AIR CONTROLLED

Aero-matic

AUTOMATIC PROPELLER

Model F-200

Automatic Variable-Pitch Propeller

Service Manual

UNIVERSAL AIRCRAFT INDUSTRIES

FIELD, OFFICES AND WAREHOUSES: SKY RANCH AIRPORT

POST OFFICE BOX 5306 Telephone: EMpire 6-1591 DENVER 17, COLORADO

UNIVAIR

PRICE: $2.50

SECTION I
INTRODUCTION

1. GENERAL.

a. This Handbook contains descriptive data and instructions covering the installation, operation, inspection, maintenance, overhaul, and parts replacement of the Aeromatic variable-pitch propeller, hub Model F200, manufactured by the *Universal Aircraft Industries, Aeromatic Propeller Dept., Denver, Colorado.*

b. The propeller is designed, assembled, and tested for power plants with standard flange mounting shafts.

2. DEFINITIONS.

The "Front" of the propeller is to be understood as the surface toward the front of the airplane when installed. The "Rear" is the portion toward the aft of the airplane when installed.

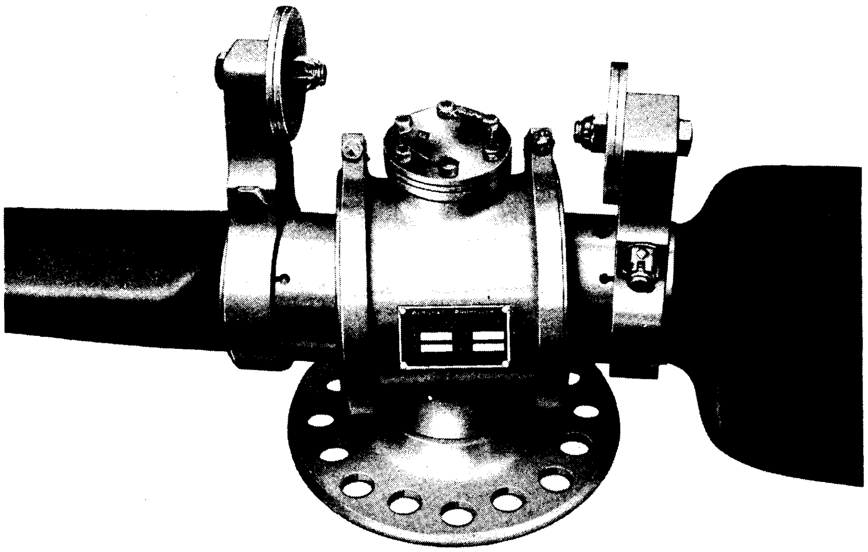


Figure 2. Three-Quarters Front View of Propeller Model F200

SECTION II
DESCRIPTION

1. GENERAL DESCRIPTION.

a. The Aeromatic propeller functions automatically in changing the pitch angle of the blades, thus enabling the desired horsepower of the engine to be maintained under various flight conditions such as take-off, climb, dive, and level flight cruising.

b. Engine manifold pressures are controlled by throttle settings for which the automatic action of the propeller maintains the corresponding rpm to their specified values for each particular flight condition up to the critical cruising pressure altitude.

2. DETAILED DESCRIPTION.

(See figure 1.)

a. HUB.—The hub of the propeller Model F200 is provided with two oppositely placed symmetrical blade barrel bores and a hub flange having SAE standard dimensions to fit flange engine shafts.

b. BLADE FLANGES.—Two similar blade flanges are designed to fit into blade bores number one and number two, respectively, to hold and rotate with the blades at a fixed angle from the blade pivot axis. Both flanges have a stud extending from the inner face, to which the synchronizer arms are attached.

c. FLANGE SEAL PLATES.—The open inner ends of the blade flanges are sealed against hub lubricant leakage by flat seal plates fitted against synthetic rubber sealing rings from inside the flange bores and locked in place with snap rings.

d. SYNCHRONIZER.—Two connecting links are fastened on the end of each of the flange studs. The other ends of both links are fastened to a single piston on one wrist pin. The wrist pin is free floating with plugs in each end. The piston is held in the cylinder by an end plate secured by 6 screws. Shims are placed between the cylinder and plate to vary the low pitch angle.

e. BLADE STOPS.—The low pitch stop can be varied by changing the thickness of shims placed between the synchronizer cylinder flange and the end cover plate. Approximately .030″ shim will change low pitch 1°. No changes can be made in high pitch. Ample range has been provided to cover all flight conditions.

f. PRELOAD BEARING AND PRELOAD PARTS.—Radial ball bearings are mounted on an adjustable sleeve, located in the web at the center of the hub. Adjustments are made by lengthening the preload assembly by means of special tools which are applied through the end of blade flange after it is assembled in the hub.

g. THRUST BEARINGS.—Large thrust bearings, which carry the centrifugal load of the blade assemblies, are fitted into the hub barrel bores and against the outer bearing shoulder of the flanges.

