Instruction Book

for

WRIGHT

Aviation Engines

WRIGHT AERONAUTICAL CORPORATION
PATERSON, NEW JERSEY
U. S. A.

WRIGHT

"T" Series

AVIATION ENGINES

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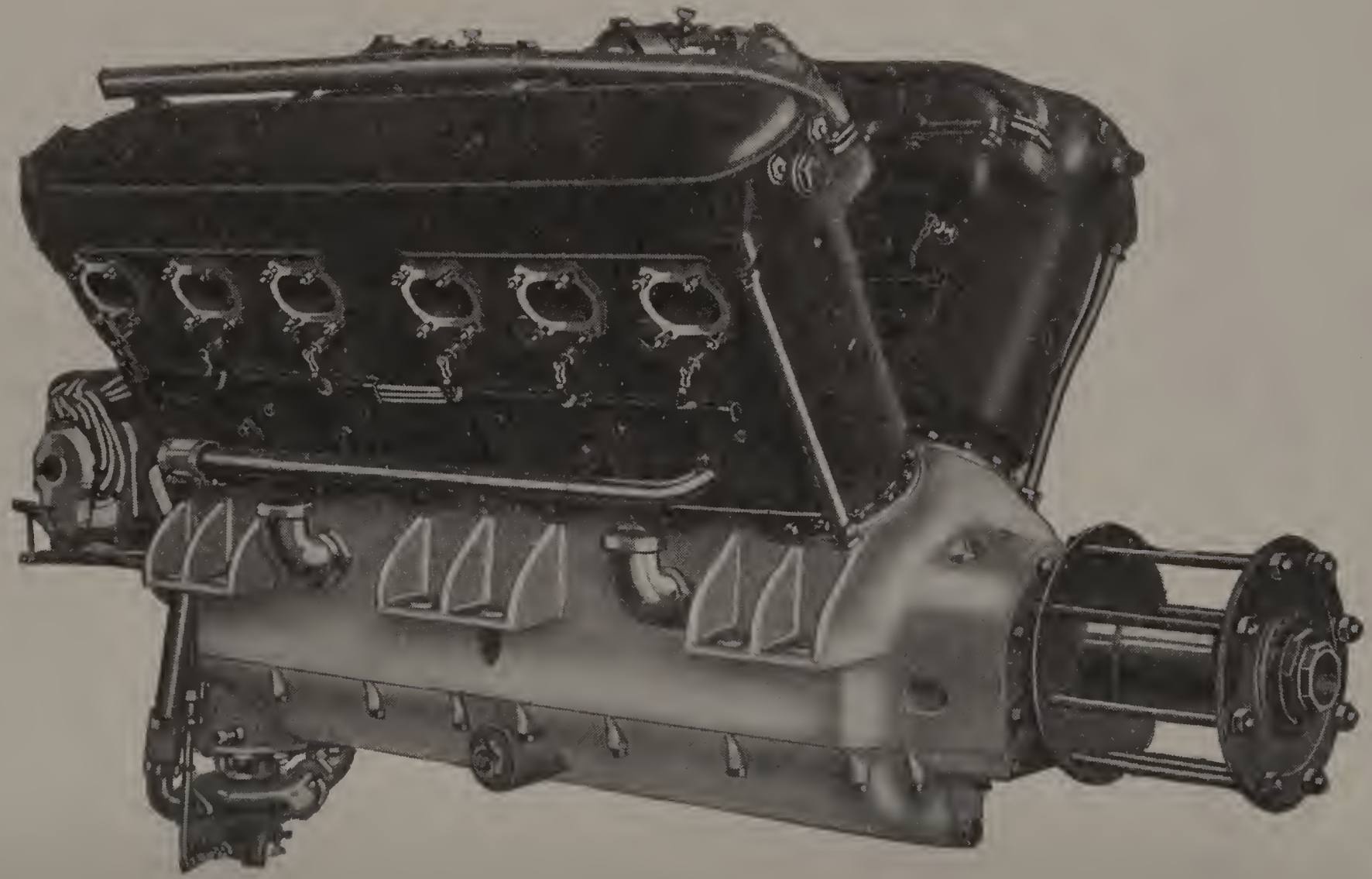


WRIGHT
Model T-3 Engine

Wright "T" Series Engines

The Wright T-3 engine is a further development of the Wright T-2. It is shorter in overall length than the T-2, lower in height and develops a greater horsepower; many refinements have been introduced into the design and construction of the T-3 engine, but the basic design is the same in both engines, and as no dimensional data are given in the following description of the T-2 engine, it may be taken also as a description of the T-3, except where otherwise stated. Dimensional data of both engines will be found in a convenient, tabulated form in another part of the book.

Description T-2 Engine

12 cyl., 60° Vee, water cooled

Cylinders
Cylinder Sleeves

Steel cylinder sleeves of the open end type are screwed and shrunk into aluminum cylinder blocks. These sleeves provide bearings for the pistons and through flanges near their lower ends, the means whereby the cylinder blocks are attached to the crankcase.

The cylinders are aluminum, cast in blocks of three with integral water jackets. The blocks are enameled both inside and out as a protection against corrosion of the aluminum due to impurities in the cooling water or to atmospheric action.

Valves
Valve Seats

Two inlet and two exhaust valves are provided for each cylinder. They are the tulip type of valve made of silcrome steel and have hollow stems which work in long guides pressed into the cylinder head. The valves are operated by overhead rocker arms, tappet adjustment being secured by means of screws inserted in the ends of the rocker arms.

Because of the open end type of cylinder sleeve employed, the valve seats, which are made of aluminum bronze, are shrunk into the cylinder head. This aluminum bronze has about the same coefficient of expansion as the aluminum and therefore there is no likelihood of the seats becoming loose.

Bronze spark plug bushings are screwed, shrunk and pinned into the cylinder walls, thus assuring good mechanical and thermal contact with the cylinders.

Camshaft Camshaft Housing and Covers The camshaft and all the valve operating mechanism for each bank of cylinders are carried in a cam housing and form a complete, easily detachable unit. The camshaft housing which runs the whole length of the cylinder bank is an aluminum casting with integrally cast inlet manifolds, thus contributing to the rigidity of the engine.

The camshaft is hollow throughout, for lightness and lubrication. It has two large central bearings (slightly larger than the outside diameter of the cams). This makes great accuracy in machining and alignment possible and the idea of lightness is carried out in the making of these bearings, by shrinking steel shells over webs turned on the shaft. The camshaft runs in four plain bearings, three of which are integral with the camshaft housing. The other is made from a special copper aluminum alloy, which is lighter than the bronze ordinarily used for this purpose, and is secured in the camshaft housing by means of a set screw.

Oil tight covers enclose the whole of the valve mechanism and prevent oil leaking to the exterior of the engine.

Crankshaft The crankshaft is of unusually large diameter and is made hollow to allow for the passage of oil and to reduce its weight. It runs in seven main bearings and is provided just behind the propeller hub with a deep row radial thrust bearing which gives a positive endwise location to the shaft. The propeller end has seventeen splines, the space in which the eighteenth would come being left blank to make sure that the hub is always placed on the shaft in the same position. These splines are intended to take torque only, the axial position and centering of the hub being determined by two cones, one at each end of the splines. The plugs which seal the holes in the crankthrows are easily removable to facilitate cleaning.

Connecting Rods There are two connecting rods to each crankpin, an inner and an outer. Both are tubular. The inner rod is forked at the large end and embodies a new feature in the type of bearing used. This bearing is a split sleeve about 3/8" thick cast from a special copper-tin-lead alloy which requires no babbit and will not seize on the crankpins even in the event of total failure of the lubrication system. The bearing is ground on the outside, in the space between the fork of the inner rod, to form a bearing for the outer rod.

Pistons Piston Pins The pistons are made of aluminum alloy and are simple in design. No ribbing is employed under the head, as the section is amply strong without and heavy enough to dissipate heat from the centre of the head rapidly.

Each piston has four compression rings near the head and one scraper ring in the skirt.

The piston pins are free to turn in both the piston pin bosses and the small ends of the connecting rods. Bronze plugs are driven into the ends of the pins to remove the possibility of scratching the walls of the cylinders. (The T-3 engine has Duralumin plugs.)

Crankcase The crankcase is composed of two aluminum castings joined below the centre line of the crankshaft. The sections are rather heavy and well ribbed for rigidity. All the bearings are carried in the upper half of the case, the bearing caps being made of forged duralumin. The lower half of the case is a sump from which oil is pumped as rapidly as it is thrown off by the bearings and cylinders. This construction makes the bearings very accessible after removing the lower half of the crankcase.

Vertical Shaft Camshaft Drive Shaft In the upper half of the crankcase at the rear end is a vertical shaft which is driven from a bevel gear on the crankshaft. This vertical shaft in turn drives the inclined shafts running to the camshafts, two synchronizers, the magneto drives and the fuel pump.

The inclined shafts, or camshaft drive shafts, as they are called, have serrated couplings near their upper ends to facilitate timing of the engine. The operation of these is described under the heading "timing the engine."

Magneto Drive Magneto Coupling There are two magnetos, each twelve cylinder instruments. One is wired to all spark plugs located on the outside of the cylinders and the other to all plugs situated in the Vee between the blocks. The magnetos are mounted horizontally and crosswise with their distributor boxes towards the outside of the engine.

The magneto couplings used differ on the T-2 and the T-3 engines. The T-2 coupling is the solid gear drive described under the E-4 engine. The T-3 coupling is composed of two halves joined together with a thermoid disc. Adjustment of the spark is obtained through a little worm and worm wheel in the half of the coupling attached to the armature shaft, and provision is made for locking the adjustment when it has been set. Great accuracy in the magneto timing is possible by this means and once it is set there is no chance of accidental alteration of the timing.

Lubrication Oil Pumps The lubrication system is operated by three pumps which form a single assembly. Two of these are suction pumps which draw oil from the front and rear of the crankcase, respectively, and deliver it to the external oil tank. The third is a pressure pump which delivers oil through a

tubular strainer arranged transversely in the lower half of the crankcase, to an oil manifold bolted to the bearing caps, from which it is distributed to all crankshaft bearings.

Oil is supplied to the centre of the camshaft housings by means of two copper pipes, leading from an annular passage around the center main bearing. The center bearings in the housings are drilled in such a way as to distribute the oil supply to the bore of the rocker arm shafts and the rocker arms and cam surfaces are lubricated by the oil forced through small holes in the rocker arms. The camshaft bearings are lubricated through drilled passages which connect the bearing surfaces with the rocker arm shaft bores. Oil holes are drilled in the rear camshaft bearing and the oil which lubricates this bearing is allowed to force its way into the bore of the camshaft, through holes drilled in the shaft. It then flows out through holes in the tachometer shaft and returns to the sump by gravity, oiling in its downward path, the camshaft drive shaft, gears and bearings. The surplus oil in the camshaft housing returns to the sump through pipes, located one at each lower corner of each housing.

The pistons and wrist pins are lubricated by splash from the crankpins. The pressure employed in the lubrication system is controlled by a relief valve located in one end of the oil strainer.

Water Pump Below the oil pump and driven from the same shaft is a water pump with two outlets which deliver water to the base of each of the four cylinder blocks. The pump is of the centrifugal type.

Gasoline Supply Fuel Pump Gasoline is supplied to two Stromberg NA-U6T carburetors, located in the Vee of the engine, by means of a Wright-Viking fuel pump. Both carburetors are attached to an aluminum air horn which can be removed with the carburetors and their control levers as a single assembly.

The Wright-Viking fuel pump consists of a bronze body in which runs a steel gear with teeth cut internally; this is driven by the pump drive gear which meshes with a bevel gear on the vertical shaft. The internal gear drives another small bronze or fibre gear which runs on a shaft offset from the centre line of the internal gear. The gasoline drawn in by the pump is carried round the pump in the pockets formed by the spaces between the teeth of the internal gear and it is delivered in a constant stream to the outlet nipple. Carried in a boss in the pump cover is a relief valve. This consists of a bronze plunger which is held on to its seat in the cover by a helical spring. The pressure of this spring can be adjusted by means of the adjusting screw so that the valve will open and allow surplus gasoline to flow through the relief line to the gasoline tank, when the working pressure is exceeded.

Installation

General Notes

Aligning Engine Plywood or fibre shims approximately ¼" thick, and each the full length of the engine feet, should be used in lining up the engine. By fitting these shims accurately, a good bearing on the engine feet is secured. The engine bearers should be faced with hard wood.

Oil Tank In designing the oil tank, the filler hole should be so placed that there will be a space at the top of the tank, which cannot be filled, equal to 10% of the volume of the tank; this is to provide for expansion. A large vent line should be provided (½" to ¾"). Oil tank connections should be as short and simple as possible.

Fuel Tank The fuel tank should be located as near the engine as possible and the relief line should go to the main tank and not to the gravity tank. If the fuel tank is lower than the pump it will be necessary to make provision for priming the fuel pump when starting up. The outlet from the fuel tank should be equipped with a strainer which will be easily accessible, and another strainer at the entrance to the carburetor should be installed.

As a rule a U pipe connects the primer nozzles and the gasoline is led into this U tube at the bottom of the U. As planes are usually started with the tail down, especially land planes, the rear cylinders get the prime and the forward cylinders do not get any. For this reason, with each installation the primer pipe assembly with nozzles should be removed and laid on top of the engine with the plane in its position for starting. By trying the primer and flattening the rear nozzles carefully, it will be possible to make sufficient restriction in the rear nozzles to cause gasoline to come out of the forward nozzles as well as the rear nozzles. This operation cannot be carelessly done but with the exercise of a little care very even distribution can be secured.

Besides this, the primer pump valves are not apt to be tight and with the throttles more or less closed in starting, there have been cases of the cylinders becoming full of gasoline which is drawn from the primer pump. If possible the primer pump supply should be located below the pump. If this is not possible a shut-off valve should be provided between the primer and the engine so that after the cylinders have been primed this valve can be closed. If this is done each time there will be no trouble from flooding the cylinders.

Propeller Before attaching the propeller it should be tested carefully, with the hub in position, for both balance and track.

Water Connections In the case of the E-3, E-4 and T-2 engines in tractor installations, the water outlets should be at the propeller end of each cylinder block. In pusher installations, the water outlets should be located at the magneto end of each block. The T-3 water outlets are so designed as to be satisfactory, without change, for either type of installation.

Air Intake The air intake pipe should open outside the cowling. In order to prevent foreign matter (such as bits of waste, etc.) from entering, the pipe should be covered with a wire screen (about ½" mesh).

Access to Parts Magnetos should be accessible from the sides and for this reason doors should be provided in the cowling. Access to the oil relief valve and to oil screen in lower half of crankcase should be provided for, and the access to the oil screen should be large enough to permit the screen to be removed. The cowling should also be designed so as to give easy access to the spark plugs.

In order to reduce the fire hazard the engine compartment should be ventilated and drained.

Starting and Operation

General Notes

Before Starting See that cooling system is filled with water and that gasoline and oil tanks are full. In cold weather a suitable mixture of water and anti-freezing mixture should be used in the cooling system.

Starting (1) Turn fuel control valve to the "start" position.

(2) Adjust mixture control to full rich position and open throttle about ¼ way on quadrant.

(3) Turn ignition switches to "off" position.

(4) Prime engine by means of special primer. (If no primer is installed, engine should be primed through pet-cocks in the intake manifolds.) The exact amount of prime to use will vary with the engine temperature and must be determined by experiment, but it will usually be found that about six (6) strokes of a Lunkenheimer primer will be sufficient.

(5) Move spark lever to full retard position.

(6) Crank engine for about two revolutions with ignition switches "off."

(7) Turn ignition switch to "start" position. This position also turns on the starting magneto located on top of the starting mechanism.

(8) Crank engine until it starts.

If trouble in starting is experienced it may be due to over-priming. This can be remedied by turning the engine over backwards two or three revolutions with throttle open.

The engines should start readily in cold weather. If, after two or three trials, an engine does not start, something is wrong and a careful check should be made to locate the trouble.

After Starting As soon as engine has started, advance spark, throttle to about 600 R. P. M. and watch oil pressure gauge; if this does not show at least 20 pounds pressure within two minutes (15 lbs. for T-2), stop engine and determine cause of trouble. Pressure should rise gradually from this point until normal pressure is indicated. If normal pressure is not reached within a reasonable time, the engine should be stopped and the cause of the trouble located and removed. In no case should engine be run above 600 R. P. M. until 50 lbs. pressure is recorded (30 lbs. for T-2). After oil pressure reaches the above value, increase throttle opening gradually to warm up engine. The speed should not be over 1,000 R. P. M., however, until the oil pressure is normal the water outlet temperature reaches 120° F. (50° C.), and the oil 100° F. (38° C.). During the warming up period the gravity tank should be filled by turning the fuel control lever to the proper position.

When the outlet water has reached 120° F. (50° C.) and the oil 100° F. (38° C.), try both switches to make sure that all spark plugs are firing (clean or replace any that are found defective). The engine should now be tried out at full throttle, during which time the tachometer, oil pressure gauge, fuel supply gauge or indicator, water outlet thermometer and oil outlet thermometer should be carefully observed to see that everything is functioning correctly. The engine operation should be smooth and without any missing or back firing. If this is the case, and all instruments show the proper readings, the engine is ready for flight.

In the Air The instruments should be noted at frequent intervals to see that the engine is functioning properly. The engine should be operated to keep within the following limits:

Oil pressure between 60 and 80 lbs. per sq. in. (40-70 lbs. per sq. in. for T-2).

Water temperature between 140° F. and 190° F. (60° C. to 90° C.).

Oil temperature not over 180° F. (82° C.).

Fuel pressure, 2 to 4 lbs. per sq. in.

If the oil pressure falls below the low limit of 60 lbs. per sq. in. (40 lbs. for T-2), an immediate landing should be made and the relief valve readjusted, or the cause of the trouble located and removed. It is not so serious when the oil pressure exceeds the high

limit and it is not necessary to make an immediate landing providing the pressure does not exceed 100 lbs. per sq. in. When the flight is over, however, excessive oil pressure should be corrected. This can generally be done by readjustment of the relief valve.

The water temperature should be maintained between 140° F. and 190° F. by proper manipulation of the radiator shutters.

Oil temperature above 180° F. is a bad symptom and when this occurs a landing should be made as soon as convenient.

It is not necessary to adjust the spark setting during flight, and it should be allowed to remain in the full advance position except for starting.

Mixture Control Proper manipulation of the altitude or mixture control is essential in order to get the most satisfactory results from the engine. The control operates on the back suction principle, the mixture being adjusted by opening a valve which transmits a suction to the float chamber of the carburetor, thus retarding the flow of fuel through the jets and making the mixture lean.

In taking off, this control should always be set in the full rich position. During a long climb it should be adjusted every 4,000 or 5,000 feet to the leanest point which can be obtained without lowering the R. P. M. or causing uneven running. When the cruising altitude is reached and the engine has been adjusted to the desired cruising speed, the mixture control should again be carefully adjusted to the leanest point obtainable without sacrificing R. P. M. or inducing uneven running. Observance of these instructions will lengthen the flying period between overhauls, a great deal of fuel will be saved and the radius of action of the airplane will be considerably increased.

There is one precaution to be observed in the use of the altitude control, that is to move it to the full rich position before throttling for a glide. If this is not done it may be found that the engine will not respond properly when the throttle is opened at the end of the glide.

Daily Inspection It is recommended that the engine be given an inspection before each day of flying, the inspection covering at least the following items:

(1) Inspect all accessible bolts and nuts and tighten where necessary, special attention being paid to propeller hub lock nut, propeller hub bolts, engine hold-down bolts and cylinder hold-down nuts.

(2) Inspect all pipe and hose connections for leakages or signs of loosening.

(3) Inspect all wiring, especially at the terminals, to see that connections are tight. It is particularly important to see that the ignition wires are in place and properly connected.

(4) Inspect all control linkage by moving it to the extreme positions and by seeing that there is no undue looseness or sticking and that full travel of the levers on the engine is obtained.

(5) Pull propeller over by hand to find whether there is any sign of bearing seizure, loose bearings or severe valve leakage.

(6) See that carburetors do not flood when gasoline is turned on.

Twenty-Hourly Inspection It is strongly urged that after every 20 hours' flying time, a very systematic and complete inspection be made. This inspection should include all the items in the daily inspection with the following additions:

(1) Clean oil, gasoline and carburetor strainers.

(2) Drain oil completely from system and fill with fresh oil.

(3) Inspect ignition breakers and distributors, cleaning with alcohol and brush and adjusting where necessary.

(4) Inspect tappet clearances and adjust any that vary more than .004" from specified limits.

(5) Inspect spark plugs; clean and adjust gaps where necessary.

Dismantling Engine

"T" Series

1. DRAW OFF PROPELLER HUB ASSEMBLY WITH PROPELLER HUB CENTERING RING (SMALL).
   This should be done in the following manner:
   a. Remove the locking device.
   b. Loosen the outer nut and back it off 5 turns.
   c. Loosen the inner nut and back it off 3 turns.
   d. Hold the inner nut firm and screw up on the outer nut until the hub breaks away from the rear cone and moves out about ⅛".
   e. Screw in on the inner nut 2 turns.
   f. Strike front end of hub with a soft hammer to loosen the front cone.
   g. Back off inner nut and remove hub.

   NOTE—It is important that the propeller hub be removed according to the above procedure in order to prevent injury to the threads on the crankshaft.

2. Disconnect carburetor gas and water connections, loosen inlet manifold nuts and LIFT OFF CARBURETOR TEE AND AIR HORN ASSEMBLY. Care must be taken that this assembly is lifted out vertically, otherwise there is a danger of breaking the ears on manifold tee.
3. REMOVE CARBURETOR DRAIN TEE.
4. REMOVE CAM HOUSING COVERS.
5. Take off nuts and REMOVE HAND STARTER ASSEMBLY and STARTING MAGNETO.
6. Disconnect all terminals from spark plugs.
   Loosen ignition wire manifolds inside and outside and aluminum ignition wire manifold at rear of engine.
   Cut wire from magneto hold down bolts and take out bolts.
   Disconnect magneto advance rod assembly from bracket, remove magneto coupling pins and LIFT OFF TWO MAGNETO AND GEAR ASSEMBLIES, MAGNETO ADVANCE ROD ASSEMBLY AND ALL IGNITION WIRE ASSEMBLIES, TOGETHER. (On T-3 the magneto coupling is disconnected from drive by removing two nuts.)
7. Disconnect vertical shaft oil feed pipe assembly at crankcase, take off 4 nuts from vertical shaft housing and REMOVE VERTICAL SHAFT HOUSING ASSEMBLY COMPLETE WITH OIL PIPE ASSEMBLY (this includes FUEL PUMP AND GUN CONTROLS).
8. Remove cylinder water outlet pipe assemblies.
   Remove nuts from camshaft drive shaft pinion housings and camshaft drive shaft housings. Loosen packing nuts and camshaft drive dog housings. Disconnect oil inlet and outlet pipes from camshaft housings, remove all camshaft housing hold down nuts. Remove carburetor water pipe assembly and LIFT OFF CAMSHAFT HOUSING ASSEMBLIES RIGHT AND LEFT HAND.
9. REMOVE CAMSHAFT DRIVE SHAFT ASSEMBLIES AND CAMSHAFT DRIVE SHAFT HOUSING ASSEMBLIES COMPLETE.
10. Take out 8 Fillister. Head screws and REMOVE MAGNETO DRIVE SHAFT ASSEMBLIES.
11. Take off 6 nuts and LIFT OFF CAMSHAFT DRIVE HOUSING ASSEMBLY.
12. Remove spark plugs, cylinder water inlet pipes, crankcase breathers, camshaft housing oil return pipes and cylinder hold down nuts. TAKE OFF ONE CYLINDER BLOCK AND REMOVE THREE PISTONS FROM CONNECTING RODS.

(NOTE:—Care must be taken that in removing the cylinder block the pistons do not come in contact with the cylinder studs; rubber tubing should be placed over these studs or they should be covered with rag to remove the possibility of marring the pistons.

It is important that the pistons be removed from the exposed connecting rods before another block is taken off, otherwise there is a danger of breaking the piston rings in the exposed pistons when turning the motor over.)

REMOVE OTHER CYLINDER BLOCKS AND PISTONS AS ABOVE.

13. UNSCREW SOLDERING UNION TEE FROM UPPER HALF OF CRANKCASE.
14. TAKE OFF CRANKCASE COVER, FRONT.
15. INVERT CRANKCASE ON STAND AND REMOVE OIL AND WATER PUMP ASSEMBLY.
16. Remove oil strainer, oil pressure relief valve, oil manifold plug and TAKE OFF LOWER HALF OF CRANKCASE.
17. Remove oil pressure pipe assembly, take off 7 bearing caps and LIFT OUT CRANKSHAFT AND CONNECTING ROD ASSEMBLY.
18. TAKE OFF CONNECTING RODS, BEING SURE TO KEEP THE BOLTS AND NUTS WITH THE RODS FROM WHICH THEY ARE TAKEN.
19. BLOW OUT ALL OIL LEADS IN BOTH UPPER AND LOWER HALVES OF CRANKCASE WITH POWERFUL KEROSENE SQUIRT.

Disassembly, Overhaul and Reassembly of Units

Crankshaft Assembly

Dismantling On each complete disassembly of the engine the crankshaft should be blown out with a powerful kerosene squirt, the crankshaft plugs being removed to insure perfect cleansing. Special screw driver WA-32 should be used for removing these plugs. The crankshaft gear and thrust bearing should not be disturbed without urgent cause, but if they have to be removed the following is the procedure: Remove crankshaft gear by pulling out cotter pin and unscrewing crankshaft gear nut with special tubular wrench WA-69. (On T-3 engines tool WA-76 will be necessary.) With special offset wrench WA-48 unscrew crankshaft ball bearing nut. This will force off the large propeller hub centering ring and leave the oil slinger and ball thrust bearing free to be drawn off the shaft.

Reassembly The preceding order of disassembly may be reversed for reassembly. When putting in the crankshaft

plugs be sure to screw them in tightly, otherwise there will be a possibility of oil leakage. To prevent their loosening it is advisable to lock them by center punching at two or three points near the outside diameter.

Cylinder Block Assembly

Dismantling Remove valves. When performing this operation a block of wood should be inserted in the cylinder bore in order to support the valves when they are released. Using tool WA-45, compress the valve springs and pick out the valve spring washer locks. (These are small steel cones each made in two halves.) Take off valve springs and washers. Inspect valves and valve seats for signs of wear or pitting and lap-in any that need it. All valves are numbered and care must be taken that they are lapped into the corresponding seats.

Examine cylinder bores for signs of scoring or scratching. Stone out or lap any cylinders which require it.

Reassembly This is a reversal of the order of dismantling.

NOTE—Make sure before reassembling that all cylinder bores, valves and valve seats are absolutely free from lapping compound or dirt of any kind.

Camshaft Housings

Dismantling Take off camshaft housing cover rear; remove set-screw which secures camshaft bearing and draw out camshaft complete with camshaft bearing gear and nut and tachometer drive shaft. Take out two steel plugs and withdraw two rocker arm shafts, using tool WA-128 (the rocker arms will drop off as the shafts are withdrawn). Remove camshaft housing cover, front, and withdraw two remaining rocker arm shafts. Remove tachometer shaft by taking out cotter pin. Take off camshaft nut and draw off camshaft gear and bearing. For replacement of rollers on rocker arms tool WA-60 will be found useful.

Reassembly Insert four rocker arm shafts, slipping on the rocker arms as the shaft enters. Screw in two plugs and replace front and rear covers.

Assemble camshaft bearing, camshaft gear and tachometer drive shaft on camshaft. Insert this camshaft assembly from the rear of the camshaft housing and secure by means of set screw in bearing.

IMPORTANT: If for any reason the camshaft gear has to be renewed, particular attention must be paid to the amount of backlash between this gear and the camshaft drive shaft pinion—this backlash should be .006″ to .012″ and it may be found necessary to grind the flange of the camshaft gear to obtain this amount.

Vertical Shaft Housing, Oil Pipe, Gun Controls and Fuel Pump Assembly

Remove oil pipe assembly from top of vertical shaft housing cover. Inspect the oil metering jet and clean thoroughly if necessary. Take off 4 nuts and washers and remove fuel pump from vertical shaft housing.

Fuel Pump Assembly

Dismantling Take out 2 fill. hd. screws and remove cast iron cover; draw out brass or fibre pinion and internal gear and from opposite end of body take out bevel gear and bearing. Take off fuel pressure relief cover and inspect relief valve seat, lapping it, if necessary. Unless it is absolutely essential, the packing in the stuffing box should not be disturbed.

Reassembly Assembly of the pump should start with the replacing of the steel internal gear and in doing this great care must be taken that the packing in the stuffing box is not injured. If, for urgent reason, the packing has had to be removed, replacement of it should include a very careful caulking with the internal gear in position, making sure that the gear is a free running fit after the packing is fitted.

IMPORTANT: It is essential that all bearing surfaces be lubricated thoroughly with castor oil before putting them together, and this applies particularly to the pinion shaft which extends into the cast iron cover.

Vertical Shaft Housing

Dismantling Remove vertical shaft housing cap by taking out 4 fill. hd. screws. Take off 8 nuts and washers and remove 2 gun control gear bearing caps. This leaves the gun control drives free to be taken out. Tap on bottom of vertical shaft gear upper, and thus remove gears, ball bearing cage and ball bearing. If it is necessary to renew the bushings on the gun control shafts, remove cotter pins and nuts and draw off gears and bushings.

Reassembly Assembly order is a reversal of the order of disassembly.

Oil and Water Pump Assembly

Remove 3 nuts and washers. Loosen lock screw in water pump packing gland and detach oil pump assembly from water pump assembly.

Oil Pump Assembly

Dismantling Take out 3 cotter pins from oil pump gears and remove 3 castled nuts (a piece of copper sheet in-

serted in the slot in pump drive gear, lower, and bent so as to fit between the teeth of the gear will be found to provide a suitable lock for the gears when removing the nuts). Draw out pump drive gear, lower, and with tool WA-10 draw three oil pump drive gears from tapered ends of oil suction pump gears; remove 3 woodruff keys.

Take off 8 ¼" nuts and washers and remove oil pump cover plate from body by tapping ends of protruding studs with a brass or lead drift. Take out 3 pump idler gears and 3 pump suction gears. Inspect all gears and suction chambers for signs of roughness.

Reassembly Start reassembly by replacing 3 pump idler gears, and 3 oil suction pump gears in body. Fit cover plate, using a little shellac on edge of body face between pressure and suction pump sections. Secure with 8 nuts and washers, Replace pump drive gear, lower, making sure that cork is in position in shank and put oil pump drive gears back on oil suction pump gears, using the copper strip for a lock as explained under dismantling. Secure gears with nuts and cotter pins.

NOTE: If the pump drive gear lower bushing has been renewed, ream it from open end of body before reassembly is started. This will insure a straight hole accurately located with regard to the three oil suction pump gears.

Water Pump Assembly

Dismantling Remove water pump packing gland, take off 6 nuts and remove water pump cover. Draw out shaft and impeller assembly and inspect thrust button in bottom of shaft.

Reassembly Reassembly is a reversal of order of dismantling.

Reassembly of Oil Pump with Water Pump

Attach water pump to oil pump by means of 3 nuts and lock water pump packing gland by means of locking screw.

Camshaft Drive Housing Assembly

Dismantling Cut and remove wire which locks fill. hd. screws, take out 6 fill. hd. screws and drive out vertical shaft gear, lower (complete with ball bearings and gears) from upper end of camshaft drive housing. Take out cotter pin, remove slotted nut and draw off vertical shaft drive gear and ball bearing. Take off magneto drive gear. Remove lock ring and take off nut at top of vertical shaft gear, lower. Take off ball bearing.

Reassembly Reassembly is reversal of order of dismantling.

Camshaft Drive Shaft and Housing Assembly

Dismantling Pull off camshaft drive shaft housing and packing nut. Remove locking ring and unscrew camshaft

drive dog housing. Take out cotter pin, remove nut and washer and draw out camshaft drive shaft with camshaft drive dog, lower. Take off camshaft drive dog, upper, and draw camshaft drive shaft pinion from housing.

Reassembly Reassembly is reversal of order of dismantling.

Hand Starter Assembly and Starting Magneto

Dismantling Release starting magneto strap and remove starting magneto. Drive out 2 pins from starter worm collar and remove collar. Draw out starter worm complete with starting magneto gear and ball bearing. Take out 2 screws and remove starter ball bearing retainer. Lift out starter worm wheel and ball bearings.

Reassembly Reassembly is reversal of order of dismantling.

Carburetor Tee and Air Horn Assembly

Dismantling Disconnect carburetor control rods which connect throttle levers of both carburetors. Remove fill head screws and lift off carburetors. Take off nuts and remove carburetor tees.

NOTE: Precise setting of the throttle valves on both carburetors is essential to the smooth operation of the engine; therefore, in removing the control rods great care should be taken that the adjustment on the rods is not disturbed.

Reassembly This is a reversal of the order of dismantling. The operation of the throttle valves should be checked carefully to make sure that the control rod adjustment has not been altered, but that both valves open and close in unison.

Reassembly T-2 and T-3 Engines

This is a reversal of the order of dismantling, but several points must be watched carefully:

1. Make sure that the passages in all oil leads and pipe lines are clear and clean, before they are assembled to engine.
2. Oil all parts before assembling.
3. See that the oil pump drive gear is in place before the lower half of the crankcase is assembled to the upper half and in assembling the two halves together use a little shellac on the joint.
4. Shellac also the crankcase front cover plate in assembling.
5. In assembling the pistons, it is advisable that they be done in lots of three, otherwise a lot of trouble due to the breaking of piston rings will result. On the T-2 engine the order of fitting the cylinder blocks is of importance. Start with the left rear block (magneto end), then fit the left front block, next the right

rear, finishing with the right front block. In assembling the blocks, a special piston ring clamp WA-44 should be used. Get pistons 1 and 3 on the left bank at the top of the stroke. Attach clamp over compression rings and lower the block carefully. This will push down the clamp which must be fitted over the scraper rings of pistons 1 and 3 and the compression rings of piston 2. In order to get the cylinder block over the scraper ring of piston 2 (that is, the centre piston of the 3) a spring steel clamp or piece of wire may be used. This will be pushed down into the crankcase by the descending block and may be removed from the opposite side. Assemble the other blocks in the order mentioned, tightening each one down as it is put in place. When it comes to the last block (right front propeller end) the spring steel clamp or wire on the last scraper ring will have to be removed through the breather hole.

6. The camshaft drive shaft assembly must be fitted in place before the cam housings are assembled to the engine.
7. After the cam housings are fitted, the valve tappet clearances should be adjusted and the engine timed. Complete instructions for timing are given on pages 18-19.
8. It is important that the valve mechanism be flooded liberally with oil before the cam housing covers are put in place and the plug on top of the cam housing (magneto end) should be removed and the space completely filled with lubricating oil.
9. Make sure on the T-2 engine that the cotter pins are fitted in the magneto couplings after timing the magnetos. On the T-3 engine care must be taken that the magneto couplings are assembled in such a way that the adjusting screw is facing outwards.
10. Before assembling the propeller hub to the crankshaft, oil the splines and the cones, otherwise subsequent difficulty in removing the hub may be experienced.

Timing Engine

Check all valve tappet clearances.

1. Insert dead center indicator WA-43 in number 1 cylinder (magneto end) of left block (left from magneto end).

   (NOTE:—In the 8-cylinder engines the cylinders are numbered from the propeller end. For E-3 and E-4 engines, therefore, read "propeller end" instead of "magneto end." Also note that dead center indicator WA-4 should be used with E-3 and E-4 engines.)

2. Mount timing disc WA-114 (WA-13 is used on E-3 and E-4) on crankshaft, loosen cap screws so that disc is free on hub and put pointer in place.

3. Turn crankshaft till piston of number 1 cylinder is at top dead center.

4. Loosen nut on top of camshaft drive shaft; unscrew and slip down camshaft drive dog housing and tap the loosened nut. This will separate the serrated coupling and free the camshaft from its drive.

5. Turn camshaft till the cam of number 1 left intake is just in contact with the roller on the rocker arm.

6. Turn crankshaft till the pointer registers with the mark on timing disc for the opening of number 1 left intake valve and then tighten up nut on top of camshaft drive shaft, thus drawing serrated coupling together.

   NOTE:—Before putting in cotter pin, check over this setting to make sure that camshaft did not move whilst tightening nut.

7. Repeat the above operations for number 6 cylinder right hand.

   NOTE:—On E-3 and E-4 engines the procedure will be repeated on number 4 right hand cylinder.

Magneto Timing

1. Insert dead center indicator in number 1 cylinder (magneto end) of left block (left from magneto end).

   NOTE:—In the 8-cylinder engines, the cylinders are numbered from the propeller end. For E-3 and E-4 engines, therefore, read "propeller end" instead of "magneto end."

2. Mount timing disc on crankshaft, loosen cap screws so that disc is free on hub and fix pointer in place.

3. Turn crankshaft till piston of number 1 cylinder is at correct number of degrees before top dead center as shown on timing disc.

4. Fully advance magneto, and disconnect magneto coupling.

5. Adjust breaker cam so that points are just breaking with brush on number 1 segment of distributor.

6. Re-mesh coupling.

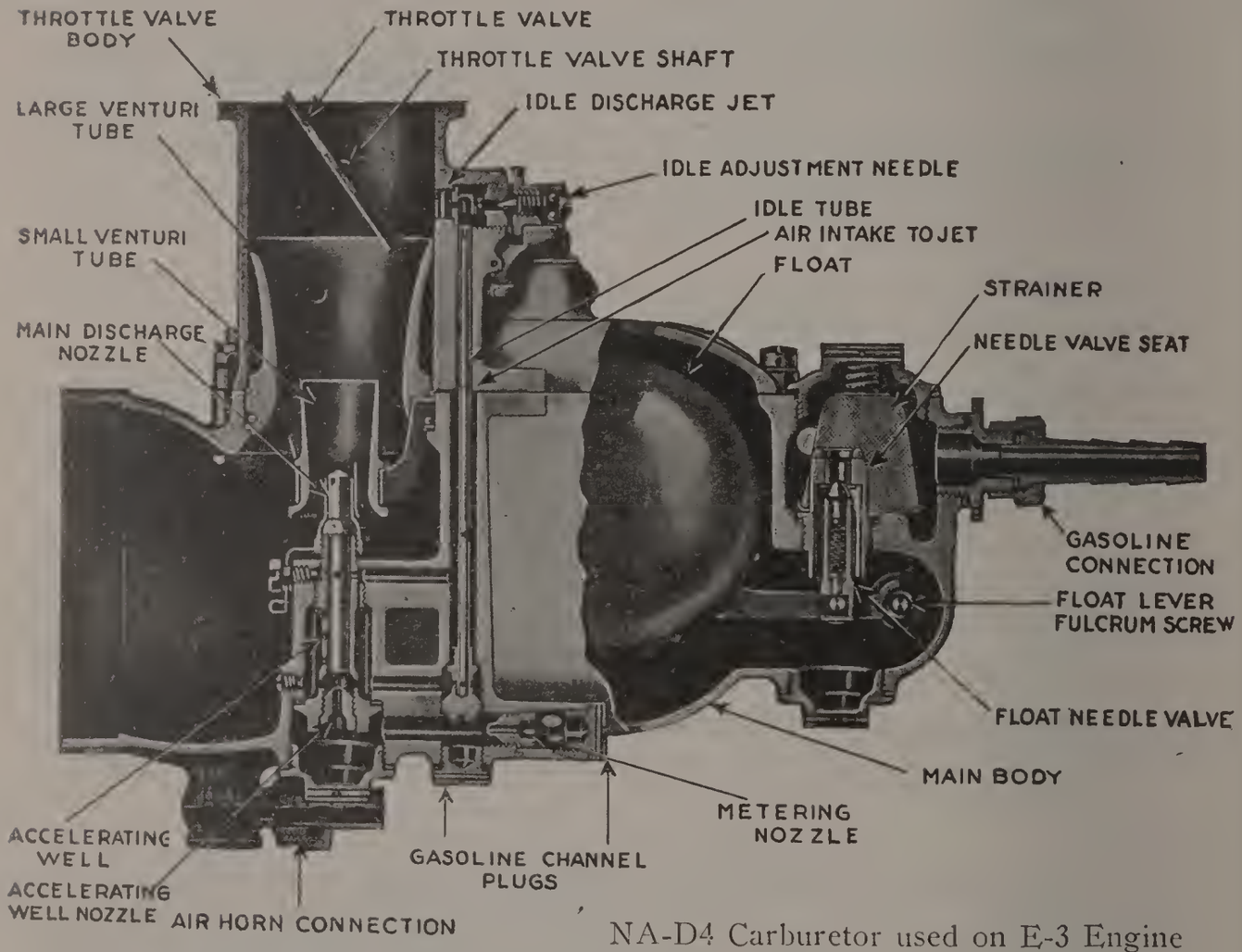
   NOTE:—On T-3 engines where the thermoid disc type of coupling is used, magneto adjustment is obtained by releasing the locking screw on the magneto coupling adjusting hub and turning the magneto coupling adjusting screw. Turning to the right advances the spark and to the left retards it.

   Do not forget to tighten the locking screw after the magnetos are timed.

Carburetor Overhaul

Instructions for taking apart Stromberg carburetors used on Wright Engines and for Inspection and Reassembly

The usual objective in overhauling the carburetor is to make sure that all parts are clean (particularly the fuel passages), that the needle valve and seat are in good condition and that no internal parts are loose. Therefore, it is seldom necessary, nor is it advisable, to disassemble the instrument completely. This applies particularly to the throttle valves. These should never be removed, for it is on the *precise* setting of these valves, relative to the idling slots, that the operation of the carburetor in idling and acceleration is dependent.



NA-D4 Carburetor used on E-3 Engine

Dismantling

1. REMOVE NEEDLE VALVE PLUG AND STRAINER.

2. TAKE OUT BOLTS AND SET SCREWS AND SEPARATE THE TWO HALVES OF THE BODY.
These two halves of the body must be separated very carefully to avoid the bending of the idling tubes which extend through both halves. If the halves do not part readily,

loosen the set screws which lock the Venturi in place and tap the air entrance lightly with some soft substance. Try not to damage the gasket, as the operation of the mixture control depends on this being perfectly tight on re-assembly.

3. REMOVE NEEDLE VALVE SEAT.
In carburetors with serial numbers larger than 753156, the valve seat is taken out from the top after the removal of the needle valve plug. In carburetors with smaller serial numbers, the valve seat is screwed in from the underside of the body; in these cases it is necessary to remove the gas chamber plug, take out float fulcrum pin, remove the float and then unscrew the seat with a special screw driver.
Examine the seat and needle valve plug for wear. Wear is usually confied to the seat, which can be made good by grinding if only slightly worn or by replacement if badly pitted. Whether the seat is removed from above or from below, be sure to preserve the gasket under it, as the thickness of this determines the level of the fuel in the float chamber. There is usually no need to remove the float excepting in the case of the older carburetors, where it is necesary in order to get at the valve seat.

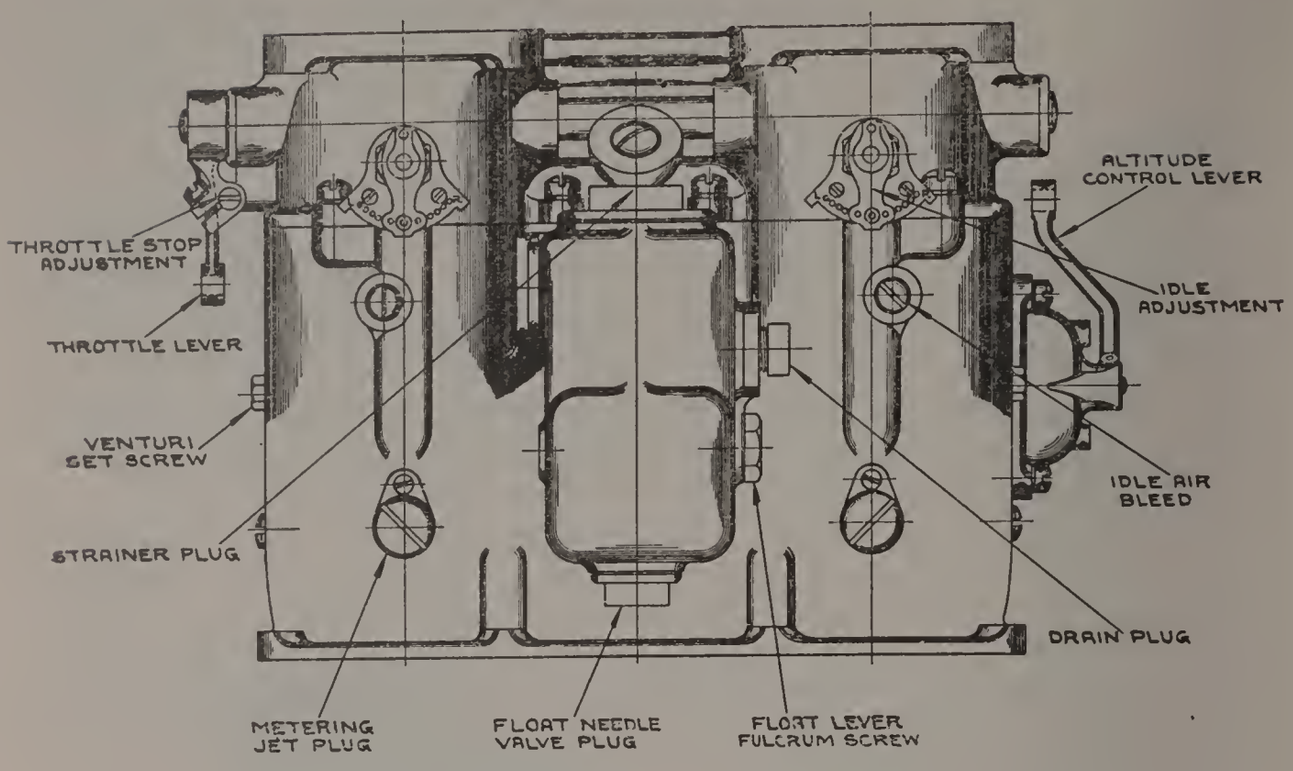
4. REMOVE THE GASOLINE CHANNEL PLUGS AND THE ACCELERATING WELL PLUG. TAKE OUT THE BODY METERING NOZZLE AND THE IDLING TUBES.
It is not usually necessary to remove the main discharge nozzles, since the gas passages can be washed out thoroughly without doing this.

