine for several minutes should prove to be beneficial.

CAB WARNS AGAINST USE OF LOW GRADE FUELS

The following is a quotation from a recent National Aeronautic Association NEWSLETTER:

"Stating that it has received 'far too many reports' of aircraft engine failures caused by use of unspecified fuels, the Civil Aeronautics Board labeled such carelessness not only dangerous but unpatriotic. The Board asserted that the use of low grade fuel other than the quality specified by the engine manufacturer amounts to practically willful damage to aviation equipment that might be useful in the war effort. It was emphasized that under these circumstances 'it should be sufficient to point out that an operator using such fuels must accept full responsibility for doing so.'"

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A



December 7, 1942

SERVICE BULLETIN NO. 21
FRANKLIN AIRCRAFT ENGINES

CAMSHAFT GEARS

A few of the early 80, 85, 90, 120, and 130 HP Franklin engines were equipped with an all-celoron camshaft gear. We have been recommending that this gear be replaced at the first major overhaul by a new aluminum rim celoron gear which is designed to withstand more severe operation than the all-celoron type.

Indications are that the life of this gear will not be as long as was expected. Therefore, it is recommended that all Model 4AC-199 engines below serial #200533, all Model 4AC-176 (80 HP) engines below serial #125270, all Model 6AC-264, and all Model 6AC-298 engines below serial #400131 be examined to determine the type of camshaft gear. This can be accomplished by removing the starter or any of the other accessories.

If the gear is found to be of the all-celoron type we recommend, as a precautionary measure, that the new aluminum rim type #10725 be installed immediately.

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A



June 12, 1943

SERVICE BULLETIN NO. 23

FRANKLIN AIRCRAFT ENGINES

CRANKSHAFT REGRINDING

Improper regrinding may cause crankshaft failure under severe operation. Proper facilities and an appreciation of the necessity of accurate workmanship are highly essential. All fillets should be carefully ground to .125 - .135" radius, free from grinding marks. Expert magnafluxing and checking for alignment and balance are also important.

SPARK PLUG INSERTS

Tests have proven the Heli-coil insert to be very satisfactory. Stripped spark plug holes can be repaired with this type insert if sufficient stock is left in the cylinder head. Do not attempt repairs with special inserts but ship cylinders to the factory for expert and prompt reconditioning.

It is important that a spark plug wrench be used only to loosen and tighten spark plugs. They should always be carefully removed straight out with the fingers and likewise started into the spark plug holes and turned down to within the last one or two turns with the fingers. Recommended torque wrench specification for tightening is 15 foot pounds. Care and patience save valuable time and material now on the critical list.

MAGNAFLUXING

It is recommended that crankshafts, camshafts, valve rockers, piston pins, valve rocker pins, connecting rods, and valves be magnafluxed at each major overhaul. If the necessary equipment is not available in your territory, do not hesitate to ship the parts to the factory. A little delay is preferable to an accident.

RECOMMENDED CHANGES IN SPARK ADVANCE

On Models 4AC-176-B2, 4AC-176-BA2, 4AC-176-F2, and 4AC-176-F3 retarding of spark setting from 28° to 26° has been approved and recommended by Civil Aeronautics Administration as a preventive measure against detonation. It is a recognized fact that gasoline

VALVE SPRING TENSION

Model 4AC-150, 4AC-150-A and 4AC-171 valve springs should support 63 to 68 pounds without allowing valve to open when assembled to cylinders. Before assembly to cylinder, springs should weigh as follows:

	<u>Compressed to</u>	<u>Weight</u>
Inner Spring	1 5/16"	63 - 68 lbs.
Inner Spring	1 11/16"	25 - 28 lbs.
Outer Spring	1 13/16"	32 - 35 lbs.
Outer Spring	1 7/16"	65 - 70 lbs.

Model 4AC-176, 4AC-199, 6AC-264 and 6AC-298 valve springs should support 50 to 60 pounds without allowing valve to open when assembled to cylinder. Before assembly to cylinder, springs should weigh as follows:

	<u>Compressed to</u>	<u>Weight</u>
Short Spring #10188 (1 27/32")	1 17/32"	44 - 50 lbs.
Short Spring #10188 (1 27/32")	1 5/32"	98 - 106 lbs.
Long Spring #10824 (1 15/16")	1 5/8"	46 - 52 lbs.
Long Spring #10824 (1 15/16")	1 1/4"	108 - 116 lbs.