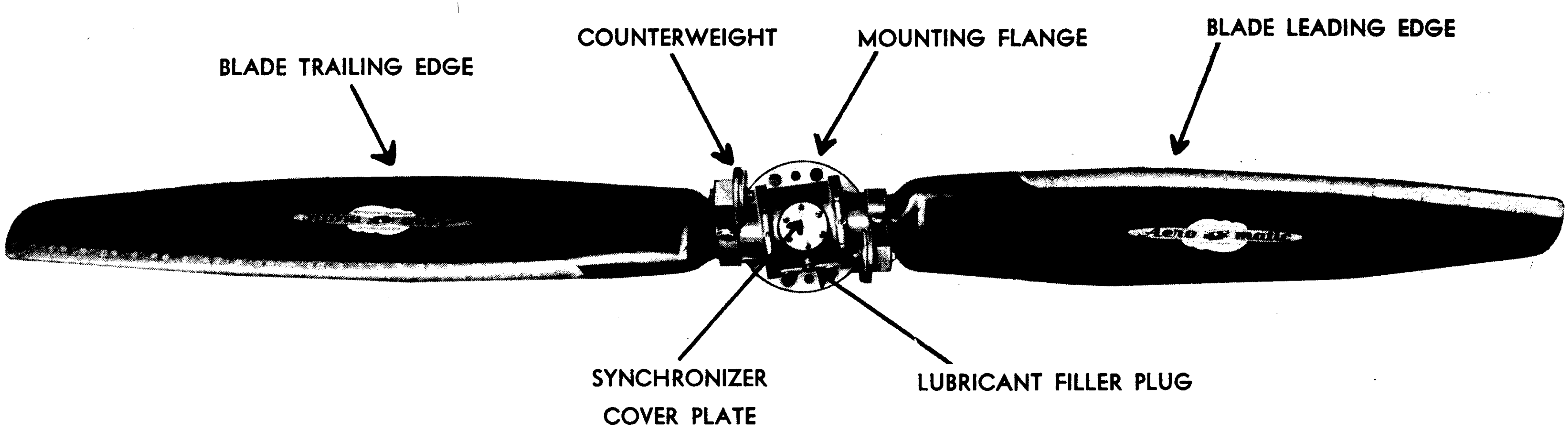


Figure 3. Front View of Complete F200 Propeller

b. THRUST BEARING RETAINER PLATES AND SEALS.—The thrust bearings are held in place by circular inner-recessed retainer plates which are secured at their periphery in the hub bores with heavy Truarc snap rings. Lubricant seal rings are placed around the outer circumference of the thrust bearings and each retainer plate carries one lubricant seal packing to seal off any escape of lubricant around the blade flanges. Laminated shims are fitted between the packing and thrust bearing to allow for adjustment of the packing compression and to effect the desired seal without undue increase in friction between the flange and the packing seal.

i. BLADES.—The propeller blades have metal shanks which are threaded to screw into the blade flanges. The blades are restricted against unscrewing by the counterweight arm clamped tightly around the slotted outer ends of the flanges.

j. COUNTERWEIGHT ARMS.—The outer ends of the counterweight arms extend toward the front of the propeller from the blade and carry a series of different sized weights which may be varied by adding or removing flat discs held in place with bolts and castellated nuts. Bolts and castellated nuts are also used to clamp the counterweight arms around the blade flanges. Round snap rings are placed between the counterweight arm and the blade flange rim to hold the arm in position.

k. BALANCE WEIGHTS.—Final static balance is obtained for the entire propeller assembly by balancing weight lugs which are banded around the outer ends of the hub barrels and fastened with bolts and nuts. Balance corrections may be made by adjusting the position of the weights and by adding or removing small lead balance washers which are fitted on the bolts inside the counterbores of the weight lugs and held in position with springs.

l. ASSEMBLY PISTON.—For setting blade angles and counterweight arm angles, a solid piston with integral flange is substituted for the free-moving piston and end plate. The synchronizer links are attached to the solid piston, thus holding blade flanges from rotating while blades and counterweight arm angles are being set.

m. ATTACHING PARTS.—The F200 is attached to the engine shaft flange by means of special heat treated bolts with heads drilled for safety wire. A special spacer is provided to fit under the bolt head.

n. BLADE CONSTRUCTION. — The center of gravity and center of pressure positions are made uniform in all Aeromatic blades of the same model in order to provide the necessary interchangeability in service. This uniformity in blades is maintained by the use of thin wood laminations splayed at alternate angles, then adhered with a thermal setting resin under uniform heat and pressure. The blades are aeroloid plastic covered to make them resistant to moisture absorption and abrasion.

SECTION III
INSTALLATION

1. UNPACKING.

a. ATTACHING PARTS AND TOOLS.

(1) The standard parts for attaching the propeller to the engine crankshaft will be found in a special compartment at the bottom of one end of the shipping box.

(2) Before discarding the shipping box, remove the attaching parts, also filler plug wrench.

2. INSTALLING.

a. ATTACHING.

(1) Clean flange surface of both crankshaft and propeller, also the pilot on the shaft. Apply attaching bolts and spacer as specified for the particular installation.

(2) On 4-cylinder engines make sure propeller is installed in proper position on the flange to allow easy starting of engine by hand cranking.

b. SECURING.

(1) Safety the attaching bolts through the holes provided in the screw head.

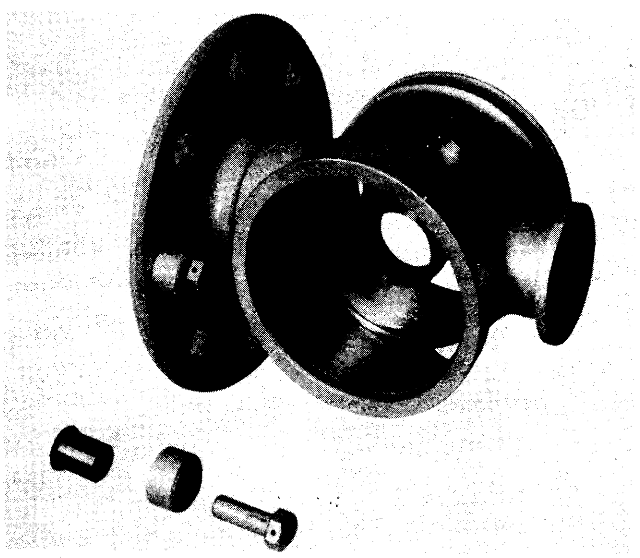


Figure 4. F200 Hub and Attaching Parts

(2) Safety in pairs or not more than groups of three.

c. STORING.

(1) Before storing the propeller fill the hub completely with lubricant. Replace filler plug.

(2) Coat all exposed metal parts with exterior surface-corrosion preventive.

SECTION IV

OPERATION

1. PRINCIPLES OF OPERATION.

a. GENERAL.

(1) The Aeromatic propeller utilizes the natural forces acting on the blade and counterweight arms to accomplish automatically the desired change in pitch for varying conditions of flight.

(2) The automatic operation represents a continuous state of balance between the pitch changing tendencies of the aerodynamic force components of thrust and torque, the blade centrifugal and the counterweight centrifugal forces, all acting on the blade.

b. DESIGN.

(1) BLADE AND FLANGE. *(See figure 5.)*

(a) The flange of the propeller is designed to hold the blade at a fixed angle from the blade pivot axis, about which the blade is allowed to turn to change its pitch. The flange is so arranged in the hub that the blade describes an arc of a cone, forward of the plane of rotation toward low pitch, or describes an arc of a cone rearward of the plane of rotation toward high pitch, or any intermediate position. The range of pivoting or the range of blade angle is governed by predetermined low and high pitch stops.

(b) With the blade free to pivot, the thrust force acting on the center of pressure of the blade tends to turn the blade forward to the low pitch position.