5. REMOVE IDLE ADJUSTING SCREWS FROM UPPER HALF OF BODY.
Before unscrewing these, screw them in as far as they will go, making a note of the number of turns required to screw them home. This information will be required in the re-assembly.

Mixture Control

Do not take apart the pilot's control valve, but merely wash it and blow it out with compressed air. There is a small hole leading from a passage near the side of the Venturi into the float chamber. This should be examined and cleaned, if necessary; also the small screen at the entrance to this passage should be cleaned.

Model NA. U6T Carburetor



Reassembly

The order of reassembling is a reversal of the order of disassembly, but the following points should be very carefully watched:

1. Be sure the valve seat is screwed right home.
2. If the float has been removed, be sure that a 1/32″ hard washer is put beneath the head of the float lever fulcrum screw when it is replaced. If this is left out, the screw will sink in far enough to bind the float lever. Make sure that the float operates freely after it is replaced.
3. Checking fuel level.
   Whenever the valve seat or the float has been removed, the fuel level should be checked, in fact, it is advisable to check this in all overhauls. To do this, take the lower half of the carburetor and set it up with the top surface level and with all plugs, etc., in place. Then connect the fuel nozzle to a gasoline supply and apply the same pressure as that it will be subjected to in actual operation in the plane.

   Using an ordinary scale measure, the distance from the top of the float chamber to the gas level should be 1⅜″. A tolerance of 1/16″ either way may be allowed.

   If the level is too high, that is, if the scale reads less than 1⅜″, the needle valve seat must be lowered so that the valve will strike it sooner. This means changing the gasket under the seat so as to lower it. The amount the seat

should be moved is ¼ the error in level. Thus, if the level is 1¼" below the top instead of the desired 1⅜", the valve seat needs to be lowered 1/32". If the seat is too low this means the valve cuts off too soon and the seat requires to be raised.

4. In replacing the nozzles and plugs, be sure they are all tight. It is recommended that for carburetor work the screw drivers used should be of the proper sizes and be kept in good condition, for burrs on the nozzles can easily interfere with the flow of the fuel.

5. In reassembling the two halves of the carburetor, be sure that the large Venturi are properly seated in the lower half and that their lock screws enter the gaps in the locking rings. See that the surfaces of the two halves are undamaged and that the gasket is in good condition. Draw the halves together with the bolts and cap screws by tightening them gradually and in turn. The existence of a perfect joint between the halves is essential to the efficient operation of the carburetor.

6. Under Item 5 of the Dismantling it was mentioned that before removing the idle adjusting screws they should be screwed home and the number of turns required, noted. On reassembling, run the screws right home and then unscrew until the original adjustment is obtained.

7. Where two carburetors are used as in the case of the NAU-6T carburetor, the synchronization of the throttle valves of the two carburetors is more important than even the mixture adjustment, in getting good low speed operation. If the throttle valves of one carburetor can open further than those of the other, the engine speed will be too high for the smaller throttle openings and the cylinders receiving the smaller charge will miss or fire in the exhaust ports. Accurate throttle synchronization can be obtained after the carburetors have been bolted to the air horn, by adjusting the rod connecting the throttle levers of the two carburetors.

Magneto Overhaul

Magnetos should never be handled by anybody but a magneto specialist, except for cleaning the distributors and adjusting the platinum breaker points. Nevertheless, a magneto should be taken apart for examination and cleaning by a properly qualified man after 100 hours' service.

For Normal Magneto Examination Remove the two cotter keys which hold the distributor block clasps in position. Press forward the two clasps on either side of the block and spring them out, releasing the distributor block. Do not remove the wires from the distributor block. Remove binding post screw and breaker point cover. This is as much disassembly as will be necessary for a normal examination of the magneto, and, generally speaking, magnetos should not be further disassembled.

Magneto Disassembly Loosen the four screws from the sides of the magneto near base and remove the two bars and the magneto cover plate.

To remove the magnets place a soft iron keeper against the magnet at the base. Remove two nuts and cotter from the end of steel strap at driven end of magneto and raise strap up. Slip magnet up vertically, then tilt out at bottom and slide down and out from behind magneto frame bolt. Repeat for other magnet. Magnets should never be removed without the use of a keeper and should either be stored separately with a keeper in place or placed end to end with semi-circular cuts on opposite sides.

Remove screw and disconnect primary winding cable where attached to breaker point arm and loosen small clip on rotor housing which holds the cable in position. Remove screw and loosen woven copper primary ground connection. Loosen four screws and slip the two clasps off the end of the coil core piece. Lift off coil, drawing flexible cable out of hole through magneto frame.

This will be sufficient to give the magneto a careful examination and test the strength of the magnets, to clear out any dirt which may have accumulated around the rotor and to dust the condenser.

Complete disassembly is accomplished by removing the double nuts and lock washers at the top of the magneto frame and the two other bolts at the bottom. Remove nut and drive gear from taper end of rotor shaft and pry the aluminum castings off the two dowel pins which hold them at their base. Use great care in this operation, as the dowels are very tight, being put in place on an arbor press. Next remove the four screws which hold in place the rotor housing end plate and bearing support. After removing the special screw and the rotor cam, drive the rotor shaft back out of the housing (toward driven end). This is as far as the magnetos should ever be disassembled except when some part of the adjustable breaker frame may be actually broken. This frame is adjustable, being held by three screws which have special grooved heads provided with a permanent locking device. The timing of the magneto is correctly done

at the factory before shipment and should never be tampered with except for the actual replacement of broken parts. In case it is loosened it will be necessary to retime the magneto.

Inspection Inspect the rotor member for signs of binding, either on the outer face of the soft iron members or on the ends of these members.

Inspect the flexible copper ground connection to see that it is clean and tight.

See that the inner-distributor rotor carbon brush is in good condition and makes good contact with the high tension winding. Examine the platinum points to see that they are free from serious pits, have a smooth contact surface and are adjusted to the correct clearance when wide open. (See specification list on pages 91-96.)

Reassembly Reassemble rotor shaft and ball bearings in rotor housing, using extreme care that all parts are entirely clean and that the ball bearings are packed in with a small amount of vaseline. Great care must be exercised that the two spacing washers on the rotating shaft are of such thickness that the shaft has 0.002 to 0.004 play, both between the collars on the shaft and between each collar and the opposite front or back plate. Also that the rotated member is in the center of the field structure so that a 0.003 feeler gauge can be passed completely around it in any position. If this rotor should bind at any point, heat will be produced and it may eventually break the shaft.

Replace the drive coupling part and the cam with its lock screw. Also replace the magneto drive coupling part together with its nut and cotter pin at the driven end of the shaft.

Reassemble the coil, being sure that the winding clamp screws are tight and that their lock nuts are tight. Also that the wire connections are clean and tight.

Replace the magnets, being careful that the magneto support pieces are in place. Screw the magneto strap down tight and lock it by tightening the double nuts against lock washers. Replace magneto cover. Replace breaker cover and terminal screw. Clean the inside of the distributor box of all free carbon and replace.

Numerical Parts List

T-2 and T-3 Engines

Part No.	Part Name	Quantity per engine T-2	T-3
B-28	Gasket, $\frac{45}{64}$" I. D. x $\frac{15}{16}$" O. D. x $\frac{5}{64}$	24	24
B-32	Gasket, $2\frac{17}{32}$" I. D. x $2\frac{27}{32}$" O. D. x $\frac{3}{32}$"	1	1
B-63	Cotterpin, $\frac{3}{32}$ x $1\frac{1}{4}$	2	2
B-64	Cotterpin, $\frac{5}{64}$ x 1	2	
656	Cotterpin, $\frac{3}{32}$ x $\frac{3}{4}$	12	13
657	Cotterpin, $\frac{3}{32}$	24	22
904	Ball Bearing	1	2
1437	Dowel, $\frac{5}{16}$ x $\frac{3}{4}$	20	20
1458	Washer, $\frac{13}{32}$ plain	6	4
6204-A	Ball Bearing	5	5
6205-A	Ball Bearing	1	1
6207-A	Ball Bearing	1	1
6208-A	Ball Bearing	2	2
6306-A	Ball Bearing #6306		1
6315-A	Ball Bearing	1	
6316-A	Ball Bearing #316		1
10487	Lock Ring, Vert. Shaft Casing Nut	2	2
10561	Coupling, Tachometer		1
11161	Rivet, .066"-.072" Dia. x $\frac{3}{16}$" Rd. Head Iron		8
11163	Dowel, Conn. Rod Bushing	12	12
11168	Packing $\frac{1}{8}$"	13′	9′
11169	Cotterpin, $\frac{1}{16}$ x $\frac{1}{2}$	78	54
11204	Hose, $\frac{3}{8}$" I. D. x 3" Long		4
11206	Pin, Tachometer Coupling		1
11207	Cotterpin, $\frac{3}{64}$" Dia. x $\frac{1}{2}$"		2
11233	Plug, $\frac{3}{4}$" Pipe		1
11235	Clamp, Hose $1\frac{1}{2}$" I. D.		8
11245	Clamp, $\frac{3}{8}$" Hose	8	12
11340	Terminal, Ignition Wire (Rajah)	24	24
11348	Cotterpin, $\frac{1}{8}$ x $1\frac{1}{2}$	2	2
11440	Gasket, $1\frac{1}{2}$ x $1\frac{3}{4}$ x $\frac{5}{64}$	3	1
11443	Pin, Straight $\frac{1}{16}$ x $\frac{3}{8}$	16	16
11445	Cotterpin, $\frac{1}{16}$ x 1	3	3
11449	Ring, Ignition Wire, large	4	
11457	Ring, Ignition Wire, small	2	4
11503	Nut, Slotted $\frac{3}{8}$ x 24 x $\frac{1}{2}$	24	24
11508	Nut, Slotted $\frac{1}{2}$ x 20 x $\frac{1}{2}$	14	14
11530	Spring, Oil press. relief	1	1
11531	Plunger, Oil press. relief	1	
11540	Pin, straight $\frac{1}{16}$ x $\frac{11}{16}$	7	6
11559	Gasket, $\frac{5}{8}$ I. D.	1	2
11680	Key, #3 Woodruff	5	5
11705	Washer, $\frac{21}{64}$" x $\frac{5}{8}$ x $\frac{1}{16}$	3	3
11707	Cotterpin, $\frac{5}{64}$ x $\frac{3}{4}$	24	24
11796	Cock, Spring key $\frac{1}{8}$"	3	3
11819	Plug, $\frac{5}{8}$-18	5	6
11820	Screw, Fill. Head #14-24 x $\frac{9}{16}$	6	14
11896	Spring, Mag. Coupling	2	
11897	Coupling, Magneto	2	
11898	Washer, Mag. Coupling spring	2	
11900	Nut, $\frac{3}{8}$-16 x $\frac{3}{8}$	2	2
11901	Rivet, Rd. Hd. $\frac{1}{8}$ x $\frac{3}{8}$	24	
11945	Cotterpin, $\frac{5}{32}$ x $2\frac{1}{4}$	2	
11893	Rivet, Flat Hd. $\frac{5}{32}$ x $\frac{1}{4}$	32	40
11985	Spark Plug, Champion AC large porcelain	24	
12053	Screw, Rd. Hd. #4—32 x $\frac{1}{4}$	8	8

Part No.	Part Name	Quantity per engine T-2	T-3
14143	Washer, Valve Spring, lower	48	48
14218	Rivet, Rd. Hd. 1/8 x 1/2		2
14221	Rivet, Rd. Hd. 1/8 x 1/4	6	6
14282	Cotterpin, 1/8 x 1	19	19
14408	Plug, 1/8 Pipe	15	13
14437	Nut, Castled 3/8-24 x 13/32	32	32
14574	Nut, Plain 5/16 x 24	138	125
14575	Nut, Plain 3/8 x 24	85	39
14605	Gear, Oil pump drive	3	3
14608	Gear, Oil pump 5/8 face	1	1
14631	Plug, Oil and Water pump dr. shaft	1	1
14632	Gasket, Oil Pump Cover plate	1	1
14633	Gear, Pump Idler 5/8 face	1	1
14641	Plate, Oil filter end	1	1
14642	Spring, Oil filter	1	1
14644	Tube, Oil suction filter	1	
14648	Hose, 1" I. D. x 3"	2	
14649	Clamp, 1" I. D. Hose	4	12
14692	Packing, 9/16 I. D. x 7/8 O. D.	2	2
14700	Screw, Fuel press. relief adj	1	1
14701	Nut, Lock, Fuel press. relief adj	1	1
14702	Cover, Fuel press. relief	1	1
14711	Gasket, 7/8 x 1 1/8 x 1/16	12	12
14712	Nut, Castled 5/16-24	7	7
14734	Plug, Crankshaft (large)	13	6
14771	Spring, Valve outer	48	48
14772	Spring, Valve inner	48	48
14774	Washer, Valve spring upper	48	
14775	Lock, Valve spring washer	96	96
14792	Plug, 1 3/8 x 12		2
14800	Adapter, Tachometer Shaft	1	
14810	Body, Oil press. relief	1	1
14826	Connection, 3/4 I. D. Hose	2	2
14832	Nut, Slotted 9/16 x 18 x 5/16	2	
14833	Screw, Fill. Hd. 1/4 x 20 x 5/16	2	2
14835	Gasket, 3/4 x 1	2	6
14837	Screw, Fill. Hd. 1/4 x 20 x 9/16	10	
14873	Dowel, 3/16 x 3/8	2	2
14889	Screw, Hdless. Set 5/16 x 24 x 1/2	6	6
14921	Nut, 3/8 x 24 x 5/32	48	48
14922	Gasket, 1 3/8 I. D. x 1 5/8 O. D.		2
14931	Nut, Plain 1/4 x 28	22	30
14940	Lock washer, 5/16 x 1/8 x 1/16	3	3
14941	Lock washer, 1/4 x 3/32 x 3/64	14	14
14950	Nut, Castled 7/16 x 20	7	6
14952	Stud, 5/16 x 24 x 18 x 1 3/16	4	20
14953	Stud, 5/16 x 24 x 18 x 1 1/4	11	12
14954	Stud, 5/16 x 24 x 18 x 1 1/2	24	24
14955	Stud, 5/16 x 24 x 18 x 1 3/4	5	5
14956	Stud, 5/16 x 24 x 18 x 1 3/8	6	6
14957	Stud, 3/8 x 16 x 24 x 1 1/2	2	4
14958	Stud, 3/8 x 16 x 24 x 1 9/16	4	
14959	Stud, 1/4 x 20 x 28 x 1 3/16	4	12
14960	Stud, 1/4 x 20 x 28 x 1	10	6
14961	Stud, 1/4 x 20 x 28 x 1 1/16	4	4
14964	Stud, 5/16 x 18 x 24 x 1 17/32	72	48
14965	Nut, 5/16 x 24 x 3/8	72	48
14975	Hose, 1/2" I. D. x 2	3	3
14977	Clamp, 1/2" I. D. Hose	6	6
14979	Dowel, 1/4 x 5/8	12	6

Part No.	Part Name	Quantity per engine T-2	T-3
14981	Gasket, Crankcase Rear Cover	2	1
14987	Pin, $\frac{7}{32}$ x $\frac{13}{32}$	4	4
14988	Nut, #10 x 32 x $\frac{3}{16}$	2	2
14994	Washer, $\frac{17}{64}$ x ½ x $\frac{1}{16}$	6	14
14995	Washer, $\frac{21}{64}$ x $\frac{19}{32}$ x $\frac{5}{64}$	110	95
14996	Washer, $\frac{25}{64}$ x $\frac{11}{16}$ x $\frac{5}{64}$	71	97
14997	Washer, $\frac{29}{64}$ x $\frac{13}{64}$ x $\frac{3}{32}$	11	9
15019	Plate, Motor Name	1	1
*15189	Screen, Oil filter	1	1
*15190	Screen, Oil filter reinforcement	1	1
15200	Stud, ⅜ x 16 x 24 x 1⅜	2	
15202	Union Brazing—elbow ⅛ x $\frac{5}{16}$		1
15203	Union Brazing—elbow ¼ x ⅜	5	
15204	Union Brazing—str. ¼ x ⅜	1	1
15253	Bushing, Fuel Pump gear	1	1
15256	Gasket, Fuel Pump cover	2	2
15258	Nut, Packing, fuel pump	1	1
15259	Spring, Fuel press. relief valve	1	1
15266	Tag, Mag. inside	1	1
15267	Tag, Mag. outside	1	1
15283	Clip, ⅜ O. D. Pipe	2	
15286	Valve, Fuel press. relief	1	1
15287	Guide, Fuel press, relief adj. screw	1	1
15330	Nut, Propeller hub bolt	8	8
15372	Stud, $\frac{5}{16}$ x 18 x 24 x 1$\frac{1}{16}$	8	8
15421	Screw Cap, ⅜ x 16 x 1$\frac{3}{32}$	4	4
15422	Stud, $\frac{5}{16}$ x 18 x 24 x 1$\frac{5}{32}$		2
15440	Plug, 1¼ x 12		7
15472	Screw, Fill. Hd. ¼ x 20 x $\frac{11}{16}$	16	26
15487	Plug, ⅞ x 14	1	1
15489	Cap, Oil press relief	1	
15513	Bushing, Conn. Rod	12	
15516	Pin, Piston	12	
15517	Plug, Piston pin	24	
15524	Ring, Piston	60	60
15537	Roller, Cam	24	
15541	Screw, Valve adj	48	48
15542	Shaft, Rocker arm	8	
15543	Guide, Valve intake	24	
15545	Rocker, Valve	24	
15560	Bolt, Conn. Rod inner	24	
15563	Bushing, Valve Rocker	24	48
15564	Bushing, Valve Rocker oil feed	24	
15565	Nut, Castled ¼ x 28 x $\frac{9}{32}$	14	14
15598	Pin, Escutcheon .080 x ⅝	3	3
15610	Screw, Lock ⅜ x 16 x $\frac{13}{32}$	2	
15678	Pin, Brazing	1	1
15681	Union, Brazing Str. ⅛ x ¼	1	1
*15694	Crankshaft	1	
15732	Plug, ¼ Pipe	1	1
15740	Nut, Camshaft	2	2
15741	Clamp, 1¼ I. D. hose	20	
15742	Cover, Camshaft Housing rear	2	
15743	Gasket, Camshaft Housing cover rear	2	
15744	Shaft, Tachometer Drive	2	
15750	Dowel, Crankshaft Bearing	7	7
*15752	Connecting Rod, inner	6	
*15753	Connecting Rod, outer	6	
15754	Bolt, Conn. Rod, outer	12	

*** Not to be ordered as spares.**

Part No.	Part Name	Quantity per engine T-2	T-3
15759	Cover, Oil filter	1	1
15761	Plug, 3/4 x 16	4	4
15763	Dowel, 1/4 x 7/16	24	24
*15767	Housing, Camshaft L. H.	1	
*15768	Housing, Camshaft R. H.	1	
15769	Cover, Camshaft Housing	4	
15770	Gasket, Camshaft Housing Cover	4	
*15772	Hub, Propeller	1	
15773	Flange, Propeller Hub	1	
15779	Bearing, Camshaft	2	
15780	Key, #8 Woodruff	2	2
15781	Stud, 5/16 x 18 x 24 x 1 7/16	40	24
15782	Bolt, Crankshaft Bearing	2	
15783	Stud, 7/16 x 14 x 20 x 2	7	16
15784	Nut, Propeller Hub outer	1	
15785	Nut, Propeller Hub inner	1	
15787	Ring, Prop. Hub Centering Small	1	
15788	Ring, Prop. Hub Centering Large	1	
15789	Bolt, Prop. Hub	8	8
15790	Nut, Crankshaft Ball Bearing	1	
15791	Slinger, Crankshaft Oil	1	
*15792	Camshaft L. H.	1	
*15793	Camshaft R. H.	1	
15794	Gear, Crankshaft	1	
15796	Gear, Vert. Shaft Drive	1	
15797	Gear, Mag. Drive	1	1
15798	Gear, Mag.	2	2
15799	Gear, Camshaft	2	
15801	Gear, Camshaft Drive Shaft	2	
15803	Pinion, Camshaft Drive Shaft	2	
15807	Stud, 5/16 x 18 x 24 x 1 5/16	13	13
15809	Bolt, Crankshaft Bearing slotted	8	
15810	Stud, Crankshaft Bearing Rear	2	
15811	Washer, 37/64 x 1 1/8 x 3/32	2	2
15812	Washer, 37/64 x 1 x 3/32	18	18
18813	Nut, Castled 9/16 x 18	18	18
15815	Stud, 3/8 x 16 x 24 x 3 5/16	16	
*15821	Sleeve, Camshaft Bearing	4	
15822	Tube Breather	2	
15823	Cap, Breather Tube	2	
15824	Gasket, Camshaft Housing bearing	8	
15825	Gasket, Breather tube	2	
15828	Key, #5 Woodruff	2	
15831	Cover, Crankcase front	1	
15832	Clip, Wire manifold	16	8
*15833	Manifold, Cyl. Ignition wire outside front	2	2
*15834	Manifold, Cyl. Ignition wire outside rear	2	2
15837	Stud, 5/16 x 18 x 24 x 7/8	16	20
*15840	Cap, Crankshaft Bearing front	1	
15845	Gasket, Camshaft Housing	4	
15851	Hose, 1 1/4 I. D. x 1 11/16 O. D. x 3 1/4	6	
15857	Washer, 1 1/2 x 2 5/8 x .175	1	
15866	Washer, 45/64 x 1 3/8 x 3/32	1	1
15867	Nut, Slotted 11/16 x 16	2	2
15869	Nut, Crankshaft Gear	1	
15870	Key, Str. 1/4 x 1/4 x 1 15/16	1	1
15871	Cover, Camshaft Housing front	2	
15872	Gasket, Camshaft Housing Cover fr	2	
15873	Bearing, Camshaft drive shaft gear	2	

*** Not to be ordered as spares.**

Part No.	Part Name	Quantity per engine T-2	T-3
15875	Cage, Mag. gear b. b.	2	
15876	Retainer, Mag. gear b. b.	2	
15877	Spacer, .792 I. D. x 1. O. D. x 3/8	2	2
15878	Nut, 1 1/8 x 12 x 3/8	2	2
15879	Gasket, Camshaft Drive Housing	2	2
15880	Retainer, Vert. Shaft b. b.	1	1
15881	Screw, #10 x 24 x 1/2	8	8
15882	Nut, Castled 1/2 x 20 x 5/16	2	
15883	Dog, Camshaft Drive, upper	2	
15884	Dog, Camshaft Drive, lower	2	
15885	Shaft, Gun Control Drive	2	
15886	Bushing, 1 1/16 x 1 1/4 x 2 1/64	2	
15888	Gasket, Camshaft dr. shaft pinion housing	2	2
15893	Bearing, Gun Control gear	2	
15894	Dowel, Gun control gear bearing	2	
15895	Nut, Packing 2 1/4 x 16	2	
15896	Stud, 5/16 x 18 x 24 x 1 5/16	4	4
15897	Bolt, 3/8 x 24 x 1 1/8	2	2
15905	Lock Ring, 1 7/16 I. D.	2	2
15906	Cap, Tachometer shaft	1	
15909	Flange, Exhaust pipe	12	
15910	Gasket, Exh. pipe flange	12	
15911	Stud, 3/8 x 16 x 24 x 5 7/32	8	
15912	Stud, 3/8 x 16 x 24 x 4 11/32	16	
15913	Stud, 3/8 x 16 x 24 x 4 7/16	32	
15927	Pin, 1/4 x 21/32	2	2
15939	Insert, Spark plug	24	24
*15940	Seat, Valve	48	
*15941	Ring, Oil filter	1	1
16026	Union, Soldering-Tee 1/8 x 5/16 x 5/16	2	1
16027	Union, Soldering-Str. 1/8 x 5/16	3	3
16044	Plug, 1/2" pipe	2	
16045	Bearing, Conn. Rod	12	
16075	Retainer, Starter b. b.	1	
16076	Cover, Starter	1	
16079	Spring, 12/64 x 1	1	
16080	Ball, 5/16 dia.	1	
16081	Pin, taper #4 x 1 1/4	2	
16082	Pin, 5/16 x 1 3/4	2	2
16084	Collar, Starter worm	1	
16085	Stud, 3/8 x 16 x 24 x 3 3/4	7	
16086	Screw, 5/16 x 18	2	2
16087	Shaft, Starter drive-long	1	
16093	Body, Fuel Pump	1	1
16095	Gear, Fuel pump internal	1	1
16096	Pinion, Fuel pump	1	1
16098	Connection, Elbow 1/2 I. D. hose	3	
16099	Spring, 11/16 x 13/16	1	1
16105	Pipe, Cyl. water inlet tee	2	
*16106	Connection, Cyld. water inlet tee	2	
16107	Pipe, Cyld. water inlet, front	2	
16108	Elbow, Cyld. water inlet	2	
16109	Connection, Cyl. water inlet elbow	2	
16114	Pipe, Camshaft hous. oil return	4	
16116	Nut, Packing 7/8 x 14	8	
16117	Plug, 1" Pipe	53	55
16118	Bearing, Crankshaft large, lower	2	
16119	Bearing, Crankshaft large, upper	2	
16120	Bearing, Crankshaft small, upper	5	

*** Not to be ordered as spares.**

Part No.	Part Name	Quantity per engine T-2	T-3
16121	Bearing, Crankshaft small, lower	5	
*16122	Nipple, Oil return pipe, lower	4	4
16123	Valve, Inlet & Ex	48	
16125	Gear, Oil pump drive	1	1
16126	Bearing, Oil pump drive gear	1	
*16130	Pipe, Oil suction	1	
*16139	Nipple, Oil return pipe, upper	4	4
16151	Stud, 5/16 x 18 x 24 x 2 1/8	6	6
16156	Gasket, Fuel pump mounting flange	1	1
16162	Guide, Valve Ex	24	
*16163	Cap, Crankshaft Bearing inter	4	
*16185	Dowel, Prop. Hub	1	1
16201	Plug, Valve stem	48	48
16205	Magneto, Splitdorf S. S. 12	2	2
16207	Bushing, Cam Roller	24	
16212	Housing, Crankshaft dr. shaft pinion	2	
*16236	Cap, Crankshaft bearing centre	1	
16237	Pin, Cam Roller	24	
16238	Bushing, 5/8 x 18 x 7/16 x 20 x 13/16	4	3
16239	Screw, Cap 7/16 x 20 x 1 1/4	4	3
16254	Housing, Camshaft Drive Dog	2	
16257	Plate, Hub flange name	1	1
*16280	Crankcase, upper	1	
*16288	Cylinder Block	4	
*16289	Cylinder sleeve	12	
16295	Hose, 1 3/8 x 1 13/16 x 3		4
16301	Gasket, Cyl. flange	4	
16302	Shaft, Camshaft Drive	2	
16303	Housing, Camshaft Drive shaft	2	
16304	Cover, Vert. Shaft housing	1	
16306	Housing, Camshaft drive	1	
16307	Gear, Pump Drive	1	1
16309	Lock Ring, 1 3/16 I. D.	1	1
16310	Nut, 1 5/16 x 16 x 1/4	1	1
16312	Cage, #6204 b. b.	1	1
16314	Gear, Vert. shaft upper	1	
16315	Gear, Vert. shaft lower	1	
16317	Gear, Gun Control	2	
16319	Gear, Oil pump (7/8 face)	2	2
16320	Gear, Pump Idler (7/8 face)	2	2
*16321	Crankcase, lower	1	
*16322	Pipe, Oil pressure	1	
*16323	Flange, Oil press. pipe	2	2
16324	Gasket, Oil press. pipe flange	2	2
16325	Body, Oil pump	1	1
*16327	Screen, Oil suction pump, rear	1	1
*16328	Screen, Oil suction pump frame	1	1
16329	Gear, Pump drive—lower	1	
16330	Bushing, Pump drive gear lower	1	1
16331	Cork, 17/32 x 7/8	1	1
16332	Housing, Vert. Shaft	1	
16333	Cap, Gun control gear brg.	2	
16335	Pipe, Water pump outlet	2	
16336	Gasket, Water pump cover	1	1
16337	Rivet, 1/4 x 1/2	4	4
16338	Stud, 7/16 x 14 x 20 x 1 5/8	112	120
16339	Nut, 7/16 x 20 x 7/16	112	120
16340	Plug, 1 1/2" pipe	2	
*16341	Pipe, Camshaft housing feed	2	

* Not to be ordered as spares.

Part No.	Part Name	Quantity per engine T-2	T-3
16342	Body, Water pump	1	1
16343	Cover, Water pump	1	
*16344	Impeller, Water pump	1	1
*16345	Shaft, Water pump	1	1
16347	Gasket, 3/4 x 1 1/16 x 1/16	1	1
16348	Plug, Water pump cover thrust	1	1
16349	Bushing, Water pump shaft	1	1
16350	Button, Water pump thrust	1	1
16351	Bushing, Water pump shaft, lower	1	1
16352	Nut, Packing 1 1/4 x 12	1	1
16353	Gland, Water pump packing	1	
*16354	Flange, 1 1/4 O. D. pipe	2	
16355	Gasket, 1 1/4 O. D. pipe	2	2
16356	Plate, Oil pump cover	1	
16357	Stud, 3/8 x 16 x 24 x 2 1/4	2	2
*16361	Pipe, Cyl. water L. H.	1	
*16362	Pipe, Cyl. water R. H.	1	
16363	Screw, Lock 1/4 x 20 x 43/64	1	1
16365	Cover, Generator Drive	1	
16366	Gasket, Generator Drive Cover	1	
16367	Gasket, Vert. shaft housing cover	1	1
*16368	Pipe, Vert. drive oil feed	1	
16373	Gasket, Camshaft drive housing	3	3
16374	Piston	12	
16375	Stud, 3/8 x 16 x 24 x 1 3/8	4	4
16376	Stud, 3/8 x 16 x 24 x 2 1/16	2	2
16377	Stud, 1/4 x 20 x 28 x 1	14	14
*16378	Manifold, Oil, front	1	
*16379	Manifold, Oil, rear	1	
*16380	Tube, Oil manifold front	1	
*16381	Tube, Oil manifold rear	1	
*16382	Tube, Oil manifold inter.	4	
16383	Tube, 5/16 O. D. x 4"	1	
*16384	Flange, Oil manifold	1	
16385	Gasket, 9/16 pipe flange	1	1
*16386	Flange, 5/16 pipe	7	3
16387	Gasket, 5/16 pipe flange	7	7
16388	Clip, 9/16 pipe	4	4
16389	Bushing, 13/16 x 5/8 x 1/2	1	1
16390	Stud, 5/16 x 18 x 24 x 1 1/4	1	4
16391	Worm, Starter 15 to 1	1	
16392	Wheel, Starter worm—15 to 1	1	
*16393	Housing, Starter	1	
*16396	Bushing, Starter worm—large	1	
*16397	Bushing, Starter worm—small	1	
16398	Washer, Thrust Bearing	1	1
16399	Gear, Starting Mag.	1	
16400	Pinion, Starting mag.	1	
16401	Tube, Oil 5/16 x 8 3/8	1	1
16403	Tube, Oil 5/16 x 6 21/32	1	
16404	Lock, Starting mag.	1	1
16405	Spring, Starting mag.	1	1
16406	Lock pad, Starting mag.	1	1
16407	Stud, Starting Mag.	2	2
16408	Rein, Starting Mag. Strap	2	2
16409	Strap, Starting Mag.	1	1
16411	Link, Mag. advance R. H.	1	1
16412	Bell Crank, 90° 2 7/8 x 3 1/4 R. H.	1	1
16414	Magneto, Starting (Drive 100)	1	

* Not to be ordered as spares.

Part No.	Part Name	Quantity per engine T-2	T-3
*16415	Gear, Coupling 23 teeth	2	
*16416	Gear, coupling 24 teeth	2	
16417	Gear, Mag. shaft	2	
16418	Gear, Mag. dr. shaft	2	
*16419	Manifold, Ig. wire	1	1
16432	Adapter, 1" pipe thrd. ¼ pipe thd	1	
16436	Connection, St. ⅜ I. D. Hose	4	6
*16438	Seat, Valve		48
16440	Ball End, ⅜ dia.	4	4
16441	Yoke end, $\frac{5}{16}$ dia. threaded	1	1
16442	Yoke end, $\frac{5}{16}$ dia. plain	1	1
16443	Rod, Mag. advance	1	
16444	Nut, Adj. Ball end	4	4
16445	Bell Crank, 90° 2⅞ x 3¼ L. D.	1	1
16446	Lever, 2" Str.	1	1
16447	Bolt, ⅜ x 24 x $1\frac{13}{32}$	2	2
16448	Bushing, ⅜ x ½ x ½	2	2
16449	Stud, Crankshaft bearing centre	6	
16458	Plug, ⅜ pipe	8	8
16460	Carburetor, N. A. U-6-T	2	
16464	Bell Crank 90° x 2 x 2	1	1
*16470	Tee, Carburetor	2	
16473	Nut, Packing 2¾ x 16 x $\frac{11}{16}$	2	
16474	Extension, Carb. tee	2	
*16476	Manifold, Cyl. ig. wire, inside fr.	2	
*16477	Manifold, Cyl. ign. wire inside rear	2	2
16480	Body, Air horn	1	
16481	Gasket, Air horn body	2	2
16482	Rod, Carb. control	2	
16483	Hose, ⅜ x ⅝ x 2	4	2
16484	Yoke end single	2	2
16485	Yoke end special	2	2
*16486	Pipe, Air horn drain	1	1
*16487	Pipe, Fuel pump drain	1	1
*16488	Pipe, Gasoline feed	1	
*16489	Extension, Gasoline feed pipe	1	
*16490	Pipe, Carb. tee water	2	
*16491	Extension, Carb. tee water inlet pipe	1	
16492	Nut, #10 x 32 L. H. x $\frac{3}{16}$	4	4
*16493	Pipe, Carb. tee water outlet branch	1	
*16497	Pipe, Cyl. water outlet	2	
*16498	Extension, Cyld. water outlet pipe	2	
16500	Clip, ½ O. D. pipe	2	2
16501	Tee, Water pump drain	1	
*16502	Extension, Carb. tee water outlet pipe	1	
16503	Gasket, Carb.	4	4
16504	Gasket, Intake Manifold tee	4	
16505	Hose, 1¼ x $1\frac{11}{16}$ x 2½	4	
16507	Marker, Ign. wire	2 sets	1 set
*16514	Crankcase, upper		1
*16515	Crankcase, lower		1
16516	Plate, Engine Data	1	1
16518	Plate, Exhaust port	12	
*16538	Cylinder Sleeve		12
16542	Pin, Piston		12
16543	Plug, Piston pin		24
16544	Bushing, Conn. Rod		12
*16548	Cap, Crankshaft front bearing		1
*16549	Cap, Crankshaft center bearing		1

* Not to be ordered as spares.

Part No.	Part Name	Quantity per engine T-2	T-3
*16550	Cap, Crankshaft inter. bearing		1
16566	Valve, Intake & Exhaust		48
16568	Shaft, Rocker Arm		8
16571	Stud, Crankshaft Brg.—short		8
16572	Guide, Valve—Intake		24
16573	Guide, Valve—Exh.		24
16574	Roller, Cam		24
16577	Gear, Vert. shaft dr		1
16578	Gear, Crankshaft		1
16581	Pin, Escutcheon .057 x ¼	2	6
16582	Tube, Breather		2
16583	Cap, Breather tube		2
16584	Housing, Vert. shaft		1
16585	Gear, Gun Control		2
16586	Housing, Gun control gear		2
16587	Bushing, Oil pump dr. gear		1
16588	Spacer, Crankshaft gear		1
16589	Nut, Crankshaft gear		1
16590	Cover, Crankcase front		1
16591	Housing, Camshaft drive		1
16594	Cap, Oil press. relief		1
16595	Housing, Camshaft dr. shaft pinion		2
16596	Cover, Camshaft Housing, rear		2
16597	Gasket, Camshaft housing cover, rear		2
16598	Bushing, Tach. shaft		1
16599	Shaft, Tach. Drive		1
16600	Adapter, Tach. Coupling		2
*16602	Pipe, Cyl. water outlet front		2
16604	Gasket, Camshaft housing cover		2
16607	Gasket, Ex. pipe flange		12
16609	Stud, Crankshaft Bearing long		8
16610	Bearing, Crankshaft front upper		1
16611	Bearing, Crankshaft front lower		1
16612	Bearing, Crankshaft center, upper		1
16613	Bearing, Crankshaft center lower		1
16614	Bearing, Crankshaft intermed., upper		5
16615	Bearing, Crankshaft intermed., lower		5
16616	Stud, ⅜ x 16 x 24 x 2 $\frac{18}{32}$		16
*16618	Manifold, Oil front		1
*16619	Tube, Oil Manifold front		1
*16620	Tube, Oil manifold rear		1
*16621	Tube, Oil manifold intermed.		4
*16622	Tube, Oil manifold center		1
16624	Link, Mag. advance L. H.	1	1
*16626	Pipe, Oil press.		1
*16627	Pipe, Oil suction		1
16629	Gasket, Breather tube		2
16630	Stud, ⅜ x 16 x 24 x 3 $\frac{1}{32}$		2
*16631	Manifold, Oil rear		1
16632	Cover, Generator Drive		1
16633	Gasket, 2⅜ sq. x 1 $\frac{31}{32}$ I. D.		1
16634	Stud, ⅜ x 16 x 24 x 1 $\frac{13}{16}$		16
16636	Stud, ¼ x 20 x 28 x 1 $\frac{1}{16}$		4
16637	Plug, Rocker Arm shaft		4
16638	Body, Air horn		1
16639	Screw, Camshaft housing cover		22
16640	Nut, Camshaft Housing cover		16
16642	Clamp, Ign. wire manifold	1	1

* Not to be ordered as spares.

Part No.	Part Name	Quantity per engine T-2	T-3
16643	Nut, 3/8 x 24 P. special		
16644	Dowel, 1/16 x 1/8 x 9/32	24	24
16645	Plunger, Oil press. relief		1
*16647	Nozzle, Vert. drive oil feed pipe	1	
16449	Hose, 1" x 1 7/16 x 2 3/4		6
*16650	Extension, Cyl. water outlet conn	4	
*16651	Connection, Cyl. water outlet	4	
*16652	Tube, Oil suction filter		1
16653	Tube, 5/16 x 5 13/16		1
16654	Rod, Mag. Advance		1
16655	Plug, 3/4 x 16 x 1"		1
16659	Housing, Camshaft dr. shaft		2
16660	Casing, Camshaft Drive Shaft		2
16661	Nut, Camshaft dr. shaft casing		1
16662	Shaft, Camshaft Drive		2
16663	Dog, Camshaft Drive, upper		2
16664	Dog, Camshaft drive, lower		2
16665	Bolt, Camshaft drive dog clamp		2
16666	Spring, Camshaft dr. shaft thrust		2
16667	Pin, 3/32 x 13/32		2
16668	Lock Ring, 1 7/16 I. D.		1
16669	Gasket, Cyl. flange		4
16670	Gasket, Intake Ell		4
16671	Bolt, Crankshaft bearing		2
*16672	Connection, Cyl. water outlet		6
*16674	Flange, Water pipe coupling, threaded		2
*16675	Flange, Water pipe coupling		2
16676	Packing, 31/32 x 1 5/16 x 1/4		2
16677	Screw, 5/16 x 24 x 9/16		4
16678	Rod, Carb. control		2
16681	Pipe, Camshaft Housing Oil Return		4
16684	Gasket, Camshaft Housing		4
16685	Gasket, Camshaft Housing Bearing large		4
16686	Gasket, Camshaft Housing Brg. small		8
16687	Washer, 13/32 x 7/8 x 3/32		2
16688	Washer, 7/32 x 5/8 x 1/32		16
16689	Nut, Slotted #10 x 32 x 3/16		8
16690	Bolt, #10 x 32 x 21/32		8
16691	Screw, fill. hd. #10 x 32 x 21/32		2
16693	Plug, Expansion 1 1/8"		1
16695	Washer, Camshaft dr. shaft pinion	2	2
16696	Cap, Crankshaft Bearing, rear	1	
16697	Bolt, 3/8 x 24 x 7/8	2	
16698	Plug, 1/2" pipe		2
*16699	Pipe, Camshaft Housing feed		2
16700	Cork, 13/32 x 7/8		2
*16702	Flange, 1 3/8 pipe		2
*16703	Pipe, Water pump outlet		2
*16704	Pipe, Cyl. water R. H.		1
*16705	Pipe, Cyl. water L. H.		1
16707	Stud, 3/8 x 16 x 24 x 1 3/8	4	8
16708	Cover, Water pump		1
16716	Stud, 3/8 x 16 x 24 x 1 3/16	4	
16718	Bushing, 7/16 x .317 x 21/32	1	1
16719	Shaft, Fuel pump pinion	1	1
16722	Cover, Fuel Pump	1	1
*16723	Pipe, Carb. float chamber	1	
16734	Pinion, Camshaft dr. shaft		2

* Not to be ordered as spares.

Part No.	Part Name	Quantity per engine T-2	T-3
16736	Bushing, Reducing 3/8 x 1/8		1
16737	Connection Str. 1/2 I. D. Hose		1
16749	Flange, Prop. Hub		1
16761	Tee, 1/4 x 1/4 x 3/8		1
16764	Gear, Camshaft		2
16769	Plug, Expansion 1 1/4		1
16773	Screw, Mag. Coupling adj		2
16774	Nut, Mag. coupling adj. screw		2
16775	Hub, Mag. coupling adj		2
16777	Disc, Mag. Coupling		2
16778	Nut, Slotted 9/16 x 18 x 5/16		2
16781	Tee, 1/4x 1/4 x1/4		1
16796	Bushing, Cam Roller		24
16800	Connection, 3/8 I. D. Hose		2
*16801	Pipe, Intake Ell. water		2
*16802	Extension, Intake Ell. water inlet pipe		1
*16803	Pipe, Carb. feed		1
*16804	Pipe, Intake Ell. water Outlet branch		1
*16805	Extension, Intake ell. water outlet branch pipe		1
*16806	Pipe, Cyl. water outlet branch		1
*16810	Pipe, Fuel pump outlet		1
16819	Connection, Str. 1/4 x 3/8		3
16820	Connection, Elbow 1/4 x 3/8		6
16821	Valve, Check		1
*16822	Pipe, Fuel pump by pass		1
16823	Adapter, 1/8 pipe		2
*16825	Extension, Carb. feed pipe		1
*16830	Pipe, Carb. float chamber		1
16836	Nut, 5/16 x 24 x 3/16		20
16868	Coupling Mag.		2
16890	Rocker, Valve		24
16924	Pin, Cam Roller		24
16925	Washer, Valve spring, upper		48
16939	Stud, 3/8 x 16 x 24 x 3 1/16		8
17047	Stud, Dowel 3/8 x 16 x 1 1/16		2
17085	Ring, Pump Drive gear	1	
17090	Bearing, Conn. Rod		12
17091	Gland, Water pump packing		1
*17093	Camshaft, R. H.		1
*17094	Camshaft, L. H.		1
*17095	Housing, Camshaft R. H.		1
*17096	Housing, Camshaft L. H.		7
17097	Bearing Camshaft		2
*17098	Sleeve, Camshaft bearing		4
17099	Gear, Pump Drive, lower		1
17100	Piston		12
17101	Gear, Vert. shaft, lower		1
17102	Gear, Camshaft dr. shaft		2
*17103	Pipe, Cyl. water inlet		2
*17104	Extension, Cyl. water inlet pipe		6
*17105	Flange, 7/8 pipe		8
17106	Gasket, 7/8 pipe flange		8
*17107	Cylinder Block		4
*17108	Housing, Camshaft dr. shaft gear brg.		2
*17109	Bearing, Camshaft dr. shaft gear, upper		2
*17110	Bearing, Camshaft dr. shaft gear, lower		2
17111	Gear, Vert. shaft upper		1
*17112	Crankshaft		1
*17113	Hub, Propeller		1

* Not to be ordered as spares.

Part No.	Part Name	Quantity per engine T-2	T-3
17114	Ring, Propeller Hub centering small		1
17115	Ring, Prop. Hub centering, large		1
17116	Nut, Prop. Hub, outer		1
17117	Nut, Prop. Hub, inner		1
17118	Nut, Crankshaft b.b.		1
17119	Cover, Camshaft Housing		2
17120	Screw, Camshaft bearing		4
17121	Stud, Camshaft Housing Cover		2
17123	Carburetor NA-U6-T		2
*17124	Ell. Intake		4
*17125	Pipe, Cyl. water outlet, R. H.		1
*17126	Pipe, Cyl. water outlet L. H.		1
*17127	Extension, Cyl. water outlet pipe		6
17128	Hub, Mag. gear coupling		2
17129	Cage, Mag. gear b. b.		2
17130	Retainer, Mag. gear b. b.		2
17131	Slinger, Mag. gear oil		2
17132	Packing, 1⅞ x 2$\frac{5}{32}$		2
17134	Gasket, 1¾ x 2$\frac{1}{16}$ x $\frac{1}{32}$		2
17135	Nut, Packing 2¼ x 16		2
17136	Nut, Packing ⅞ x 14		8
17138	Cover, Vert. shaft housing		1
*17139	Pipe, Vert. drive oil feed		1
17140	Cover, Oil pump		1
17144	Clip, Wire manifold		12
*17145	Manifold, Cyl. ign. wire inside intermed.		2
*17146	Manifold, Cyl. ign. wire inside front		2
17147	Slinger, Crankshaft oil		1
17148	Flange, Exhaust pipe		12
17150	Screw, rd. hd. #14 x 20 x $\frac{5}{16}$		2
*17151	Flange, Oil manifold		1
*17152	Flange, $\frac{5}{16}$ pipe		4
17164	Piston, 5.3 to 1		12
*17254	Connecting Rod, inner		6
*17255	Connecting Rod, outer		6
17256	Bolt, Conn. Rod, inner		24
17257	Bolt, Conn. Rod, outer		12
17272	Spark Plug, B. G.—Type 1 x 4		24
*17285	Crank, Starting		1
*17286	Sleeve, Starting Crank		1
*17287	Jaw, Starting Crank		1
17288	Bearing, Starting Crank		1
17299	Collar, $\frac{57}{64}$ x 1⅛ x ¼		4
17290	Pin, Str. $\frac{3}{16}$x 1$\frac{3}{16}$		2
17291	Pin, Str. $\frac{3}{32}$ x 1$\frac{3}{16}$		4
17306	Shaft, Starter drive		1
17307	Retainer, Clutch Spring		1
17308	Spring, Clutch		4
17309	Retainer, Clutch plate, front		1
17310	Retainer, Clutch plate, rear		1
17311	Shim, Clutch plate		2
17312	Plate, Clutch, outside spline		8
17313	Plate, Clutch, inside spline		7
*17316	Shaft, Starter worm		1
17317	Bearing, Starter worm wheel		1
17318	Nut, Starter Drive Shaft		1
17319	Lock Ring, 1$\frac{1}{16}$ I. D.		1
17320	Washer, Starter Drive Shaft		1
*17321	Housing, Starter		1

* Not to be ordered as spares.