Additional copies will be furnished upon request.

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A



April 8, 1944

SERVICE BULLETIN NO. 24

RECOMMENDED CHANGE IN SPARK ADVANCE

Supplementing Service Bulletin No. 23 on this subject, retarding of spark setting from 28 degrees to 26 degrees has been approved and recommended by Civil Aeronautics Administration on Model 4AC-199-E3 engines.

SPARK PLUGS

References have been made in service bulletins and operator's handbooks concerning the proper care and handling of spark plugs. However, the spark plugs are so common and sometimes so easily forgotten until trouble develops that too much emphasis cannot be put upon the importance of correct procedure.

1. Do not attempt to remove or install spark plugs until cylinder heads have been allowed to cool. Damage to spark plug hole threads may take place.
2. Frequent inspection and removal of lead and carbon deposit will insure good operation and may save costly delay resulting from stripped spark plug hole threads caused by an excessive amount of lead on that portion of the spark plug extending into the combustion chamber. Scrape all surfaces free of deposit or clean with spark plug cleaning apparatus. This should be done every 25 hours or less.
3. Check gap and adjust carefully to .020 clearance. Excessive clearance may cause difficulty with engine starting. If worn sufficiently to prevent correct adjustment, discard and install new plug.
4. Use care when reinstalling the spark plug. Turn in with fingers as far as possible and complete installation with spark plug wrench furnished with the engine. Whenever possible a torque wrench should also be used. The correct torque is 15 foot pounds.



FEDERAL BUREAU OF INVESTIGATION
 DEPARTMENT OF JUSTICE
 WASHINGTON, D. C. 20535

MEMORANDUM FOR THE DIRECTOR

SUBJECT: [Illegible]

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August 10, 1944

SERVICE BULLETIN NO. 25

FRANKLIN AIRCRAFT ENGINES

AIR CLEANER

Operation of airplanes from temporary fields, necessitated by the closing of many airports to all civilian flying, has emphasized the need of a carburetor air cleaner to prevent induction of dirt and thereby prolong the life of the engine.

An air cleaner designated as AC #1529265 and manufactured by AC Spark Plug Division, Flint, Michigan, has been tested and found satisfactory. Installation on various airplanes as illustrated in the sketches shown below has been approved by the Civil Aeronautics Administration and we recommend immediate attention to this item as one that will prove to be beneficial.

Prints of drawings shown will be gladly furnished on request.

CONVERSION OF MODEL 4AC-176-F3 (80 HP) ENGINE

Tests recently conducted by our Engineering Department have proven that conversion of the Model 4AC-176-F2 (or 3) 80 HP engine from a compression ratio of 7:1 to 6.3:1 is highly advantageous and eliminates possibility of damage from detonation.

Engine designation with this lower compression ratio is known as 4AC-176-D2 (or 3) and it develops rated 80 HP at 2650 RPM. Approval has been received from the Civil Aeronautics Administration, and we recommend that immediate action be taken by all owners of Franklin 80 HP engines installed in Culver Model LFA airplanes to avail themselves of this opportunity. The work involved is practically the same as for a top overhaul, and can be accomplished by a competent aircraft engine mechanic. Cylinders should be carefully checked and if any unusual condition is noted, it is suggested that they be shipped to the factory for reconditioning.

The new name plate will be stamped to specify use of 80 octane gasoline. Lower octane gasoline should either be drained from the tanks or mixed half and half with 91 octane.

Parts required for this change are pistons, piston rings, piston pins, valve case oil pipes, gaskets, packings and name plate. This material can be obtained for a limited time at a special price of \$29.00 F.O.B., Syracuse, New York. It is suggested that a check or money order accompany the purchase order with priority to save time.

It will be sincerely appreciated if you will advise the name and address of any new owners of airplanes equipped with Franklin engines in order that we may mail them copies of this bulletin. Many transfers of ownership have taken place since the beginning of the war concerning which we have not been advised.

AIRCOOLED MOTORS CORPORATION

SYRACUSE NEW YORK U S A