(c) The torque force acting on the blade tends to keep the center of pressure of the blade in the plane of rotation, but its effect is relatively small.

(d) The centrifugal force acting on the blade has the following effects:

1. The centrifugal torsion force tends to flatten or reduce the pitch of the blade in all forward and rearward positions with respect to plane of rotation.

2. The centrifugal displacement force tends to increase the blade pitch when the blade is forward of the plane of rotation, and to reduce the blade pitch when it is rearward of the plane of rotation.

(2) COUNTERWEIGHT ARM. *(See figure 7.)*

(a) The protruding counterweight arm and weight are oriented and set in front of the plane of rotation at a fixed angle with respect to the blade.

(b) The centrifugal force acting on the weight tends to move the counterweight toward the plane of rotation, which in turn causes the blade to come to higher pitch.

(c) The net centrifugal force acting on the blade and the counterweight tends to increase the blade pitch.

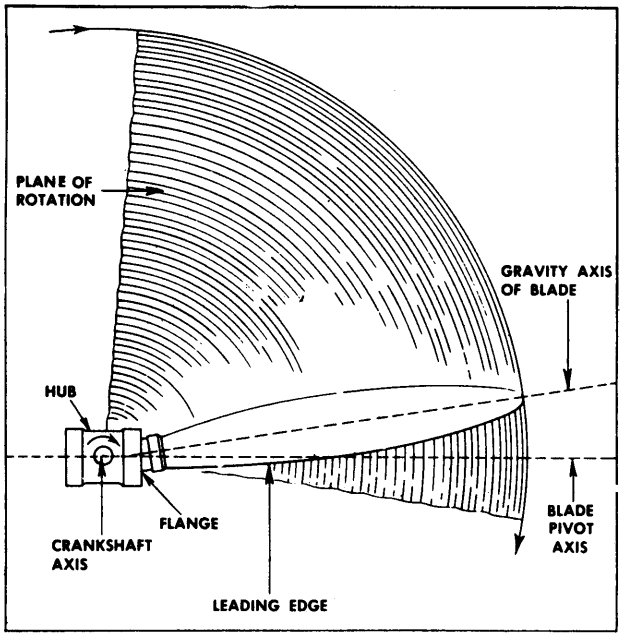


Figure 5. Rear View of Hub and Blade Showing Blade Lag Angle

c. OPERATION IN FLIGHT.

(1) The stability of the Aeromatic propeller is obtained by balancing the pitch decreasing effect of the aerodynamic force with the pitch increasing effect of the net centrifugal force acting on the masses of the blade and counterweight.

(2) At take-off, the pitch decreasing forces are greatest and will, therefore, move the blade forward to low pitch to permit the engine to develop full take-off power.

(3) During the climb, maximum power is made available due to the fact that the blade pitch increases as the velocity of the airplane increases.

(4) By maintaining given cruising rpm, constant horsepower of the engine is available at altitude up to cruise critical (open throttle) altitude.

d. INSTALLATION.—The Aeromatic propeller is a self-contained unit requiring no controls from the propeller to the cockpit. The propeller is mounted on the engine crankshaft in the conventional fashion using standard attaching parts for standard mountings.

2. OPERATION INSTRUCTIONS.

a. GENERAL.

(1) The Aeromatic propeller tends to govern the rpm of the engine, with relatively small variations, at a fixed power setting, through a wide range of air speeds and attitudes of the airplane.

(2) The Aeromatic propeller load curve follows the calculated propeller load curve relationship as shown by the engine manufacturer's power specifications. The power, rpm and manifold pressure, therefore, will bear a fixed relationship to the throttle setting.

(3) There are no controls or instruments required for the operation of this propeller.

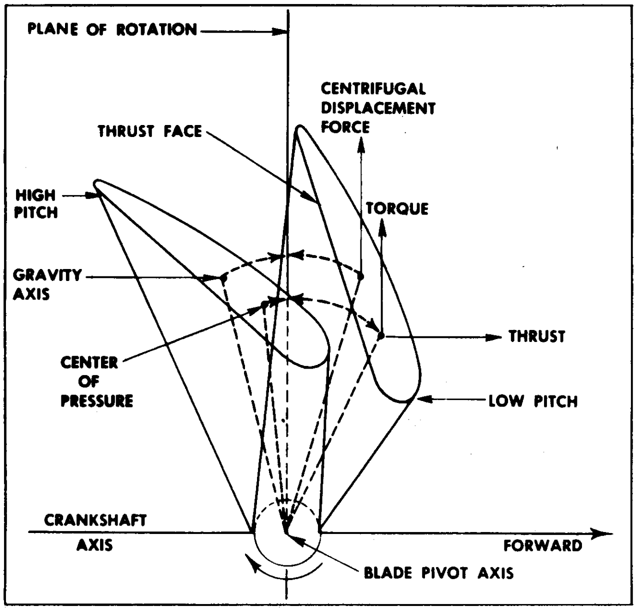


Figure 6. Tip View of Blade Through Center of Pressure Showing High and Low Pitch Positions

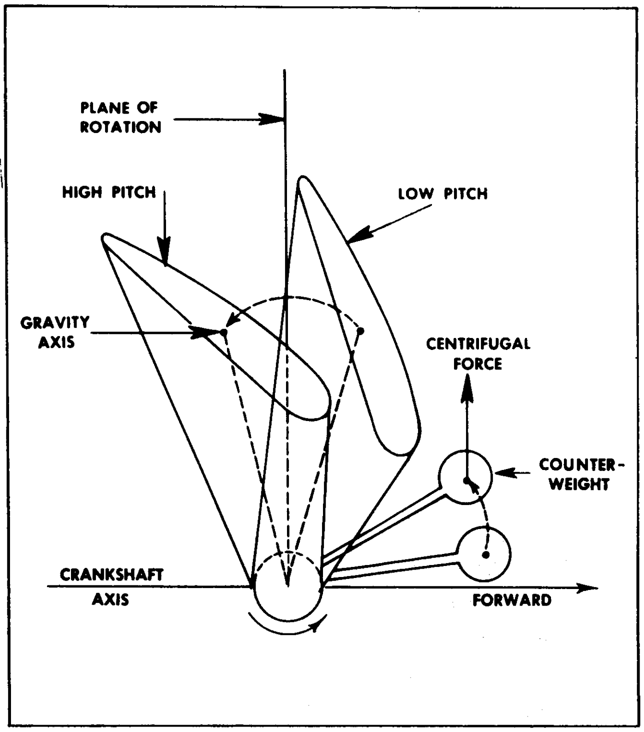


Figure 7. Tip View of Blade and Counterweight Assembly

b. STARTING.—No special procedure is required to start the engine other than that recommended by the engine manufacturer.