Part No.	Part Name	Quantity per engine T-2	T-3
17322	Retainer, Starter B. B.		1
17323	Cover, Starter Housing		1
17324	Gasket, $2\frac{27}{32}$ x 4¼ x $\frac{1}{64}$		1
17325	Bushing, Starter Housing		1
17326	Bushing, ⅞ x 1⅛ x $1\frac{13}{16}$		1
17327	Spring, Starter Worm Lock		1
17330	Stud, ⅜ x 16 x 24 x 4⅝		5
17337	Retainer, Thrust bearing		1
17338	Ratchet, Starter fixed		1
17339	Ratchet, Starter movable		1
17342	Support, Starting Mag. gear		1
17343	Gear, Starting Mag. drive		1
17344	Gear, Starting Mag. inter.		1
17345	Gear, Starting Mag.		1
17346	Shaft, Starting Mag. gear inter.		1
17347	Screw, Oval Hd. #8 x 32 x $2\frac{1}{16}$		2
17349	Worm, Starter, 15 to 1		1
17350	Wheel, Starter worm, 15 to 1		1
17351	Magneto, Starting		1
17352	Spring, $1\frac{31}{32}$ x 2⅛ x 2⅜		1

Numerical Assembly List

T-2 and T-3 Engines

Assy. No.	Assy. Name	Quantity per engine T-2	T-3
12548	Manifold, Ig. wire outside rear R. H.	1	1
12549	Manifold, Ig. wire outside rear L. H.	1	1
12550	Manifold, Ig. wire outside front R. H.	1	1
12551	Manifold, Ig. wire outside front L. H.	1	1
12552	Pipe, Water pump outlet R. H.	1	
12553	Pipe, Water pump outlet L. H.	1	
12607	Tee, Cyld. Water inlet	2	
12608	Elbow, Cyld. water inlet	2	
12609	Pump, Oil	1	
12652	Filter, Oil	1	1
12653	Pipe, Oil pressure	1	
*12660	Engine, after valve timing	1	
12661	Pipe, vert. shaft oil feed	1	
12662	Screen, oil suction pump	1	1
12663	Pipe, Camshaft Housing feed	1	
12664	Shaft and Impeller, Water pump	1	1
12665	Pump, water	1	
12666	Valve, Oil press. relief	1	
12667	Piston	12	
12668	Pin, Piston	12	
12669	Hub, Propeller	1	
12670	Hub and Dowel, Propeller	1	
12671	Flange, Propeller Hub	1	
12672	Crankshaft	1	
12674	Connecting Rod Outer	6	
12676	Connecting Rod Inner	1	
12677	Crankshaft and Conn. Rod	1	
12679	Tube, Oil suction filter	1	
12683	Manfold, Ig. wire	1	
12686	Camshaft L. H.	1	
12687	Camshaft R. H.	1	
12691	Housing, Camshaft L. H.	1	
12692	Housing, Camshaft R. H.	1	
12695	Pump, Fuel	1	
12696	Housing, Vert. shaft	1	
12697	Housing, Camshaft Drive	1	
12698	Shaft, Gun Control Drive	2	
12699	Gear and Bearing Camshaft dr. shaft	2	
12700	Shaft, Camshaft Drive	2	
12701	Housing, Vertical Shaft Machining	1	
12702	Gear, Fuel pump internal	1	1
12703	Manifold, Oil	1	
12704	Starter, Hand	1	
12705	Tube, Oil	1	1
12706	Strap, Starting Mag.	1	
12707	Body and Cover Plate, Oil Pump	1	
12708	Crankshaft and Plug	1	
12711	Manifold, Ig. wire inside rear R. H.	1	
12712	Manifold, Ig. wire inside rear L. H.	1	
12713	Manifold, Ig. wire inside front R. H.	1	
12714	Manifold, Ig. wire inside front L. H.	1	
12718	Coupling, Magneto	2	
12719	Body and Cover, Water Pump	1	
12721	Rocker, Valve	24	
12723	Valve and Plug	48	
12724	Rod, Mag. Advance	1	

* Not to be ordered as spares.

Assy. No.	Assy. Name	Quantity per engine T-2	T-3
12725	Pipe, Outboard Drain	1	1
12726	Pipe, Gasoline Feed	1	
12727	Pipe, Carb. tee water inlet	1	
12728	Pipe, Carb. tee water outlet	1	
12730	Stud and Bearing, Crankcase	1	
12750	Housing, Camshaft Drive Shaft	2	
12763	Tee, Carburetor, front	1	
12764	Tee, Carburetor, rear	1	
*12765	Engine, before valve timing	1	
12767	Carburetor and Tee, front	1	
12768	Carburetor and Tee, rear	1	
12769	Shaft, Mag. drive	2	
12770	Mag. and Gear Starting	1	
12771	Mag. and Gear R. H.	1	
12772	Mag. and Gear L. H.	1	
12773	Cover, Camshaft Housing R. H. rear	1	
12774	Cover, Camshaft Housing L. H. rear	1	
12775	Tube, Breather	2	
12776	Crankcase, Stud and Brg.	1	
12777	Rod, Carb. control	2	
12778	Rod, Carb. control complete	2	
12779	Rod, Mag. advance complete	1	
12780	Carburetor Tee and Air Horn	1	
12781	Cylinder, complete R. H. front	1	
12782	Cylinder, complete R. H. rear	1	
12783	Cylinder, complete L. H. front	1	
12784	Cylinder, complete L. H. rear	1	
12785	Pipe, Cyl. water outlet	2	
12808	Casing and Nut Camshaft Drive Shaft		2
12811	Connection, Cyl. water outlet	4	
12812	Manifold, Oil		1
12813	Pipe, Water pump outlet R. H.		1
12814	Pipe, Water pump outlet L. H.		1
12818	Pipe, Camshaft Housing feed		1
12819	Pipe, Carb. float chamber	1	
12830	Pipe, Intake Ell. Water outlet		1
12831	Pipe, Intake Ell. Water inlet		1
12832	Pipe, Oil pressure		1
12834	Pipe, Carburetor feed		1
*12850	Engine, after valve timing		1
12853	Rocker, valve		24
12855	Pipe, Cyl. water inlet		2
12856	Pipe, Cyl. water outlet R. H.		1
12857	Pipe, Cyl. water outlet L. H.		1
12858	Pipe, Vert. shaft oil feed		1
12859	Pump, Oil		1
12860	Pump, Water		1
12861	Valve, Oil press. relief		1
12862	Piston		12
12863	Pin, Piston		12
12864	Hub, Propeller		1
12865	Hub and Dowel, Propeller		1
12866	Hub Flange, Propeller		1
12867	Crankshaft		1
12869	Conn. Rod outer		6
12871	Conn. Rod inner		6
12872	Crankshaft and Conn. Rod		1
12873	Tube, Oil suction filter		1
12876	Crankcase, Upper and Lower Machining		1

*** Not to be ordered as spares.**

Assy. No.	Assy. Name	Quantity per engine T-2	T-3
12877	Manifold, Ign. wire		1
12879	Camshaft R. H.		1
12880	Camshaft L. H.		1
12881	Camshaft, Machining, R. H.		1
12882	Camshaft, Machining, L. H.		1
12883	Housing, Camshaft R. H.		1
12884	Housing, Camshaft L. H.		1
12887	Pump, Fuel		1
12888	Housing, Vert. shaft		1
12889	Housing, Camshaft Drive		1
12890	Gear and Brg. Camshaft dr. shaft		2
12891	Shaft, Camshaft Drive		2
12892	Housing, Vertical Shaft Machining		1
12893	Starter, Hand		1
12894	Crankshaft and Plug		1
12895	Manifold, Ig. wire inside rear R. H.		1
12896	Manifold, Ig. wire inside rear L. H.		1
12897	Manifold, Ig. wire inside front R. H.		1
12898	Manifold, Ig. wire inside front L. H.		1
12899	Manifold, Ig. wire inside inter. R. H.		1
12900	Manifold, Ig. wire inside inter L. H.		1
12902	Valve and Plug		48
12903	Rod, Mag. advance		1
12904	Housing, Camshaft dr. shaft		2
12905	Ell. Intake R. H.		2
12906	Ell. Intake L. H.		2
12907	Carburetor and Ell. front		1
12908	Carburetor and Ell. rear		1
12909	Shaft, Mag. drive		2
12910	Mag. and Gear R. H.		1
12911	Mag. and Gear L. H.		1
12912	Tube, Breather		4
12913	Crankcase, Stud and Bearing		1
12914	Rod, Carb. control		2
12915	Rod, Carb. control, complete		2
12916	Rod, Mag. advance, complete		1
12917	Carb. Ell. and Air Horn		1
12918	Cylinder, Complete R. H. front and L. H. rear		2
12919	Cylinder, Complete L. H. front and R. H. rear		2
*12920	Engine, before valve timing		1
12921	Nut and Plug, Crankshaft gear		1
12922	Gear and Plug, Crankshaft		1
12923	Handle, Starter		1
12936	Body & Cover Plate, Oil Pump		1
12937	Housing & Bushing, Camshaft Drive Shaft Pinion		1
12938	Stud and Bearing, Camshaft Housing, R. H.		1
12939	Stud and Bearing, Camshaft Housing, L. H.		1
12940	Body and Cover, Water Pump		1
12942	Intake Ell. and Stud		2
12943	Stud and Core Plug, Cylinder		4
12944	Housing and Bushing, Starter		1
12947	Handle, Starter		1

* Not to be ordered as spares.

Alphabetical Parts List

of

T-2 and T-3 Engines

Part Name	Part Number T-2	T-3
A		
Adapter, Tachometer Coupling		16600
Adapter, Tachometer Shaft	14800	
Adapter, ⅛ pipe		16823
Adapter, 1″ pipe thrd. ¼ pipe thrd	16432	
B		
Ball, $\frac{5}{16}$ dia	16080	
Ball Bearing	904	904
Ball Bearing	6204-A	6204-A
Ball Bearing	6205-A	6205-A
Ball Bearing	6207-A	6207-A
Ball Bearing	6208-A	6208-A
Ball Bearing #6306		6306-A
Ball Bearing	6315-A	
Ball Bearing #316		6316-A
Ball End ⅜ dia	16440	16440
Bearing, Camshaft	15779	17097
Bearing, Camshaft drive shaft gear	15873	
Bearing, Camshaft drive shaft gear, lower		17110
Bearing, Camshaft drive shaft gear, upper		17109
Bearing, Conn. Rod	16045	17090
Bearing, Crankshaft large, lower	16118	
Bearing, Crankshaft large, upper	16119	
Bearing, Crankshaft small, upper	16120	
Bearing, Crankshaft small, lower	16121	
Bearing, Crankshaft front upper		16610
Bearing, Crankshaft front lower		16611
Bearing, Crankshaft center upper		16612
Bearing, Crankshaft center lower		16613
Bearing, Crankshaft intermed. upper		16614
Bearing, Crankshaft intermed. lower		16615
Bearing, Gun control gear	15893	
Bearing, Oil pump drive gear	16126	
Bearing, Starting Crank		17288
Bearing, Starter worm wheel		17317
Bell Crank, 90° x 2⅞ x 3¼ R. H.	16412	16412
Bell Crank, 90° x 2 x 2	16464	16464
Bell Crank, 90° x 2⅞ x 3¼ L. H.	16445	16445
Body, Air Horn	16480	16638
Body, Fuel Pump	16093	16093
Body, Oil press. relief	14810	14810
Body, Oil pump	16325	16325
Body, Water pump	16342	16342
Bolt, #10 x 32 x $\frac{21}{32}$		16690
Bolt, ⅜ x 24 x ⅞	16697	
Bolt, ⅜ x 24 x 1⅛	15897	15897
Bolt, ⅜ x 24 x $1\frac{13}{32}$	16447	16447
Bolt, Camshaft drive dog clamp		16665
Bolt, Conn. Rod inner	15560	17256
Bolt, Conn. Rod outer	15754	17257
Bolt, Crankshaft Bearing	15782	16671
Bolt, Crankshaft Bearing slotted	15809	
Bolt, Prop. Hub	15789	15789
Bushing, Cam Roller	16207	16796

Part Name	Part Number T-2	T-3
Bushing, Conn. Rod	15513	16544
Bushing, Fuel Pump Gear	15253	15253
Bushing, Oil pump dr. gear		16587
Bushing, Pump drive gear lower	16330	16330
Bushing, Starter Housing		17325
Bushing, Starter Worm (small)	16397	
Bushing, Starter worm (large)	16396	
Bushing, Tach. shaft		16598
Bushing, Valve Rocker	15563	15563
Bushing, Valve rocker oil feed	15564	
Bushing, Water pump shaft	16349	16349
Bushing, Water pump shaft, lower	16351	16351
Bushing, 3/8 x 1/2 x 1/2	16448	16448
Bushing, Reducing 3/8 x 1/8		16736
Bushing, 7/16 x .317 x 21/32	16718	16718
Bushing, 5/8 x 18 x 7/16 x 20 x 13/16	16238	16238
Bushing, 7/8 x 1 1/8 x 1 13/16		17326
Bushing, 13/16 x 5/8 x 1/2	16389	16389
Bushing, 1 1/16 x 1 1/4 x 2 1/64	15886	15886
Button, Water pump thrust	16350	16350
C		
Cage, Mag. gear b. b.	15875	17129
Cage, #6204 b. b.	16312	16312
Camshaft, L. H.	15792	17094
Camshaft, R. H.	15793	17093
Cap, Breather Tube	15823	16583
Cap, Crankshaft Bearing—rear	16236	16549
Cap, Crankshaft Bearing—Centre	16236	16540
Cap, Crankshaft Bearing—inter.	16163	16550
Cap, Crankshaft Bearing—front	15840	16548
Cap, Gun control gear brg.	16333	
Cap, Oil press. relief	15489	16594
Cap, Tachometer Shaft	15906	
Carburetor, NAU-6-T	16460	17123
Casing, Camshaft Drive Shaft		16660
Clamp, 3/8 Hose	11245	11245
Clamp, 1/2 I. D. Hose	14977	14977
Clamp, 1" I. D. Hose	14649	14649
Clamp, 1 1/4 I. D. Hose	15741	
Clamp, Hose 1 1/2" I. D.		11235
Clamp, Ign. wire manifold	16642	16642
Clip, Wire manifold	15832	15832
Clip, Wire manifold		17144
Clip, 1/2 O. D. pipe	16500	16500
Clip, 3/8 O. D. pipe	15283	
Clip, 9/16 pipe	16388	16388
Cock, Spring key 1/8"	11796	11796
Collar, Starter worm	16084	
Collar, 57/64 x 1 1/8 x 1/4		17299
Connecting Rod, outer	15753	17255
Connecting Rod, inner	15752	17254
Connection, Cyld. water inlet tee	16106	
Connection, Cyld. water inlet elbow	16109	
Connection, Cyld. water outlet	16651	16672
Connection, Elbow 1/2 I. D. Hose	16098	
Connection, Elbow 1/4 x 3/8		16820
Connection, Str. 1/4 x 3/8		16819
Connection, 3/8 I. D. Hose		16800
Connection, St. 3/8 I. D. Hose	16436	16436

Part Name	Part Number T-2	T-3
Connection, Str. ½ I. D. Hose		16737
Connection, ¾ I. D. Hose	14826	14826
Cork, 17/32 x 7/8	16331	16331
Cork, 19/32 x 7/8		16700
Cotterpin, 3/64" Dia. x ½"		11207
Cotterpin, 1/16 x ½	11169	11169
Cotterpin, 1/16 x 1	11445	11445
Cotterpin, 5/64 x ¾	11707	11707
Cotterpin, 5/64 x 1	B-64	
Cotterpin, 3/32	657	657
Cotterpin, 3/32 x ¾	656	656
Cotterpin, 3/32 x 1¼	B-63	B-63
Cotterpin, ⅛ x 1	14282	14282
Cotterpin, ⅛ x 1½	11348	11348
Cotterpin, 5/32 x 2¼	11945	
Coupling, Magneto	11897	16868
Coupling, Tachometer		10561
Cover, Camshaft Housing	15769	17119
Cover, Camshaft Housing, rear	15742	16596
Cover, Camshaft Housing, front	15871	
Cover, Crankcase, front	15831	16590
Cover, Fuel press. relief	14702	14702
Cover, Fuel Pump	16722	16722
Cover, Generator Drive	16365	16632
Cover, Oil filter	15759	15759
Cover, Oil pump		17140
Cover, Starter	16076	
Cover, Starter Housing		17323
Cover, Vert. Shaft Housing	16304	17138
Cover, Water pump	16343	16708
Crank, Starting		17285
Crankcase, lower	16321	16515
Crankcase, upper	16280	16514
Crankshaft	15694	17112
Cylinder Block	16288	17107
Cylinder Sleeve	16289	16538
D		
Disc, Mag. Coupling		16777
Dog, Camshaft Drive, upper	15883	16663
Dog, Camshaft Drive, lower	15884	16664
Dowel, Conn. Rod Bushing	11163	11163
Dowel, Crankshaft Bearing	15750	15750
Dowel, Gun control gear bearing	15894	
Dowel, Prop. Hub	16185	16185
Dowel, 1/16 x ⅛ x 9/32	16644	16644
Dowel, 3/16 x ⅜	14873	14873
Dowel, ¼ x 7/16	15763	15763
Dowel, ¼ x ⅝	14979	14979
Dowel, 5/16 x ¾	1437	1437
E		
Elbow, Cyld. water inlet	16108	
Ell, Intake		17124
Extension, Carb. tee	16474	
Extension, Carb. tee water inlet pipe	16491	
Extension, Carb. tee water outlet pipe	16502	
Extension, Cyl. water inlet pipe		17104
Extension, Cyl. water outlet conn.	16650	
Extension, Cyld. water outlet pipe	16498	17127

Part Name	Part Number T-2	T-3
Extension, Gasoline feed pipe	16489	16825
Extension, Intake Ell water inlet pipe		16802
Extension, Intake Ell water outlet branch pipe		16805
F		
Flange, Exhaust pipe	15909	17148
Flange, Oil manifold	16384	17151
Flange, Oil press. pipe	16323	16323
Flange, Propeller Hub	15773	16749
Flange, Water pipe coupling		16675
Flange, Water pipe coupling, threaded		16674
Flange, 5/16 pipe	16386	16386
Flange, 5/16 pipe		17152
Flange, 7/8 pipe		17105
Flange, 1 1/4 O. D. Pipe	16354	
Flange, 1 3/8 pipe		16702
G		
Gasket, Air Horn Body	16481	16481
Gasket, Breather Tube	15825	16629
Gasket, Camshaft Drive Housing	15879	15879
Gasket, Camshaft Drive Housing	16373	16373
Gasket, Camshaft Drive Shaft Pinion Housing	15888	15888
Gasket, Camshaft Housing	15845	16684
Gasket, Camshaft Housing Bearing	15824	
Gasket, Camshaft Housing Bearing, large		16685
Gasket, Camshaft Housing Bearing, small		16686
Gasket, Camshaft Housing Cover	15770	16604
Gasket, Camshaft Housing Cover, rear	15743	16597
Gasket, Camshaft Housing Cover, fr.	15872	
Gasket, Carb.	16503	16503
Gasket, Crankcase Rear Cover	14981	14981
Gasket, Cyl. flange	16301	16669
Gasket, Exh. pipe flange	15910	16607
Gasket, Fuel pump cover	15256	15256
Gasket, Fuel pump mounting flange	16156	16156
Gasket, Generator Drive Cover	16366	
Gasket, Intake Manifold Tee	16504	
Gasket, Intake Ell		16670
Gasket, Oil press. pipe flange	16324	16324
Gasket, Oil pump cover plate	14632	14632
Gasket, Vert. shaft housing cover	16367	16367
Gasket, Water pump cover	16336	16336
Gasket, 5/16 pipe flange	16387	16387
Gasket, 9/16 pipe flange	16385	16385
Gasket, 5/8 I. D.	11559	11559
Gasket, 45/64" I. D. x 15/16" O. D. x 5/64	B-28	B-28
Gasket, 3/4 x 1 1/16 x 1/16	16347	16347
Gasket, 3/4 x 1	14835	14835
Gasket, 7/8 pipe flange		17106
Gasket, 7/8 x 1 1/8 x 1/16	14711	14711
Gasket, 1 1/4 O. D. pipe	16355	16355
Gasket, 1 3/8 I. D. x 1 5/8 O. D.		14922
Gasket, 1 1/2 x 1 3/4 x 5/64	11440	11440
Gasket, 1 3/4 x 2 1/16 x 1/32		17134
Gasket, 2 3/8 sq. x 1 31/32 I. D.		16633
Gasket, 2 17/32" I. D. x 2 27/32" O. D. x 3/32"	B-32	B-32
Gasket, 2 27/32 x 4 1/4 x 1/64		17324
Gear, Camshaft	15799	16764
Gear, Camshaft Drive Shaft	15801	17102

Part Name	Part Number T-2	T-3
Gear, Coupling 23 teeth	16415	
Gear, Coupling 24 teeth	16416	
Gear, Camshaft	15794	16578
Gear, Fuel pump internal	16095	16095
Gear, Gun Control	16317	16585
Gear, Mag.	15798	15798
Gear, Mag. Drive	15797	15797
Gear, Mag. drive shaft	16418	
Gear, Mag. Shaft	16417	
Gear, Oil pump (5/8 face)	14608	14608
Gear, Oil pump (7/8 face)	16319	16319
Gear, Oil pump drive	14605	14605
Gear, Oil pump drive	16125	16125
Gear, Pump Drive	16307	16307
Gear, Pump drive—lower	16329	17099
Gear, Pump Idler (5/8 face)	14633	14633
Gear, Pump Idler (7/8 face)	16320	16320
Gear, Starting Mag.	16399	17345
Gear, Starting Mag. drive		17343
Gear, Starting Mag. inter.		17344
Gear, Vert. shaft drive	15796	16577
Gear, Vert. shaft lower	16315	17101
Gear, Vert. shaft upper	16314	17111
Gland, Water pump packing	16353	17091
Guide, Fuel press. relief adj. screw	15287	15287
Guide, Valve, Intake	15543	16572
Guide, Valve, Ex.	16162	16573
H		
Hose, 3/8 x 5/8 x 2	16483	16483
Hose, 3/8" I. D. x 3" Long		11204
Hose, 1/2" I. D. x 2"	14975	14975
Hose, 1" x 1 7/16 x 2 3/4		16649
Hose, 1" I. D. x 3"	14648	
Hose, 1 1/4 x 1 11/16 x 2 1/2	16505	
Hose, 1 1/4 I. D. x 1 11/16 O. D. x 3 1/4	15851	
Hose, 1 3/8 x 1 13/16 x 3		16295
Housing, Camshaft L. H.	15767	17096
Housing, Camshaft R. H.	15768	17095
Housing, Camshaft Drive	16306	16591
Housing, Camshaft Drive Dog	16254	
Housing, Camshaft Drive Shaft	16303	16659
Housing, Camshaft Drive Shaft Gear Brg.		17108
Housing, Camshaft Drive Shaft Pinion	16212	16595
Housing, Gun Control Gear		16586
Housing, Starter	16393	17321
Housing, Vert. Shaft	16332	16584
Hub, Mag. Coupling Adj.		16775
Hub, Mag. Gear Coupling		17128
Hub, Propeller	15772	17113
I		
Insert, Spark Plug	15939	15939
Impeller, Water pump	16344	16344
J		
Jaw, Starting Crank		17287
K		
Key, #3 Woodruff	11680	11680
Key, #5 Woodruff	15828	
Key, #8 Woodruff	15780	15780
Key, Str. 1/4 x 1/4 x 1 15/16	15870	15870

Part Name	Part Number T-2	T-3
L		
Lever, 2" Str.	16446	16446
Link, Mag. Advance	16624	16624
Link, Mag. Advance R. H.	16411	16411
Lock, Starting Mag.	16404	16404
Lock, Valve spring washer	14775	14775
Lock, Pad Starting Mag.	16406	16406
Lock, Ring, Vert. Shaft Casing Nut	10487	10487
Lock Ring, 1 1/16 I. D.		17319
Lock Ring, 1 3/16 I. D.	16309	16309
Lock Ring, 1 7/16 I. D.	15905	15905
Lock Ring, 1 7/16 I. D.		16668
Lockwasher, 1/4 x 3/32 x 3/64	14941	14941
Lockwasher, 5/16 x 1/8 x 1/16	14940	14940
M		
Magneto, Splitdorf S. S. 12	16205	16205
Magneto, Starting	16414	17351
Manifold, Cyl. ig. wire, inside fr.	16476	17146
Manifold, Cyl. ign. wire, inside rear	16477	16477
Manifold, Cyl. ign. wire inside intermed.		17145
Manifold, Cyl. ign. wire outside front	15833	15833
Manifold, Cyl. ign. wire outside rear	15834	15834
Manifold, Ig. wire	16419	16419
Manifold, Oil, front	16378	16618
Manifold, Oil, rear	16379	16631
Marker, Ign. wire	16507	16507
N		
Nipple, Oil return pipe, lower	16122	16122
Nipple, Oil return pipe, upper	16139	16139
Nozzle, Vert. drive oil feed pipe	16647	
Nut, Adj. Ball end	16444	16444
Nut, Camshaft	15740	15740
Nut, Camshaft dr. shaft casing		16661
Nut, Camshaft Housing cover		16640
Nut, Crankshaft Ball Bearing	15790	17118
Nut, Crankshaft Gear	15869	16589
Nut, Lock, Fuel press. relief adj.	14701	14701
Nut, Mag. coupling adj. screw		16774
Nut, Propeller Hub Bolt	15330	15330
Nut, Prop. Hub inner	15785	17117
Nut, Propeller Hub Outer	15784	17116
Nut, Starter Drive Shaft		17318
Nut, #10 x 32 x 3/16	14988	14988
Nut, #10 x 32 L. H. x 3/16	16492	16492
Nut, 5/16 x 24 x 3/8	14965	14965
Nut, 5/16 x 24 x 3/16		16836
Nut, 3/8 x 24 P. special		16643
Nut, 3/8 x 16 x 3/8	11900	11900
Nut, 3/8 x 24 x 5/32	14921	14921
Nut, 7/16 x 20 x 7/16	16339	16339
Nut, 15/16 x 16 x 1/4	16310	16310
Nut, 1 1/8 x 12 x 3/8	15878	15878
Nut, Castled 1/4 x 28 x 9/32	15565	15565
Nut, Castled 5/16 x 24	14712	14712
Nut, Castled 3/8 x 24 x 13/32	14437	14437
Nut, Castled 7/16 x 20	14950	14950
Nut, Castled 1/2 x 20 x 5/16	15882	
Nut, Castled 9/16 x 18	15813	15813

Part Name	Part Number T-2	T-3
Nut, Packing, fuel pump	15258	15258
Nut, Packing 7/8 x 14		17136
Nut, Packing 7/8 x 14	16116	
Nut, Packing 1 1/4 x 12	16352	16352
Nut, Packing 2 1/4 x 16	15895	17135
Nut, Packing 2 3/4 x 16 x 11/16	16473	
Nut, Plain 1/4 x 28	14931	14931
Nut, Plain 7/16 x 24	14574	14574
Nut, Plain 3/8 x 24	14575	14575
Nut, Slotted #10 x 32 x 3/16		16689
Nut, Slotted 3/8 x 24 x 1/2	11503	11503
Nut, Slotted 1/2 x 20 x 1/2	11508	11508
Nut, Slotted 9/16 x 18 x 5/16	14832	16778
Nut, Slotted 11/16 x 16	15867	15867
P		
Packing, 1/8"	11168	11168
Packing, 9/16 I. D. x 7/8 O. D.	14692	14692
Packing, 31/32 x 1 5/16 x 1/4		16676
Packing, 1 7/8 x 2 5/32		17132
Pin, 3/32 x 13/32		16667
Pin, 7/32 x 19/32	14987	14987
Pin, 1/4 x 21/32	15927	15927
Pin, 5/16 x 1 3/4	16082	16082
Pin, Brazing	15678	15678
Pin, Escutcheon .057 x 1/4	16581	16581
Pin, Escutcheon .080 x 5/8	15598	15598
Pin, straight 1/16 x 11/16	11540	11540
Pin, straight 1/16 x 3/8	11443	11443
Pin, Str. 3/32 x 1 3/16		17291
Pin, Str. 3/16 x 1 3/16		17290
Pin, taper #4 x 1 1/4	16081	16081
Pin, Cam Roller	16237	16924
Pin, Piston	15516	16542
Pin, Tachometer Coupling		11206
Pinion, Camshaft Drive Shaft	15803	16734
Pinion, Fuel Pump	16096	16096
Pinion, Starting Mag.	16400	
Pipe, Air Horn Drain	16486	16486
Pipe, Camshaft Housing feed	16341	16699
Pipe, Camshaft Housing Oil Return	16114	16681
Pipe, Carb. float chamber	16723	16830
Pipe, Carb. tee water	16490	
Pipe, Carb. tee water outlet branch	16493	
Pipe, Cyl. water L. H.	16361	16705
Pipe, Cyl. water R. H.	16362	16704
Pipe, Cyl. water inlet tee	16105	
Pipe, Cyl. water inlet, front	16107	
Pipe, Cyl. water inlet		17103
Pipe, Cyl. water outlet	16497	
Pipe, Cyl. water outlet L. H.		17126
Pipe, Cyl. water outlet R. H.		17125
Pipe, Cyl. water outlet branch		16806
Pipe, Cyl. water outlet front		16602
Pipe, Fuel pump drain	16487	16487
Pipe, Fuel pump by pss		16822
Pipe, Fuel pump outlet		16810
Pipe, Gasoline feed	16488	16803
Pipe, Intake Ell water outlet branch		16804
Pipe, Intake Ell, water		16801

Part Name	Part Number T-2	T-3
Pipe, Oil suction	16130	16627
Pipe, Oil pressure	16322	16626
Pipe, Vert. drive oil feed	16368	17139
Pipe, Water pump outlet	16335	16703
Piston	16374	17100
Piston 5.3 to 1		17164
Plate, Clutch inside, spline		17313
Plate, Clutch outside, spline		17312
Plate, Engine Data	16516	16516
Plate, Exhaust Port	16518	
Plate, Hub flange name	16257	16257
Plate, Motor name	15019	15019
Plate, Oil filter end	14641	14741
Plate, Oil pump cover	16356	
Plug, Crankshaft (large)	14734	14734
Plug, Expansion 1⅛"		16693
Plug, Expansion 1¼"		16769
Plug, Oil and Water Pump dr. shaft	14631	14631
Plug, Piston pin	15517	16548
Plug, Rocker Arm shaft		16637
Plug, Valve stem	16201	16201
Plug, Water pump cover thrust	16348	16348
Plug, ⅛ Pipe	14408	14408
Plug, ¼ Pipe	15732	15732
Plug, ⅜ Pipe	16458	16458
Plug, ½" Pipe		16698
Plug, ½" Pipe	16044	
Plug, ⅝-18	11819	11819
Plug, ¾ x 16	15761	15761
Plug, ¾" Pipe		11233
Plug, ¾ x 16 x 1"		16655
Plug, ⅞ x 14	15487	15487
Plug, 1" Pipe	16117	16117
Plug, 1⅜ x 12		14792
Plug, 1½" Pipe	16340	
Plug, 1½ x 12	16290	
Plug, 1¾ x 12		15440
Plunger, Oil press. relief	11531	16645
R		
Ratchet, Starter fixed		17338
Ratchet, Starter movable		17339
Retainer, Clutch plate, front		17309
Retainer Clutch plate, rear		17310
Retainer, Clutch Spring		17307
Retainer, Mag. gear b. b.	15876	17130
Retainer, Starter b. b.	16075	17322
Rein, Starting Mag. Strap	16408	16408
Retainer, Thrust Bearing		17337
Retainer, Vert. shaft b. b.	15880	15880
Ring, Ignition wire, large	11449	
Ring, Ignition wire, small	11457	11457
Ring, Oil filter	15941	15941
Ring, Piston	15524	15524
Ring, Prop. Hub Centering, small	15787	17114
Ring, Prop. Hub Centering, large	15788	17115
Ring, Pump Drive gear	17085	
Rivet, .066"-.072" Dia. x $\frac{3}{16}$" Rd. Head Iron		11161
Rivet, Rd. Hd. ⅛ x ¼	14221	14221
Rivet, Rd. Hd. ⅛ x ⅜	11901	

Part Name	Part Number T-2	T-3
Rivet, Rd. Hd. ⅛ x ½		14218
Rivet, ¼ x ½	16337	16337
Rivet, Flat Hd. 5/32 x ¼	11983	11983
Rocker, Valve	15545	16890
Rod, Carb. Control	16482	16678
Rod, Mag. Advance	16443	16654
Roller, Cam	15537	16574
S		
Screen, Oil filter	15189	15189
Screen, Oil filter reinforcement	15190	15190
Screen, Oil suction pump, rear	16327	16327
Screen, Oil suction pump frame	16328	16328
Screw, Camshaft bearing		17120
Screw, Camshaft Housing cover		16639
Screw, Fuel press. relief adj.	14700	14700
Screw, Mag. coupling adj.		16773
Screw, Valve adj.	15541	15541
Screw, Rd. H. #4 x 32 x ¼	12053	12053
Screw, Oval Hd. #8 x 32 x 2 1/16		17347
Screw, #10 x 24 x ½	15881	15881
Screw, Fill Hd. #10 x 32 x 21/32		16691
Screw, Fill Hd. #14 x 24 x 9/16	11820	11820
Screw, Rd. Hd. #14 x 20 x 5/16		17150
Screw, Fill. Hd. ¼ x 20 x 5/16	14833	14833
Screw, Fill. Hd. ¼ x 20 x 9/16	14837	
Screw, Fill. Hd. ¼ x 20 x 11/16	15472	15472
Screw, Lock ¼ x 20 x 43/64	16363	16363
Screw, 5/16 x 18	16086	16086
Screw, Hdless. Set 5/16 x 24 x ½	14889	14889
Screw, 5/16 x 24 x 9/16		16677
Screw, Lock ⅜ x 16 x 13/32	15610	
Screw, Cap ⅜ x 16 x 1 3/32	15421	15421
Screw, Cap 7/16 x 20 x 1¼	16239	16239
Seat, Valve	15940	16438
Shaft, Camshaft Drive	16302	16662
Shaft, Fuel pump pinion	16719	16719
Shaft, Gun Control Drive	15885	
Shaft, Starter Drive		17306
Shaft, Starter Drive—long	16087	
Shaft, Starter worm		17316
Shaft, Starting Mag. gear inter.		17346
Shaft, Tachometer Drive	15744	16599
Shaft, Rocker arm	15542	16568
Shaft, Water pump	16345	16345
Shim, Clutch plate		17311
Sleeve, Camshaft bearing	15821	17098
Sleeve, Starting Crank		17286
Slinger, Crankshaft oil	15791	17147
Slinger, Mag. gear oil		17131
Spacer, Crankshaft gear		16588
Spacer, .792 I. D. x 1 O. D. x ⅜	15877	15877
Spark Plug, B. G.—Type 1 x A		17272
Spark Plug, Champion AC large porcelain	11985	
Spring, Camshaft dr. shaft		16666
Spring, Clutch		17308
Spring, Fuel press. relief valve	15259	15259
Spring, Mag. Coupling	11896	
Spring, Oil filter	14642	14642
Spring, Oil press. relief	11530	11530

Part Name	Part Number T-2	T-3
Spring, Starting Mag.	16405	16405
Spring, Starter Worm Lock		17327
Spring, Valve, Inner	14772	14772
Spring, Valve, Outer	14771	14771
Spring, $\frac{11}{16}$ x $\frac{13}{16}$	16099	16099
Spring, $\frac{19}{64}$ x 1	16079	
Spring, $1\frac{31}{32}$ x $2\frac{1}{8}$ x $2\frac{3}{8}$		17352
Strap, Starting Mag.	16409	16409
Stud, Crankshaft bearing, centre	16449	
Stud, Crankshaft bearing, rear	15810	
Stud, Crankshaft bearing, short		16571
Stud, Crankshaft bearing, long		16609
Stud, Camshaft Housing Cover		17121
Stud, Starting Mag.	16407	16407
Stud, $\frac{1}{4}$ x 20 x 18 x 1	16377	16377
Stud, $\frac{1}{4}$ x 20 x 28 x 1	14960	14960
Stud, $\frac{1}{4}$ x 20 x 18 x $1\frac{3}{16}$	14959	14959
Stud, $\frac{1}{4}$ x 20 x 28 x $1\frac{11}{16}$	14961	14961
Stud, $\frac{1}{4}$ x 20 x 28 x $1\frac{1}{16}$		16636
Stud, $\frac{5}{16}$ x 18 x 24 x $\frac{7}{8}$	15837	15837
Stud, $\frac{5}{16}$ x 18 x 24 x $1\frac{1}{16}$	15372	15372
Stud, $\frac{5}{16}$ x 18 x 24 x $1\frac{5}{32}$		15422
Stud, $\frac{5}{16}$ x 24 x 18 x $1\frac{3}{16}$	14952	14952
Stud, $\frac{5}{16}$ x 18 x 24 x $1\frac{1}{4}$	16390	16390
Stud, $\frac{5}{16}$ x 24 x 18 x $1\frac{1}{4}$	14953	14953
Stud, $\frac{5}{16}$ x 18 x 24 x $1\frac{5}{16}$	15807	15807
Stud, $\frac{5}{16}$ x 18 x 24 x $1\frac{5}{16}$	15896	15896
Stud, $\frac{5}{16}$ x 24 x 18 x $1\frac{3}{8}$	14956	14956
Stud, $\frac{5}{16}$ x 18 x 24 x $1\frac{7}{16}$	15781	15781
Stud, $\frac{5}{16}$ x 24 x 18 x $1\frac{1}{2}$	14954	14954
Stud, $\frac{5}{16}$ x 18 x 24 x $1\frac{17}{32}$	14964	14964
Stud, $\frac{5}{16}$ x 24 x 18 x $1\frac{3}{4}$	14955	14955
Stud, $\frac{5}{16}$ x 18 x 24 x $2\frac{1}{8}$	16151	16151
Stud, Dowel $\frac{3}{8}$ x 16 x $1\frac{1}{16}$		17047
Stud, $\frac{3}{8}$ x 16 x 24 x $1\frac{3}{16}$	16716	
Stud, $\frac{3}{8}$ x 16 x 24 x $1\frac{3}{8}$	16707	16707
Stud, $\frac{3}{8}$ x 16 x 24 x $1\frac{3}{8}$	16375	16375
Stud, $\frac{3}{8}$ x 16 x 24 x $1\frac{3}{8}$	15200	
Stud, $\frac{3}{8}$ x 16 x 24 x $1\frac{1}{2}$	14957	14957
Stud, $\frac{3}{8}$ x 16 x 24 x $1\frac{9}{16}$	14958	
Stud, $\frac{3}{8}$ x 16 x 24 x $1\frac{13}{16}$		16634
Stud, $\frac{3}{8}$ x 16 x 24 x $2\frac{1}{16}$	16376	16376
Stud, $\frac{3}{8}$ x 16 x 24 x $2\frac{1}{4}$	16357	16357
Stud, $\frac{3}{8}$ x 16 x 24 x $2\frac{19}{32}$		16616
Stud, $\frac{3}{8}$ x 16 x 24 x $2\frac{1}{32}$		16630
Stud, $\frac{3}{8}$ x 16 x 24 x $3\frac{1}{16}$		16939
Stud, $\frac{3}{8}$ x 16 x 24 x $3\frac{1}{2}$	15815	
Stud, $\frac{3}{8}$ x 16 x 24 x $3\frac{3}{4}$	16085	
Stud, $\frac{3}{8}$ x 16 x 24 x $4\frac{11}{32}$	15912	
Stud, $\frac{3}{8}$ x 16 x 24 x $4\frac{7}{16}$	15913	
Stud, $\frac{3}{8}$ x 16 x 24 x $4\frac{5}{8}$		17330
Stud, $\frac{3}{8}$ x 16 x 24 x $5\frac{7}{32}$	15911	
Stud, $\frac{7}{16}$ x 14 x 20 x $1\frac{5}{8}$	16338	16338
Stud, $\frac{7}{16}$ x 14 x 20 x 2	15783	15783
Support, Starting Mag. gear	17342	
T		
Tag, Mag., inside	15266	15266
Tag, Mag., outside	15267	15267
Tee, Carburetor	16470	

Part Name	Part Number T-2	T-3
Tee, Water pump drain	16501	
Tee, ¼ x ¼ x ¼		16781
Tee, ¼ x ¼ x ⅜		16761
Terminal, Ignition wire (Rajah)	11340	11340
Tube, Breather	15822	16582
Tube, Oil Manifold centre		16622
Tube, Oil Manifold front	16380	16619
Tube, Oil Manifold inter.	16382	16621
Tube, Oil Manifold rear	16381	16620
Tube, Oil suction filter	14644	16652
Tube, 5/16 O. D. x 4"	16383	
Tube, 5/16 x 5 13/16		16653
Tube, Oil 5/16 x 8⅜	16401	16401
Tube, Oil 5/16 x 6 21/32	16403	
U		
Union, Brazing Str. ⅛ x ¼	15681	15681
Union, Brazing, elbow ⅛ x 5/16		15202
Union, Brazing, elbow ¼ x ⅜	15203	
Union, Brazing, Str. ¼ x ⅜	15204	15204
Union, Soldering, str. ⅛ x 5/16	16027	16027
Union, Soldering, Tee ⅛ x 5/16 x 5/16	16026	16026
V		
Valve, Check		16821
Valve, Fuel press, relief	15286	15286
Valve, Inlet and Ex	16123	16566
W		
Washer, Camshaft dr. shaft pinion	16695	16695
Washer, Mag. coupling spring	11898	
Washer, Starter Drive shaft		17320
Washer, Thrust Bearing	16398	16398
Washer, Valve spring, lower	14143	14143
Washer, Valve spring upper	14774	16925
Washer, 7/32 x 5/8 x 1/32		16688
Washer, 17/64 x ½ x 1/16	14994	14994
Washer, 21/64 x 5/8 x 1/16	11705	11705
Washer, 21/64 x 19/32 x 5/64	14995	14995
Washer, 25/64 x 11/16 x 5/64	14996	14996
Washer, 13/32 x 7/8 x 3/32		16687
Washer, 13/32 Plain	1458	1458
Washer, 29/64 x 13/64 x 3/32	14997	14997
Washer, 37/64 x 1 x 3/32	15812	15812
Washer, 37/64 x 1⅛ x 3/32	15811	15811
Washer, 45/64 x 1⅜ x 3/32	15866	15866
Washer, 1½ x 2⅝ x .175	15857	
Wheel, Starter worm 15 to 1	16392	17350
Worm Starter 15 to 1	16391	17349
Y		
Yoke, End 5/16 dia. plain	16442	16442
Yoke, End single	16484	16484
Yoke, End special	16485	16485
Yoke, End 5/16 dia. threaded	16441	16441

Alphabetical Assembly List

for

T-2 and T-3 Engines

Assembly Name	T-2	T-3
B		
Body and Cover Plate, Oil Pump	12707	12936
Body and Cover, Water Pump	12719	12940
C		
Camshaft, R. H.	12687	12879
Camshaft, L. H.	12686	12880
Camshaft Machining, R. H.		12881
Camshaft Machining, L. H.		12882
Carburetor and Tee, front	12767	
Carburetor and Tee, rear	12768	
Carburetor, Tee and Air Horn	12780	
Carburetor and Ell., front		12907
Carburetor and Ell., rear		12908
Carburetor, Ell and Air Horn		12917
Casing and Nut, Camshaft Drive Shaft		12808
Connecting Rod, outer	12674	12869
Connecting Rod, inner	12676	12871
Connection, Cyl. water outlet	12811	
Coupling, Magneto	12718	
Cover, Camshaft Housing R. H., rear	12773	
Cover, Camshaft Housing L. H., rear	12774	
Crankcase, Stud and Brg.	12776	12913
Crankcase, Upper and Lower Machining		12876
Crankshaft	12672	12867
Crankcase and Conn. Rod	12677	12872
Crankcase and Plug	12708	12894
Cylinder, Complete R. H., front	12781	12918
Cylinder, Complete R. H., rear	12782	12919
Cylinder, Complete L. H., front	12783	12919
Cylinder, Complete L. H., rear	12784	12918
Cylinder, Stud and Core Plug		12943
E		
Elbow, Cyld. water inlet	12608	
Ell, Intake R. H.		12905
Ell, Intake L. H.		12906
Engine, after valve timing	12660	12850
Engine, before valve timing	12765	12920
Engine Shipping	12766	12924
F		
Filter, Oil	12652	12652
Flange, Propeller Hub	12671	
G		
Gear, Fuel Pump internal	12702	12702
Gear and Bearing, Camshaft dr. shaft	12699	12890
Gear and Plug Crankshaft		12922
H		
Handle Starter		12923
Housing, Camshaft R. H.	12692	12883
Housing, Camshaft L. H.	12691	12884
Housing, Camshaft Stud and Bearing, R. H.		12938
Housing, Camshaft Stud and Bearing, L. H.		12939

Assembly Name	T-2	T-3
Housing, Camshaft Drive	12697	12889
Housing, Camshaft Drive Shaft	12750	12904
Housing and Bushing, Camshaft Drive Shaft Pinion		12937
Housing and Bushing, Starter		12944
Housing, Vertical Shaft	12696	12888
Housing, Vertical Shaft Machining	12701	12892
Hub, Propeller	12669	12864
Hub and Dowel Propeller	12670	12865
Hub Flange Propeller		12866
I		
Intake Ell and Stud		12942
M		
Magneto and Gear, R. H.	12771	12910
Magneto and Gear, L. H.	12772	12911
Magneto and Gear Starting	12770	
Manifold, Ignition wire	12683	12877
Manifold Oil	12703	12812
Manifold Ignition wire inside front, L. H.	12714	12898
Manifold Ignition wire inside front, R. H.	12713	12897
Manifold Ignition wire inside inter., L. H.		12900
Manifold Ignition wire inside inter., R. H.		12899
Manifold Ignition wire inside rear, L. H.	12712	12896
Manifold Ignition wire inside rear, R. H.	12711	12895
Manifold Ignition wire outside front, L. H.	12551	12551
Manifold Ignition wire outside front, R. H.	12550	12550
Manifold Ignition wire outside rear, L. H.	12549	12549
Manifold Ignition wire outside rear, R. H.	12548	12548
N		
Nut and Plug, Crankshaft Gear		12921
P		
Pin, Piston	12668	12863
Pipe, Camshaft Housing Feed	12663	12818
Pipe, Carb. float chamber	12819	
Pipe, Carb. tee water inlet	12727	
Pipe, Carb. tee water outlet	12728	
Pipe, Cyl. water outlet, L. H.	12785	12857
Pipe, Cyl. water outlet, R. H.	12785	12856
Pipe, Cyl. water inlet		12855
Pipe, Gasoline feed	12726	12834
Pipe, Intake Ell water inlet		12831
Pipe, Intake Ell water outlet		12830
Pipe, Oil pressure	12653	12832
Pipe, Outboard Drain	12725	12725
Pipe, Vert. shaft oil feed	12661	12858
Pipe, Water pump outlet, R. H.	12552	12813
Pipe, Water pump outlet, L. H.	12553	12814
Piston	12667	12862
Pump, Fuel	12695	12887
Pump, Oil	12609	12859
Pump, Water	12665	12860
R		
Rocker Valve	12721	12853
Rod, Carb. control	12777	12914
Rod, Carb. control complete	12778	12915
Rod, Mag. Advance	12724	12903
Rod, Mag. Advance complete	12779	12916

Assembly Name	T-2	T-3
S		
Screen, Oil suction pump	12662	12662
Shaft, Camshaft Drive	12700	12891
Shaft, Gun Control Drive	12698	
Shaft, Mag. Drive	12769	12909
Shaft and Impeller Water Pump	12664	12664
Starter Hand	12704	12893
Strap, Starting Mag	12706	
T		
Tee, Carburetor, front	12763	
Tee, Carburetor, rear	12764	
Tee, Cyld. water inlet	12607	
Tube, Breather	12775	12912
Tube, Oil	12705	12705
Tube, Oil suction filter	12679	12873
V		
Valve, Oil press, relief	12666	12861
Valve and Plug	12723	12902

Notes on the Use of Service Tools "T" Series Engines

The Service Tool Kit

The Service Tool Kit is designed to be carried in the airplane. It is sufficient for making all minor repairs in the field and should not be removed from the airplane for hangar use or for work on a ship when base repair tools are available. Even a top overhaul is possible with this kit, but more work than this is not practicable and should not be attempted.