c. TAKE-OFF.—Full throttle will make available approximately rated take-off power. If the indicated power is less at static condition, it will become available before the end of the take-off run.

d. CLIMB.—During the climb, any power up to rated is available and can be maintained with altitude by increasing throttle to compensate for altitude horsepower loss. Generally speaking, maintaining a rated cruising rpm with altitude by this means will result in developing rated cruising horsepower up to cruise critical altitude with either a sea level or supercharged engine.

e. CRUISE.—Any altitude up to cruise critical can be selected and still have rated cruise power available by only adjusting the throttle to cruise rpm. Since the relationship between rpm and manifold pressure is fixed, and is a function of the normal power load curve of the engine, a proper relationship between fuel and air mixture is maintained at all times.

f. POWER GLIDE.—From any fixed power setting in level flight, the airplane can be put into a glide of any angle and still maintain and not exceed, within tolerances, the original fixed power condition.

g. STALL.—At full throttle the same power will be available at this low air speed condition as is available during take-off at a similar low air speed. At full throttle stall the rpm and manifold pressure will correspond to the available horsepower at the altitude at which the stall occurs.

h. LANDING APPROACH.—During the landing with idle throttle, propeller blades are approximately in the plane of rotation. In the event of over-shooting the landing, full throttle will instantly locate the propeller blades in low pitch making available the same horsepower as available on the initial take-off at the same air speed.

3. REGULATION.

a. GENERAL.

(1) Adjustment of the Aeromatic propeller for control of engine speed is termed "regulation." This regulation is accomplished as outlined below and not by change of the blade angle in the flange. The positioning of the blade in the flange has been accurately determined for each airplane-engine-propeller combination and should not be altered. A lock screw maintains this position by passing through the counterweight arm, flange, and blade ferrule in addition to the clamping action of the counterweight arm.

b. STATIC RPM.

(1) The ground (static) RPM of the engine is adjusted by the addition or removal of laminated shims between the synchronizer cylinder and cover plate.

(2) ADD SHIMS TO INCREASE RPM.
REMOVE SHIMS TO DECREASE RPM.

For instance, a shim .030" thick will change the RPM approximately 100 when added or removed. Correspondingly, thinner or thicker shims will cause proportionate speed changes.

c. FLIGHT RPM.

(1) The flight RPM of the engine is adjusted by the addition or removal of counterweight disc on the counterweight arm.

(2) ADD WEIGHTS TO DECREASE RPM.
REMOVE WEIGHTS TO INCREASE RPM.

For instance, addition of counterweight disc No. 2721-1 will cause a decrease of approximately 50 RPM, while addition of counterweight disc No. 2721-2 will effect a change of 100 RPM. Determination of flight RPM is conducted with full throttle at the level flight position.

Note

Always add or remove the same amount of weights from both counterweight arms.

CAUTION

The Aeromatic propeller is a precise and well-made mechanism and should be treated as such to insure long life and high performance. Its makers, in cooperation with aircraft manufacturers, have determined the correct adjustments to provide maximum performance. These adjustments must not be altered except for minor RPM changes which are outlined here. When these adjustments are necessary, follow instructions carefully. Remember:

Static RPM is adjusted by stop shims.
Flight RPM is adjusted by counterweights.

4. ADJUSTMENT FOR CONTINUED HIGH ALTITUDE AIRPORT OPERATION.

a. GENERAL.—In the event that an airplane equipped with an Aeromatic Propeller is to be operated from a high altitude airport, further RPM adjustment may be desired. As indicated above, the Aeromatic has been regulated to average flying conditions at low altitude airports. (Sea level to 2000 ft.)

b. LOW TO HIGH ALTITUDE.—If operations are changed to a high altitude airport (5000 ft.) marginal operations may result because of runway length or aircraft weight. This condition may be remedied by adjusting the Aeromatic if the cause is due to lack of rated RPM.

(1) ALTITUDE RPM DETERMINATION.—To determine RPM conditions at altitude, a full throttle level flight run may be conducted as close as practicable to the altitude of the airport. Using optimum lean mixture, the maximum RPM figure may be obtained. As an example, 2300 RPM may be obtained when the rated speed is 2500 RPM.

(2) To pick up the required 200 RPM, a counterweight may be removed from each arm as indicated on the list below.

To Pick Up	*Remove Counterweight*
100 RPM	No. 2721-2
200 RPM	No. 2721-2 and 3
300 RPM	No. 2721-2 and 4

Secure remaining counterweights and conduct another full throttle level flight RPM check. The resulting RPM may not reach maximum but will be correct in that it represents the normal altitude loss for an unsupercharged engine.

c. ADJUSTMENT FOR HIGH TO LOW AIRPORT OPERATION.—If operation is to be resumed at a lower altitude airport after the above adjustment for high altitude operation has been made, it is necessary to add the weights previously removed in order to prevent over-speeding of the engine. Do not allow engine RPM to exceed the manufacturer's rated RPM at lower altitudes.

SECTION V

SERVICE INSPECTION, MAINTENANCE AND LUBRICATION

1. SERVICE TOOLS REQUIRED.

(See figure 29.)

Part Number	*Nomenclature*	*Application*
2719	Fixed Stop	Fixing position of flanges for angle measurements.
4031	Protractor	Measuring blade angle and counterweight arm angle.
2626	Protractor Adapter	Used with protractor for measuring blade angles.
3290	Grease Gun	Filling hub with lubricant.
4077	Balance Arbor	Checking Static Balance.
	Machinist's Square	Checking blade track and edge alignment.
	Torque Wrench	Tightening counterweight clamp bolt nuts.
	Socket Wrench, 5/8", Hex.	Tightening counterweight arm bolts and nuts.
	Socket Wrench, 7/16", Hex.	Adjusting balancing weight assembly.
	Screw Driver	Installing counterweight arm safety screws.
	Pliers	Installing lock wires.

2. SERVICE INSPECTION.

a. DAILY.

(1) SAFETIES.—Check to see that all safety wires, cotter pins, nuts and screws are firmly in position.

(2) LUBRICANT LEAKS.—Look around the flanges, synchronizer piston and filler plug for extensive leaks. It is permissible for a small amount to leak out around the flanges due to changes of internal pressure caused by temperature changes while the propeller is on the ground.

(3) BLADES.

(a) Check to be certain that the blade flanges move freely from the high to low pitch stops.

(b) Wipe the blades clean with a soft rag and inspect carefully, particularly on the leading edges, for dents, cracks, or bad gravel marks. Examine the metal for splits, holes, or loose rivets.

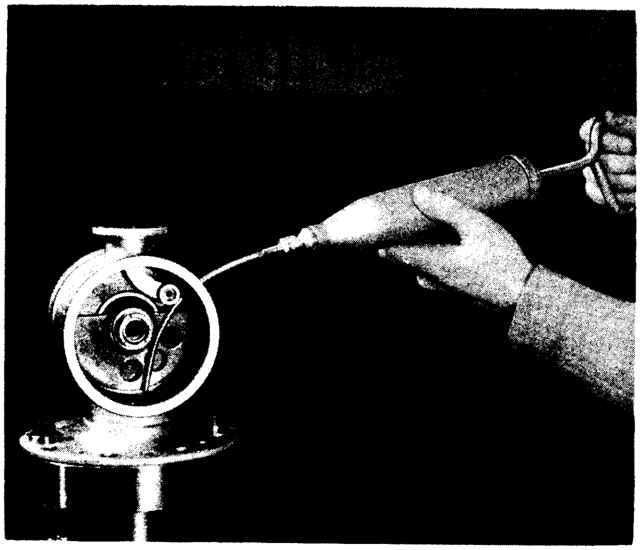


Figure 8. Method of Bottoming Grease Gun Tube Extension When Checking Lubricant

b. 25-HOUR LUBRICANT CHECK. *(See figure 8.)*—Place the propeller with the 1/8" filler plug up, use a grease gun with 3/16" o.d. tube extension about 6" long, insert tube to bottom of hub and pump until lubricant comes out filler hole around the inserted tube. By using this method, the air will escape through the filler hole when displaced by lubricant. When full, insert plug. This operation can be performed on the airplane.

3. MAINTENANCE.

a. REMOVING PROPELLER FROM ENGINE.—If, in removing the propeller from the engine flange shaft, the hub sticks to the flange, this trouble is remedied by using two attaching bolts and screwing them into the two tapped holes on the mounting flange. The bolts will serve to jack the flanges apart so that the propeller can be easily removed.

b. REPAIRING PLASTIC-COVERED BLADES.

(1) Small holes in the Aeroloid plastic covering (up to size of a dime) may be repaired with the Aeromatic plastic repair kit as follows:

(a) Use acetone to clean and soften around the damaged area.

(b) While the plastic is still soft from operation No. 1, use a knife or spatula to apply plastic paste. Press material firmly into hole and apply material until the paste extends about 1/16" above the surface to allow for shrinkage during drying. Allow to dry 24 hours.

(c) File off excess paste when dry. Smooth off with very fine sandpaper.

(d) To make a glossy finish, wipe once only with a soft cloth well saturated with acetone.

(2) Reasons for condemnation or rejection of blades from service are as follows:

(a) A comparatively long, wide, or deep cut in the plastic covering.

(b) An appreciable warp which would result in rough operation and which would be determined by inspection measurement on the propeller stand.

(c) An appreciable portion of the covering missing which could not be successfully replaced by suitable repairs.

(d) Obvious damage or wear beyond economical repair.

(3) If the metal leading edge is dented or split, back up the opposite side with a piece of metal and tap into place with a hammer. Fill any large dents or holes with solder, and scrape until the surface is smooth. Then rebalance propeller.

(a) Minor scratches or abrasions on the surface of the plastic covering in no way affect the operation or serviceability of the blade. If the plastic should be nicked or scratched, however, to a sufficient depth to expose base wood, the scratched portion should immediately be given two coats of any good clear nitrate dope, allowing one hour drying time between coats. A repair of this nature should be considered only temporary, and the blade should be returned to the service shop for complete repair as soon as possible, using the Aeromatic plastic repair kit.

(b) Rebalance the propeller assembly after repairs. If slightly out of balance, make balance weight corrections according to Section VII, paragraph 2b. If considerably out of balance, blades should be checked and adjusted for Center of Gravity position at the Aeromatic factory.

(c) REMOVING BLADES.—See Section VI, paragraphs 2. a. to f.

(d) REPLACEMENT BLADES.—See Section VI, paragraph 4. n.

c. OPERATIONAL.

(1) If the RPM of the propeller during flight varies excessively with increasing or decreasing air speed, or if the performance of the propeller should become otherwise irregular or erratic, remove it and send it to the repair station for overhaul.

(2) Should the propeller become immersed in salt water, send it to the overhaul station at once to be disassembled and cleaned in order to prevent corrosion.

(3) If lubricant leaks develop, the propeller must be sent for overhaul inspection and replacement of seals.

4. LUBRICATION.

a. 25 HOUR. *(See figure 8.)*

(1) To check lubricant, place the propeller in a horizontal position with the 1/8" filler plug up. Remove filler plug, insert extension of grease gun to bottom of hub barrel, fill hub until lubricant comes out filler hole around extension tube of grease gun. The clearance between filler tube and hole will allow displaced air to escape thereby insuring a completely filled hub with lubricant. Replace filler plug.

(2) Notice: Always use Aeromatic propeller lubricant 7-F. In an emergency, if the average temperature is above freezing, use SAE No. 30 oil; or if below freezing, use SAE No. 10. If SAE No. 10 or 30 oil is used in an emergency, it should be replaced with Aeromatic propeller lubricant 7-F as soon as possible as oil tends to soften the seals.

(3) The hub must be completely filled with lubricant whenever the propeller is put away for storage.