The Crescent Adjustable Wrench WA-125 can be used for carburetor inspection, removal of magnetos and in several other places where several sizes of open end wrenches would be necessary.

The Monkey Wrench WA-132 and the Stillson Wrench WA-136 will be found useful for the removal of large nuts, tank caps and in other places where the Crescent Wrench is too light.

The Cutting Pliers WA-131 are intended for the removal of cotter pins, safety wire, etc.

The Hammer WA-104 saves other tools from being used for that purpose. It is not often needed for heavy work, but it will be found very valuable for minor work in the field.

The Canvas Tool Container WA-34 is made of ten-ounce brown duck with pockets to accommodate all tools. There are two straps on the outside for securing the roll. Many of the pockets are large enough and the roll is full enough to carry several additional tools, such as those used for work on the plane, if it is desired to carry them.

Complete List of Service Tools

This list shows a complete set of tools for any kind of service on Wright "T" Series engines. For a base repair shop or mother ship servicing several planes, the complete list would be required, while for a larger number of planes, possibly two sets would be necessary or at least, two or more of some of the tools, such as Handles for Valve Seat Cutters, Valve Clearance Gauges, Valve Grinding Screw Drivers, etc.

WA- 7 is the Handle for cutting valve seats with cutters WA-117. (Detail #12 and #14.)

WA-114 is properly graduated for timing all "T" series engines.

WA-117 (Detail #12 and #14) are to be used with Handle WA-7.

WA-115 is intended for the removal of all main crankshaft bearings.

WA- 37 is intended primarily for valve tappet adjustment, but it will also be found useful for other work, such as cylinder cover screws and magnetos.

WA- 10 is for removing magneto gears. Another gear puller WA-6, which is part of the equipment for Wright (Hispano type) engines can also be supplied and will be useful for removing Camshaft Gears.

WA- 46 is for inserting new Valve Guides.

1. Tool Kit for T-2 and T-3: Assy. No. W. A. 33.

Tool No.	*Tool Name*
WA- 34	Canvas Tool Container
WA-122	Valve Clearance Gage—.012"—.015"
WA- 35	Propeller Hub Nut Wrench, Inner
WA- 36	Propeller Hub Nut Wrench—Outer
WA-104	Hammer, Ball Pean No. 1
WA-131	One Pair Pliers—Combination 6"
WA-102	One Screw Driver 12"
WA- 37	Screw Driver 4"
WA- 24	Hook, Spanner 4"—Adjustable
WA- 25	Spark Plug Wrench and Handle
WA- 42	Cylinder Stud Nut Wrench
WA-125	Crescent Adjustable Wrench 6"
WA-132	Monkey Wrench—Flat—10"
WA-133	Wrench, Open End ¼"x$\frac{5}{16}$"
WA- 30	Wrench, Open End ⅜"x$\frac{9}{16}$"
WA- 41	Wrench, Tubular—For Carburetor and Oil Strainer
WA- 23	Wrench, Water Pump Packing Nut
WA-137	Wrench, Magneto Breaker Points, with gage for Breaker Point's Gap
WA-134	Cold Chisel—6"
WA-155	Drift Pin—6"
WA-136	Wrench—Stillson—8"
WA- 39	Wrench, Box 1" Hex., Camshaft Dr. Sh. Nut
WA- 40	Wrench, Box ¾" Hex., Vertical Shaft Nut
WA- 45	Valve Spring Compressor

2. Service Tools—Common to T-2 and T-3:

WA-115	Bearing Puller
WA- 7	Handle, Valve Seat Cutter
WA-107	Spring, Valve Grinding
WA-126	Cone and Handle for Valve Grinding
WA- 45	Valve Spring Compressor
WA-122	Valve Clearance Gage
WA- 49	Gage, Valve Guide Plug
WA- 46	Valve Guide Puller
WA- 50	Reamer, Valve Guide
WA- 48	Wrench, Crankshaft Thrust Bearing Nut
WA- 35	Wrench, Propeller Hub Nut, Inner
WA- 36	Wrench, Propeller Hub Nut, Outer
WA- 44	Piston Ring Clamp
WA-114	Timing Disc with Hub and Indicator
WA- 43	Indicator, Dead Center
WA- 10	Gear Puller
WA- 52	Reamer, Cam Rocker Bushing
WA- 62	Reamer, Water Pump Line
WA- 60	Rivet Set, Cam Rocker Roller Pin
WA- 61	Bar, Aligning Vertical Shaft Bearing
WA- 42	Wrench, Cylinder Stud Nut
WA- 25	Spark Plug Wrench and Handle
WA-121	Wrench, Water Pump Bracket Nut
WA- 32	Special Screw Driver for Crankshaft Plugs
WA-128	Special Tool for Withdrawing Rocker Arm Shaft
WA-118	Piston Pin Extractor
WA- 41	Double End Wrench—One End Hex. for Oil Strainer, Other End Square for Carb. Strainer

3. Service Tools—Special for T-2:

WA-117	(Det. No. 12) Cutter, Valve Seat with Pilot, but Without Handle No. WA-7
WA- 68	Reamer—Main Bearing
WA- 70	Reamer, Conn. Rod Bushing—Small End
WA- 69	Wrench, Tubular Hex., Outside Crankshaft Gear Nut

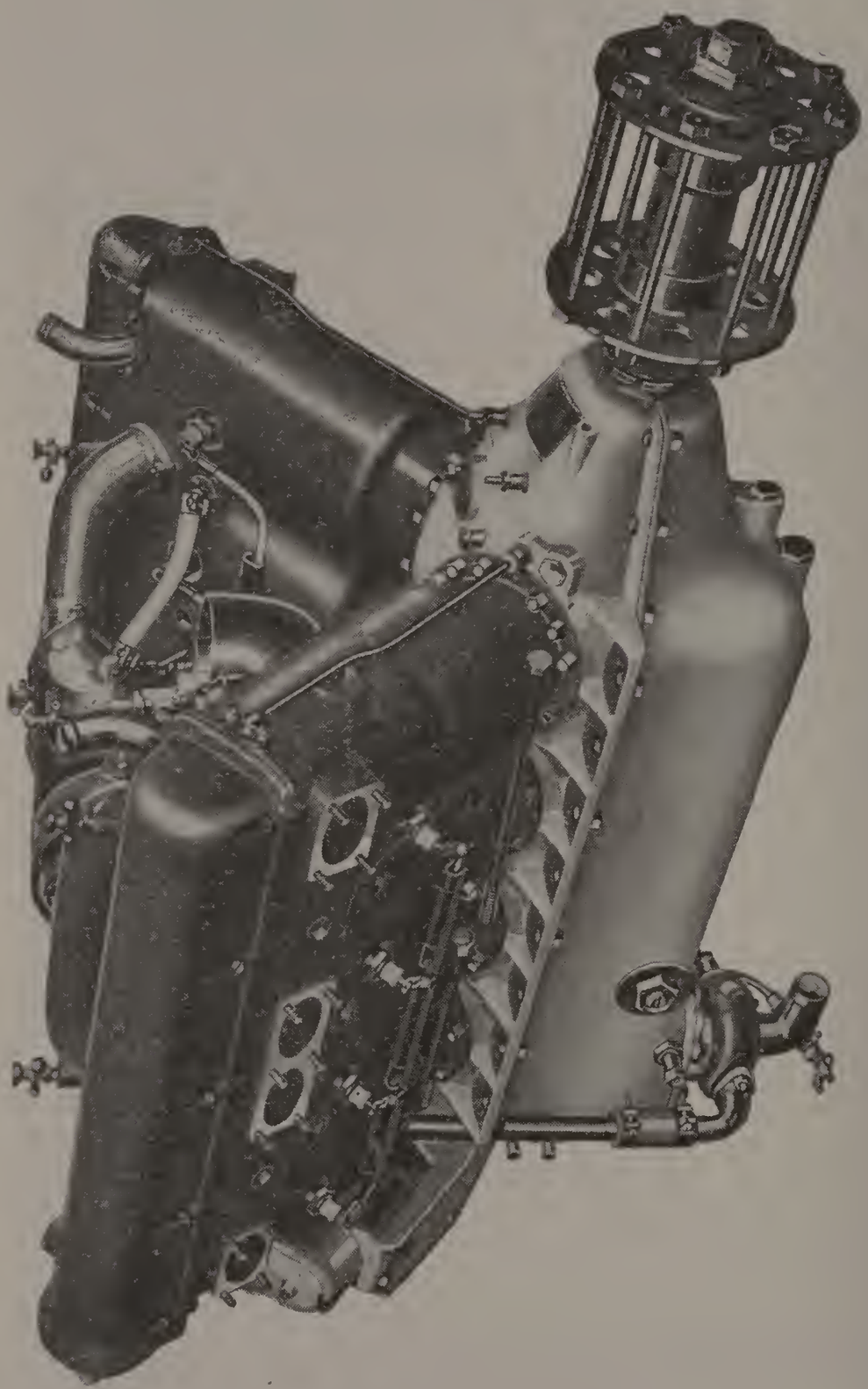
4. Service Tools—Special for T-3:

WA-117	(Det. No. 14) Cutter, Valve Seat with Pilot, but Without Handle No. WA-7
WA- 77	Reamer, Main Bearing
WA- 74	Reamer, Conn. Rod Bushing, Small End
WA- 76	Wrench, Tubular 1¾" Hex., Crankshaft Gear Nut

WRIGHT
E-3 and E-4
AVIATION ENGINES

Description
Installation
Starting & Operation
Dismantling Engine
Disassembly, Overhaul & Reassembly of Units
Numerical Parts List
Alphabetical Parts List
Drawings:-Assembly, Installation and Clearance

WRIGHT AERONAUTICAL CORPORATION
PATERSON, NEW JERSEY
U. S. A.



WRIGHT
Model E-4 Engine

Instructions for Wright E-3 and E-4 Engines

It has not been thought necessary to include in this section the disassembly, overhaul and reassembly of separate units, as these are almost identical on all other Wright 8-cylinder, water-cooled engines (Hispano Type), which have been treated very fully in a previous publication—WRIGHT AIRCRAFT ENGINES, 1922—to which attention is directed. Some units, e. g., fuel pump and hand starter, which are not to be found in the early publication, will be found in this book under the "T" Series engines.

Under the "T" Series engines will also be found notes on carburetor and magneto overhaul, timing of engines and magnetos, installation and starting and operation of engines, all of which apply to the T-2, T-3, E-3 and E-4 engines.

No assembly drawings of the E-3 engine are included, but complete alphabetical and numerical parts lists are given along with those of the E-4 engines, and if it is desired to locate an E-3 part on the engine, one can refer to the parts lists, find the corresponding part on the E-4 engine and locate this on the E-4 assembly drawings.

Wright E-3 and E-4 Engines

8 Cylinder, 90° Vee, Water Cooled

Wright E-3 and E-4 engines are very similar and the following description of the E-4 will serve also to explain the E-3, the major points in which the E-3 differs from the E-4 being mentioned in the description.

Description E-4 Engine

Cylinder Sleeves Cylinders Steel cylinder sleeves of the open end type are screwed and shrunk into aluminum cylinder blocks. These sleeves provide bearings for the pistons and through flanges at the lower ends, the means whereby the cylinder blocks are attached to the crankcase. (In the E-3 engine the closed end type of sleeve is used. These sleeves are shrunk into the cylinder block and secured by studs passing through the head of the sleeve and the head of the block.)

The cylinder blocks have integrally cast water jackets and are enameled both inside and out as a protection against corrosion of the aluminum due to impurities in the cooling water or to atmospheric action.

Valve Seats Valve seats are shrunk into the head of the cylinder block. These seats are made of aluminum bronze which has about the same co-efficient of expansion as the cylinder head and thus the possibility of the seats becoming loose is removed. (Valve seats in the E-3 are cut in the head of the steel sleeve.) Bronze spark plug bushings are screwed, shrunk and pinned into the cylinder walls, thus providing good mechanical and thermal contact with the cylinder. (The E-3 engines have steel spark plug bushings.)

Valves The valves are operated directly from the camshaft, through flat tappets of mushroom form which are attached directly to the upper end of each valve stem. The valve stems are of large diameter and are hollow, being threaded internally to receive the screwed stems of the tappets. The tappets have flat heads with notched edges and the bottom surfaces are serrated to mate with washers which fit underneath and perform an important role in the timing of the engine. The top surface of the tappet, on which the cam bears, is case hardened to resist wear. Each valve washer is held in mesh with its tappet by means of two valve springs, one inside the other.

Camshaft Camshaft Drive Upper Vert. Shaft The camshaft is hollow for lightness and lubrication, and runs in three bearings made of lynite, a copper aluminum alloy which is lighter than the bronze ordinarily used for this purpose. (E-3 engine has bronze bearings.) These bearings are

screwed to the top of the cylinder block and the whole of the camshaft and valve mechanism is enclosed by an oil tight cover, thus insuring ample and efficient lubrication.

At the end of each cylinder block there is a vertical shaft which drives the camshaft through bevel gearing. This is called "the *upper* vertical shaft" and has a disconnecting joint above the level of the crankcase so that it forms a unit with the cylinder assembly. Thus, cylinders, valves, camshaft and camshaft drive form a complete unit which is both light and compact.

Crankcase Lower Vert. Shaft

Owing to the nature of the cylinder assemblies the crankcase is comparatively simple. There are upper and lower halves split on the center line of the crankshaft and the respective parts of the bearings are carried directly in the crankcase halves. The upper and lower halves are bolted together very strongly, and since each half takes its share of the support of the crankshaft, the crankcase as a whole is very rigid and light in weight. Both halves are aluminum castings and the upper half has a projecting foot running the entire length of the case on each side, thus forming the bedplate by which the engine is supported.

In bronze carriers in the upper half, at the rear end, there are two short shafts called "the *lower* vertical shafts." Each of these shafts has a bevel gear at the lower inside end, meshing with a bevel gear on the crankshaft. The upper ends of these shafts project above the crankcase and are slotted to receive the tongues on the ends of the upper vertical shafts. It is thus possible to remove and replace cylinders without disturbing any of the camshaft gearing.

Crankshaft Connecting Rods

The crankshaft is hollow throughout for lightness and for the passage of oil. It is supported on four babbitt faced bronze bearings and one ball bearing situated at the rear end immediately in front of the bevel gear. The front end of the crankshaft has a taper on which the propeller hub is mounted and directly behind this is a ball thrust bearing housed in the crankcase. In the rear end of the crankshaft is a slot which engages with a tongue on the magneto drive gear shaft and operates the fuel pump and the magneto drives.

There are two connecting rods, an inner and outer, operating on each crankpin. The inner rod has a hollow tubular shank which is forked at the lower end and opens out into two flat feet to which is attached a special copper-tin-lead alloy bearing. The four bolts which secure the bearing to the rod also hold the two halves of the bearing together. The outside of the bearing, in the space between the two feet of the forked rod, is turned and forms a bearing for the outer connecting rod large end, this being split in the normal way and held together by two bolts.

Piston
Piston Pins

The pistons are of aluminum alloy and are simple in design. There is no ribbing beneath the heads, the section being amply strong without and heavy enough to dissipate heat from the center of the head, rapidly. Each piston has three compression rings near the head and one scraper ring in the skirt.

The piston pins are free to turn in both the piston pin bosses and the small ends of the connecting rods. Bronze plugs are driven into the ends of the pins to remove the possibility of scratching the walls of the cylinders.

Pump Drive

In the lower half of the crankcase, running in a bronze bearing, is a vertically located shaft with a bevel pinion at its upper end. This bevel pinion meshes with the bevel on the crankshaft and drives the oil and water pumps through a tongue on the shaft. In order to minimize weight all the intermediate shafts run at a speed one-fifth greater than that of the crankshaft. The lubrication system is operated by two suction pumps and a pressure pump in a similar manner to that described under the "T" series description.

Magneto Drive
Magneto Coupling

There are two magnetos, each an eight-cylinder instrument. One is wired to all spark plugs located on the outside of the cylinders and the other to all spark plugs situated in the Vee between the blocks. The magnetos are mounted crosswise with their distributor ends tilted upwards and toward the outside of the engine. This method of mounting makes the breaker boxes very accessible and it also permits the engine bearers to be continued straight back as far as the airplane designer may desire.

Both magnetos with their drive shaft and gears are made up in a unit and are demountable as such. The rear end of the crankcase has a circular, flanged opening, provided with a ring of studs and the aluminum magneto bracket is attached thereto. There are three magneto gears. Located centrally in the bracket is a short shaft with a tongue on the front end which engages with the slot in the end of the crankshaft and at the other end, housed in the bracket, is a ball bearing which supports the shaft. A bevel pinion on this shaft meshes with the two magneto driving gears, one on each side, these also being mounted on ball bearings.

The magnetos themselves are attached to the bracket by cap screws and a very simple and effective form of coupling is used. On the end of the armature shaft is a small spur gear with 23 teeth and on the bevel pinion shaft is a similar gear with 24 teeth. To connect the armature and pinion shafts there is a sleeve, furnished at each end with an internal gear. The internal gear at the arma-

ture end has 23 teeth. The other end has an internal gear with 24 teeth. When this sleeve is located symmetrically, the internal gears mesh with their corresponding spur gears and so give a positive drive connection, which has ample freedom to allow for any slight inaccuracies in alignment that may exist. A spring is used to keep the sleeve in its driving position, but by removing a cotter pin the sleeve is freed, can be slid out of mesh and the magneto can then be timed with great accuracy, for by moving forward one of the 23 teeth and simultaneously moving backward one of the 24 teeth the effect of an advance of seven-tenths of a degree is obtained. A magneto can be removed without affecting the coupling, since the gear simply slides out when the cap screws which hold the magneto to the bracket are removed.

It should be noted that due to the bevel drive, both magnetos rotate in the same direction and therefore are identical.

Gasoline Supply Fuel Pump Gasoline is supplied by means of a Wright Viking Fuel Pump, to a Stromberg NA-U5 carburetor (NA-D4 on the E-3 engine), which is located in the vee of the engine. The fuel pump is attached to the bottom of the magneto bracket, taking its drive from a short vertical shaft and another bevel gear meshing with the main magneto driving gear. The construction and operation of the pump is explained in the description of the "T" series engine.

Dismantling E-3 and E-4 Engines

1. DRAW OFF PROPELLER HUB ASSEMBLY.
   This should be done in the following manner:
   a. Remove the locking device.
   b. Loosen the outer nut and back it off 5 turns.
   c. Loosen the inner nut and back it off 3 turns.
   d. Hold the inner nut firm and screw up on the outer nut until the hub breaks away from the shaft.
   e. Back off inner nut and remove hub.

   NOTE:—It is important that the propeller hub be removed according to the above procedure in order to prevent injury to the threads on the crankshaft.

2. Disconnect carburetor gas and water connections, loosen 4 nuts on manifold and LIFT OFF CARBURETOR AND MANIFOLD TEE ASSEMBLY TOGETHER WITH CONNECTIONS and HOSE.

3. Take off nuts and REMOVE INLET MANIFOLDS RIGHT AND LEFT HAND.

4. Disconnect all ignition wires from spark plugs, loosen ignition wire manifolds from cylinder walls, disconnect magneto advance clamps from tubes, take out spark plugs and LIFT OFF TWO DISTRIBUTOR COVERS and MAGNETO ADVANCE ASSEMBLIES.

5. REMOVE HAND STARTER.

6. Take out 2 cotter pins from magneto couplings, cut wire from magneto hold down screws, remove screws and TAKE OFF 2 MAGNETO and GEAR ASSEMBLIES WITH COUPLINGS and IGNITION WIRES.

7. Take off nuts and set screws and DRAW OFF MAGNETO SUPPORT ASSEMBLY and FUEL PUMP.

8. REMOVE TACHOMETER SHAFT.

9. Take out screws and REMOVE CYLINDER COVERS RIGHT and LEFT HAND.

10. Take off nuts on camshaft bearings and LIFT OUT 2 CAMSHAFT and BEARING ASSEMBLIES.

11. REMOVE CRANKCASE BREATHER ASSEMBLY.

12. Take off nuts and REMOVE 2 GUN CONTROL ASSEMBLIES.

13. Loosen vertical shaft housing packing nuts, remove nuts from interrupter drive gear housings and slip up housings on vertical shaft casing. Disconnect water pipes and remove them. Loosen oil pipe nipple packing nut. Remove cylinder hold down nuts and LIFT OFF ONE CYLINDER ASSEMBLY WITH OIL PIPE ATTACHED and REMOVE PISTONS FROM EXPOSED CONNECTING RODS.

    NOTE:—Care must be taken that in removing the cylinder block, the pistons do not come in contact with the cylinder studs; rubber tubing should be placed over these studs or they should be covered with rag to remove the possibility of marring the pistons.

    It is important that the pistons be removed from the exposed connecting rods before the other block is taken off, as there is a danger of breaking the piston rings in the exposed pistons when turning the motor over.

    REMOVE OTHER CYLINDER BLOCK IN THE SAME MANNER.

14. Invert crankcase on stand and REMOVE OIL and WATER PUMP ASSEMBLIES.

15. REMOVE COTTER PINS and NUTS FROM REAR MAIN BEARING STUDS (INSIDE THE CRANKCASE). Remove all flange bolts and nuts, reinvert case on stand, take off remaining main bearing nuts, turn crankshaft till webs are horizontal and LIFT OFF UPPER HALF CRANKCASE.
16. LIFT OUT CRANKSHAFT and CONNECTING ROD ASSEMBLY and REMOVE BEARINGS.
17. REMOVE OIL STRAINER, OIL PRESSURE RELIEF VALVE and OIL MANIFOLD PLUG FROM LOWER HALF CRANKCASE.
18. REMOVE CONNECTING RODS FROM CRANKSHAFT, BEING SURE TO KEEP BOLTS and NUTS WITH RODS FROM WHICH THEY WERE TAKEN.
19. BLOW OUT ALL OIL LEADS IN BOTH UPPER and LOWER HALVES OF CRANKCASE WITH A POWERFUL KEROSENE SQUIRT.

Reassembly E-3 and E-4 Engines

1. ASSEMBLE CONNECTING RODS ON CRANKSHAFT.
2. REPLACE OIL MANIFOLD PLUG, OIL PRESSURE RELIEF VALVE and OIL STRAINER IN LOWER HALF CRANKCASE.
3. Put main bearings in upper half crankcase and PUT IN CRANKSHAFT and CONNECTING ROD ASSEMBLY.
4. Put main bearings in lower half, drop oil and water pump drive gear into place in bearing and ASSEMBLE TWO HALVES OF CRANKCASE TOGETHER, using a little shellac on the joint.
5. PUT NUTS ON REAR BEARING STUDS and COTTER PIN THEM.
   It is important that these nuts and cotter pins be put on at this stage of the assembly, for they cannot by reached after the oil pump is in place.
6. ATTACH OIL and WATER PUMP ASSEMBLY and invert crankcase on stand.
7. Assemble 4 pistons to connecting rods and PUT ON ONE CYLINDER ASSEMBLY. Put on other assembly in same manner.
8. PUT ON WATER PIPE CONNECTIONS and connect vertical shaft housings.
9. PUT ON GUN CONTROL ASSEMBLIES.

10. ATTACH CRANKCASE BREATHER ASSEMBLY.
11. REPLACE CAMSHAFT and BEARING ASSEMBLIES.
12. PUT ON and SECURE MAGNETO SUPPORT ASSEMBLY and FUEL PUMP.
13. REPLACE MAGNETO and GEAR ASSEMBLIES, WITH COUPLINGS and IGNITION WIRES, and put in spark plugs on inside banks of cylinders.
14. ATTACH DISTRIBUTOR COVERS and MAGNETO ADVANCE ASSEMBLIES TO MAGNETOS, fix ignition wire manifolds to cylinder walls (inside) and connect wires to spark plugs.
15. Put on inlet manifolds and ASSEMBLE CARBURETOR and MANIFOLD TEE ASSEMBLY.
16. SET VALVE CLEARANCES and TIME ENGINE.
    Be sure to replace cotter pin in vertical shaft nut after timing.
17. TIME MAGNETOS, making sure that couplings are secured by cotter pins after the timing.
18. PUT ON CYLINDER COVERS and TACHOMETER SHAFT.
19. SCREW IN OUTSIDE SPARK PLUGS and connect ignition wires to terminals.
20. PUT ON PROPELLER HUB.

Numerical Parts List

for

E-3 and E-4 Engines

Part Number	Part Name	Quan. per Engine E-3	E-4
B-27	Gasket, ½" I. D.	4	2
B-28	Gasket, 11/16" I. D.	13	20
B-32	Gasket, 2 17/32" I. D.	1	1
B-33	Gasket, 1 " I. D.	1	1
B-63	Cotterpin, 3/32" x 1¼"	2	2
B-64	Cotterpin, 5/64" x 1 "	20	30
B-93	Nut, 6 m/m x 1 P.	30	28
T-129	Key, Camshaft Gear	2	2
T-210	Stud, 8 m/m x 1.25 P. x 1 1/16" lg.	16	28
594-P	Ring, Piston L. H.	8	8
595-P	Ring, Piston R. H.	16	16
596-P	Ring, Piston Oil	8	8
656	Cotterpin	4	4
657	Cotterpin, 3/32" dia.	10	10
B-574	Screw, Lock 6 m/m x 53/64" lg.	1	1
B-759	Gasket, Breather Tube	1	1
B-760	Gasket, Oil Manifold Plug	1	1
B-767	Dowel, .315" Dia. x 5/8"	8	8
B-768	Dowel, .236" Dia. x 5/8"	16	16
B-781	Screw, 5 m/m x .75 x 9/16" C'ts'k Hd. Mach.	10	10
B-784	Stud, 6 m/m x 1 P. x 1 9/64" long	10	4
B-785	Gasket, Intake Pipe and Tee	2	
B-786	Gasket, Carburetor	1	
B-788	Gasket, Intake Pipe	4	4
B-789	Lockwasher for 6 m/m Dia.	24	28
B-790	Lockwasher for 8 m/m Dia.	73	61
B-794	Stud, 6 m/m x 1 P. x 61/64" long	8	16
B-803	Screw, 5 m/m x .75 P. x 5/16" Fill. Hd. Mach.	3	3
B-904	Ball Bearing #904		1
T-948	Stud, 8 m/m x 1.25 P. x 3 5/32" long	12	12
T-949	Stud, 8 m/m x 1.25 P. x 1 17/64" long	8	
T-950	Bushing, Cylinder Cover Screw	20	20
T-952	Screw, Camshaft Center Bearing	8	8
T-954	Stud, 8 m/m x 1.25 P. x 1 11/32" long	10	10
T-955	Stud, Cylinder	72	72
T-956	Stud, Crankshaft Center Brg.	8	8
T-957	Stud, Crankshaft Rear Brg.	2	2
T-958	Stud, Crankshaft Front Brg.	2	2
T-960	Screw, Water Pump Cover	6	6
T-961	Stud, 8 m/m x 1.25 P. x 1 3/16" long	36	24
T-970	Screw, Main Bearing Dowel	4	4
T-982	Gasket, Water Pump Cover	1	1
T-989	Nipple, Oil Pipe	2	2
T-990	Nut Packing, Oil Pipe Nipple	2	2
T-1032	Gasket, Cylinder Cover	2	2
T-1092	Gasket, Water Pipe	16	8
1426	Gasket, Magneto Support	1	1
1437	Dowel, 5/16" Dia. x ¾" Dowel	4	4
1439	Gasket, Cylinder Base	2	2
1441	Stud, 10 m/m x 1.5 P. x 1 5/16" long	3	
1442	Stud, 10 m/m x 1.5 P. x 1 5/32" long	3	3
1443	Nut, 10 m/m x 1.5 P. x 3/8" slotted	2	2
1444	Nut, Plain 10 m/m x 1.5 P.	6	3
1458	Washer, 13/32" I. D. Plain	34	17

Part Number	Part Name	Quan. per Engine E-3	E-4
6203	Ball Bearing #6203	4	4
6204	Ball Bearing H. B. #6204	4	4
6208	Ball Bearing H. B. #6208	1	3
6408	Ball Bearing H. B. #6408	1	1
9619	Bearing, Camshaft—Front	2	
9622	Bearing, Camshaft—Rear	2	
9635	Bushing, Connecting Rod	8	8
9638	Gear, Crankshaft	1	1
9667	Plug, 38 m/m x 1.5 P	30	1
9930	Taperpin, Magneto Drive Pinion, Vertical Shaft Gear	2	2
9939	Washer, Camshaft Front Brg	2	2
9941	Gear, Vertical Shaft—Lower	2	2
9959	Tube, Breather	1	1
9960	Cap, Breather	1	1
9967	Bearing, Crankshaft Intermediate—Lower	3	3
9968	Bearing, Crankshaft Intermediate—Upper	3	3
10357	Nut, Vertical Shaft Hous. Packing	2	2
10376	Shaft, Water Pump	1	1
10378	Bushing, Water Pump	1	1
10428	Tee, Inlet Manifold	1	
10432	Nut Packing, Inlet Pipe	1	
10434	Nozzle, Water	1	
10443	Manifold, Inlet—L. H.	1	
10444	Manifold, Inlet—R. H.	1	
10474	Gear, Camshaft	2	2
10487	Ring, Vert. Shaft Casing Nut Lock	2	2
10510	Washer, Crankshaft Ball Bearing	1	1
*10540	Flange, Propeller Hub	1	1
10561	Coupling, Tachometer	1	1
10637	Nut, Crankshaft Centering Lock	1	1
10685	Gasket, Vert. Shaft Gear Cover	2	2
10693	Lock, Crankshaft Cent. Nut	1	1
11003	Nut, Propeller Thrust Brg.	1	1
11008	Bearing, Crankshaft Front—Upper	1	1
11009	Bearing, Crankshaft Front—Lower	1	1
11012	Lock, Thrust Bearing Nut	1	1
11137	Plate, Water Hole	10	2
11160	Tube, Wire Manifold End	2	2
11161	Rivet, Round Head	8	8
11163	Dowel, Connecting Rod Bushing	8	8
*11164	Tube, Oil Manifold	3	3
11168	Packing, Water Pump	9″	9″
11169	Cotterpin	9	11
*11171	Sleeve, Oil Manifold	1	1
11188	Packing, Stuffing Box	6′	6′
11197	Flange, Water Pipe	4	4
11198	Button, Water Pump Thrust	2	2
11204	Hose, Manifold Water Pipe Coupling	2	2
11206	Pin, Tachometer Coupling	1	1
11207	Cotterpin	2	2
*11214	Plate, Engine License	1	1
11233	Plug, ¾″ Pipe	1	1
11245	Clamp, for ⅜″ I. D. Hose	8	8
*11272	Cover, Engine	1	1
11302	Nut, Slotted 8 m/m x 1 25 P	16	26
11303	Nut, Plain 8 m/m x 1.25 P. x $\frac{5}{16}$″	85	73
11304	Nut, Plain 8 m/m x 1.25 P. x $\frac{15}{64}$″	16	
11305	Nut, Plain 10 m/m x 1.5 P. x $\frac{15}{32}$″	72	72

* Not to be ordered as spares.

Part Number	Part Name	Quan. per Engine E-3	E-4
11313	Plug, 12 m/m x 1.25 P	2	
11322	Rivet, Flat Head	4	4
11323	Plug, Crankshaft 25 m/m x 1.5 P	8	8
11324	Plug, Crankshaft—Small	4	4
11340	Terminal, Ignition Wire	16	16
11342	Magneto, Starting	1	
11348	Cotterpin	2	2
11366	Screw, Vert. Shaft Brg. Dowel	2	2
*11373	Bearing, Camshaft Center	2	
*11374	Cap, Camshaft Center Brg.	2	
11386	Stud, 6 m/m x 1.25 x 7/8"		4
11397	Ring, Propeller Hub Nut Lock	1	1
11406	Spring, Valve (Inner)	16	16
11407	Spring, Valve (Outer)	16	16
11440	Gasket, 1½" I. D.	33	2
11442	Strap, Ignition Manifold	2	
11443	Pin, 1/16" Dia. x 3/8" lg. straight	10	12
11445	Cotterpin, 1/16" x 1" long	3	3
11449	Ring, Ignition wire—large	8	8
11468	Shaft, Tachometer Drive	1	1
11469	Bushing, Tachometer Drive Shaft	1	
11503	Nut, 3/8" x 24 x ½" slotted	16	
11513	Washer, Valve Spring—Lower	16	16
11517	Bolt, 8 m/m x 1.25 P. x 1 3/32"	6	6
11527	Body, Oil Pressure Relief	1	1
11530	Spring, Oil Pressure Relief	1	1
11531	Plunger, Oil Pressure Relief	1	1
11559	Gasket, 5/8" I. D.	1	1
11570	Marker, Ignition Wire	2 sets	
11574	Gasket, Spark Plug Bushing	16	
11626	Key, Propeller Hub	1	1
11630	Wire, Dia. .030" to .045"	16'	16'
*11658	Impeller, Water Pump	1	1
*11673	Connecting Rod, Outer	4	4
*11674	Connecting Rod, Inner	4	4
11677	Screw, Cylinder Cover	22	22
11680	Key, #3 Woodruff	5	7
11682	Nut, Water Pump Gland	1	1
11683	Bolt, Connecting Rod—Outer	8	8
11686	Valve Guide, Admission	8	
11687	Valve Guide, Exhaust	8	
11688	Nut, Connecting Rod Outer Bolt	8	8
11689	Bolt, Connecting Rod—Inner	16	16
11705	Washer, 21/64" I. D. x 5/8" O. D. x 1/16"	3	13
11707	Cotterpin, 5/64" dia. x 3/4"	32	16
11722	Valve, Oil press. relief Assembly	1	1
11730	Washer, Vert. Shaft Thrust	2	2
11757	Gear, Pump Idler ½" Face	1	1
11775	Screw, Oil Pump Gear Brg. Set	1	1
11778	Bushing, Spark Plug	16	
11796	Cock, 1/8" Spring Key	1	2
11812	Spacer, Thrust Bearing	1	1
11819	Plug, 5/8" x 18 P	5	5
11820	Screw, 14 x 24 x 9/16" Fil. Hd.	2	2
11844	Stud, 8 m/m x 1.25 P. x 1 13/32" long	6	6
11851	Stud, 6 m/m x 1 P. x 1 21/32" long	4	4
*11865	Crankshaft	1	1
11868	Gasket, 13/16" I. D.	2	2
11879	Stud, 8 m/m x 1.25 P. x 1 11/16" long	13	13

* Not to be ordered as spares.

Part Number	Part Name	Quan. per Engine E-3	E-4
11880	Bearing, Thrust	1	1
11893	Cap, Oil Pressure Relief	1	1
11896	Spring, Magneto Coupling	2	2
*11897	Coupling, Magneto	2	2
11898	Washer, Magneto Coupling Spring	2	2
11899	Nut, 12 m/m x 1.25 P. x $\frac{5}{16}$" slotted	2	2
11900	Nut, $\frac{3}{8}$" x 16 x $\frac{3}{8}$"		2
11901	Rivet, Round Head	24	24
*11903	Gear, Mag. Coupling (23 teeth) Int.	2	
*11904	Gear, Mag. Coupling (24 teeth) Int.	2	
11906	Gear, Magneto Shaft (23 teeth)	2	
11908	Carburetor (NA-D4) Stromberg	1	
11915	Bolt, Propeller Hub	8	8
11917	Bushing, Water Pump Drive Shaft	1	1
11937	Bushing, Cyl. Cover Screw Dowel	2	2
11945	Cotterpin	2	2
11946	Spacer, Interrupter Ball Bearing	2	2
11947	Gear, Interrupter Drive	2	2
11948	Housing, Interrupter Drive Gear	2	2
11950	Pinion, Interrupter Drive	2	2
11951	Shaft, Interrupter Gear	2	2
11960	Gasket, Interrupter Gr. Shaft Housing	2	2
11962	Stud, 8 m/m x 1.25 P. x $1\frac{1}{16}$"	2	2
11971	Stud, 8 m/m x 1.25 P. x $\frac{7}{8}$"		8
11972	Valve Tappet	16	16
11973	Cup, Priming	4	4
*11981	Manifold, Cyl. Ignition Wire	4	
11983	Rivet, $\frac{5}{32}$" Dia. Fl. Hd. $\frac{1}{4}$" long	16	16
11985	Plug, Spark (Champion AC large porcelain)	16	16
*11993	Cover, Packing Box Seal	2	2
12053	Screw, Rd. Hd. brass #4-32P	8	8
14023	Stud, Interrupter Brace	2	2
14024	Spring, Interrupter Brace	2	2
14025	Washer, $\frac{21}{64}$" I. D. x $\frac{3}{4}$" O. D. x $\frac{1}{16}$"	2	2
14058	Washer, Plain $\frac{11}{32}$" I. D.	4	4
14059	Stud, 8 m/m x 1.25 P. x $1\frac{7}{32}$" lg.	2	2
14060	Stud, 8 m/m x 1.25 P. x $1\frac{17}{32}$" lg.	2	2
*14083	Strainer, Breather Tube Oil	1	1
*14084	Ring, Breather Tube Oil Strainer	1	1
14085	Spring, Breather Tube Oil Strainer	1	1
*14098	Dowel, Propeller Hub	1	1
14105	Nut, Propeller Hub—Outer	1	1
14106	Nut, Propeller Hub—Inner	1	1
*14126	Plug, Wood for $\frac{5}{8}$" I. D. Hose	2	2
14191	Retainer, Interrupter Gr. Shaft B. B.	2	2
14207	Housing, Interrupter Gear Shaft	2	2
14221	Rivet, Rd. Hd. $\frac{1}{8}$ x $\frac{1}{4}$		6
14313	Nut, 14 m/m x 1.5 P. x $\frac{5}{16}$" slotted	2	2
14314	Gear, Magneto Drive Shaft	2	
14408	Plug, Pipe $\frac{1}{8}$" (Std.)	1	2
14432	Pinion, Magneto	2	2
14433	Nut, Magneto Pinion B. B.	2	2
14435	Spacer, Magneto Pinion B. B.	2	2
14455	Cover, Cylinder L. H.	1	
14457	Cover, Cylinder R. H.	1	
*14460	Hub, Propeller	1	1
14461	Nut, Propeller Hub Bolt Plain	1	1
14462	Nut, Propeller Hub Bolt Special	7	7
*14484	Manifold, Ignition Wire L. H	1	1

* Not to be ordered as spares.

Part Number	Part Name	Quan. per Engine E-3	E-4
14575	Nut, 3/8 x 24 P. Plain		5
*14602	Crankcase, Upper Half	1	1
*14603	Frame, Oil Suction Pump Screen	1	1
*14604	Screen, Oil Suction Pump—Rear	1	1
14605	Gear, Oil Pump Drive	3	3
14606	Shaft, Oil & Water Pump Drive	1	1
14607	Gear, Oil Pressure Pump	1	1
14608	Gear, Oil Suction Pump	2	2
*14609	Plate, Oil Pump Cover	1	1
*14610	Body, Oil Pump	1	1
14629	Gear, Oil & Water Pump Drive	1	1
14630	Bearing, Oil & Water Pump Drive Gear	1	
14631	Plug, Oil & Water Pump Drive Shaft	2	2
14632	Gasket, Oil Pump Cover Plate	1	1
14633	Gear, Pump Idler 5/8" Face	2	2
14634	Washer, Plain 1/2" I. D. x 51/64" O. D.	2	2
14635	Nut, Castled 12 m/m x 1.75 P	2	2
*14636	Body, Water Pump	1	1
*14638	Screen, Oil Filter—Fine Mesh	1	1
*14639	Screen, Oil Filter—Coarse Mesh	1	1
*14640	Ring, Oil Filter	1	1
*14641	Plate, Oil Filter End	1	1
14642	Spring, Oil Filter	1	1
14643	Cover, Oil Filter	1	1
*14646	Pipe, Cylinder Water Inlet R. H.	1	
*14647	Pipe, Cylinder Water Inlet L. H.	1	
14648	Hose, Water Pump Outlet	2	2
14649	Clamp, Hose for 1" I. D. Hose	4	4
*14650	Support, Magneto	1	1
14651	Shaft, Magneto Drive Gear	1	1
14652	Nut, Magneto Drive Gear B. B. Ret.	1	1
14653	Lock, Mag. Dr. Gear B. B. Ret. Nut	1	1
14655	Gasket, Magneto Support Cover	1	1
14656	Spring, Mag. Pinion B. B. Nut Lock	1	1
14665	Gear, Camshaft	2	
14668	Gear, Vert. Shaft—Upper	2	2
14669	Shaft, Vertical	2	2
14670	Bearing, Vertical Shaft—Upper	2	
14671	Dog, Vertical Shaft	4	4
*14672	Flange, Oil Pipe R. H.	1	
*14673	Flange, Oil Pipe L. H.	1	
*14674	Pipe, Camshaft Oil	2	
*14675	Pipe, Cam Housing Oil Return R. H.	1	
*14676	Pipe, Cam Housing Oil Return, L. H.	1	
14678	Nipple, Oil Return Pipe	2	
14679	Nut, Packing Oil Return Pipe	2	
*14680	Nut, Vertical Shaft Casing	2	2
14683	Gasket, Oil Pipe Flange	2	
*14684	Pipe, Water Pump Outlet	2	2
*14685	Casing, Vertical Shaft	2	2
14688	Flange, Exhaust Pipe	8	
14689	Gasket, Exhaust Pipe Flange	8	
*14690	Plate, Exhaust Port	8	
14692	Packing, Fuel Pump	1	1
14696	Plug, Piston Pin	16	
14700	Screw, Fuel Pressure Relief Adj.	1	1
14701	Nut, Fuel Pressure Relief Adj. Lock	1	1
14702	Cover, Fuel Pressure Relief	1	1
14711	Gasket, 7/8" I. D. x 1 1/8" O. D. x 1/16"	1	1

* Not to be ordered as spares.