5. SERVICE TROUBLES AND REMEDIES.

Trouble	*Probable Cause*	*Remedy*
Lubrication Leaks	Defective seals	Disassemble and replace
	Insufficient pressure on seal	Add .005 shim
	Weak seal spring	Shorten or replace
Tight Flange	Defective thrust or radial bearing	Disassemble and replace bearings
Excessive Backlash in Synchronizer	Worn synchronizer shaft, bushing, or piston	Disassemble and replace worn parts
Loose Blade or Counterweight Arm	Counterweight nut clamp screw-loosened, or threads stripped	Check threads, replace bolt or nut; tighten nut with torque wrench and pin. (See Section VI, paragraph 4. j.)
Blades out of Track more than 1/8 inch between the two blades or either blade out more than 1/16 inch (See Section VII, paragraph 1. b.)	Defective blade; warpage	Replace blades
	Bent by outside force	Replace blades
	Improperly stored	Replace blades
Propeller out of Static Balance	Moisture effect on blades	Change balancing weights accordingly
Increased RPM	Counterweight weights too light	Add counterweight discs
Decreased RPM	Counterweight weights too heavy	Remove counterweight discs
Operation Sluggish or Erratic	Defective bearings.	Replace bearings
	Excess bearing preload.	Relieve bearing preload
	Lack of lubrication.	Replace bearings

SECTION VI

DISASSEMBLY, INSPECTION, REPAIR AND REASSEMBLY

1. OVERHAUL TOOLS REQUIRED.

(See figure 29.)

Tool No.	*Nomenclature*	*Application*
	Pliers	Installing lock wires.
	Socket Wrench, 5/8", Hex	Tightening counterweight arm bolts and nuts.
	Machinist's Square	Checking blade track and edge alignment.
	Torque Wrench	Tightening counterweight arm bolts and nuts.
2719	Assembly—Piston, Fixed Pitch	Fixing position of flanges for angle measurements.
3290	Grease Gun with 5/16" x 6" Extension	Filling hub with lubricant.
4031	Protractor	Measuring blade angles. Measuring Counterweight arm angles.
4073	Flange Seal Plate Assembly Tool	Compressing flange seal rings while assembling snap rings.
2626	Protractor Adapter	Used with protractor for measuring blade angles.
2871-7	Retainer Snap Ring Pliers	Removing and assembling retainer snap ring.
2871-5	Flange Seal Plate Snap Ring Pliers	Removing and assembling flange plate snap ring.
2825	Preloading Tool	Adjusting bearing preload pressure.
	Socket Wrench, 7/16", Hex	Adjusting balancing weight assemblies.
	Screw Driver	Installing counterweight arm safety screws.
	Allen Head Wrench, 3/16", Hex	Installing lubricant filler plug.
2913	Drill Bushing	Drilling counterweight lock screw holes in new blades.
4077	Balancing Arbor	Balancing complete propeller assembly on ways.
20011	Plastic Repair Kit	Repairing small holes and scratches on plastic covering.
2999-1	Aeromatic 7-F Lubricant	
	Propeller Table Flange Adapter	To fit customers' protractor table.

2. DISASSEMBLY.

Note

It is important to keep all disassembled parts from the respective blade bores (No. 1 and No. 2) separated so that the same parts will be reassembled in their original location.

a. PREPARATION.—Place the propeller on the flange adapter, which has been designed for your table. Secure flange by two diametrically opposite attaching bolts. Record all settings before disassembling the propeller.

CAUTION

In handling propellers, bear in mind that the blades are covered with moisture-proofing material. Extreme care should be exercised in handling them, especially when stored or moved in metal racks. Treat the blades as if they were highly-finished furniture. Seals, rings, shims, etc., should be handled carefully so that their functions will not be impaired for operating service. Keep the various parts of each propeller together as they have been individually assembled, tested, and adjusted.

b. MEASURING HIGH AND LOW PITCH STOPS.

(1) Turn blade number one to the high pitch stop, place the protractor at the datum station and measure and record this blade angle.

(2) Then turn the blade against the low pitch stop, and block it in this position by means of an adjustable jack or support blocks placed approximately at the one-half station. Read and record the low pitch blade angle accurately within one-tenth of a degree.

(3) Repeat the same readings and recordings of high and low pitch angles for blade number two.

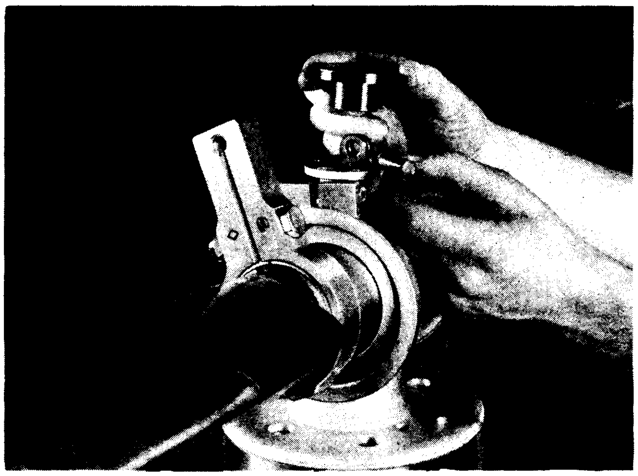


Figure 9. Attaching Assembly Piston

Note

The blade angle in this position is referred to as the blade phase angle, the value of which is specified on the instruction bulletin furnished with the propeller.

c. MEASURING PHASE ANGLE. *(See figure 10.)*—Read and record the blade angle at the datum station by placing a protractor with its measuring edge in exact line with the corresponding mark on the table. The datum station is indicated on the instruction tag. Place the adapter between the protractor blade arm and the propeller blade thrust face when measuring the phase angle. It is extremely important to measure and record the exact phase angle within one-tenth of a degree.

d. MEASURING COUNTERWEIGHT ARM ANGLE. *(See figure 11.)*

(1) Move the protractor around to the leading edge and place the blade of the protractor over the counterweight arm so that it touches the upper and lower flat surfaces evenly. Read and record the counterweight arm angle accurately within one-tenth of a degree.

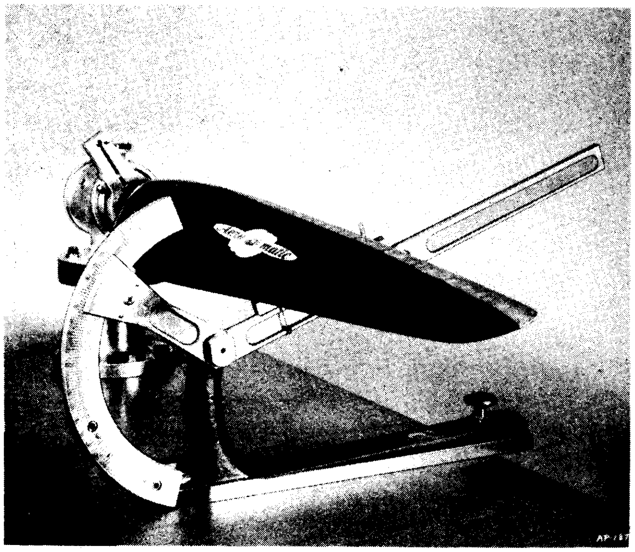


Figure 10. Measuring Phase Angle

Repeat the same readings and recordings of phase angle and counterweight arm angle for blade number two.