Part Number	Part Name	Quan. per Engine E-3	E-4
14712	Nut, Castled $\frac{5}{16}$" x 24 P.	3	3
*14726	Manifold, Ignition Wire R. H.	1	1
14873	Dowel, $\frac{3}{16}$ x $\frac{3}{8}$		2
14930	Bolt, $\frac{1}{4}$ x 28 P. x $\frac{13}{32}$" long		4
14931	Nut, $\frac{1}{4}$ x 28 P. Plain		8
14941	Lockwasher, $\frac{1}{4}$ x $\frac{3}{32}$ x $\frac{3}{64}$		4
14960	Stud, $\frac{1}{4}$" x 20 x 28 P. (Std.) x 1"		4
14981	Gasket, Crankcase Rear Cover		2
14994	Washer, $\frac{17}{64}$" x $\frac{1}{2}$" x $\frac{1}{16}$"		4
14996	Washer, $\frac{25}{64}$ x $\frac{11}{16}$ x $\frac{5}{64}$		5
*15019	Plate, Engine Name	1	1
15078	Clip Wire Manifold	8	
15087	Cover, Magneto Support	1	
15252	Gear, Pump Drive	1	1
15253	Bushing, Fuel Pump Gear	1	1
15255	Shaft, Fuel Pump Pinion	1	
15256	Gasket, $1\frac{17}{32}$" Dia. x $2\frac{1}{2}$" sq.	2	2
15258	Nut, Fuel Pump Packing	1	1
15259	Spring, Fuel Pressure Relief Valve	1	1
15260	Pin, Piston	8	
15261	Nut, 10 m/m x 1.5 P. x $\frac{53}{64}$"	10	8
15264	Tee, Water Pump Drain	1	1
*15265	Pipe, Manifold Tee Outlet $\frac{3}{8}$" O. D.	1	1
15266	Tag, Magneto (Inside)	1	1
15267	Tag, Magneto (Outside)	1	1
15272	Stud, 8 m/m x 1.25 P. x $1\frac{15}{16}$"	4	4
*15275	Plate, Hub Flange Name	1	1
15282	Cover, Water Pump	1	1
15283	Clip, $\frac{3}{8}$" O. D. Pipe	2	2
15286	Valve, Fuel Pressure Relief	1	1
15287	Guide, Fuel Pressure Relief Adj. Screw	1	1
15292	Adapter, 38 m/m x $\frac{1}{4}$" Pipe Thd.	2	
15294	Connection, $\frac{3}{8}$" I. D. Hose	4	4
15304	Plug, 18 m/m x 1.5 P.	8	4
15305	Adapter, 18 m/m x $\frac{1}{4}$" Pipe Thd.	2	
15307	Connection, $\frac{3}{4}$" I. D. Hose	2	2
15421	Screw, $\frac{3}{8}$" x 16 P. x $1\frac{3}{32}$" Cap	8	8
*15461	Cap, Oil Manifold	1	1
15565	Nut, $\frac{1}{4}$ x 28 P. x $\frac{3}{32}$ Castled		2
15598	Pin, .080" Dia. x $\frac{5}{8}$" Escutcheon	3	3
15600	Nut, Camshaft	2	2
15832	Clip, Wire Manifold		8
15881	Screw, #10 x 24 P. x $\frac{1}{2}$"		2
15939	Insert, Spark Plug		16
15990	Bearing, Camshaft Front		2
*15991	Bearing, Camshaft centre		2
*15992	Cap, Camshaft centre brg.		2
16002	Screw, 10 m/m x 1.5 P. x $\frac{15}{16}$" Cap	2	2
16005	Bushing, Magneto Support Screw	2	2
16011	Bearing, Vert. Shaft—Upper		2
16013	Bearing, Oil & Water Pump Dr. Gear		1
16020	Magneto R. H. (Splitdorf SS-8)	2	2
16044	Plug, $\frac{1}{2}$" Pipe	2	2
16075	Retainer, Starter Ball Bearing		1
16076	Cover, Starter		1
16079	Spring, $\frac{13}{64}$ x 1" long		1
16080	Ball, $\frac{5}{16}$" dia.		1
16081	Pin #4 x 1¼ Taper		2
16082	Pin, $\frac{5}{16}$ dia. x 1¾"		2

* Not to be ordered as spares

Part Number	Part Name	Quan. per Engine E-3	E-4
16084	Collar, Starter Worm		1
16086	Screw, 5/16" x 18 P		2
16088	Shaft, Starter Drive (Short)		1
16089	Adapter, Starter		1
16090	Screw, 10 m/m 1.5 P. x 1 11/32 C'ts'k—Head		1
16091	Stud, Starter Housing		5
16092	Connection, 3/8" I. D. Hose	1	1
16093	Body, Fuel Pump	1	1
16094	Cover, Fuel Pump	1	
16095	Gear, Fuel Pump Internal	1	1
16096	Pinion, Fuel Pump	1	1
16097	Connection, 1/2" I. D. Hose	1	1
16098	Elbow, Connection 1/2" I. D. Hose	2	2
16099	Spring, 11/16" O. D. x 1"	1	1
16117	Plug, 1" Pipe		31
16156	Gasket, Fuel Pump Mounting Flange	1	1
*16164	Tube, Admission Manifold Adj	1	
*16165	Elbow, Brazing Union 1/8" x 5/16"	1	1
*16166	Cylinder Block R. H	1	
*16167	Cylinder Block L. H	1	
*16168	Stud, Cylinder Sleeve	16	
*16169	Bearing, Connecting Rod, Inner	4	4
*16170	Cap, Connecting Rod Brg. Inner	4	4
16171	Bearing, Vertical Shaft—Lower	2	
*16172	Camshaft	2	
16173	Valve (Inlet & Exhaust)	16	
16174	Piston	8	
16175	Connection, 5/16" I. D. Hose	1	1
*16176	Tube, Oil Suction	1	1
*16177	Crankcase, Lower	1	1
16178	Plug, 25 m/m x 1.5 P	1	1
16179	Washer, Valve Tappet	16	16
*16180	Sleeve, Cylinder	2	
*16181	Sleeve, Cylinder	2	
*16182	Sleeve, Cylinder	2	
*16183	Sleeve, Cylinder	2	
*16188	Manifold, Oil—Front	1	1
*16189	Manifold, Oil—Rear	1	1
16199	Gasket, Intake Manifold Tee		2
*16220	Pipe, Cylinder Water Outlet	2	2
*16221	Flange, 1 1/8" O. D. Pipe	2	2
16222	Hose, 3/8" I. D. x 5/8" O. D. x 6"	2	
16225	Valve Guide, Exhaust		8
16226	Valve Guide, Admission		8
16281	Flange, Exhaust Pipe—Single		4
16282	Flange, Exhaust Pipe—Double		2
16283	Gasket, Exhaust Pipe Flange—Single		4
16284	Gasket, Exhaust Pipe Flange—Double		2
*16285	Plate, Exhaust Port (single)		4
*16286	Plate, Exhaust Port (double)		2
16287	Hose, 3/8" I. D. x 5/8" O. D. x 7"		2
16308	Nut, 8 m/m x 1.25 x 15/32" slotted	16	16
16326	Wire, Ignition		53'
*16386	Flange, 5/8" O. D. Pipe		2
16387	Gasket, 5/16" O. D. Pipe Flange		2
16393	Housing, Starter		1
*16394	Cylinder Block R. H		1
*16395	Cylinder Block L. H		1
16396	Bushing, Starter Worm (Large)		1

* Not to be ordered as spares.

Part Number	Part Name	Quan. per Engine E-3	E-4
16397	Bushing, Starter Worm (Small)		1
16398	Washer, Thrust Bearing		1
16399	Gear, Starter Magneto		1
16400	Pinion, Starter Magneto		1
*16402	Sleeve, Cylinder		8
16404	Lock, Starting Magneto		1
16405	Spring, Starting Magneto		1
16406	Lock Pad, Starting Magneto		1
16407	Stud, Starting Magneto		2
16408	Reinforcement, Starting Magneto Strap		2
16409	Strap, Starting Magneto		1
16413	Bell Crank, 90° x $2\frac{9}{32}$ x $2\frac{27}{32}$		1
16414	Magneto, Starting (Dixie Type 100)		1
*16415	Gear, Coupling (23 teeth)		2
*16416	Gear, Coupling (24 teeth)		2
16417	Gear, Magneto Shaft		2
16418	Gear, Magneto Drive Shaft		2
*16420	Wire, Stranded Lead Seal	10′	10′
16421	Manifold, Inlet R. H.		1
16422	Manifold, Inlet L. H.		1
16423	Connection, Manifold Tee		1
16424	Nut, Packing 2½″ x 16 P. x ¾″		1
*16425	Pipe, Cyld. water inlet R. H.		1
*16426	Pipe, Cyld. water inlet L. H.		1
*16427	Camshaft		2
*16428	Tee, Inlet Manifold		1
*16429	Pipe, Camshaft Oil		2
*16431	Manifold, Cyld. ign. wire		4
16432	Adapter, 1″ Pipe Thd. ¼″ Pipe Thd.		2
16433	Piston		8
16434	Marker, Ign. wire		2 sets
16435	Strap, Ign. Manifold		2
16436	Connection, Straight ⅜″ I. D. Hose		1
16437	Valve, Inlet & Exhaust		16
*16438	Seat, Valve		16
16450	Stud, Drilled 8 m/m x 1.25 P. x $1\frac{11}{32}$″		8
16451	Pin, Piston		8
16452	Plug, Piston Pin		16
16453	Cover, Cyld.		2
16454	Bushing, Tachometer Shaft		1
16455	Nut, 8 m/m x 1.25 P. x ¼″		28
16458	Plug, ⅜″ Pipe		2
16463	Bearing, Camshaft rear		2
16465	Lever $2\frac{9}{32}$ straight		1
16466	Gasket, Carburetor		2
16467	Carburetor, NA-U5		1
*16468	Seal, Engine	12	12
16471	Support, Carburetor		2
16472	Nut, Special		2
16509	Clamp, Magneto Advance		2
16519	Worm, Starter—Ratio 6 to 1		1
16520	Wheel, Starter Worm—Ratio 6 to 1		1
16521	Tube, Magneto Advance Wire		1
16522	Wire, Magneto Advance		1
16523	Bolt, Magneto Advance		2
16524	Bushing, Magneto Advance Bolt		2
*16528	Crank, Starter		1
*16529	Shaft, Starter Crank		1
*16530	Dog, Starter Crank		1

* Not to be ordered as spares.

Part Number	Part Name	Quan. per Engine E-3	E-4
*16531	Handle, Starter Crank		1
*16532	Sleeve, Starter Crank Handle		1
*16533	Spring, Starter Crank		1
*16534	Stop, Starter Crank Spring		1
*16535	Pin, $\frac{5}{16}$" dia. x $2\frac{3}{16}$"		1
*16536	Pin, $\frac{5}{16}$" dia. x $1\frac{13}{16}$"		2
16551	Bearing, Vert. Shaft lower		2
16581	Pin, .057 x ¼ Escutcheon		2
16644	Dowel, $\frac{1}{16}$" I. D. x $\frac{3}{32}$" Hollow		16
16718	Bushing, $\frac{7}{16}$ O. D. x .317" I. D. x $\frac{21}{32}$		1
16719	Shaft, Fuel Pump Pinion		1
16722	Cover, Fuel Pump		1

Numerical Assembly List

for

E-3 and E-4 Engines

Assembly Number	Assembly Name	Quan. per Engine E-3	E-4
11576	Shaft, Tachometer	1	
12008	Shaft & Impeller, Water Pump	1	1
12030	Manifold Admission R. H.	1	
12031	Manifold, Admission L. H.	1	
12109	Connecting Rod, Inner & Bushing	4	4
12110	Connecting Rod, Outer	4	4
12117	Vertical Shaft, Lower Gear	2	
12125	Coupling, Magneto	2	
12182	Bearing, Camshaft Centre	2	
*12244	Shaft, Vertical, lower and Inter. dr. pin	2	2
12266	Breather Tube and strainer	1	1
*12323	Manifold, Oil	1	1
12324	Pipe, Water pump outlet	2	2
12325	Pipe, Cyld. water inlet R. H.	1	
12326	Pipe, Cyld. water inlet L. H.	1	
12328	Magneto Support machining	1	1
12329	Pump, Oil Assembly	1	1
12330	Shaft, Vertical	2	
12331	Magneto Support	1	1
12336	Strainer, Oil	1	1
12346	Screen, Oil Suction Pump	1	1
12350	Pipe, Camshaft Oil R. H.	1	
12351	Pipe, Camshaft Oil L. H.	1	
12360	Manifold, Ig. wire	1	
12361	Casing & Nut, Vertical Shaft	2	2
12376	Hub & Dowel Propeller	1	1
12381	Manifold, Cyld. ign. wire R. H.	2	
12382	Manifold, Cyld. ign. wire L. H.	2	
12383	Strainer, Breather tube	1	1
12427	Conn. Rod, Outer machining	4	4
12428	Pump, water	1	1
12440	Pin, Piston	8	
12485	Gun Control drive	2	2
12574	Bearing, Camshaft centre		2
12604	Pump, Fuel, Wright Viking	1	1
12613	Conn. Rod Bearing & Cap	4	4
12614	Conn. Rod Inner & Bearing	4	4
12615	Hub Flange, Propeller	1	1

* Not to be ordered as spares.

Assembly Number	Assembly Name	Quan. per Engine E-3	E-4
12616	Hub, Propeller	1	1
12617	Tee, Admission Manifold	1	
12618	Valve and tappet	16	
*12619	Crankshaft	1	1
12621	Crankshaft and Conn. Rod	1	1
12622	Camshaft	2	
12623	Piston	8	
12624	Magneto Support and fuel pump	1	1
12625	Magneto Support, complete	1	1
12626	Carburetor and Manifold tee	1	
*12627	Crankcase machg	1	1
*12628	Crankcase and oil plug	1	1
12629	Crankcase stud & bearing	1	
*12630	Cyld. Bushing & Core plug R. H.	1	
*12631	Cyld. Bushing & Core plug L. H.	1	
12632	Cylinder & Camshaft Bearing R. H.	1	
12633	Cylinder & Camshaft Bearing L. H.	1	
12634	Cylinder complete R. H.	1	
12635	Cylinder complete L. H.	1	
12636	Magneto and Gear	2	2
*12639	Engine before valve timing	1	
*12640	Engine after valve timing	1	
*12641	Engine Packing	1	
12642	Pipe Cyld. water outlet R. H.	1	1
12643	Pipe Cyld. water outlet L. H.	1	1
*12644	Cylinder Bushing & Core plug R. H.		1
*12645	Cylinder Bushing & Core plug L. H.		1
12678	Shaft Tachometer		1
12706	Magneto Strap Starting		
12718	Coupling, Magneto		
*12720	Engine, after valve timing		1
*12722	Housing, Starter (machg.)		
12731	Crankcase Stud & Bearing		1
12732	Starter, Hand		1
12735	Tee, Admission Manifold		1
12736	Pipe, Camshaft Oil		2
12737	Manifold, Cyld. ign. wire R. H.		2
12738	Manifold, Cyld. ign. wire L. H.		2
12739	Pipe, Cyld. water inlet R. H.		1
12740	Pipe, Cyld. water inlet L. H.		1
12741	Valve and Tappet		16
12742	Shaft, Vertical		2
12751	Manifold, Admission R. H.		1
12752	Manifold, Admission L. H.		1
12753	Manifold, ig. wire		1
12756	Carburetor and Manifold Tee		1
12770	Magneto & Gear Starting		
12790	Cylinder and Camshaft Bearing R. H.		1
12791	Cylinder and Camshaft Bearing L. H.		1
12792	Piston		8
12793	Pin, Piston		8
12794	Camshaft		2
*12795	Engine, before valve timing		1
12796	Cylinder, complete, R. H.		1
12797	Cylinder, complete, L. H.		1
*12798	Engine, packing		1
12804	Magneto Support and Hand Starter		1
12805	Magneto Advance Clamp & Tube		1
12806	Handle Starter		1

* Not to be ordered as spares.

Alphabetical Parts List

for

E-3 and E-4 Engines

Part Name	E-3 Number	E-3 Quan. per Engine	E-4 Number	E-4 Quan. per Engine
A				
Adapter, Starter			16089	1
Adapter, 38 m/m—¼" Pipe Thd.	15292	2		
Adapter, 18 m/m—¼" Pipe Thd.	15305	2		
Adapter, 1" Pipe Thd. ¼" Pipe Thd.			16432	2
B				
Ball, $\frac{5}{16}$" dia.			16080	1
Ball Bearing, #6203	6203	4	6203	4
Ball Bearing H. B. #6408	6408	1	6408	1
Ball Bearing H. B. #6208	6208	1	6208	3
Ball Bearing H. B. #6204	6204	4	6204	4
Bearing, Camshaft—Front	9619	2	15990	2
Bearing, Camshaft—Centre	11373	2	15991	2
Bearing Camshaft—Rear	9622	2	16463	2
Bearing, Connecting Rod—Inner	16169	4	16169	4
Bearing, Crankshaft Front—Lower	11009	1	11009	1
Bearing, Crankshaft Front—Upper	11008	1	11008	1
Bearing, Crankshaft Intermediate—Upper	9968	3	9968	3
Bearing, Crankshaft Intermediate—Lower	9967	3	9967	3
Bearing, Oil & Water Pump Drive Gear	14630	1	14630	
Bearing, Thrust	11880	1	11880	1
Bearing, Vertical Shaft—Lower	16171	2	16551	2
Bearing, Vertical Shaft—Upper	14670	2	16011	2
Bell Crank, 90°—$2\frac{9}{32}$ x $2\frac{27}{32}$			16413	1
Body, Fuel Pump	16093	1	16093	1
Body, Oil Pressure Relief	11527	1	11527	1
Body, Oil Pump	14610	1	14610	1
Body, Water Pump	14636	1	14636	1
Bolt, Connecting Rod—Outer	11683	8	11683	8
Bolt, Connecting Rod—Inner	11689	16	11689	16
Bolt, Magneto Advance			16523	2
Bolt, Propeller Hub	11915	8	11915	8
Bolt, 8 m/m x 1.25" P. x $1\frac{3}{32}$"	11517	6	11517	6
Bolt, ¼ x 28 P. x $\frac{12}{32}$ long			14930	4
Bushing, Connecting Rod	9635	8	9635	8
Bushing, Cyl. Cover Screw Dowel	11937	2	11937	2
Bushing, Cylinder Cover Screw	T-950	20	T-950	20
Bushing, Fuel Pump Gear	15253	1	15253	1
Bushing, Magneto Advance Bolt			16524	2
Bushing, Magneto Support Screw	16005	2	16005	2
Bushing, Spark Plug	11778	16		
Bushing, Starter Worm (large)			16396	1
Bushing, Starter Worm (small)			16397	1
Bushing, Tachometer Drive Shaft	11469	1		
Bushing, Tachometer Shaft			16454	1
Bushing, Water Pump Drive Shaft	11917	1	11917	1
Bushing, Water Pump	10378	1	10378	1
Bushing, $\frac{7}{16}$" O. D. x .317" I. D. x $\frac{21}{32}$			16718	1
Button, Water Pump Thrust	11198	2	11198	2
C				
Camshaft	16172	2	16427	2
Cap, Breather	9960	1	9960	1

Part Name	E-3 Number	E-3 Quan. per Engine	E-4 Number	E-4 Quan. per Engine
Cap, Camshaft Center Brg.	11374	2	15992	2
Cap, Connecting Rod Brg.—Inner	16170	4	16170	4
Cap, Oil Manifold	15461	1	15461	1
Cap. Oil Pressure Relief	11893	1	11893	1
Carburetor, (NA-D4) Stromberg	11908	1		
Carburetor, (NA-U5)			16467	1
Casing, Vertical Shaft	14685	2	14685	2
Clamp, Magneto Advance			16509	2
Clamp for 3/8" I. D. Hose	11245	8	11245	8
Clamp for 1" I. D. Hose	14649	4	14649	4
Clip, 3/8" O. D. Pipe	15283	2	15283	2
Cock, 1/8" Spring Key	11796	1	11796	2
Collar, Starter Worm			16084	1
Connecting Rod, Outer	11673	4	11673	4
Connecting Rod, Inner	11674	4	11674	4
Connection, Manifold Tee			16423	1
Connection, 5/16" I. D. Hose	16175	1	16175	1
Connection, 3/8" I. D. Hose	16092	1	16092	1
Connection, 3/8" I. D. Hose	15294	4	15294	4
Connection, Straight 3/8" I. D. Hose			16436	1
Connection, 1/2" I. D. Hose	16097	1	16097	1
Connection, 3/4" I. D. Hose	15307	2	15307	2
Cotterpin, 1/16" x 1" long	11445	3	11445	3
Cotterpin, 5/64" dia. x 3/4"	11707	32	11707	16
Cotterpin, 5/64" dia. x 1"	B-64	2		
Cotterpin, 3/32" dia.	657	2		
Cotterpin, 3/32" x 1 1/4"	B-63	2	B-63	2
Cotterpin	B-64	18	B-64	30
Cotterpin	656	4	656	4
Cotterpin	657	8	567	10
Cotterpin	11169	9	11169	11
Cotterpin	11207	2	11207	2
Cotterpin	11348	2	11348	2
Cotterpin	11945	2	11945	2
Coupling, Magneto	11897	2	11897	2
Coupling, Tachometer	10561	1	10561	1
Cover, Cylinder, R. H.	14457	1		
Cover, Engine	11272	1	11272	1
Cover, Cylinder, L. H.	14455	1	16453	2
Cover, Fuel Pump	16094	1	16722	1
Cover, Fuel Pressure Relief	14702	1	14702	1
Cover, Magneto Support	15087	1		1
Cover, Oil Filter	14643	1	14643	1
Cover, Packing Box Seal	11993	2	11993	2
Cover, Starter			16076	1
Cover, Water Pump	15282	1	15282	1
Crank, Starter			16528	1
Crankcase, Upper Half	14602	1	14602	1
Crankcase, Lower	16177	1	16177	1
Crankshaft	11865	1	11865	1
Cup, Priming	11973	4	11973	4
Cylinder Block, R. H.	16166	1	16394	1
Cylinder Block, L. H.	16167	1	16395	1
D				
Dog, Starter Crank			16530	1
Dog, Vertical Shaft	14671	4	14671	4
Dowel, Connecting Rod Bushing	11163	8	11163	8
Dowel, Propeller Hub	14098	1	14098	1

Part Name	Number	E-3 Quan. per Engine	Number	E-4 Quan. per Engine
Dowel, 1/16" I. D. x 1/8" O. D. x 3/32" Hollow			16644	16
Dowel, .236" dia. x 5/8"	B-768	16	B-768	16
Dowel, 3/16 x 3/8			14873	2
Dowel, 5/16" dia. x 3/4" Dowel	1437	4	1437	4
Dowel, .315" dia. x 5/8"	B-767	8	B-767	8
E				
Elbow, Brazing Union 1/8" x 5/16"	16165	1	16165	1
Elbow, Connection 1/2" I. D. Hose	16098	2	16098	2
Enamel, Gray			16457	
Enamel, Kay & Ess Quick Air Drying	14163		14163	
F				
Flange, Exhaust Pipe—Single			16281	4
Flange, Exhaust Pipe—Double			16282	2
Flange, Exhaust Pipe	14688	8		
Flange, Oil Pipe, L. H.	14673	1		
Flange, Oil Pipe, R. H.	14672	1		
Flange, Propeller Hub	10540	1	10540	1
Flange, Water Pipe	11197	4	11197	4
Flange, 5/16" O. D. Pipe			16386	2
Flange, 1 1/8" O. D. Pipe	16221	2	16221	2
Flange, Oil Suction Pump Screen	14603	1	14603	1
G				
Gasket, Breather Tube	B-759	1	B-759	1
Gasket, Carburetor	B-786	1	16466	2
Gasket, Crankcase Rear Cover			14981	2
Gasket, Cylinder Base	1439	2	1439	2
Gasket, Cylinder Cover	T-1032	2	T-1032	2
Gasket, Exhaust Pipe Flange	14689	8		
Gasket, Exhaust Pipe Flange—Single			16283	4
Gasket, Exhaust Pipe Flange—Double			16284	2
Gasket, Fuel Pump Mounting Flange	16156	1	16156	1
Gasket, Intake Manifold Tee			16199	2
Gasket, Intake Pipe	B-788	4	B-788	4
Gasket, Intake Pipe and Tee	B-785	2		
Gasket, Interrupter Gr. Shaft Housing	11960	2	11960	2
Gasket, Magneto Support	1426	1	1426	1
Gasket, Magneto Support Cover	14655	1	14655	1
Gasket, Oil Manifold Plug	B-760	1	B-760	1
Gasket, Oil Pipe Flange	14683	2		
Gasket, Oil Pump Cover Plate	14632	1	14632	1
Gasket, Spark Plug Bushing	11574	16		
Gasket, Vert. Shaft Gear Cover	10685	2	10685	2
Gasket, Water Pipe	T-1092	16	T-1092	8
Gasket, Water Pump Cover	T- 982	1	T- 982	1
Gasket, 5/16" O. D. Pipe Flange			16387	2
Gasket, 1/2" I. D.	B-27	4	B-27	2
Gasket, 5/8" I. D.	11559	1	11559	1
Gasket, 11/16" I. D.	B-28	13	B-28	20
Gasket, 13/16" I. D.	11868	2	11868	2
Gasket, 7/8" I. D. x 1 1/8" O. D. x 1/16"	14711	1	14711	1
Gasket, 1" I. D.	B-33	1	B-33	1
Gasket, 1 1/2" I. D.	11440	33	11440	2
Gasket, 1 17/32" dia. x 2 1/2" sq.	15256	2	15256	2
Gasket, 2 17/32" I. D.	B-32	1	B-32	1
Gear, Camshaft	14665	2	10474	2

Part Name	E-3 Number	E-3 Quan. per Engine	E-4 Number	E-4 Quan. per Engine
Gear, Crankshaft	9638	1	9638	1
Gear, Fuel Pump Internal	16095	1	16095	1
Gear, Interrupter Drive	11947	2	11947	2
Gear, Mag. Coupling (23 teeth) Int.	11903	2	16415	2
Gear, Mag. Coupling (24 teeth) Int.	11904	2	16416	2
Gear, Magneto Drive Shaft	14314	2	16418	2
Gear, Magneto Shaft (23 teeth)	11906	2	16417	2
Gear, Oil Pressure Pump	14607	1	14607	1
Gear, Oil Pump Drive	14605	3	14605	3
Gear, Oil Section Pump	14608	2	14608	2
Gear, Oil & Water Pump Drive	14629	1	14629	1
Gear, Pump Drive	15252	1	15252	1
Gear, Pump Idler ½" Face	11757	1	11757	1
Gear, Pump Idler ⅝" Face	14633	2	14633	2
Gear, Starter Magneto			16399	1
Gear, Vertical Shaft—Lower	9941	2	9941	2
Gear, Vertical Shaft—Upper	14668	2	14668	2
Guide, Fuel Pressure Relief Adj. Screw	15287	1	15287	1
H				
Handle, Starter Crank			16531	1
Hose, Manifold, Water Pipe Coupling	11204	2	11204	2
Hose, Water Pump Outlet	14648	2	14648	2
Hose, ⅜" I. D. x ⅝" O. D. x 6"	16222	2		
Hose, ⅜" I. D. x ⅝" O. D. x 7"			16287	2
Housing, Interrupter Drive Gear	11948	2	11948	2
Housing, Interrupter Gear Shaft	14207	2	14207	2
Hub, Propeller	14460	1	14460	1
I				
Impeller, Water Pump	11658	1	11658	1
Insert, Spark Plug			15939	16
K				
Key, Camshaft Gear	T-129	2	T-129	2
Key, Propeller Hub	11626	1	11626	1
Key, #3 Woodruff	11680	5	11680	7
L				
Lock, Crankshaft Cent. Nut	10693	1	10693	1
Lock, Mag. Dr. Gear B. B. Ret. Nut	14653	1	14653	1
Lock, Starting Magneto			16404	1
Lock, Thrust Bearing Nut	11012	1	11012	1
Lockwasher, for 6 m/m dia.	B-789	24	B-789	28
Lockwasher, for 8 m/m dia.	B-790	73	B-790	61
Lockwasher, ¼ x $\frac{3}{32}$ x $\frac{3}{64}$			14941	4
M				
Magneto, R. H. (Dixie SS-8)	16020	2	16020	2
Magneto Starting	11342	1	16414	1
Manifold, Clip Wire	15078	8	15832	8
Manifold, Cyl. Ignition Wire	11981	4	16431	4
Manifold, Ignition Wire, L. H.	14484	1	14484	1
Manifold, Ignition Wire, R. H.	14726	1	14726	1
Manifold, Inlet—L. H.	10443	1	16422	1
Manifold, Inlet—R. H.	10444	1	16421	1
Manifold, Oil—Front	16188	1	16188	1
Manifold, Oil—Rear	16189	1	16189	1
Marker, Ignition Wire (2 sets)	11570	2 sets	16434	2 sets

Part Name	E-3 Number	E-3 Quan. per Engine	E-4 Number	E-4 Quan. per Engine
N				
Nipple, Oil Pipe	T-989	2	T-989	2
Nipple, Oil Return Pipe	14678	2		
Nozzle, Water	10434	1		
Nut, Camshaft	15600	2	15600	2
Nut, Connecting Rod Outer Bolt	11688	8	11688	8
Nut, Crankshaft Centering Lock	10637	1	10637	1
Nut, Fuel Pressure Relief Adj. Lock	14701	1	14701	1
Nut, Fuel Pump Packing	15258	1	15258	1
Nut, Megneto Drive Gear B. B. Ret	14652	1	14652	1
Nut, Magneto Pinion B. B	14433	2	14433	2
Nut, Packing, Inlet Pipe	10432	1		
Nut, Packing Oil Pipe Nipple	T-990	2	T-990	2
Nut, Packing Oil Return Pipe	14679	2		
Nut, Packing 2½" x 16 P. x ¾"			16424	1
Nut, Propeller Hub Bolt Special	14462	7	14462	7
Nut, Propeller Hub Bolt Plain	14461	1	14461	1
Nut, Propeller Hub—Inner	14106	1	14106	1
Nut, Propeller Hub—Outer	14105	1	14105	1
Nut, Propeller Thrust Brg	11003	1	11003	1
Nut, Special			16472	2
Nut, Vertical Shaft Casing	14680	2	14680	2
Nut, Vertical Shaft Hous. Packing	10357	2	10357	2
Nut, Water Pump Gland	11682	1	11682	1
Nut, 6 m/m x 1 P	B-93	30	B-93	28
Nut, 8 m/m x 1.25 P. x ¼"			16455	28
Nut, Plain 8 m/m x 1.25 P. x $\frac{15}{64}$"	11304	16		
Nut, 8 m/m x 1.25 x $\frac{15}{32}$" slotted	16308	16	16308	16
Nut, Plain 8 m/m x 1.25 P. x $\frac{5}{16}$"	11303	85	11303	73
Nut, Slotted 8 m/m x 1.25 P	11302	16	11302	26
Nut, Plain 10 m/m x 1.5 P	1444	6	1444	3
Nut, 10 m/m x 1.5 P. x ⅜" slotted	1443	2	1443	2
Nut, Plain 10 m/m x 1.5 P. x $\frac{15}{32}$"	11305	72	11305	72
Nut, 10 m/m x 1.5 P. x $\frac{53}{64}$"	15261	10	15261	8
Nut, 12 m/m x 1.25 P. x $\frac{5}{16}$" slotted	11899	2	11899	2
Nut, Castled 12 m/m x 1.75 P	14635	2	14635	2
Nut, 14 m/m x 1.5 P. x $\frac{5}{16}$" slotted	14313	2	14313	2
Nut, ¼ x 28 P. Plain			14931	8
Nut, Castled $\frac{5}{16}$" x 24 P	14712	3	14712	3
Nut, ⅜" x 24 x ½" slotted	11503	16		
Nut, ⅜" x 16 x ⅜"			11900	2
P				
Packing, Fuel Pump	14692	1	14692	1
Packing, Stuffing Box	11188	6 ft.	11188	6 ft.
Packing, Water Pump	11168	9 ft.	11168	9 ft.
Pad, Starting Magneto Lock			16406	1
Pin, Piston	15260	8	16451	8
Pin, Tachometer Coupling	11206	1	11206	1
Pin, Taper #4 x 1¼			16081	2
Pin, $\frac{1}{16}$" Dia. x ⅜" lg. Straight	11443	10	11443	12
Pin, .080" Dia. x ⅝" Escutcheon	15598	3	15598	3
Pin, $\frac{5}{16}$" Dia. x 1¾"			16082	2
Pin, $\frac{5}{16}$" Dia. x $2\frac{2}{16}$			16535	1
Pin, $\frac{5}{16}$" Dia. x $1\frac{13}{16}$			16536	2
Pin, .057" Dia. x ¼, Escutcheon			16581	2
Pinion, Fuel Pump	16096	1	16096	1
Pinion, Interrupter Drive	11950	2	11950	2
Pinion, Magneto	14432	2	14432	2

Part Name	E-3 Number	E-3 Quan. per Engine	E-4 Number	E-4 Quan. per Engine
Pinion, Starter Magneto			16400	1
Pipe, Cam Housing Oil Return, R. H.	14675	1		
Pipe, Cam Housing Oil Return, L. H.	14676	1		
Pipe, Camshaft Oil	14674	2	16429	2
Pipe, Cylinder Water Inlet, L. H.	14647	1	16426	1
Pipe, Cylinder Water Inlet, R. H.	14646	1	16425	1
Pipe, Cylinder Water Outlet	16220	2	16220	2
Pipe, Manifold Tee Outlet 3/8" O. D.	15265	1	15265	1
Pipe, Water Pump Outlet	14684	2	14684	2
Piston	16174	8	16433	8
Plate, Engine License	11214	1	11214	1
Plate, Engine Name	15019	1	15019	1
Plate, Exhaust Port	14690	8	16285	single 4
			16286	double 2
Plate, Hub Flange Name	15275	1	15275	1
Plate, Oil Filter End	14641	1	14641	1
Plate, Oil Pump Cover	14609	1	14609	1
Plate, Water Hole	11137	10	11137	2
Plug, Crankshaft 25 m/m x 1.5 P.	11323	8	11323	8
Plug, Crankshaft—Small	11324	4	11324	4
Plug, Oil & Water Pump Drive Shaft	14631	2	14631	2
Plug, Piston Plug	14696	16	16452	16
Plug, Pipe 1/8" (Std.)	14408	1	14408	2
Plug, Spark (Champion A. C. Large Porcelain)	11985	16	11985	16
Plug, 3/8" Pipe			16458	2
Plug, 1/2" Pipe	16044	2	16044	2
Plug, 5/8" x 18 P.	11819	5	11819	5
Plug, Wood for 5/8" I. D. Hose	14126	2	14126	2
Plug, 3/4" Pipe	11233	1	11233	1
Plug, 1" Pipe			16117	31
Plug, 12 m/m x 1.25 P.	11313	2		
Plug, 18 m/m x 1.5 P.	15304	8	15304	4
Plug, 25 m/m x 1.5 P.	16178	1	16178	1
Plug, 38 m/m x 1.5 P.	9667	30	9667	1
Plunger, Oil Pressure Relief	11531	1	11531	1
Primer, Kay & Ess Aero Metal	14164		14164	
Primer, Flat Gray			16456	
R				
Ring, Breather Tube	14084	1	14084	1
Ring, Ignition Wire—Large	11449	8	11449	8
Retainer, Interrupter Gr. Shaft B. B.	14191	2	14191	2
Retainer, Starter Ball Bearing			16075	1
Ring, Oil Filter	14640	1	14640	1
Ring, Piston L. H.	594-P	8	594-P	8
Ring, Piston R. H.	595-P	16	595-P	16
Ring, Piston Oil	596-P	8	596-P	8
Ring, Propeller Hub Nut Lock	11397	1	11397	1
Ring, Vert. Shaft Casing Nut Lock	10487	2	10487	2
Rivet, Flat Head	11322	4	11322	4
Rivet, 5/32" dia. Fl. Hd. 1/4" lg.	11983	16	11983	16
Rivet, Round Head	11901	24	11901	24
Rivet, Round Head	11161	8	11161	8
S				
Screw, Camshaft Center Bearing	T-952	8	T-952	8
Screw, Cylinder Cover	11677	22	11677	22
Screw, Fuel Pressure Relief Adj.	14700	1	14700	1

Part Name	E-3 Number	E-3 Quan. per Engine	E-4 Number	E-4 Quan. per Engine
Screw, Main Bearing Dowel	T-970	4	T-970	4
Screen, Oil Filter—Coarse Mesh	14639	1	14639	1
Screen, Oil Filter—Fine Mesh	14638	1	14638	1
Screw, Oil Pump Gear Brg. Set	11775	1	11775	1
Screen, Oil Suction Pump—Rear	14604	1	14604	1
Screw, Propeller Hub Key	B-781	2	B-781	10
Screw, Vert. Shaft Brg. Dowel	11366	2	11366	2
Screw, Water Pump Cover	T-960	6	T-960	6
Screw, 5 m/m x .75 x 9/16" C ts'k Hd. Mach.	B-781	8		
Screw, 5 m/m x .75 P. x 5/16" Fill. Hd. Mach.	B-803	3	B-803	3
Screw, Lock 6 m/m x 53/64" lg	B-754	1	B-754	1
Screw, 10 m/m x 1.5 P. x 15/16" Cap	16002	2	16002	2
Screw, 10 m/m 1.5 P. x 1 11/32" C'ts'k Hd.			16090	1
Screw, R. H. Brass Machine #4-32P	12053	8	12053	8
Screw, 5/16 x 18 P			16086	2
Screw, 3/8" x 16 P. x 1 3/32" Cap	15421	8	15421	8
Screw, 14 x 24 x 9/16" Fil. Hd.	11820	2	11820	2
Seal, Engine	16468	12	16468	12
Seat, Valve			16438	16
Shaft, Fuel Pump Pinion	15255	1	16719	1
Shaft, Interrupter Gear	11951	2	11951	2
Shaft, Magneto Drive Gear	14651	1	14651	1
Shaft, Oil & Water Pump Drive	14606	1	14606	1
Shaft, Starter Chank			16529	1
Shaft, Starter Drive Shaft (Short)			16088	1
Shaft, Tachometer Drive	11468	1	11468	1
Shaft, Vertical	14669	2	14669	2
Shaft, Water Pump	10376	1	10376	1
Sleeve, Cylinder	16180	2	16402	8
Sleeve, Cylinder	16181	2		
Sleeve, Cylinder	16182	2		
Sleeve, Cylinder	16183	2		
Sleeve, Oil Manifold	11171	1	11171	1
Sleeve, Starter Crank Handle			16532	1
Spring, Breather Tube Oil Strainer	14085	1	14085	1
Spring, Fuel Pressure Relief Valve	15259	1	15259	1
Spacer, Interrupter Ball Bearing	11946	2	11946	2
Spacer, Thrust Bearing	11812	1	11812	1
Spring, Interrupter Brace	14024	2	14024	2
Spring, Magneto Coupling	11896	2	11896	2
Spacer, Magneto Pinion B. B.	14435	2	14435	2
Spring, Mag. Pinion B. B. Lock Nut	14656	1	14656	1
Spring, Oil Filter	14642	1	14642	1
Spring, Oil Pressure Relief	11530	1	11530	1
Spring, Starter Crank			16533	1
Spring, 13/64 x 1" long			16079	1
Spring, Valve (Inner)	11406	16	11406	16
Spring, Valve (Outer)	11407	16	11407	16
Spring, 11/16" O. D. x 1"	16099	1	16099	1
Stop, Starter Crank Spring			16534	1
Strainer, Breather Tube Oil	14083	1	14083	1
Strap, Ignition Manifold	11442	2	16435	2
Strap, Starting Magneto (Reinforcement)			16408	2
Strap, Starting Magneto			16409	1
Stud, Crankshaft Center Brg.	T-956	8	T-956	8
Stud, Crankshaft Front Brg.	T-958	2	T-958	2
Stud, Crankshaft Rear Brg.	T-957	2	T-957	2

Part Name	Number	E-3 Quan. per Engine	Number	E-4 Quan. per Engine
Stud, Cylinder	T-955	72	T-955	72
Stud, Cylinder Sleeve	16168	16		
Stud, Interrupter Brace	14023	2	14023	2
Stud, Starter Housing			16091	5
Spring, Starting Magneto			16405	1
Stud, Starting Magneto			16407	2
Stud, 6 m/m x 1 P. x $1\frac{9}{64}$" long	B-784	10	B-784	4
Stud, 6 m/m x 1.25 x $\frac{7}{8}$"			11386	4
Stud, 6 m/m x 1 P. x $\frac{61}{64}$" long	B-794	8	B-794	16
Stud, 6 m/m x 1 p. x $1\frac{21}{32}$" long	11851	4	11851	4
Stud, 8 m/m x 1.25 P. x $\frac{7}{8}$"			11971	8
Stud, 8 m/m x 1.25 m/m P. x $1\frac{15}{16}$"	15272	4	15272	4
Stud, 8 m/m x 1.25 P. x $1\frac{1}{16}$" lg.	T-210	16	T-210	28
Stud, 8 m/m x 1.25 P. x $1\frac{1}{16}$"	11962	2	11962	2
Stud, 10 m/m x 1.5 P. x $1\frac{5}{32}$" lg.	1442	3	1442	3
Stud, 8 m/m x 1.25 P. x $1\frac{3}{16}$" lg.	T-961	36	T-961	24
Stud, 8 m/m x 1.25 P. x $1\frac{7}{32}$" lg.	14059	2	14059	2
Stud, 8 m/m x 1.25 P. x $1\frac{17}{64}$" lg.	T-949	8		
Stud, 10 m/m x 1.5 P. x $1\frac{5}{16}$" lg.	1441	3		
Stud, 8 m/m x 1.25 P. x $1\frac{11}{32}$" lg.	T-954	10	T-954	10
Stud, Drilled 8 m/m x 1.25 P. x $1\frac{11}{32}$"			16450	8
Stud, 8 m/m x 1.25 P. x $1\frac{13}{32}$" long	11844	6	11844	6
Stud, 8 m/m x 1.25 P. x $1\frac{17}{32}$" lg.	14060	2	14060	2
Stud, 8 m/m x 1.25 P. x $1\frac{11}{16}$" lg.	11879	13	11879	13
Stud, 8 m/m x 1.25 P. x $3\frac{5}{32}$" long	T-948	12	T-948	12
Stud, ¼ x 20 x 28 P. (Std.) x 1" long			14960	4
Support, Carburetor			16471	2
Surfacer, Flint's Aluminum	14165		14165	
Support, Magneto	14650	1	14650	1
T				
Tag Magneto (Inside)	15266	1	15266	1
Tag, Magneto (Outside)	15267	1	15267	1
Tape, Friction ¾"	15080	14'	15080	14'
Taperpin, Mag. Drive Pinion Vert. Shaft Gear	9930	2	9930	2
Tee, Inlet Manifold	10428	1	16428	1
Tee, Water Pump Drain	15264	1	15264	1
Terminal, Ignition Wire	11340	16	11340	16
Tube, Admission Manifold Adj.	16164	1		
Tube, Breather	9959	1	9959	1
Tube, Magneto Advance Wire			16521	1
Tube, Oil Manifold	11164	3	11164	3
Tube, Oil Suction	16176	1	16176	1
Tube, Wire Manifold End	11160	2	11160	2
V				
Valve, (Inlet & Exhaust)	16173	16	16437	16
Valve, Fuel Pressure Relief	15286	1	15286	1
Valve Guide, Admission	11686	8	16226	8
Valve Guide, Exhaust	11687	8	16225	8
Valve Tappet	11972	16	11972	16
W				
Washer, Camshaft Front Brg.	9939	2	9939	2
Washer, Crankshaft Ball Bearing	10510	1	10510	1
Washer, Magneto Coupling Spring	11898	2	11898	2
Washer, Thrust Bearing			16398	1
Washer, Valve Tappet	16179	16	16179	16

Part Name	E-3 Number	E-3 Quan. per Engine	E-4 Number	E-4 Quan. per Engine
Washer, Vert. Shaft Thrust	11730	2	11730	2
Washer, Valve Spring—Lower	11513	16	11513	16
Washer, 17/64 x 1/2 x 1/16			14994	4
Washer, 21/64" I. D. x 5/8" O. D. x 1/16"	11705	3	11705	13
Washer, 21/64" I. D. x 3/4" O. D. x 1/16"	14025	2	14025	2
Washer, 25/64 x 11/16 x 5/64			14996	5
Washer, Plain 11/32" I. D.	14058	4	14058	4
Washer, 13/32" I. D. Plain	1458	34	1458	17
Washer, Plain 1/2" I. D. x 51/64" O. D.	14634	2	14634	2
Wheel, Starter Worm, Ratio 6 to 1			16520	1
Wire, Magneto Advance			16522	1
Wire, Stranded Lead Seal	16420	10′	16420	10′
Wire, Dia. .030" to .045"	11630	16′	11630	16′
Worm, Starter, Ratio 6 to 1			16519	1

Alphabetical Assembly List

for

E-3 and E-4 Engines

Assembly Name	Assembly Number E-3	Assembly Number E-4
B		
Bearing, Camshaft Centre	12182	12574
Breather Tube, and strainer	12266	12266
C		
Camshaft	12622	12794
Carburetor and Manifold tee	12626	12756
Casing & Nut, Vertical Shaft	12361	12361
Connecting Rod, Inner & Bushing	12109	12109
Connecting Rod, Outer	12110	12110
Connecting Rod, Bearing & Cap	12613	12613
Connecting Rod, Inner & Bearing	12614	12614
Connecting Rod, Outer Machining	12427	12427
Coupling Magneto	12125	12125
Coupling Magneto		12718
Crankcase, machg.	12627	12627
Crankcase and oil pulg	12628	12628
Crankcase, Stud & Bearing	12629	12731
Crankshaft	12619	12619
Crankshaft and Conn. Rod	12621	12621
Cylinder, complete R. H.	12634	12796
Cylinder, complete L. H.	12635	12797
Cylinder, Bushing & Core Plug R. H.	12630	12644
Cylinder, Bushing & Core Plug L. H.	12631	12645
Cylinder and Camshaft Bearing R. H.	12632	12790
Cylinder & Camshaft Bearing L. H.	12633	12791
E		
Engine, before valve timing	12639	12795
Engine, after valve timing	12640	12720
Engine, Packing	12641	12798
G		
Gear, Vertical Shaft lower	12117	
Gun Control drive	12485	12485

Assembly Name	Assembly Number E-3	E-4
H		
Handle, Starter		12806
Housing, Starter (machg.)		12722
Hub, Propeller	12616	12616
Hub & Dowel Propeller	12376	12376
Hub, Flange Propeller	12615	12615
M		
Magneto, Advance Clamp & tube	12805	12805
Magneto and Gear	12636	12636
Magneto & Gear Starting		12770
Magneto Support	12331	12331
Magneto Support Complete	12625	12625
Magneto Support Machining	12328	12328
Magneto Support and fuel pump	12624	12624
Magneto Support and Hand Starter		12804
Magneto Strap Starting		12706
Manifold Admission R. H.	12030	12751
Manifold Admission L. H.	12031	12752
Manifold Cyld. ign. wire R. H.	12381	12737
Manifold Cyld. ign. wire L. H.	12382	12738
Manifold Ig. wire	12360	12753
Manifold Oil	12323	12323
P		
Pin, Piston	12440	12793
Pipe, Camshaft Oil R. H.	12350	12736 L. H. & R. H.
Pipe, Camshaft Oil L. H.	12351	
Pipe, Cyld. water inlet R. H	12325	12739
Pipe, Cyld. water inlet L. H	12326	12740
Pipe, Cyld. water outlet R. H	12642	12642
Pipe, Cyld. water outlet L. H.	12643	12643
Pipe, water pump outlet	12324	12324
Piston	12623	12792
Pump, Fuel, Wright Viking	12604	12604
Pump, Oil	12329	12329
Pump, Water	12428	12428
S		
Screen, Oil suction pump	12346	12346
Shaft & Impeller Water pump	12008	12008
Shaft, Tachometer	11576	12678
Shaft, Vertical	12330	12742
Shaft, Vertical, lower & Inter. dr. pin	12244	12244
Starter		12732
Strainer, Breather tube	12383	12383
Strainer, Oil	12336	12336
T		
Tee, Admission Manifold	12617	12735
V		
Valve, Oil press. relief	11722	11722
Valve and Tappet	12618	12741

Notes on Use of Service Tools

All Hispano Type Engines

THE SERVICE TOOL KIT

The Service Tool Kit is designed to be carried in the airplane. It is sufficient for making all minor repairs in the field and should *not* be removed from the airplane for hangar use or for work on a ship when base repair tools are available. Even a top overhaul is possible with this kit, but more work than this is not practicable and should not be attempted.

The tools in this kit are for use on all Wright (Hispano type) engines except that Propeller Hub Nut Wrenches, WA-110 and WA-111, are not used on Model A and Water Pump Bracket Nut Wrench, WA-21, is only necessary for service on Models A, E or I engines. The Model A Propeller Hub Nut Wrench, WA-72, may be substituted for Wrenches, WA-110 and WA-111.

The small Westcott Wrench, WA-101, can be used for carburetor inspection, removal of magnetos and in several other places where several sizes of open end wrenches would be necessary.

The larger Westcott Wrench, WA-106, will be found useful for the removal of large nuts, tank caps and in such other places where the 6" wrench is too light.

The Screwdriver, WA-102, is necessary for the removal and replacement of cylinder cover screws (except Model A with square head screws), hose clamps, etc., and will be a valuable aid in many minor operations.

The Cutting Pliers, WA-103, are intended for removal of cotter pins, safety wire, etc.

The Hammer, WA-104, saves other tools from being used for that purpose. It is not often needed for heavy work, but it will be found very valuable for minor work in the field.

The Canvas Tool Container is made of 10-ounce brown duck with pockets to accommodate all tools. There are two straps on the outside for securing the roll. Many of the pockets are large enough and the roll is full enough to carry several additional tools, such as those used for work on the plane, if it is desired to carry them.

COMPLETE LIST OF SERVICE TOOLS

This list shows a complete set of tools for any kind of service on all Wright (Hispano type) engines. For a base repair shop or mother ship servicing several planes, the complete list would be required, while for a very large number of planes, possibly two sets would be necessary; or at least, two or more of some of the tools, such as Handles for Valve Seat Cutters, Valve Clearance Gauges, Valve Grinding Screwdrivers, etc.

WA-3, WA-5 and WA-14 will be supplied in blueprint only. They can be easily made by mechanics at repair shops from the blueprints supplied.

WA-6 is used to remove small magneto drive shaft gears as well as ball bearing and crankshaft gears at magneto end.

WA-7 is the Handle for cutting valve seats with Cutters, WA-58, WA-59, WA-98 and WA-99.

WA-13 is used for timing all engines, the disc being properly graduated on both sides.

WA-16 is used on all engines, one end being used for Models H, H-2, H-3, Type 4 and E-4, and the other end for all other models.

WA-25, Spark Plug Wrench and Handle, may also be used for removing valve guides from cylinder blocks.

WA-31 may be used for removing nuts on water pump bracket on all models. WA-30 may also be used, but the special closed end wrench will be more convenient in some cases.

WA-106, Speed Wrench with eleven sockets, will be found very handy in many places.

WA-11 may be supplied in place of WA-110 and WA-111. It includes these two wrenches assembled with pin and lock-spring.

WA-21 is used for certain water pump bracket nuts on Model A, E and I engines which cannot be removed with WA-31.

WA-58, WA-59, WA-98 and WA-99 are used with Handle, WA-7.

WA-72 should be substituted for WA-110 and WA-111 for service on Model A engines.

WA-73 is used with High Speed Wrench Handle WA-106 on Model A engines which are equipped with square head cylinder cover screws.

Quotations on These Tools Upon Request

SERVICE TOOL LIST

All Hispano Type Engines

SERVICE TOOL KIT
Assy.-WA-112
For all Hispano Types

(See photo, page one)

Consisting of:

Tool No.	*Tool Name*
WA- 16	Valve Clearance Gauge (Double End)
WA- 20	Valve Tappet Adj. Wrench
WA- 21	Water Pump Bracket Nut Wrench (A, E, I)
WA- 22	Water Pump Gland Nut Wrench
WA- 23	Adjustable Hook Spanner (small)
WA- 24	Adjustable Hook Spanner (Large)
WA- 25	Spark Plug Wrench and Handle
WA- 26	Cylinder Stud Nut Wrench
WA- 30	Double End Wrench $\frac{9}{16}$" and $\frac{3}{8}$" Hex.
WA- 31	Water Pump Bracket Nut Wrench (All Models)
WA-101	6" Westcott Wrench
WA-102	12" Screwdriver (Pexto No. 3)
WA-103	Side Cutting Pliers (Utica 8")
WA-104	1 lb. Ball Pean Hammer (Cheney)
WA-105	10" Westcott Wrench
WA-108	Canvas Tool Container
WA-110	Propeller Hub Nut Wrench—Inner (Except A)
WA-111	Propeller Hub Nut Wrench—Outer (Except A)

COMPLETE SERVICE TOOL LIST

(Common to all models)

WA- 1	Camshaft Bearing Line Reamer
WA- 2	Camshaft Bearing Aligning Bar
WA- 3	Cylinder Holding Stand
WA- 4	Dead Center Indicator
WA- 5	Engine Tilting Stand
WA- 6	Magneto and Crankshaft Gear Puller
WA- 7	Handle for Valve Seat Cutters
WA- 12	Spark Plug Bushing Wrench Assy.
WA- 13	Timing Disc. Assy.
WA- 14	Valve Assembling Frames
WA- 16	Valve Clearance Gauge
WA- 17	Valve Grinding Screwdriver
WA- 19	Valve Tappet Socket Wrench
WA- 20	Valve Adjusting Wrench
WA- 22	Water Pump Gland Nut Wrench
WA- 23	Adjustable Hook Spanner (Small)
WA- 24	Adjustable Hook Spanner (Large)
WA- 25	Spark Plug Wrench and Handle
WA- 26	Cylinder Stud Nut Wrench
WA- 27	Valve Assembling Lever
WA- 28	Crankshaft Lock Nut Wrench
WA- 29	$\frac{11}{16}$" Socket Wrench—Crankshaft Brg. Stud Nut
WA- 30	Double End Open Wrench for $\frac{3}{8}$" and $\frac{9}{16}$" Hex.
WA- 31	Water Pump Bracket Nut Wrench
WA- 51	Crankshaft Thrust Brg. Nut Wrench
WA-101	6" Westcott Wrench
WA-102	12" Screwdriver (Pexto No. 3)
WA-103	Side Cutting Pliers (Utica 8")
WA-104	1 lb. Ball Pean Hammer (Cheney)
WA-105	10" Westcott Wrench
WA-106	Billmont Wrench Assy.—Sizes 16 to 28
WA-107	Spring, Valve Grinding
WA-109	Single End Wrench $\frac{9}{16}$" Hex.
WA-112	Service Tool Kit Assy.

(Common to all models except A)

WA- 11	Propeller Hub Nut Wrench Assy.
WA-110	Propeller Hub Nut Wrench—Inner
WA-111	Propeller Hub Nut Wrench—Outer

(Additional for A, E and I Engines)

WA- 21	Water Pump Bracket Nut Wrench

(Additional for A, E, I, E-2, E-3 & E-4 Engines)

WA- 53	Main Bearing Reamer
WA- 54	Piston Pin Bushing Reamer
WA- 55	Valve Guide Plug Gauge (Ex.)
WA- 56	Valve Guide Plug Gauge (Int.)
WA- 57	Valve Guide Reamer
WA- 58	Valve Seat Cutter and Pilot (Ex.)
WA- 59	Valve Seat Cutter and Pilot (Int.)

(Additional for H, H-2, H-3 & Type 4 Engines)

WA- 93	Main Bearing Reamer
WA- 94	Piston Pin Bushing Reamer
WA- 95	Valve Guide Plug Gauge (Ex.)
WA- 96	Valve Guide Plug Gauge (Int.)
WA- 97	Valve Guide Reamer
WA- 98	Valve Seat Cutter and Pilot (Ex.)
WA- 99	Valve Seat Cutter and Pilot (Int.)

(Additional for A Engines Only)

WA- 71	Piston Pin Set Screw Wrench
WA- 72	Propeller Hub Nut Wrench
WA- 73	Cylinder Cover Screw Wrench

Table of Specifications Covering Wright Engines

GENERAL	T-2	T-3	E-3	E-4	J-1	J-3
Average H. P. at Normal r. p. m.	530	550* (5.3 Comp.) 675 (6.5 Comp.)	200	204 (5.3 Comp.) 240 (6.0 Comp.) (2100 r.p.m.)	215*	215*
Type	Water C.	Water C.	Water C.	Water C.	Air C.	Air C.
1. Number of cylinders	12	12	8	8	9	9
2. Bore	5¾"	5¾"	4.724	4.724	4.5"	4.5"
3. Stroke	6¼"	6¼"	5.118	5.118	5.5"	5.5"
4. Piston displacement	1947 cu. in.	1947 cu. in.	718 cu. in.	718 cu. in.	787 cu. in.	787 cu. in.
5. Compression ratio	5.5 :1	5.3 :1 6.5 :1	5.3 :1	5.35 :1 6.0 :1	5 :1	5 :1
6. Normal Speed in revolutions per minute	1800	1800 (5.3 Comp.) 2000 (6.5 Comp.)	1800	1800	1800	1800
7. Guaranteed brake horsepower sea level at normal r. p. m. with aviation gasoline	525	525 (5.3 Comp.) 650 (6.5 Comp.)	180	190	200	200
8. Direction of rotation of crankshaft (looking at propeller end of engine)	Anti-Clockwise	Anti-Clockwise	Anti-Clockwise	Anti-Clockwise	Anti-Clockwise	Anti-Clockwise
9. Direction of rotation of camshafts (looking at propeller end of engine)	Anti-Clockwise	Anti-Clockwise	Clockwise	Clockwise	Clockwise	Clockwise
10. Tachometer shaft speed	½ Crankshaft	½ Crankshaft	½ Crankshaft	½ Crankshaft	½ Crankshaft	½ Crankshaft
11. Direction of rotation tachometer shaft (looking into open end of tach. drive)	Clockwise	Clockwise	Anti-Clockwise	Anti-Clockwise	Anti-Clockwise	Anti-Clockwise
12. Average weight of engine complete *with* propeller hub flange and bolts, carburetor and two magnetos. *Without* water, oil radiators, tanks, starting device, gasoline, supply system propeller, fuel pump or generator, not to exceed	1173	1160	493	474	445	465*

* Estimated

GENERAL	T-2	T-3	E-3	E-4	J-1	J-3
13. Weight as in 12, but *with* cylinder jackets full of water. Water in radiator, etc., *not* included	1228.5	1219.5	515.75	506.75	—	—
14. Position of center of gravity of engine under condition (13); Back from hub rear flange (front face).	29 5/16"	28 23/32"	21 23/32"	21 21/32"	11"	—
Up from center line of crankshaft	5 5/8"	8 9/32"	5 11/32"	4 23/32"	3/8" down	—
15. Width requisite between engine bearers	15"	15"	11 1/2"	11 1/2"	18 3/8" dia.	18 3/8"
16. Width between engine holding bolt centers	17"	17"	13 5/32"	13 5/32"	19 1/4 b. circle	19 1/4 b. circle
17. Number of holding down bolts on each side	6	6	8	8	8 total	8 total
18. Size of holding down bolts	1/2"	1/2"	3/8"	3/8"	3/8"	3/8"
19. Overall dimensions:						
Overall length of engine	66 3/8"	65 5/8"	49 3/16"	49 3/16"	42" with starter	33.8"
Overall width outside of cam covers	31 11/16"	30 7/8"	33 7/16"	33 7/16"	43 1/2" dia.	43 1/2" dia.
Height from engine bearer to highest point	26 3/16"	26 1/4"	18 3/4"	17 7/8"	21 3/4" radius	21 3/4" radius

IGNITION	T-2	T-3	E-3	E-4	J-1	J-3
20. Magneto type	Split-SS-12	Split-SS-12	Split-SS-8	Split-SS-8	Split-SS-9	Split-SS-9
21. Direction of rotation of magnetos (looking at drive coupling end)	Both Counter-Clockwise	Both Counter-Clockwise	Both Counter-Clockwise	Both Counter-Clockwise	Both Counter-Clockwise	Both Counter-Clockwise
22. Magneto speed	1½ times Crankshaft	1½ times Crankshaft	Crankshaft	Crankshaft	1⅛ times Crankshaft	1⅛ times Crankshaft
23. Magneto breaker point gap	.020″	.020″	.020″	.020″	.020″	.020″
24. Spark plug point gap	.015-.020″	.15-.020″	.015-.020″	.015-.020″	.015-.020″	.015-.020″
25. Advanced spark occurs crankshaft degrees before top dead center	30°	30° (5.3 Comp.) 45° (6.5 Comp.)	25°	25°	25° top spark plug 27° side spark plug	

	VALVES AND TIMING	T-2	T-3	E-3	E-4	J-1	J-3
26.	Intake closes	58½° A.B.C.	58½° A.B.C.	50° A.B.C.	60° A.B.C.	60° A.B.C.	60° A.B.C.
	Intake opens	8½° B.T.C.	8½° B.T.C.	10° A.T.C.	10° B.T.C.	8° B.T.C.	8° B.T.C.
27.	Exhaust opens	60° B.B.C.	60° B.B.C.	45° B.B.C.	61° B.B.C.	60° B.B.C.	60° B.B.C.
	Exhaust closes	25° A.T.C.	25° A.T.C.	10° A.T.C.	26° A.T.C.	8° A.T.C.	8° A.T.C.
28.	Intake remains open (crankshaft deg.)	247°	247°	220°	250°	248°	248°
29.	Exhaust remains open (crankshaft deg.)	265°	265°	235°	267°	248°	248°
30.	Valve lift	3/8"	½"	.393"	.511"	7/16"	7/16"
31.	Clearance between tappet and valve intake	.012	.012	.078	.031	.063	.063
	Exhaust	.015	.015	.078	.031	.063	.063
32.	Carburetor type	Stromberg NA-U6T	Stromberg NA-U6T	Stromberg NA-D4	Stromberg NA-U5	Stromberg NA- S4	Stromberg NA-U5
33.	Carburetor settings:						
	Venturi (choke)	1 15/16"	2 1/16"	1½"	1⅝"	1 7/16"	—
	Metering jet	#40	#39	#42	#47	#48	—
	Accelerating well bore	5/16"	5/16"	#3	17/64	#25	—
	Main jet air bleed	#49	#49	#60	#49	#52	—
	Idle metering jet	#57	#57	#56	#61	#62	—
	Idle air bleed	#45	#45	Needle valve	#47	—	—
34.	Guaranteed fuel consumption per H. P. hour at normal r. p. m.	.52	.52	.52	.52	.54	.54
35.	Approximate specific fuel consumption, at sea level, at normal r. p. m. and guaranteed H. P., lbs. per b. h. p. hour	.50	.50 (5.3:1) .49 (6.5:1)	.50	.50	.50	.50
36.	Correct pressure on fuel supply, lbs. per sq. in.	2-4	2-4	2-4	2-4	2-4	2-4

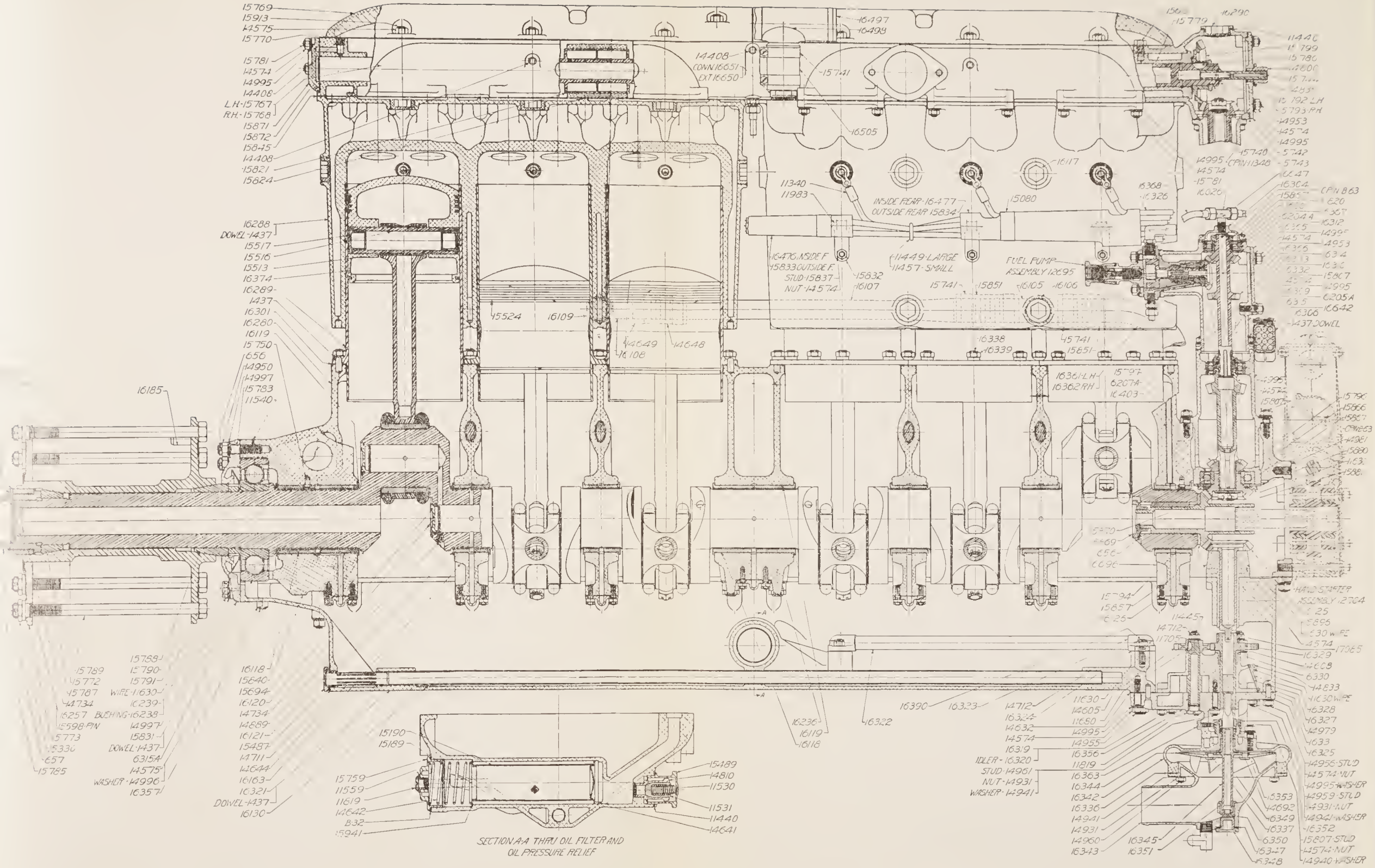
LUBRICATING SYSTEM	T-2	T-3	E-3	E-4	J-1	J-3
37. Guaranteed oil consumption, lbs. per H. P. hr.	.025	.025	.025	.025	.025	.025
38. Approximate consumption on ground; gallons per hour, normal r. p. m., guaranteed H. P. (7.5 lbs. per gal.)	.65	.65 at 1800 * 1.0 at 2000	.45	.50	55	
39. Correct oil pressure (lbs. per sq. in.) at normal r. p. m. at recommended oil temperature	40-70	60-80	60-80	60-80	30-40	30-40
40. Quantity oil circulated per min. under conditions of (38). Lbs. per min.	34	34	27	27	—	—
41. Minimum safe quantity of oil in whole system. Gallons	2	2	1	1	1	1
42. Maximum permissible outlet temperature of oil under worst conditions	180° F.	180° F.	180° F.	180° F.	180° F.	180° F.
43. Desired maximum oil outlet temperature in normal operation	160° F.	160° F.	160° F.	160° F.	160° F.	160° F.
44. Speed of oil pump	1 1/5 times crankshaft	1 1/5 times crankshaft	1 1/5 times crankshaft	1 1/5 times crankshaft	crankshaft speed	crankshaft speed
45. Direction of rotation of oil pump (looking at driven end of shaft)	Clockwise	Clockwise	Clockwise	Clockwise	Clockwise-Press. Anti-Clockwise-suction	Anti-Clockwise
46. Hose connections required between engine and lubrication system:						
Inlet and Outlet — Inside Diameter	¾"	¾"	¾"	¾"	¾"	¾"
Inlet and Outlet — Number of pieces	2	2	2	2	2	2

* Estimated

WATER SYSTEM	T-2	T-3	E-3	E-4	J-1	J-3
47. Speed of pump	1 1/5 times Crankshaft	1 1/5 times Crankshaft	1 1/5 times Crankshaft	1 1/5 times Crankshaft	—	—
48. Direction of rotation of pump looking at driven end of spindle	Anti-Clockwise	Anti-Clockwise	Anti-Clockwise	Anti-Clockwise	—	—
49. Desirable water temperature at cylinder outlet	150° F. (66° C.)	150° F. (66° C.)	150° F. (66° C.)	150° F. (66° C.)	—	—
50. Maximum permissible water temperature at cylinder outlets	190° F. (90° C.)	190° F. (90° C.)	190° F. (90° C.)	190° F. (90° C.)	—	—
51. Water flow through engine, normal speed gal. per min. on test blocks	70	70	22	22	—	—
52. Hose connections required between engine and cooling system:						
Inlet—Inside diameter	1½"	1½"	2"	2"	—	—
Number of pieces	1	1	1	1	—	—
Outlet—Inside diameter	1¾"	1½"	1⅛"	1⅛"	—	—
Number of pieces	2	2	2	2	—	—

Model T - 2 Assembly

(*Longitudinal Section*)



Assembly Drawing

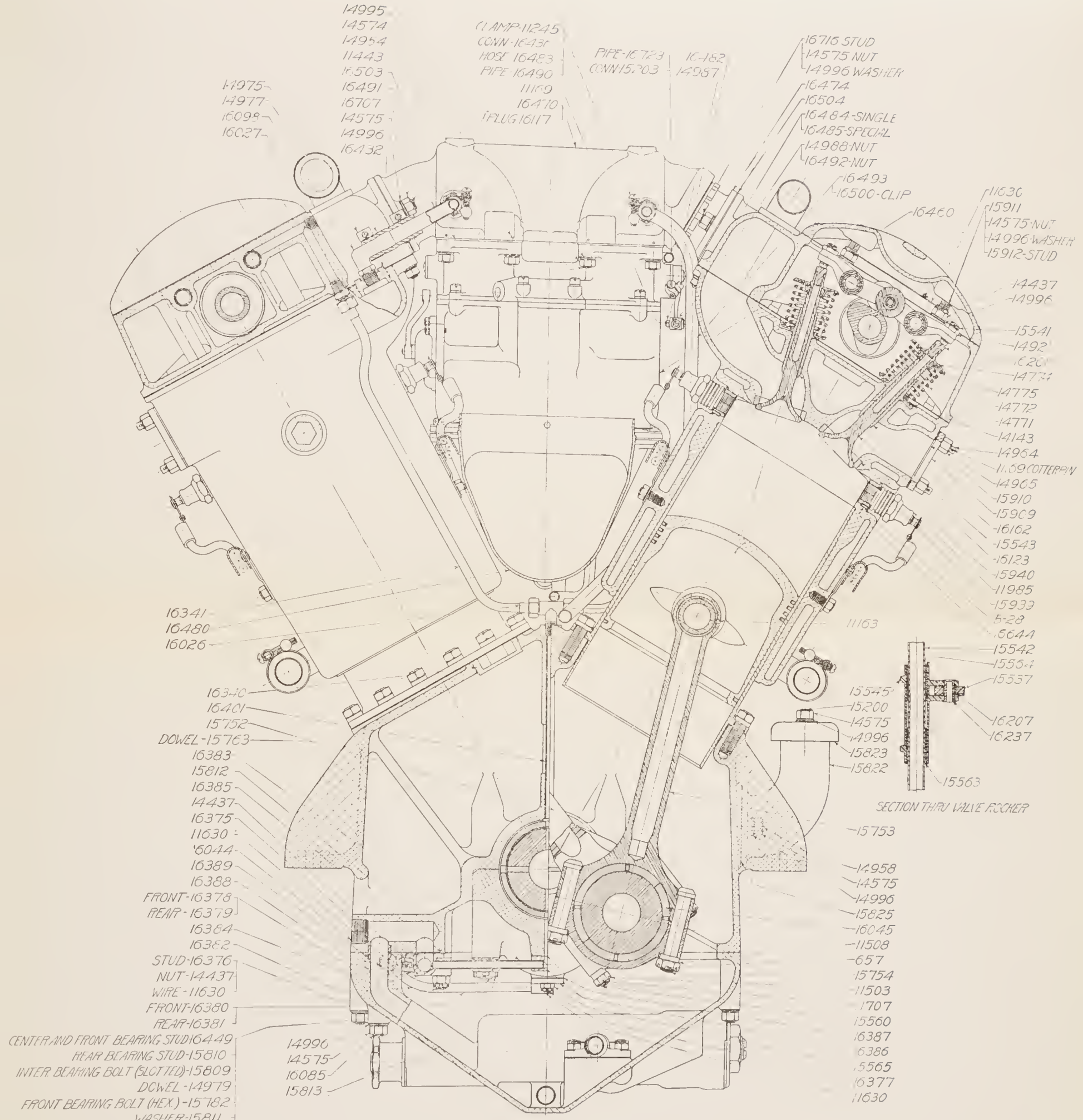
WRIGHT

Model T-2 Engine

(*Longitudinal Section*)

Model T - 2 Assembly

(Transverse Section)



Assembly Drawing

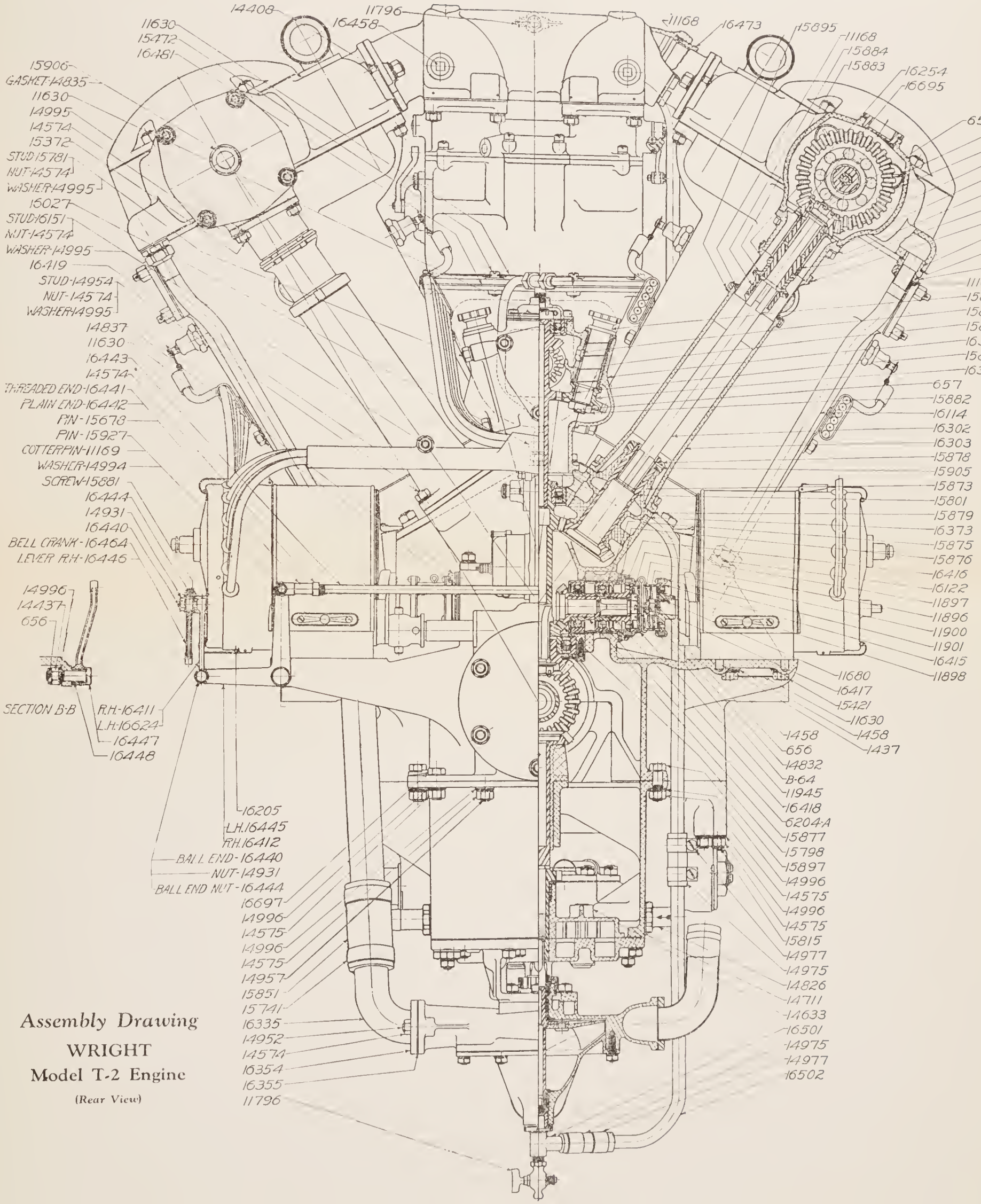
WRIGHT

Model T-2 Engine

(Transverse Section)

Model T-2 Assembly

(Rear View)



Assembly Drawing

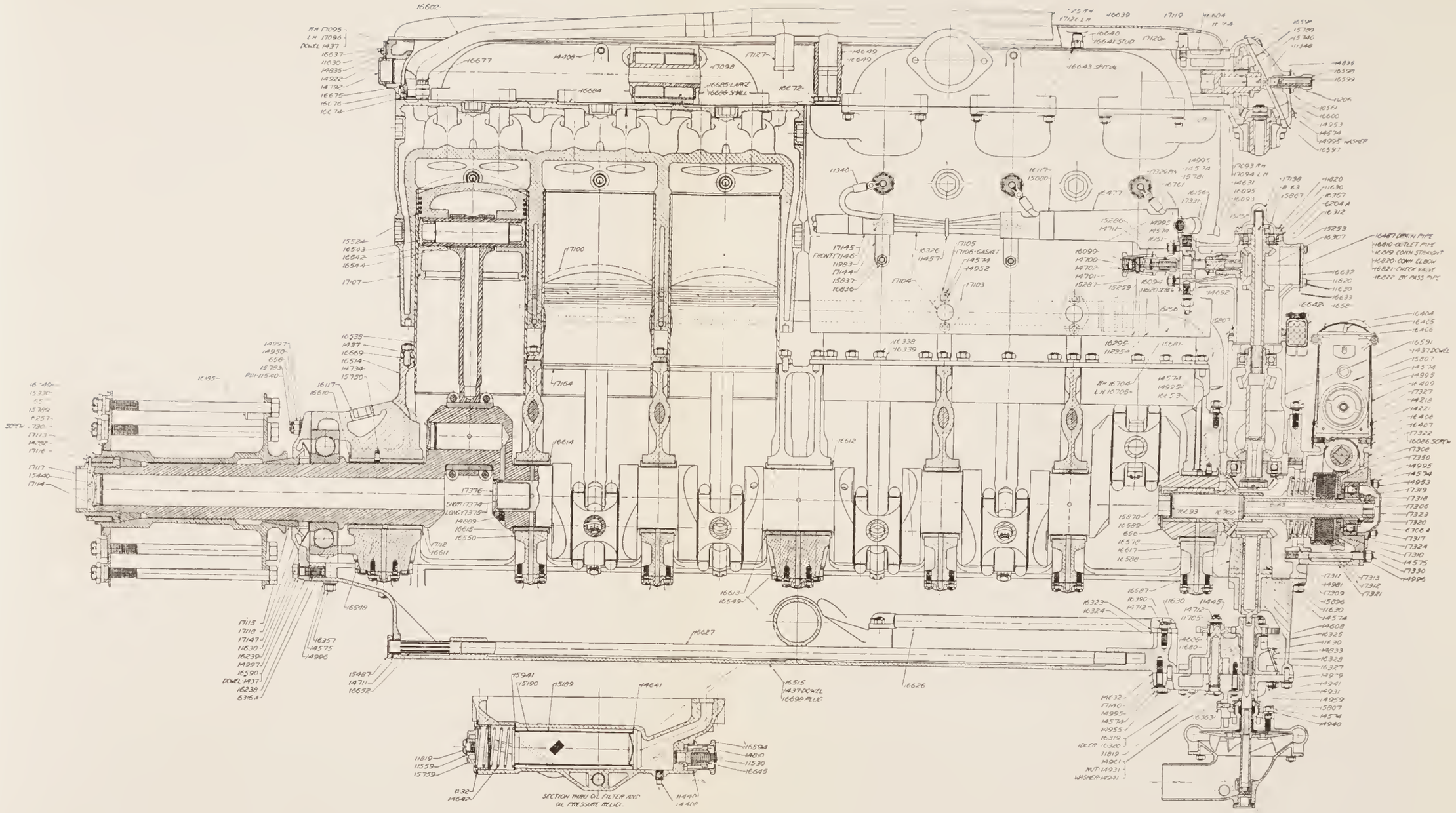
WRIGHT

Model T-2 Engine

(Rear View)

Model T-3 Assembly

(Longitudinal Section)



Assembly Drawing

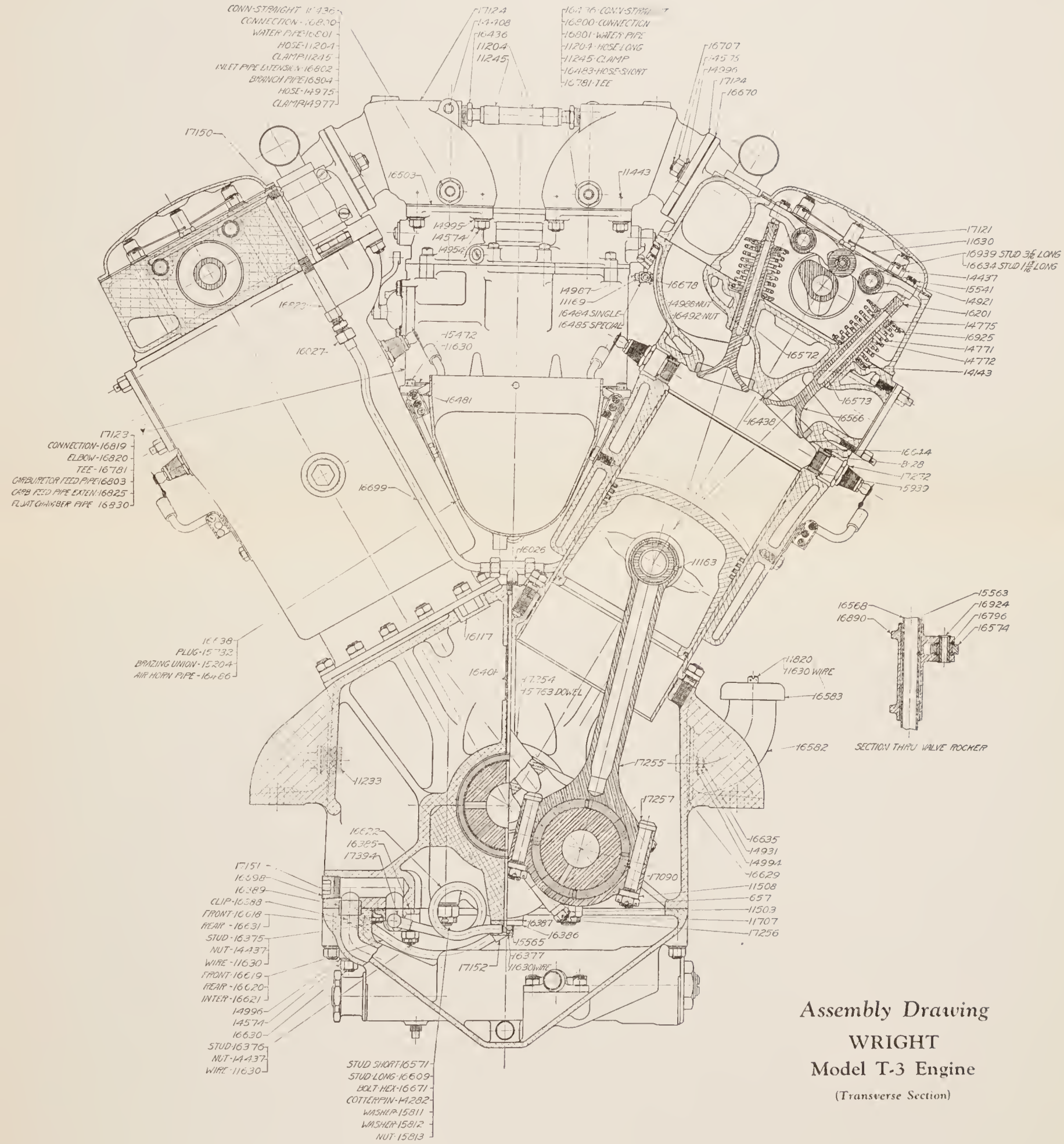
WRIGHT

Model T-3 Engine

(Longitudinal Section)

Model T-3 Assembly

(Transverse Section)



Assembly Drawing

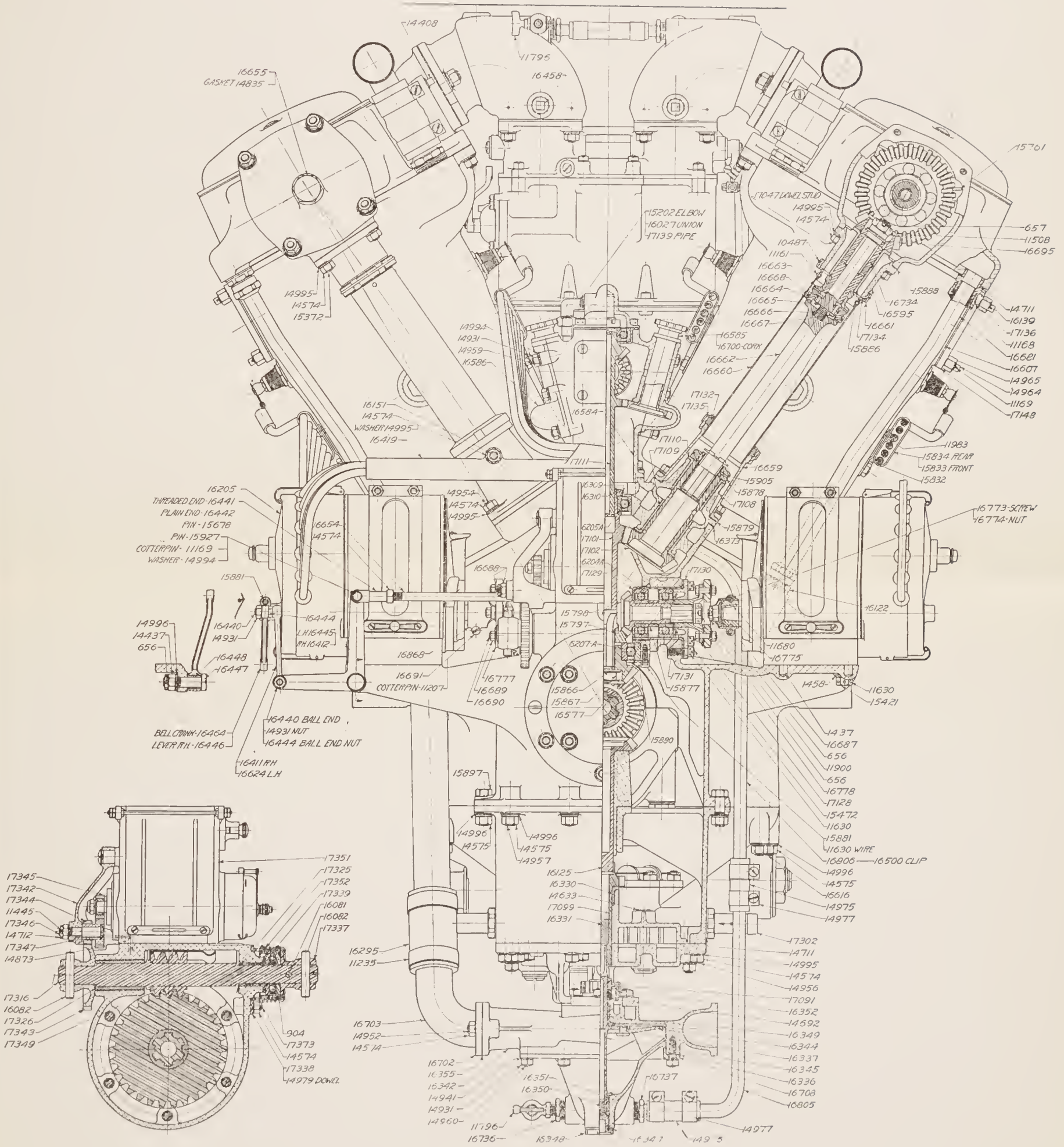
WRIGHT

Model T-3 Engine

(Transverse Section)

Model T-3 Assembly

(Rear View)

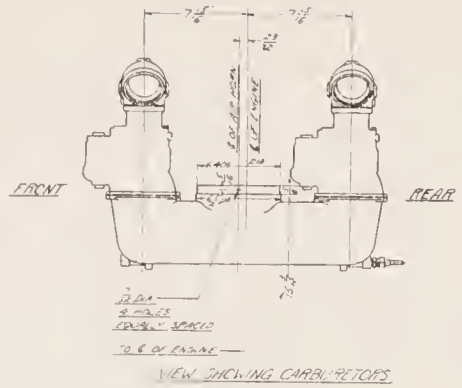


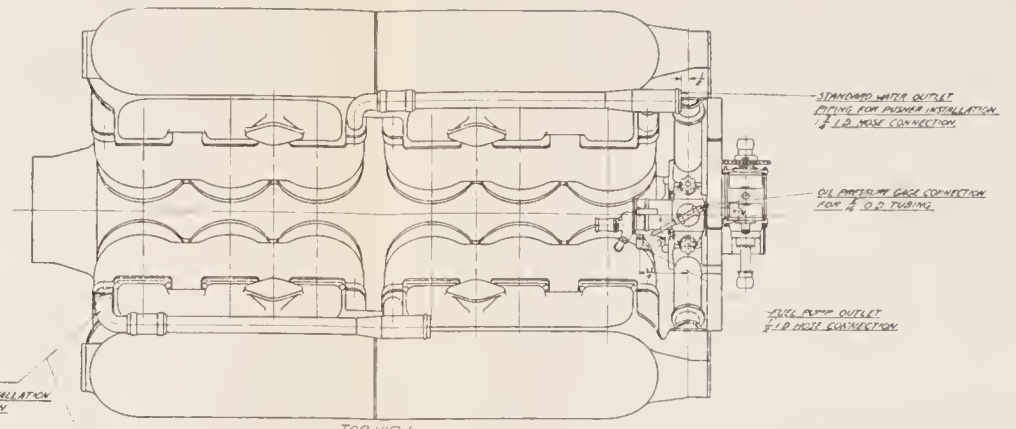
Assembly Drawing

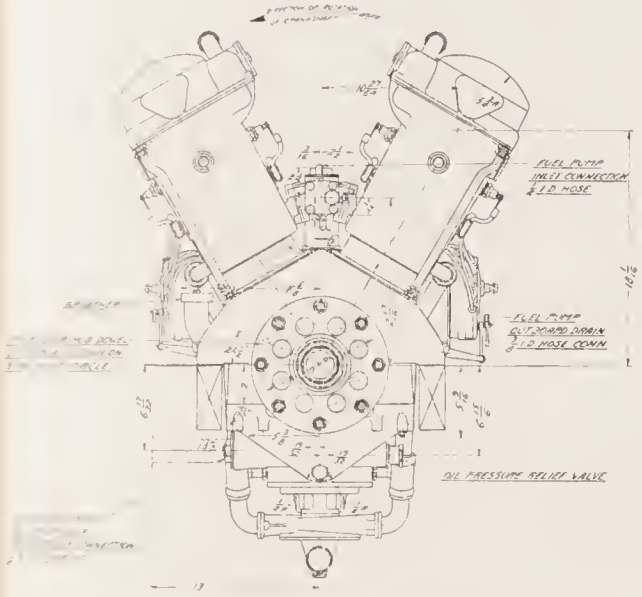
WRIGHT

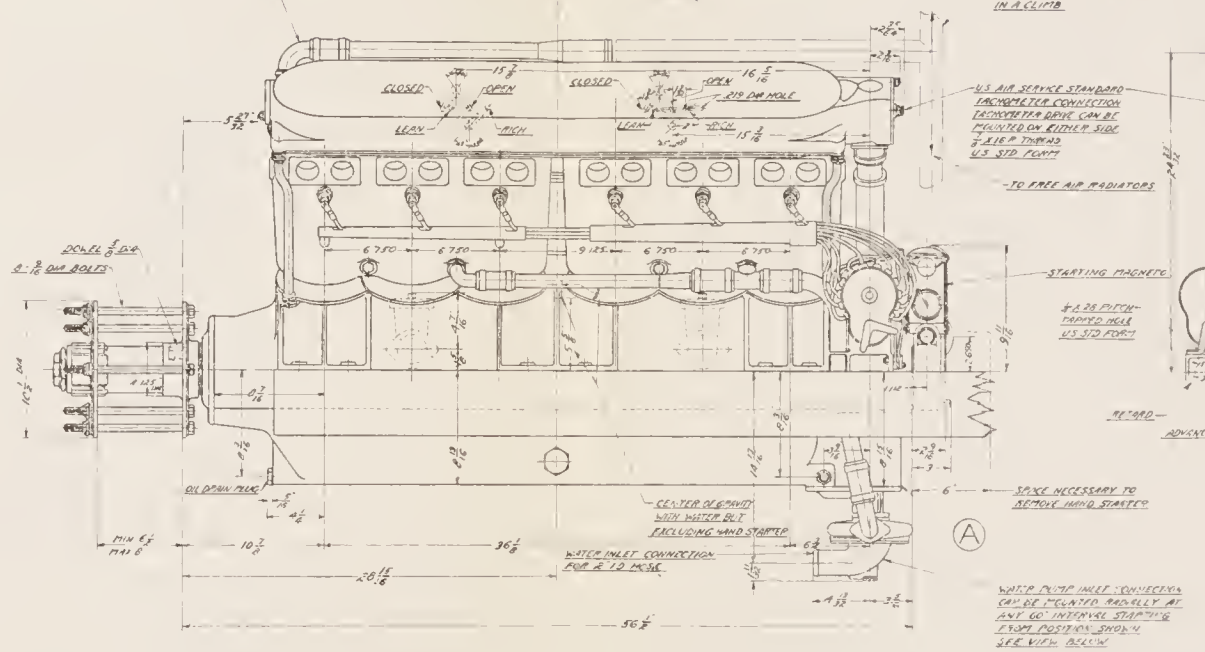
Model T-3 Engine

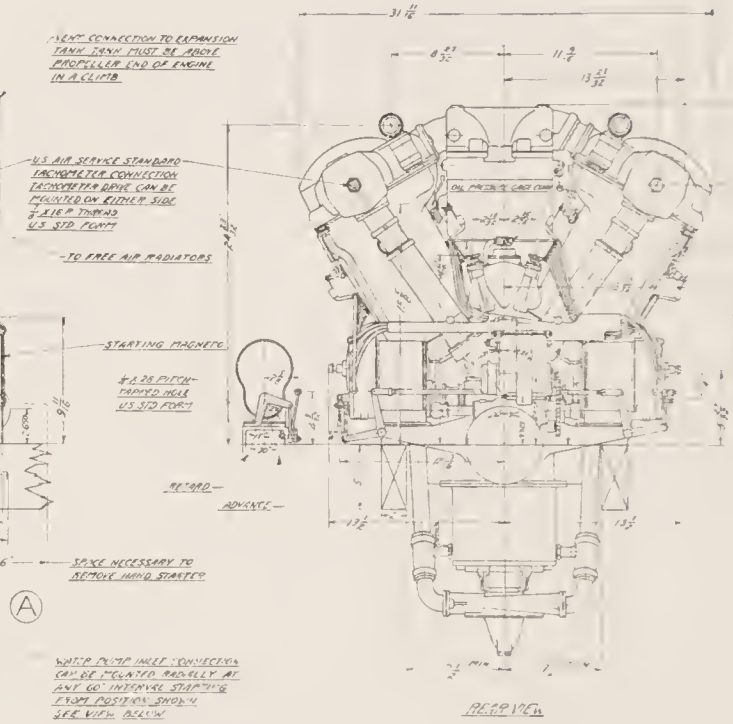
(Rear View)