Note

In emergency when the assembly table or the protractor is not available for measuring purposes, the blade, the flange, and the counterweight arm can be removed and the same parts reassembled still maintaining the proper relationship by lining these parts up and locking the assembly with the counterweight arm locking screw. Avoid removing the weights from the counterweight arm in order to maintain the assembly undisturbed.

e. ASSEMBLY PISTON (FIXED PITCH).—Remove the six screws from the cover plate of the synchronizer cylinder. Rotate the blades toward low pitch until the piston extends out of its cylinder past the

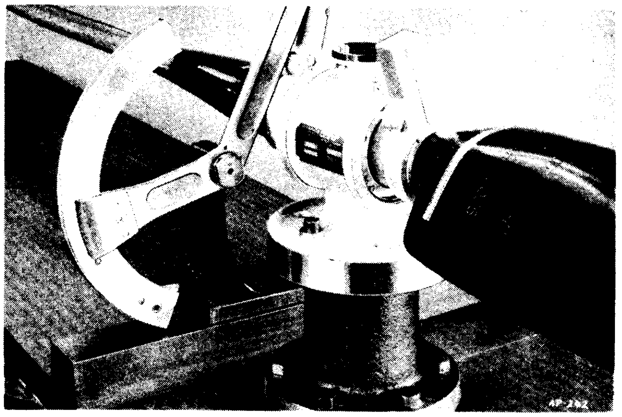


Figure 11. Measuring Counterweight Arm Angle

Figure 12. Removing Blade

wrist pin holes. Push the wrist pin out of piston. Replace the original piston with the steel fixed-pitch piston with flange attached. Before installing this piston, remove all shims from the synchronizer flange. On the flange of the synchronizer cylinder, in some cases a small number is stenciled. This number indicates the amount in thousandths of shims that are to be used with the assembly piston in order to set the blades at the proper phase angle. Hold the piston solid against the flange by two opposite screws. With the blade flanges held in this fixed position, the blade angle (phase angle) is read by means of a protractor at the designated station. The counterweight arm angle is also read in this position.

f. BLADE.—Measure the propeller radius of each blade, noting the serial number on each blade in relation to blade bore number one or two. To remove each blade, withdraw the cotter pin and counterweight arm clamp bolt. Then remove the counterweight arm lock screw and unscrew the blade slowly in a counterclockwise direction, using a blade wrench, if necessary, with great care. *(See figure 12.)*

g. COUNTERWEIGHT ARMS. *(See figure 13.)*—Push the counterweight arm back on the flange and remove the round snap ring from the groove in the end of the flange; then remove the counterweight arm.

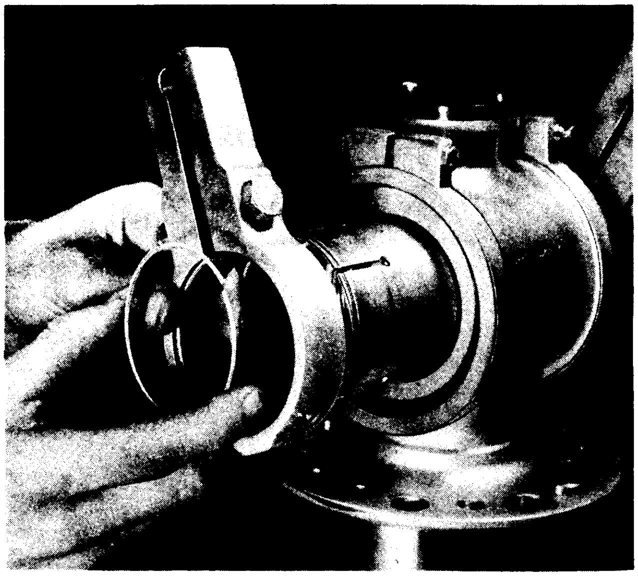


Figure 13. Removing Counterweight Arm

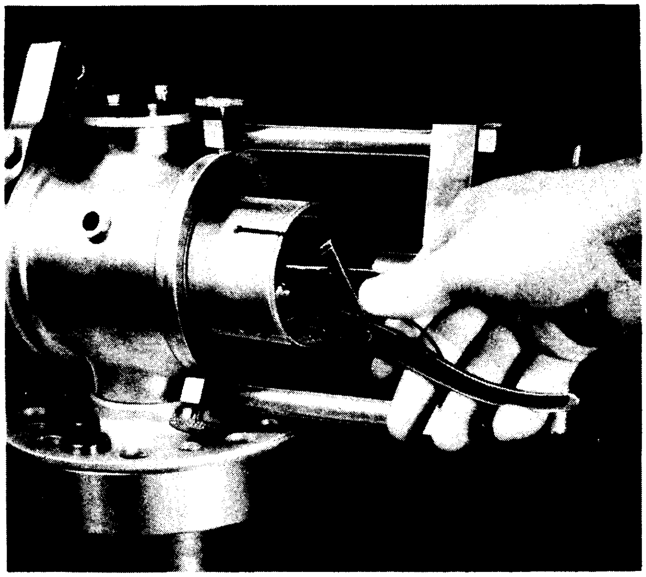


Figure 14. Removing Flange Seal Plate

h. FLANGE SEAL PLATE. *(See figure 14.)*

(1) Use snap ring pliers No. 5 to remove snap ring, then lift out flange seal plate with long nose pliers.

(2) Repeat same operations for No. 2 flange.

i. RETAINER SNAP RING *(See figure 16.)*

(1) Insert a 7/16" socket wrench through flange No. 2. Remove nut through flange No. 2 and locking bolt through flange No. 1. Insert preload tool into flange No. 1. Hold inner tool and turn outer T handle anticlockwise until blade flanges become slightly loose. This will relieve the load on the snap rings. Remove the tool. Use snap ring pliers to remove snap ring from recessed groove in hub bore.

j. BLADE FLANGE, THRUST BEARING AND RETAINER.

(1) Remove the thrust bearing retainer from hub bore.

(2) Remove the bearing lubricant seal ring from hub bore and lubricant packing seals from the flange.