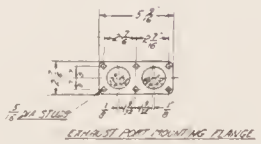


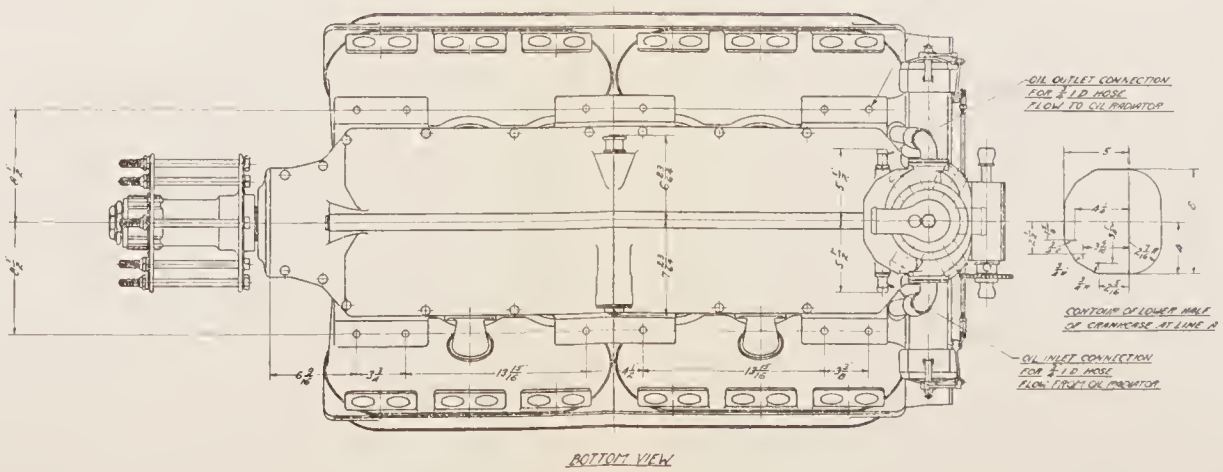








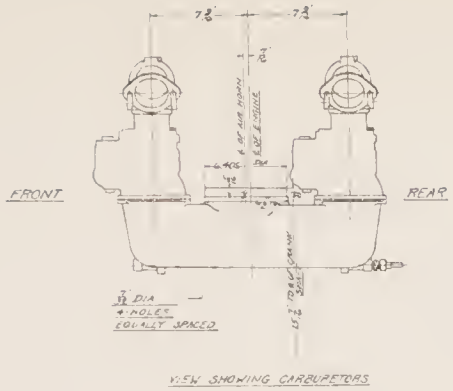




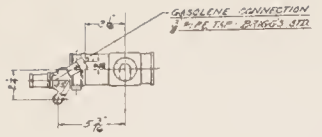
Installation Drawing

WRIGHT

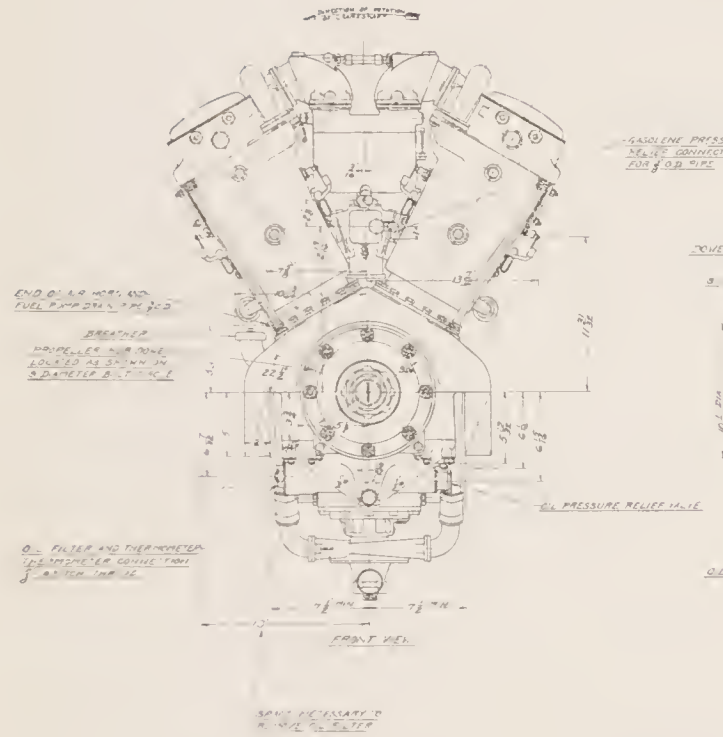
Model T-2 Engine

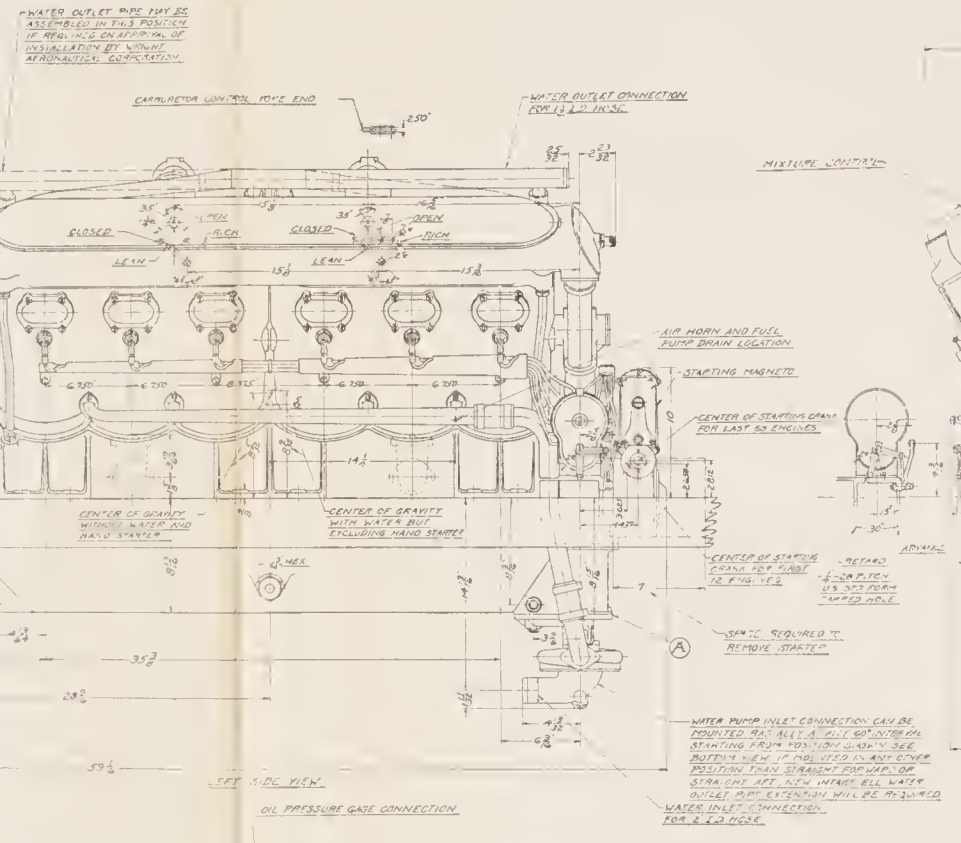


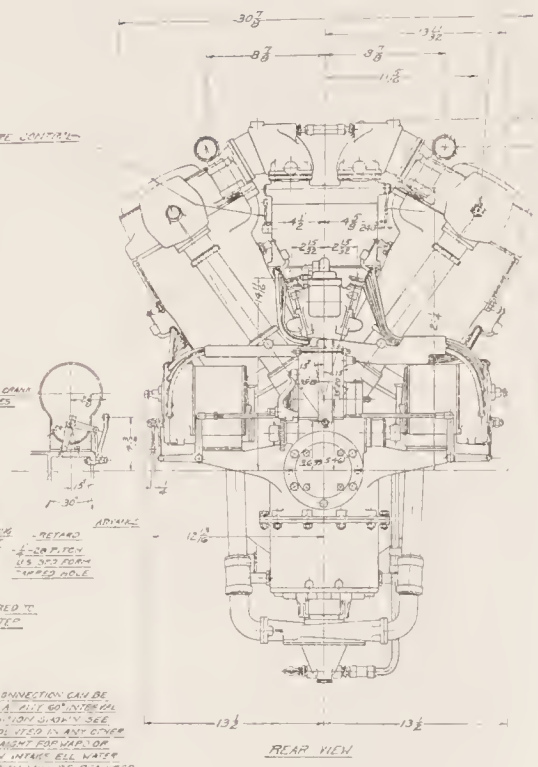
VIEW SHOWING CARBURETORS

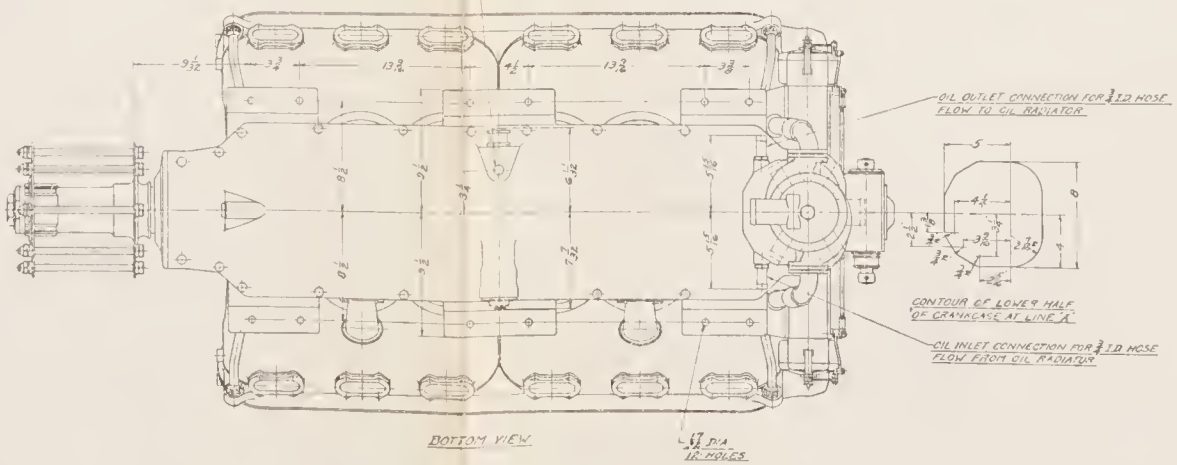


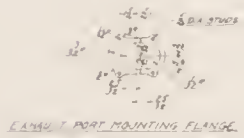
U.S. A.M. SERVICE STANDARD TACHOMETER CONNECTION. TACHOMETER DRIVE CAN BE MOUNTED ON EITHER SIDE. ⅜-18 PITCH THREAD U.S. STD. FORM









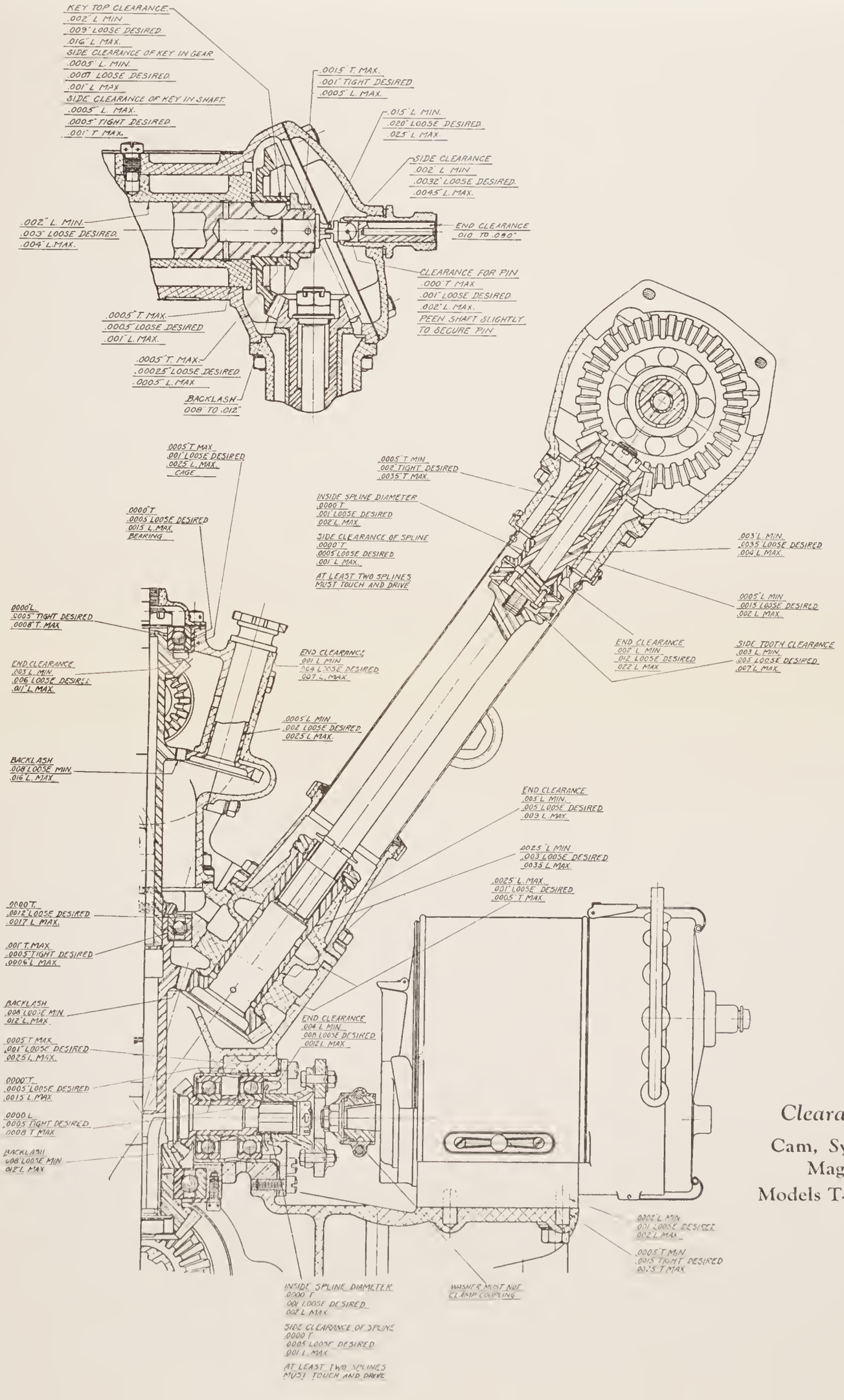


Installation Drawing

WRIGHT
Model T-3 Engine

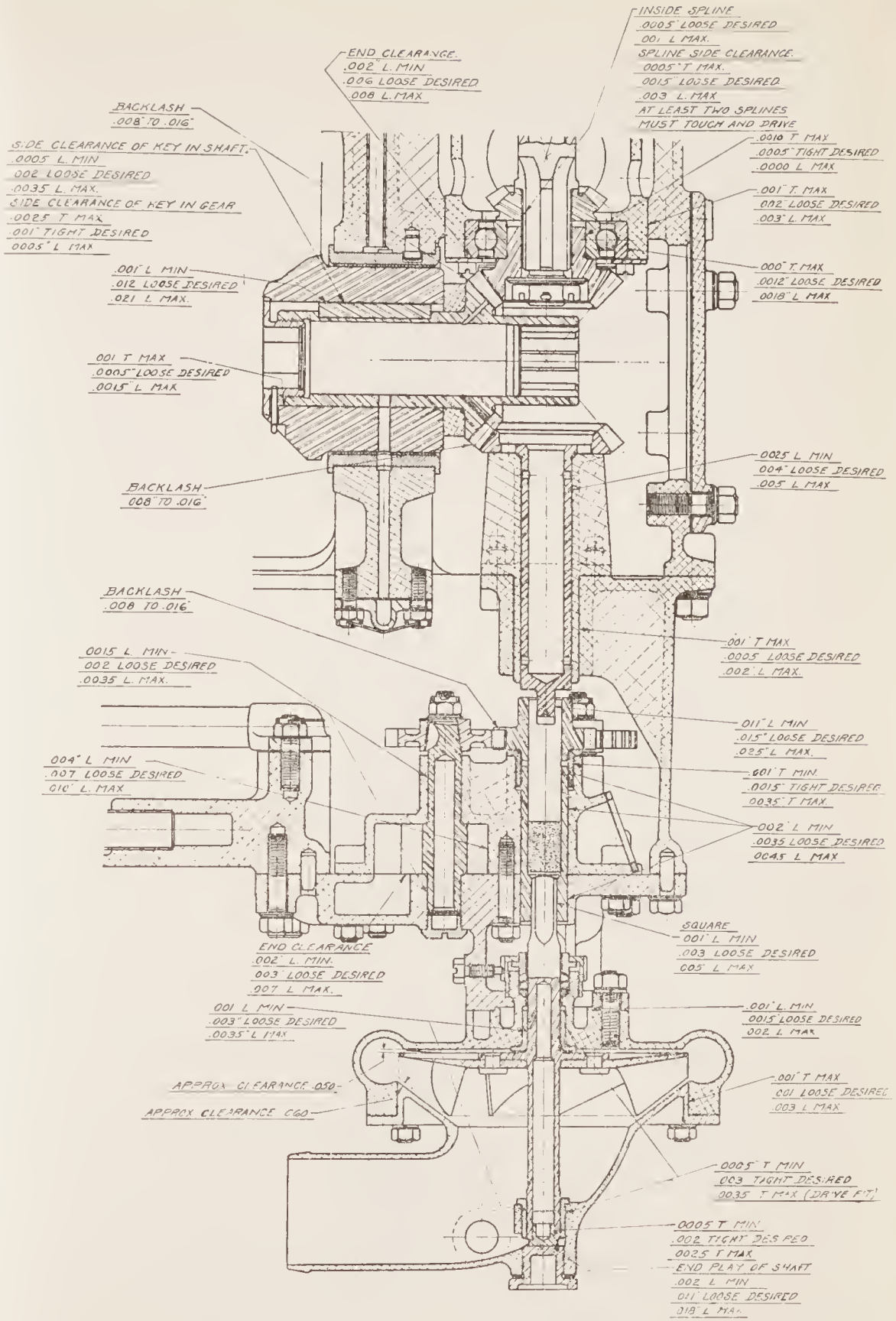
Model T - 2 and T - 3 Clearance

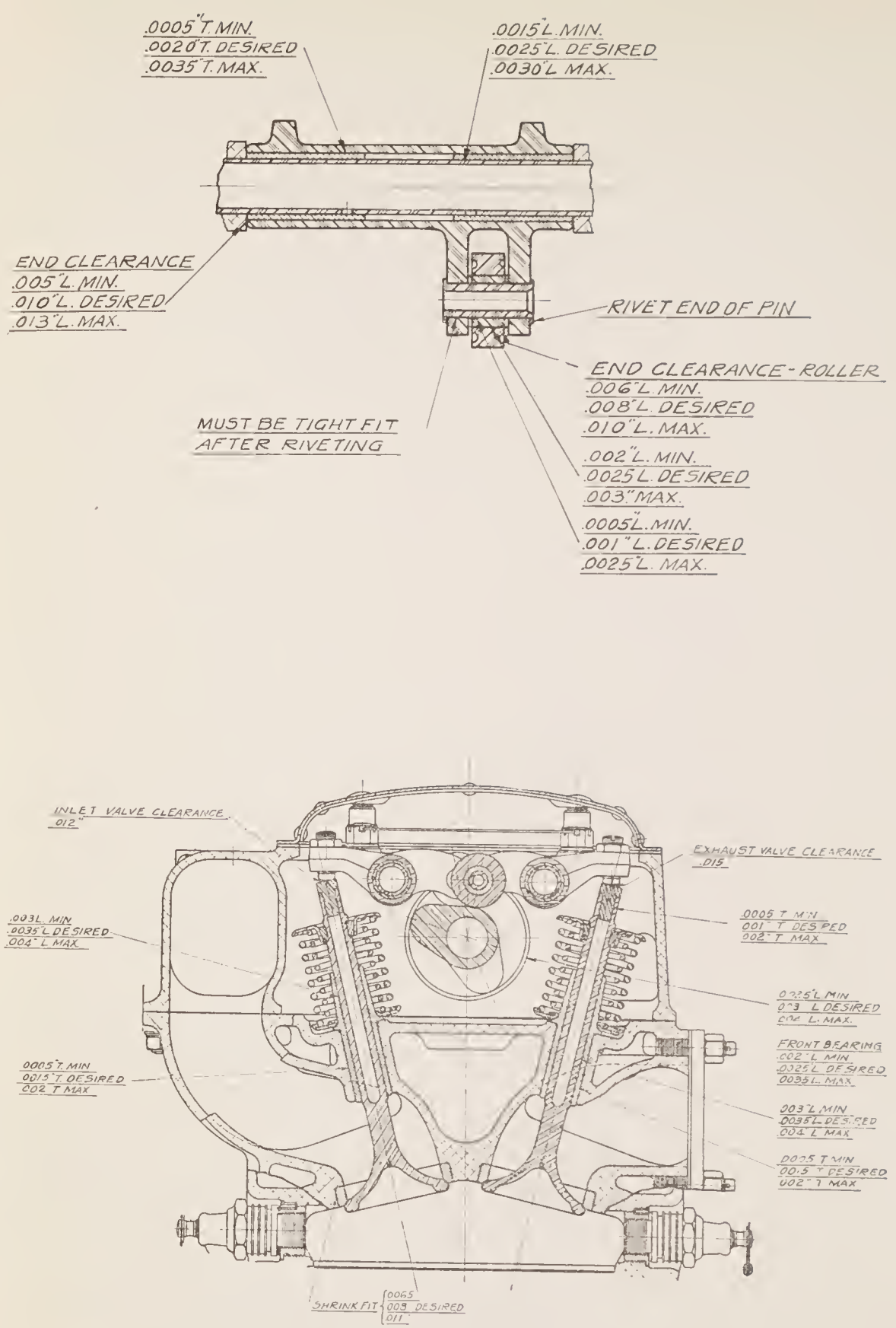
(*Cam, Synchronizer and Magneto Drive*)



Clearance Drawing

Cam, Synchronizer and
Magneto Drives
Models T-2 & T-3 Engines





Clearance Drawings

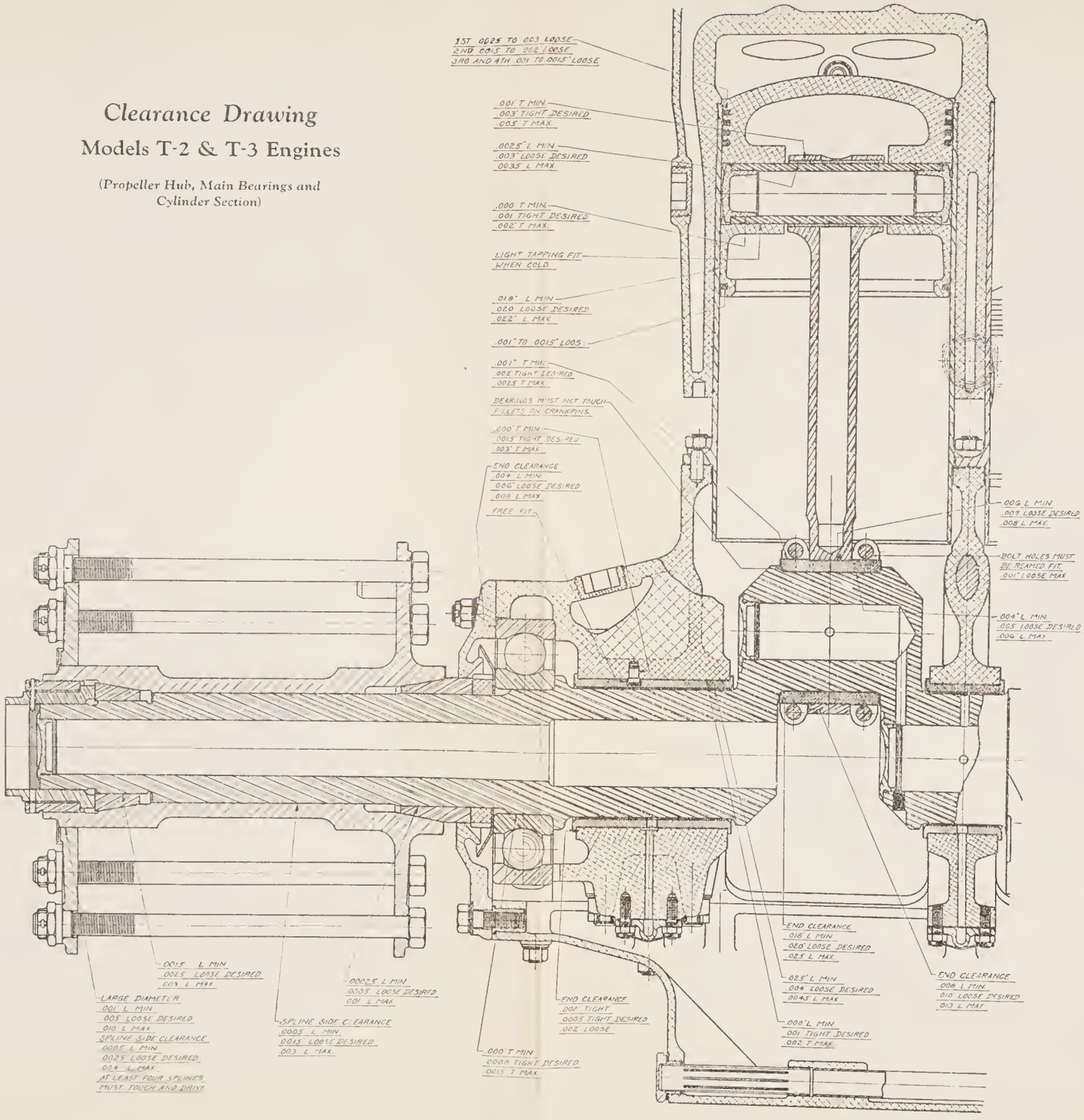
Water and Oil Pump Sections. Valves and Rocker Arms

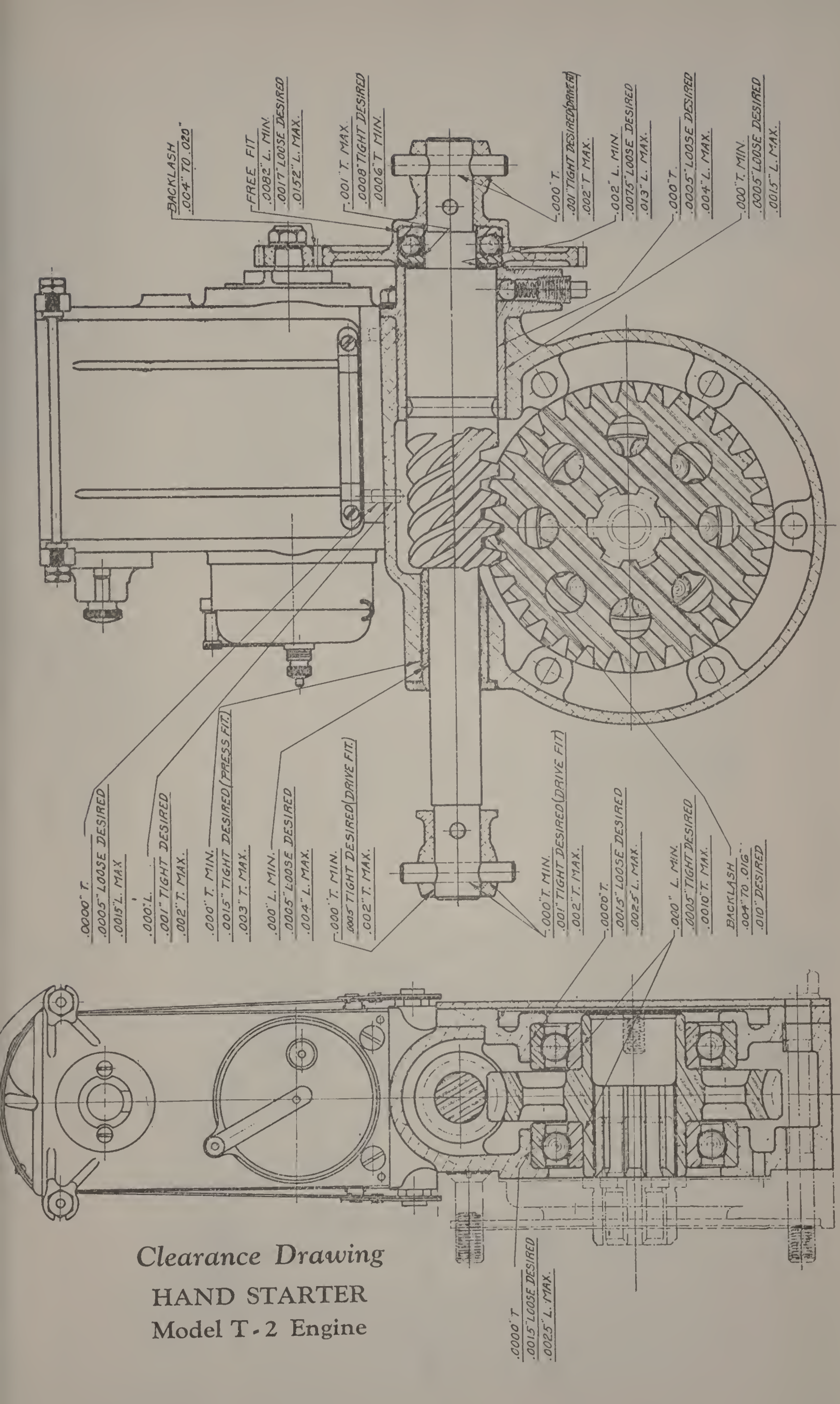
Models T-2 & T-3 Engines

Clearance Drawing

Models T-2 & T-3 Engines

(Propeller Hub, Main Bearings and Cylinder Section)

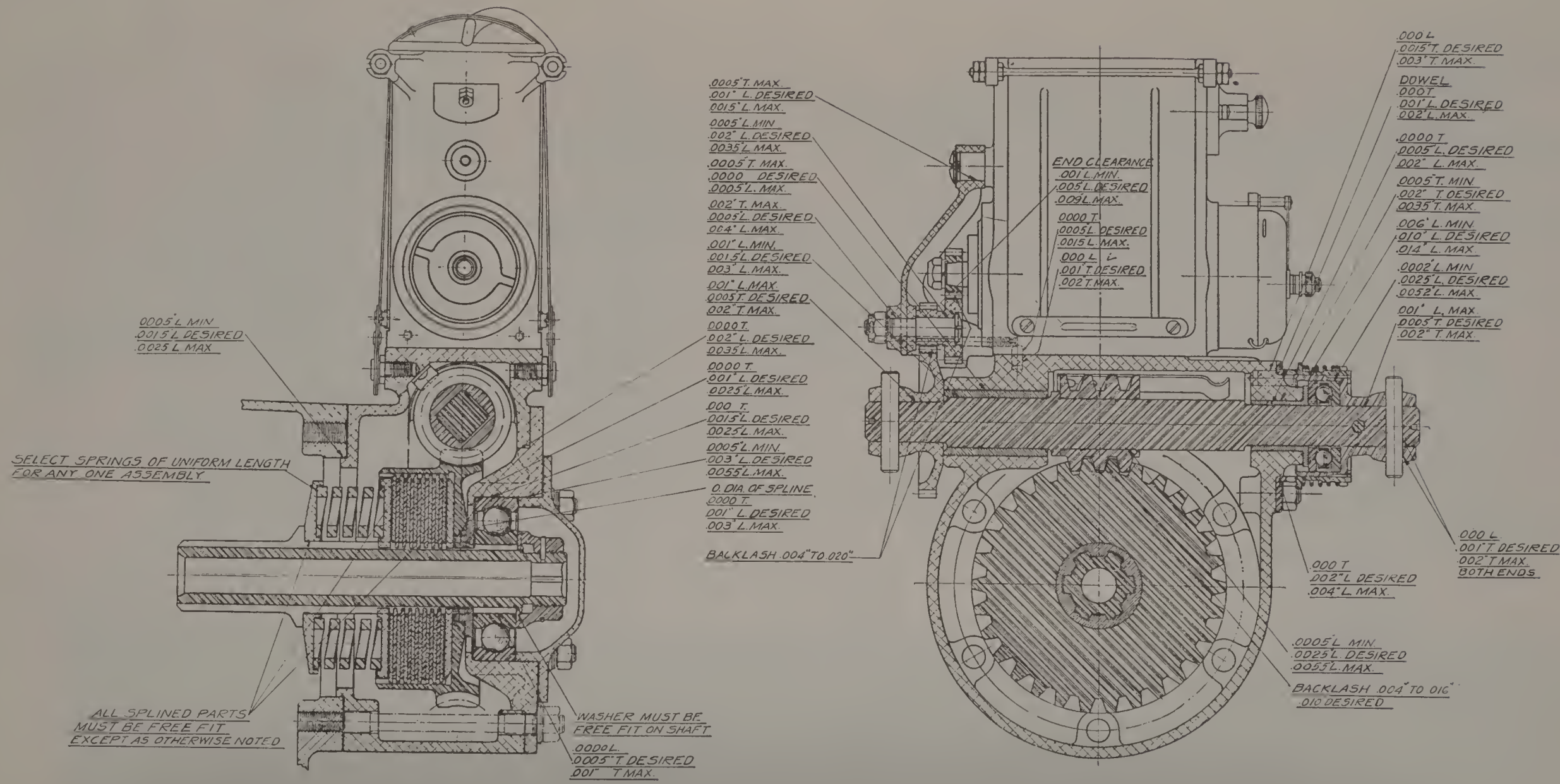




Clearance Drawing

HAND STARTER

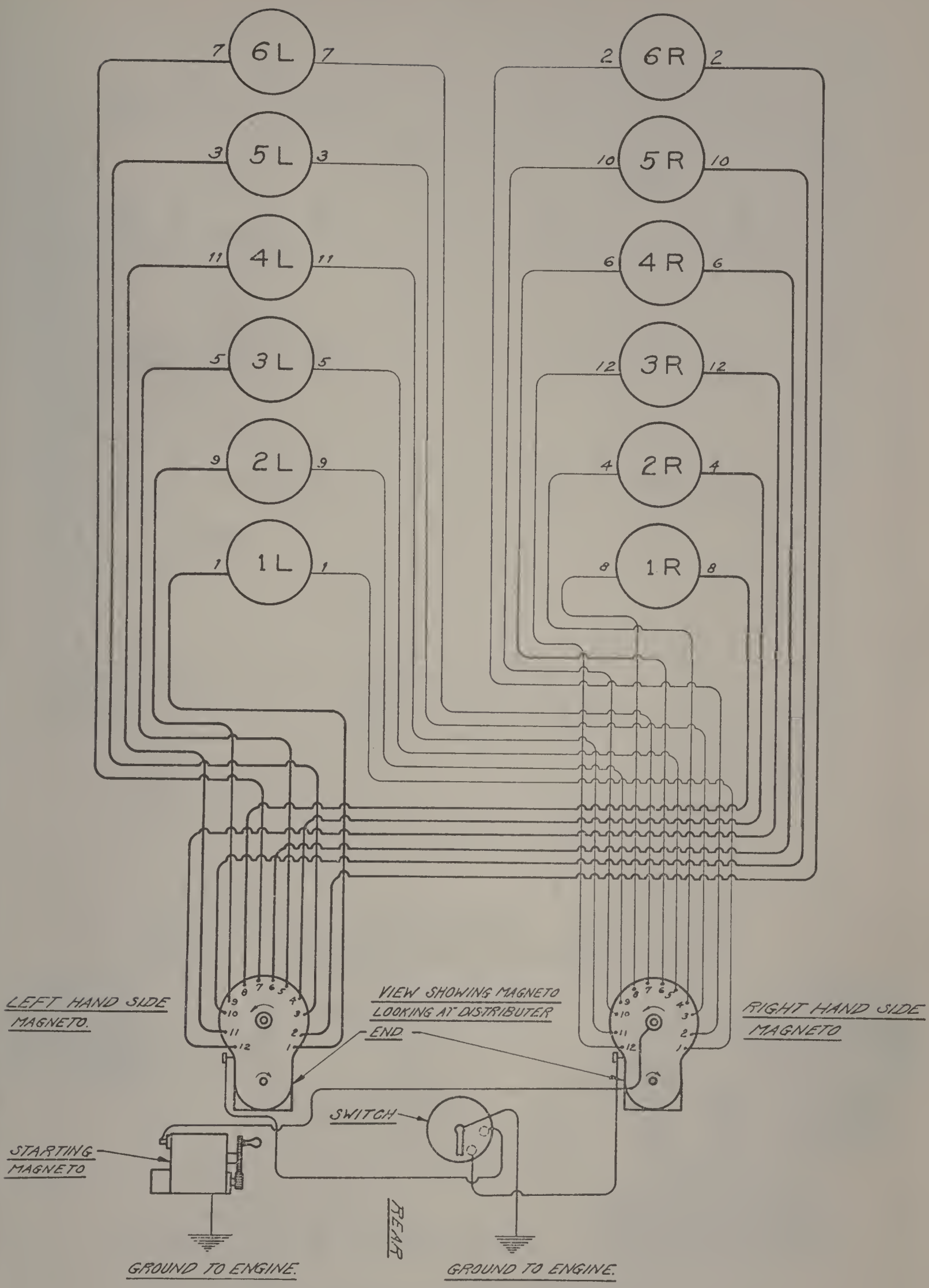
Model T-2 Engine



Clearance Drawing

HAND STARTER

Model T-3 Engine



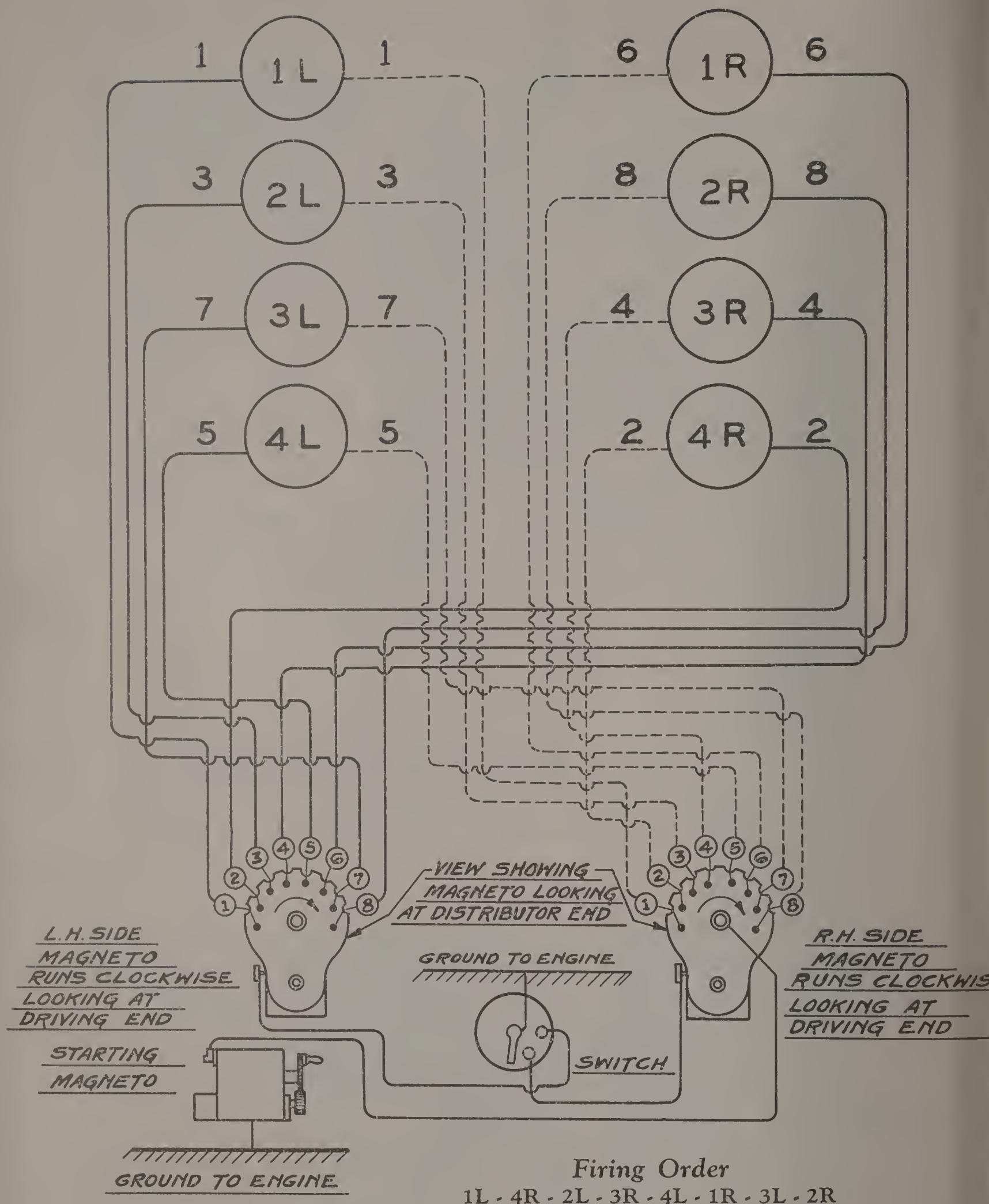
Firing Order

1L - 6R - 5L - 2R - 3L - 4R - 6L - 1R - 2L - 5R - 4L - 3R

WIRING DIAGRAM

WRIGHT

Models T-2 & T-3 Engines



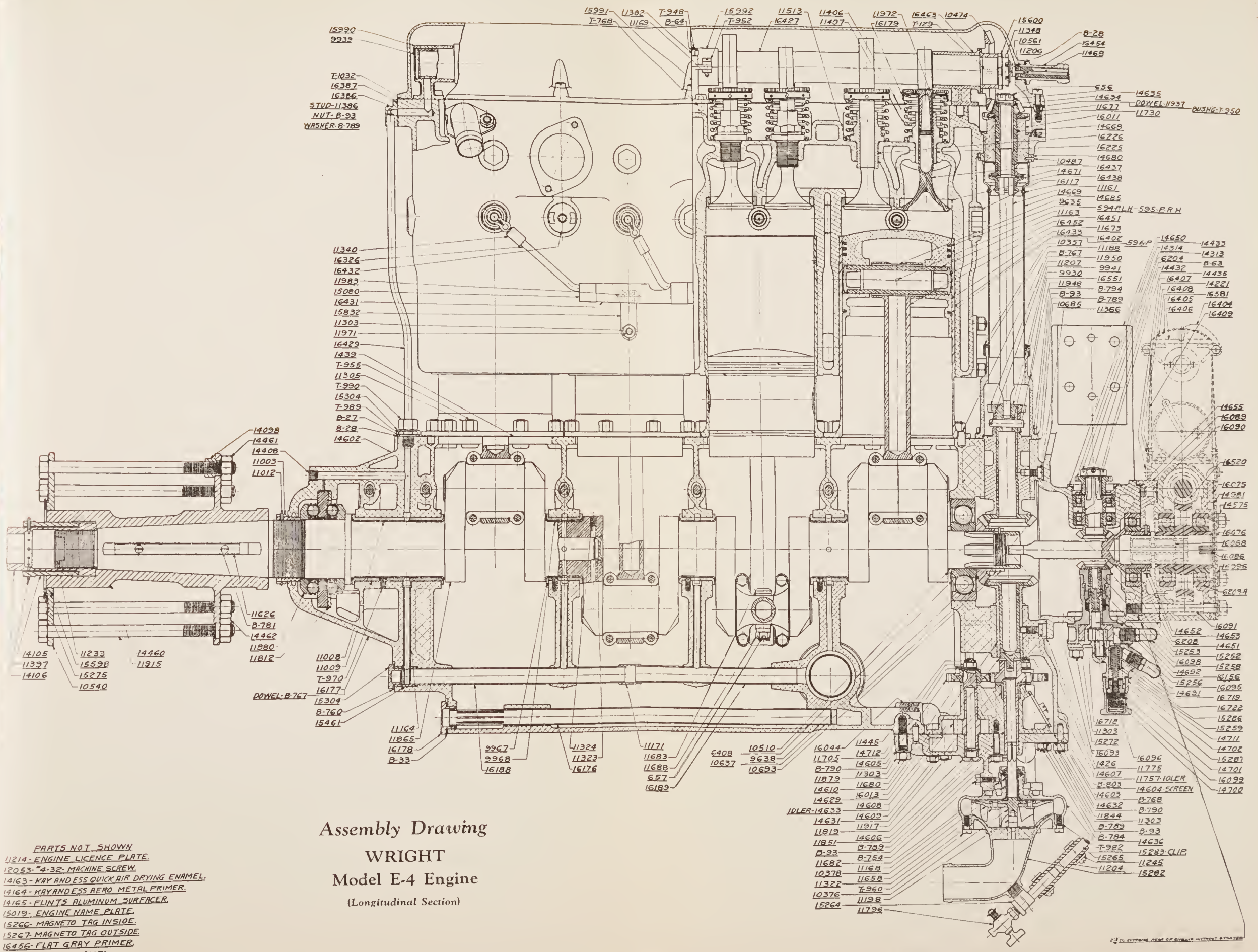
Firing Order

1L - 4R - 2L - 3R - 4L - 1R - 3L - 2R

WIRING DIAGRAM
WRIGHT
Models E-3 & E-4 Engines

Model E-4 Assembly

(*Longitudinal Section*)



Assembly Drawing

WRIGHT

Model E-4 Engine

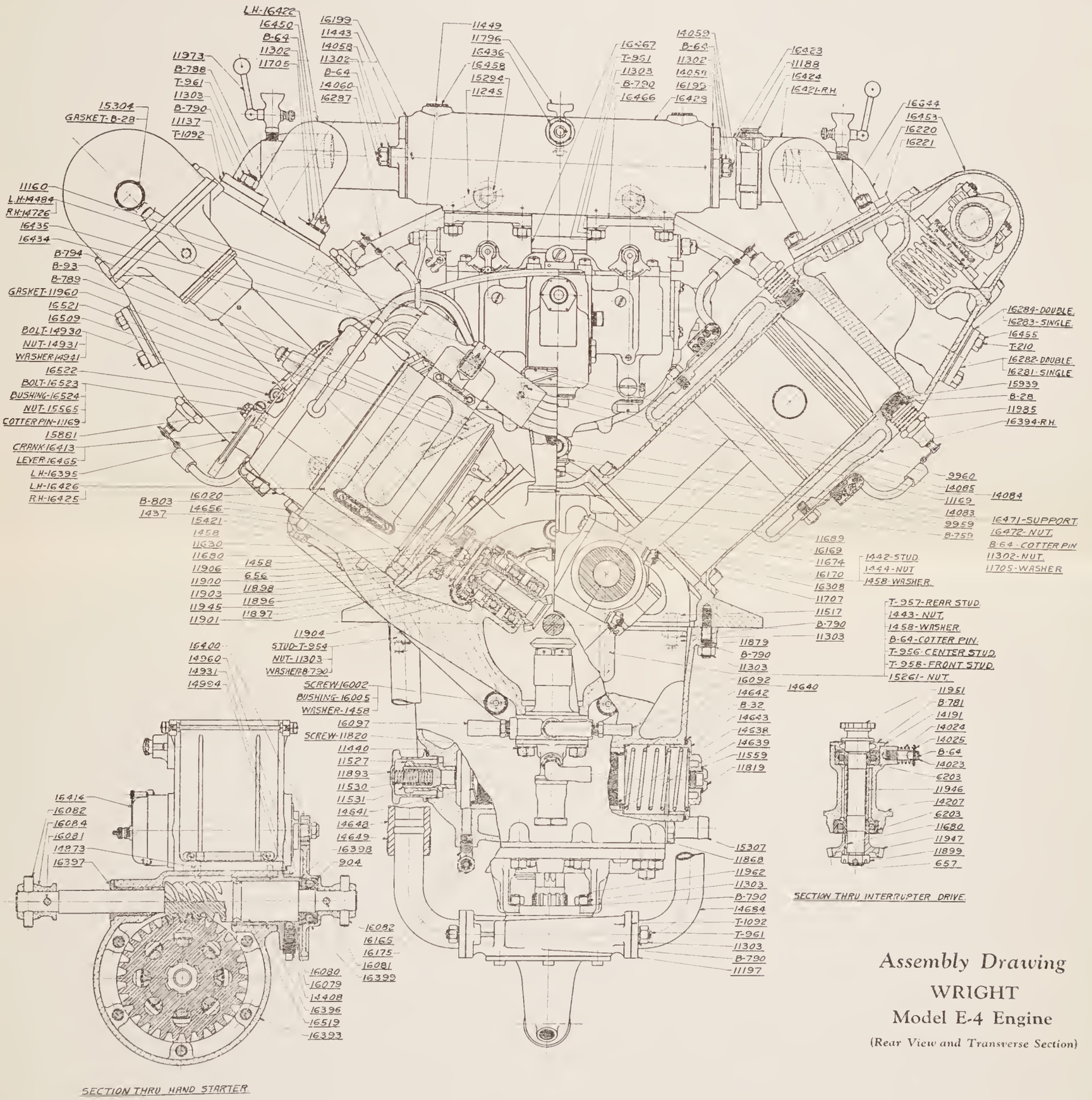
(Longitudinal Section)

PARTS NOT SHOWN

11214 - ENGINE LICENCE PLATE.
12053 - #4-32 - MACHINE SCREW.
14163 - KAY AND ESS QUICK AIR DRYING ENAMEL.
14164 - KAY AND ESS AERO METAL PRIMER.
14165 - FLINTS ALUMINUM SURFACER.
15019 - ENGINE NAME PLATE.
15266 - MAGNETO TAG INSIDE.
15267 - MAGNETO TAG OUTSIDE.
16456 - FLAT GRAY PRIMER.
16457 - GRAY ENAMEL.

Model E-4 Assembly

(Rear View and Transverse Section

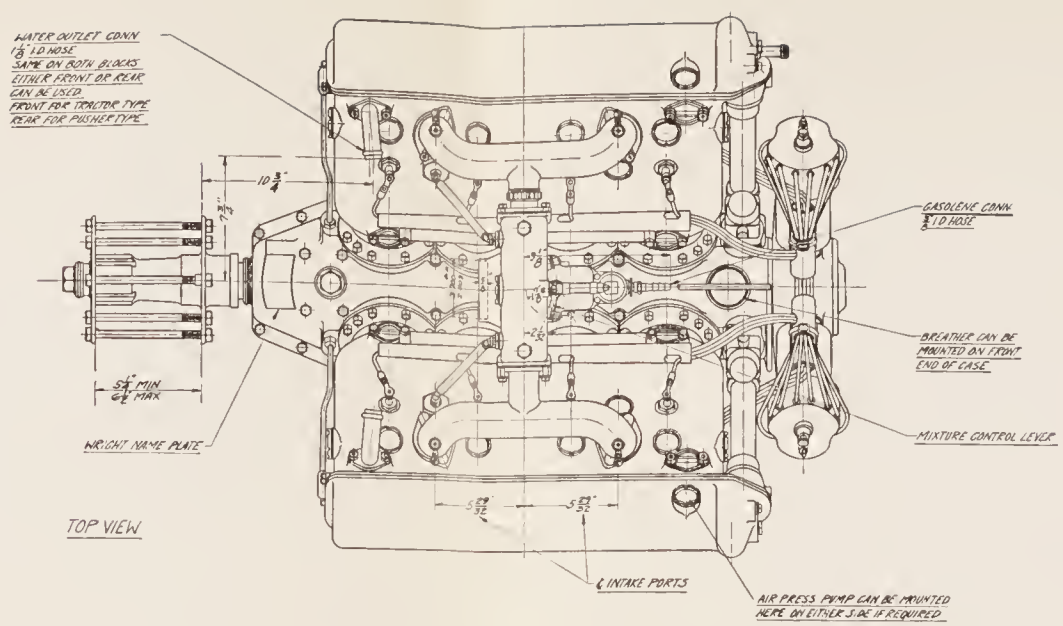


Assembly Drawing

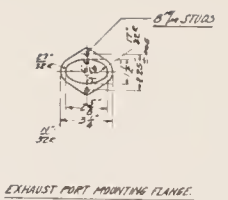
WRIGHT

Model E-4 Engine

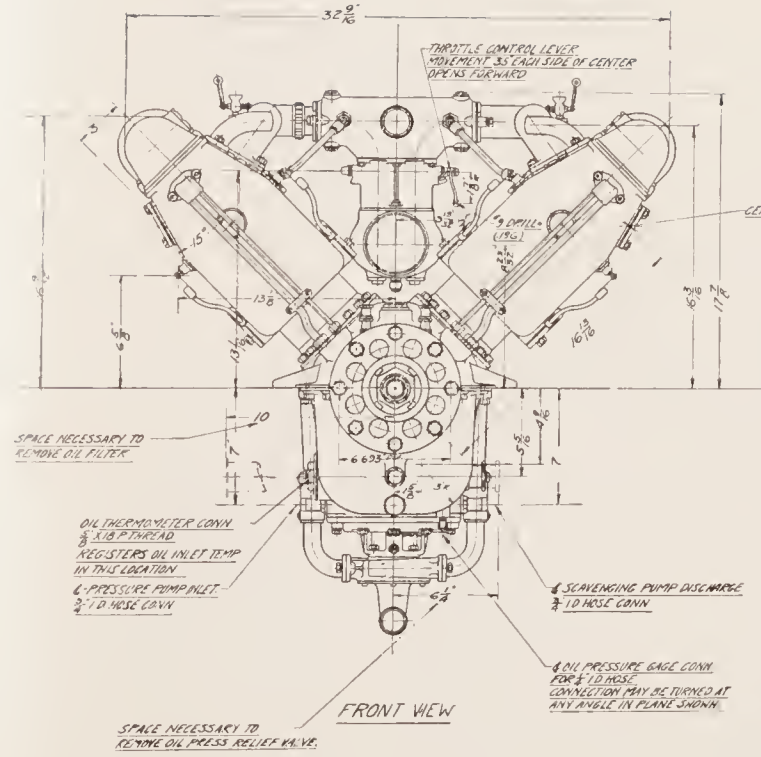
(Rear View and Transverse Section)



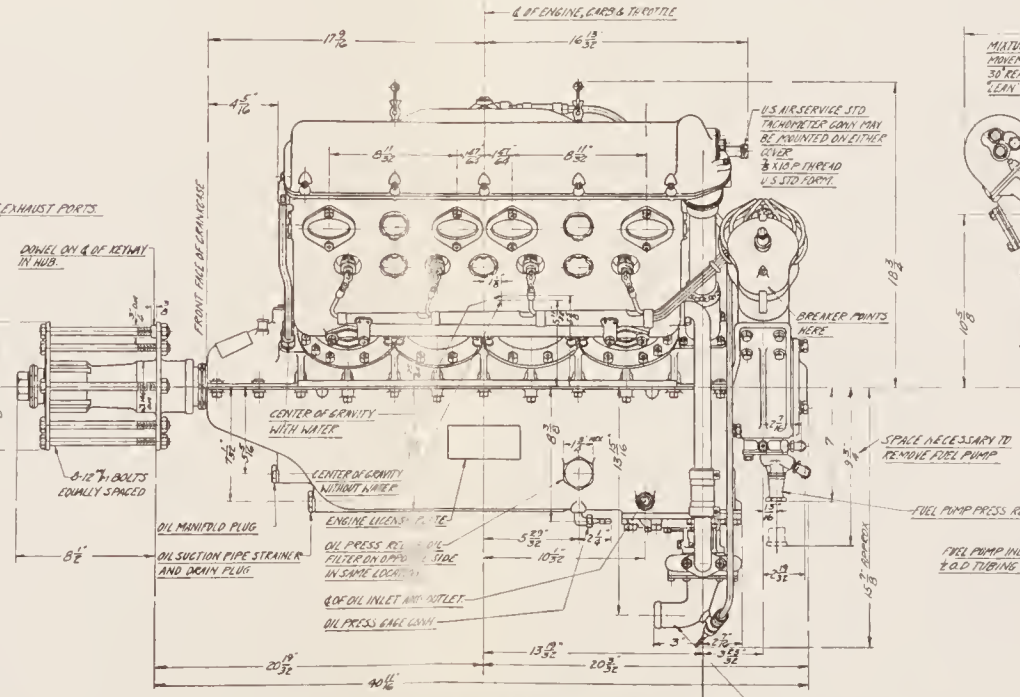
TOP VIEW



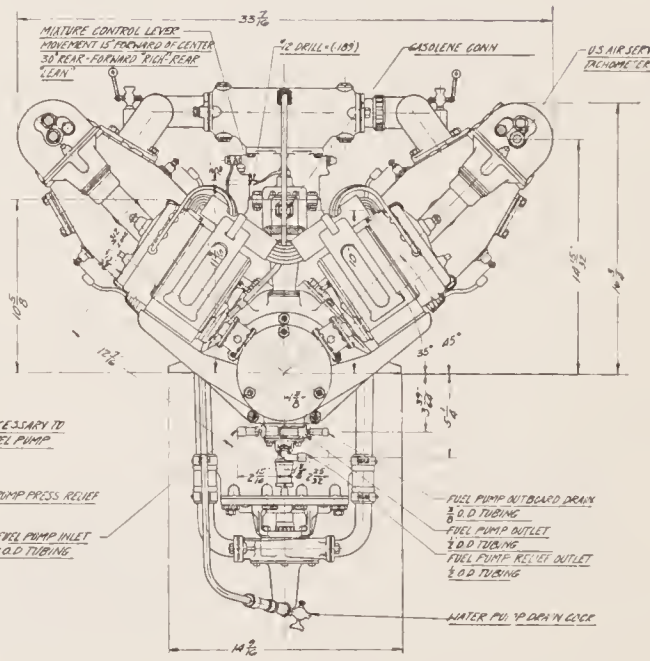
EXHAUST PORT MOUNTING FLANGE.



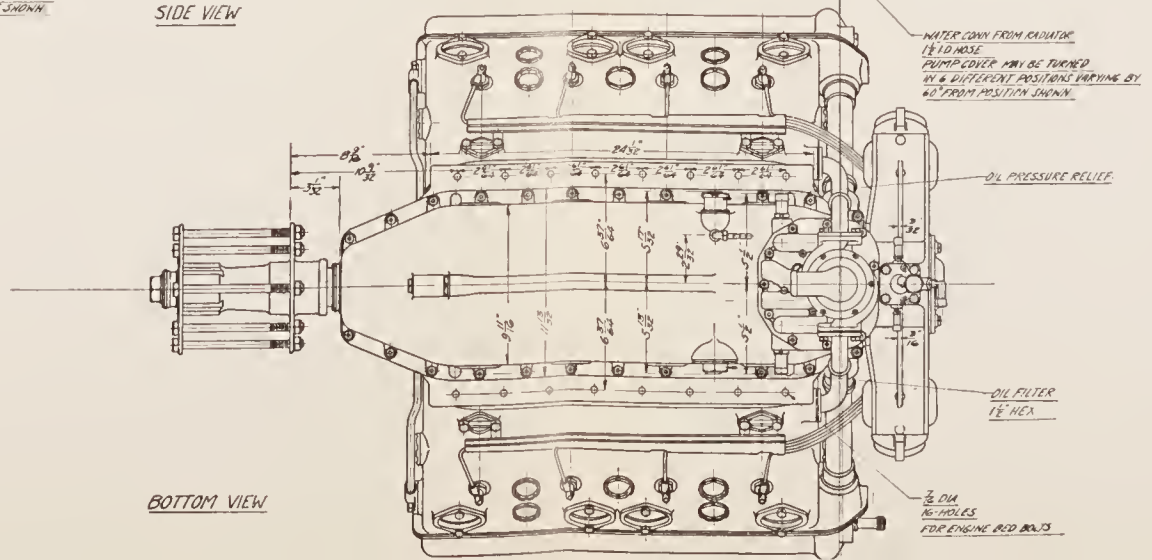
FRONT VIEW



SIDE VIEW



REAR VIEW



BOTTOM VIEW

TYPE OF FUEL PUMP CONNECTION

Installation Drawing

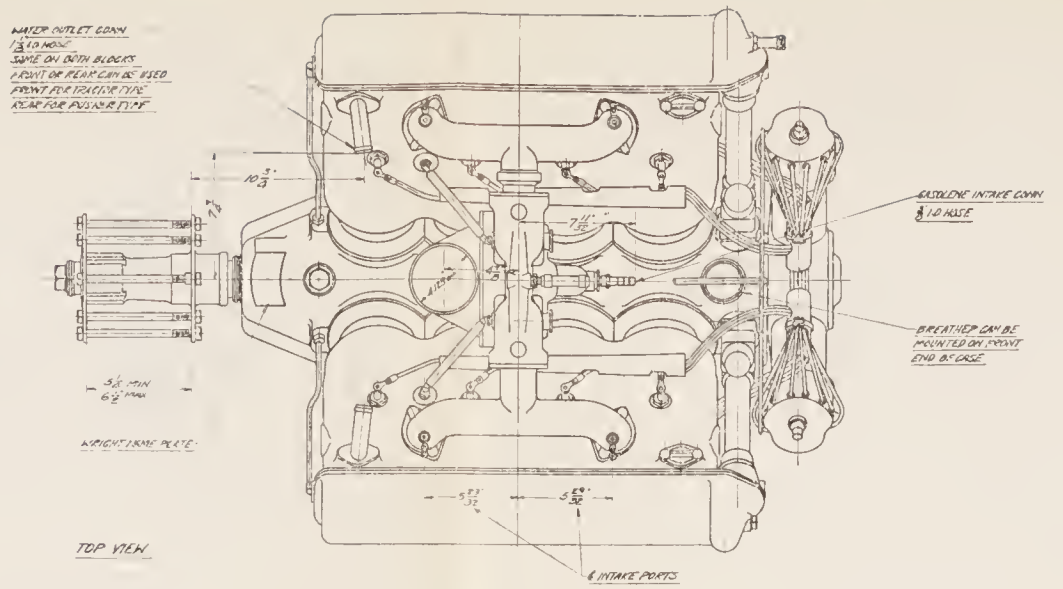
WRIGHT

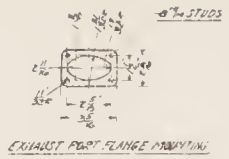
Model E-3 Engine

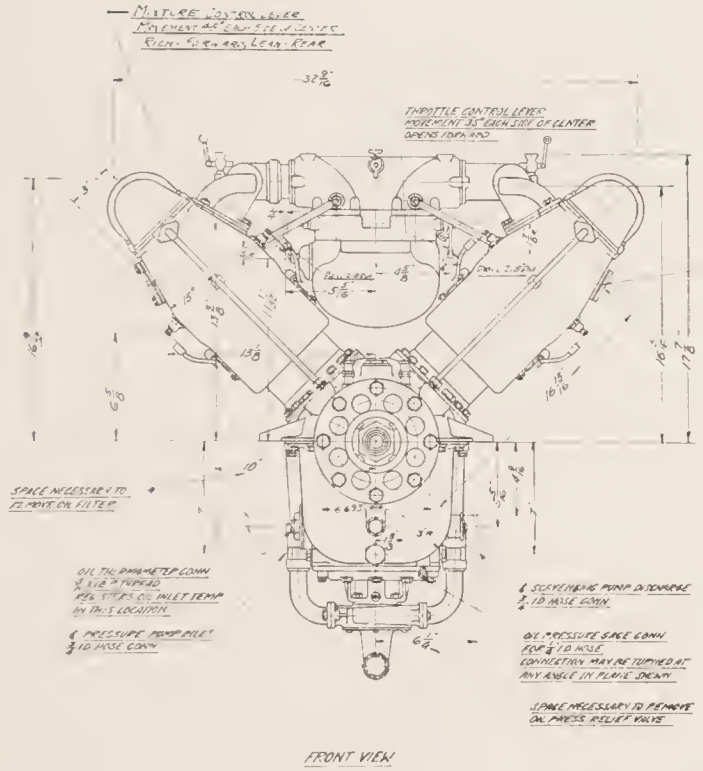
Installation Drawing

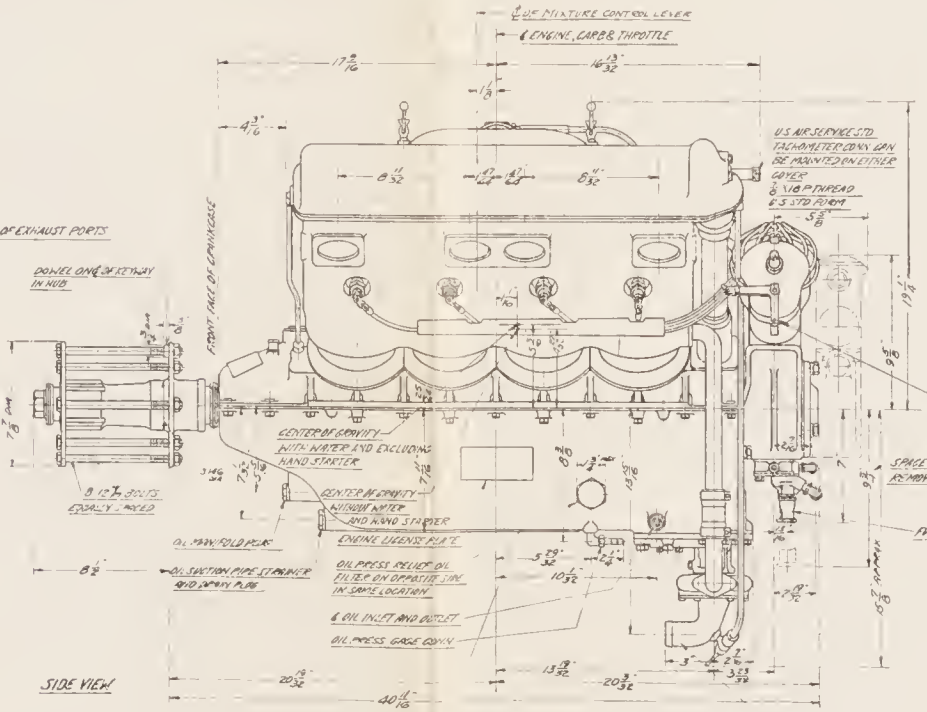
WRIGHT

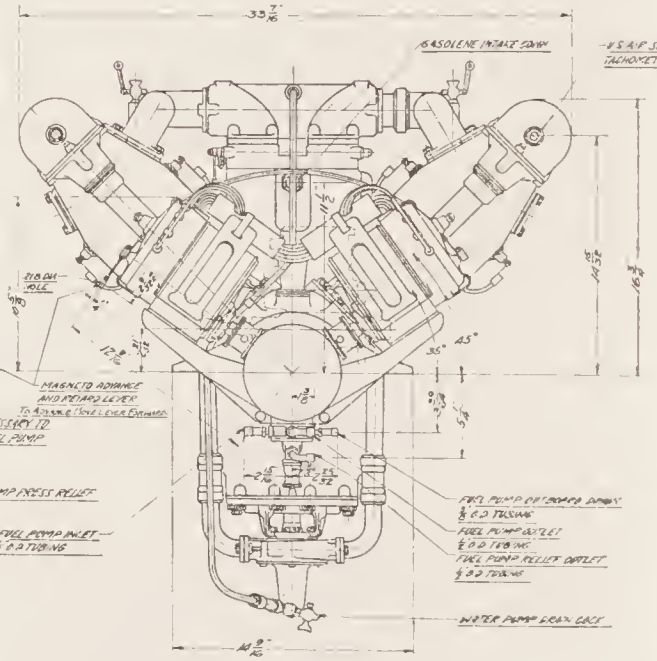
Model E-4 Engine

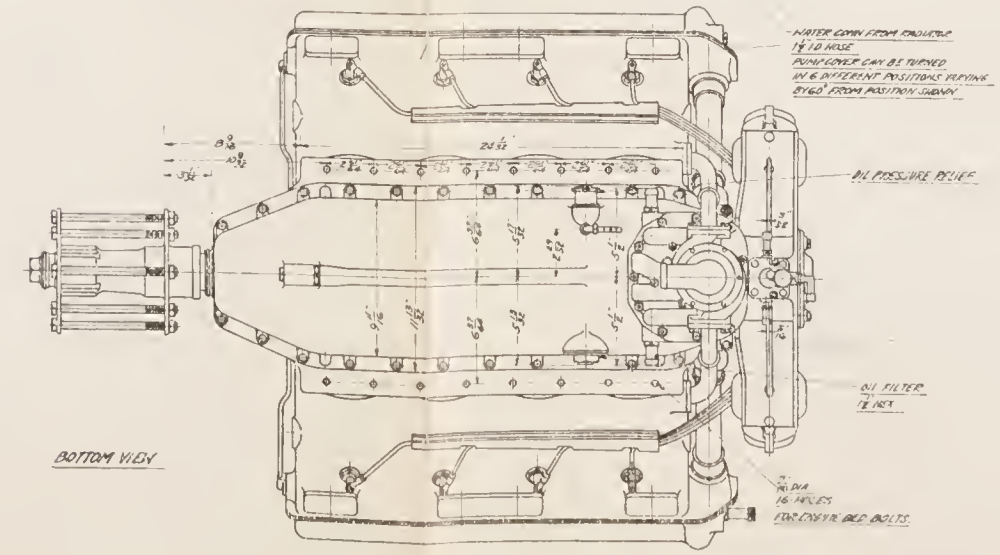


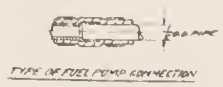






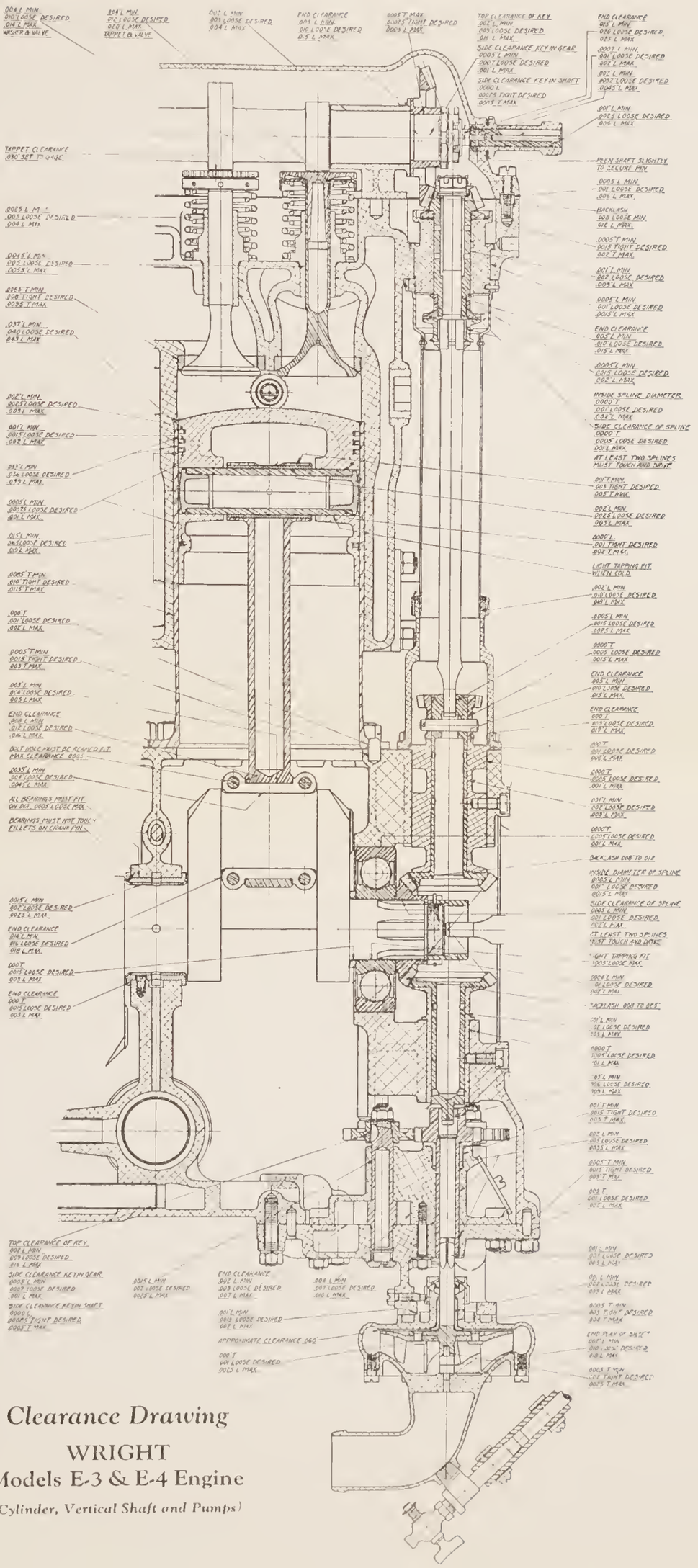






Model E-3 & E-4 Clearances

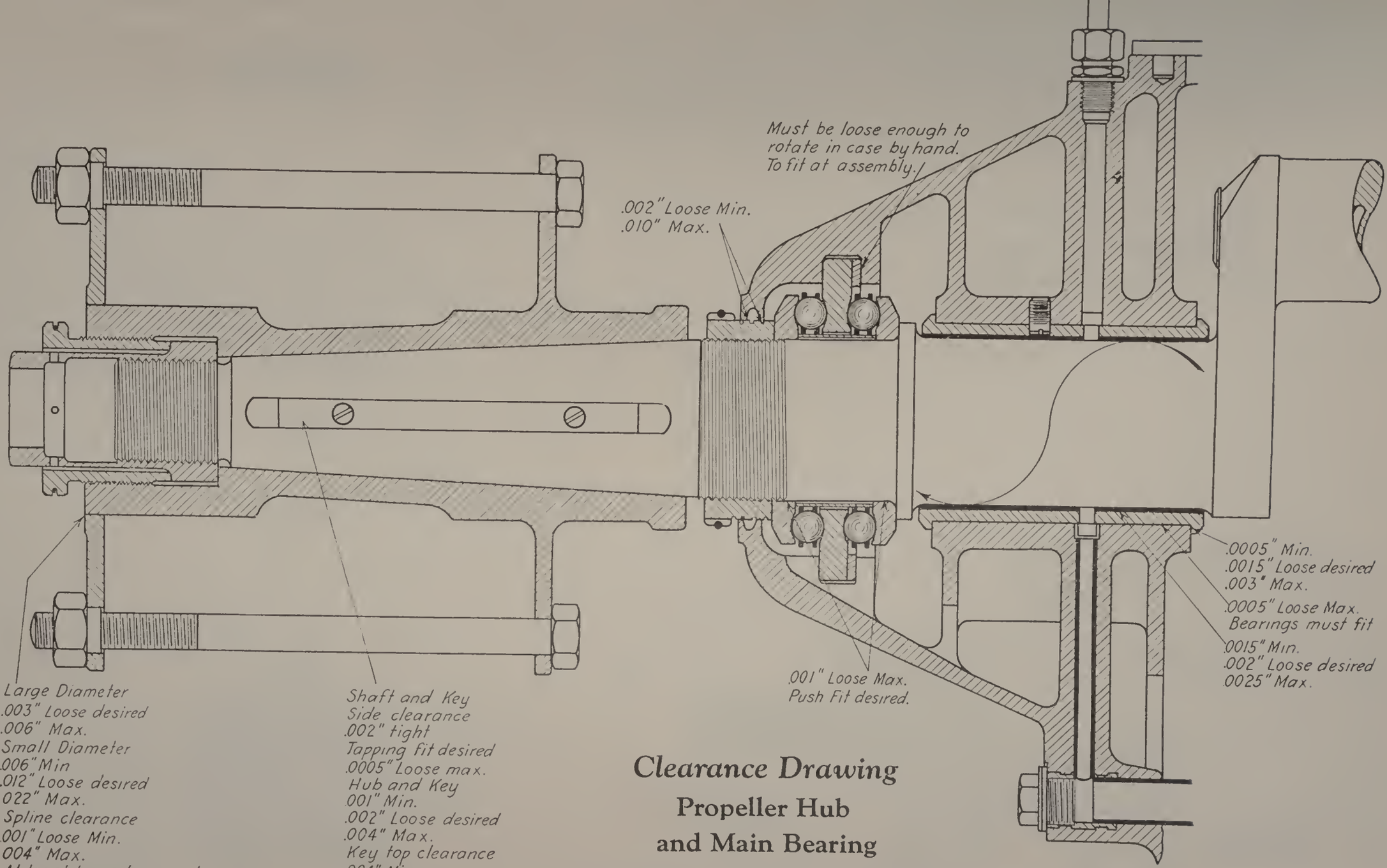
(Cylinder, Vertical Shaft and Pumps)



Clearance Drawing

WRIGHT
Models E-3 & E-4 Engine

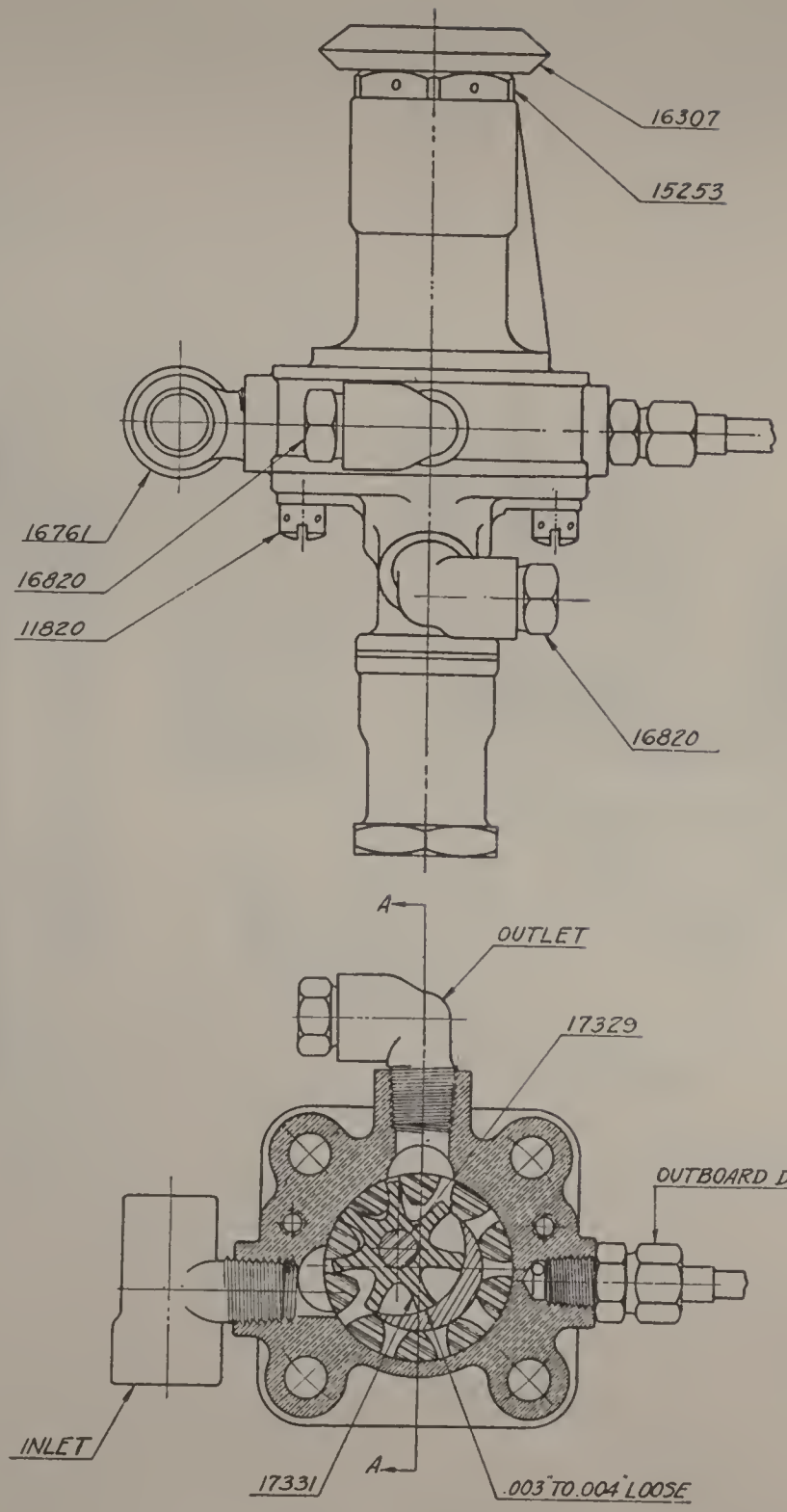
(Cylinder, Vertical Shaft and Pumps)



Clearance Drawing

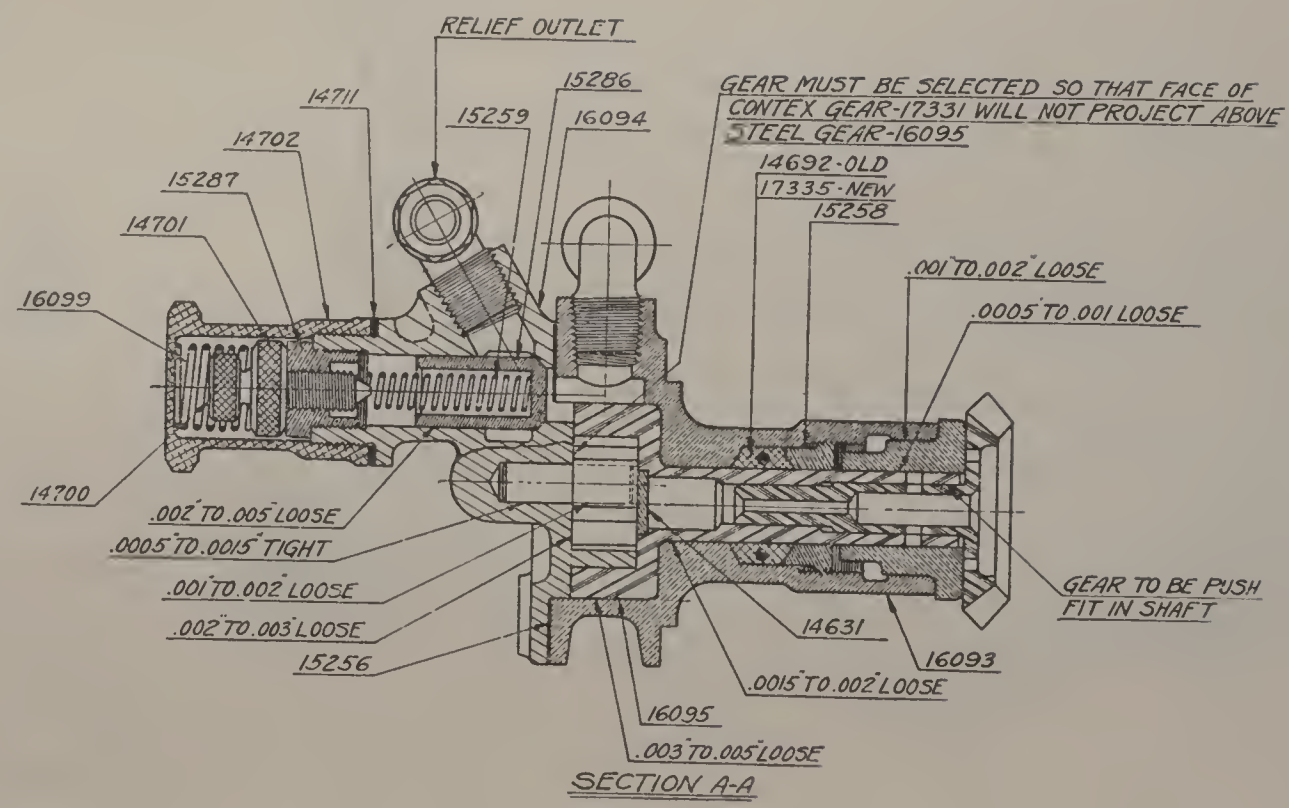
Propeller Hub and Main Bearing

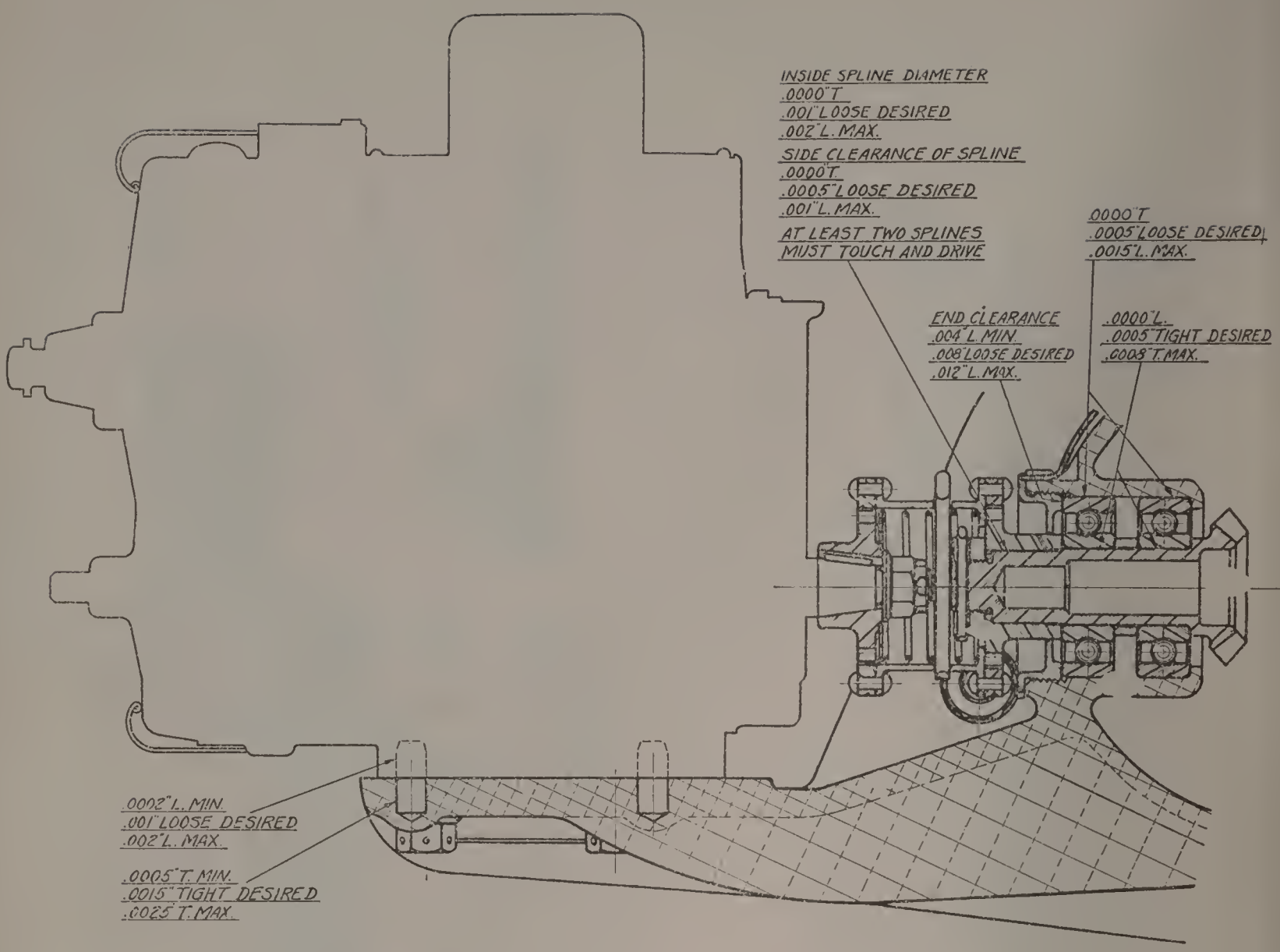
Models E-3 and E-4 Engines

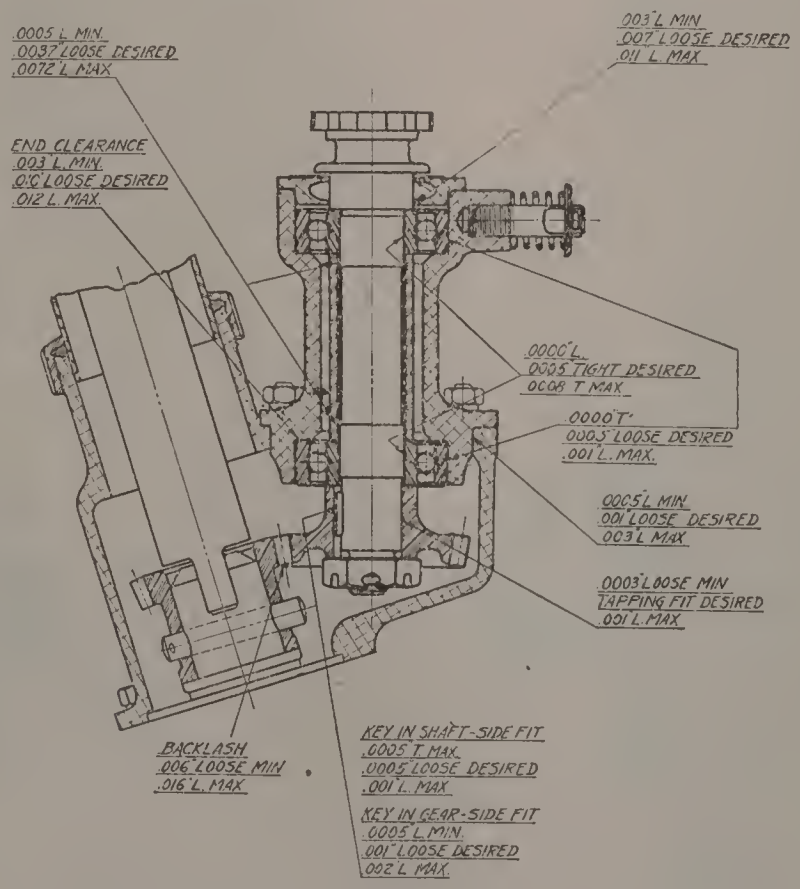


Assembly Drawing

Showing Clearances
Wright-Viking Fuel Pump







Clearance Drawings

Magneto Support and Coupling and Synchronizer Gear