(3) Pull out blade flange and thrust bearing assembly.

k. PRELOAD BEARING AND PRELOAD PARTS. *(See figure 15)*—Detach the preload bearing and sleeve, preload screw from the center bearing support in the hub.

l. SYNCHRONIZER ASSEMBLY. *(See figure 17.)*—Before starting disassembly, remove the synchronizer piston. This will allow the synchronizer links to be easily removed through the synchronizer bore as the flanges are being withdrawn.

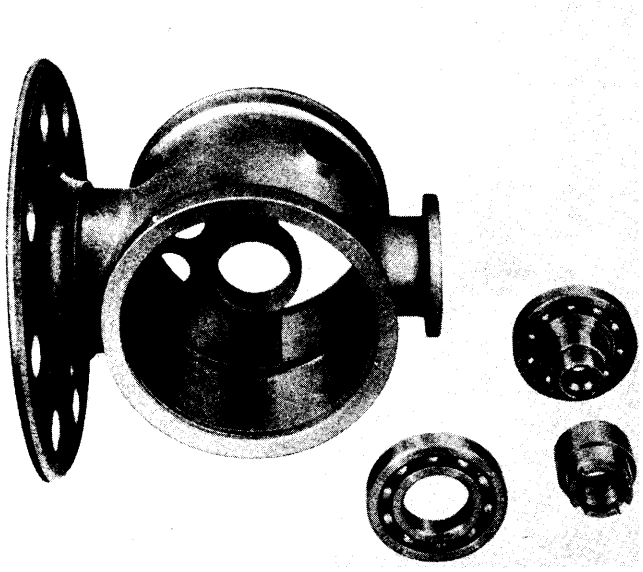


Figure 15. Preloading Bearings and Sleeve

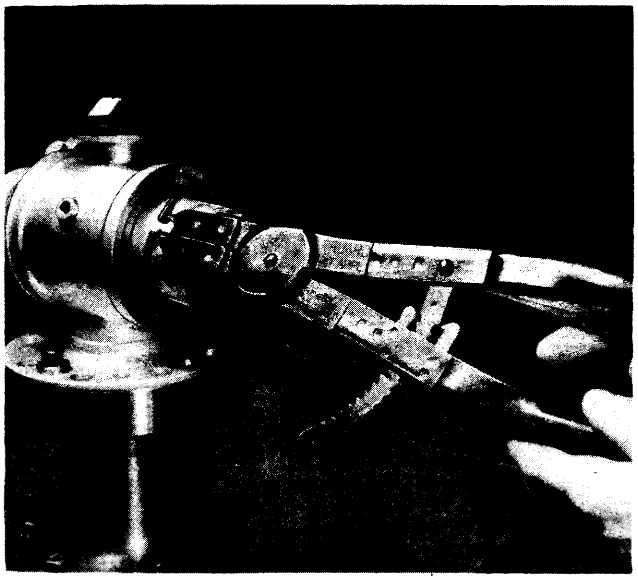


Figure 16. Removing Retainer Snap Ring

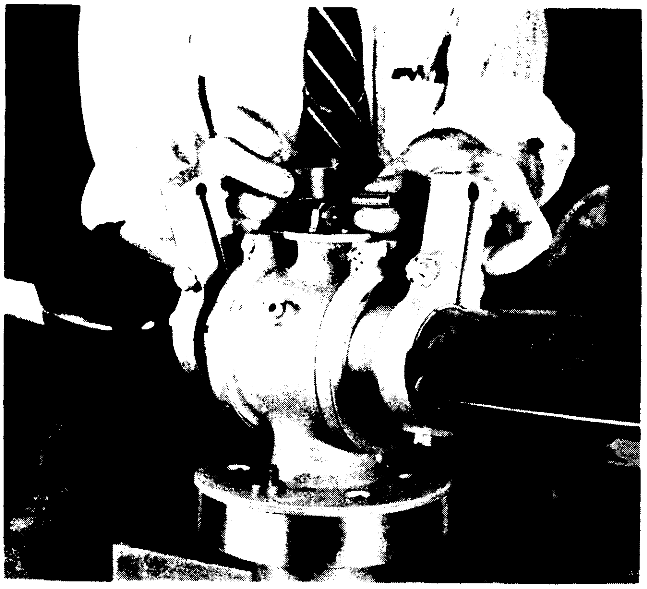


Figure 17. Removing Synchronizer Assembly

m. BALANCING WEIGHT ASSEMBLY.—The balance weight band assembly or assemblies for the entire propeller are bolted around the outer end of both blade bores *(See figure 18).* This assembly will have to be removed in order to apply the flange seal plate assembly tool when the hub is assembled. When removing, mark the original position first, then withdraw the nut, bolt, spring and washers and detach the band assembly.

n. LUBRICANT FILLER PLUG.—Use the 3/16" Allen head wrench to remove the plug from the side of the hub.

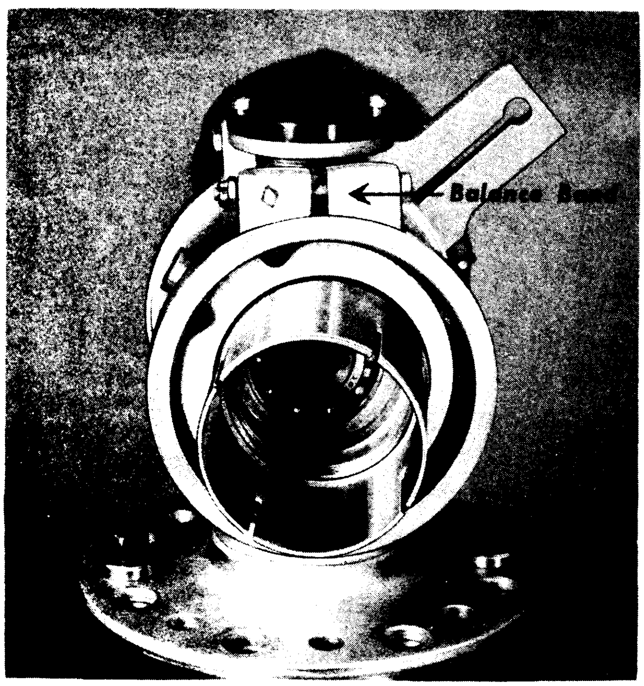


Figure 18. Balance Band

3. CLEANING, INSPECTING, TESTING AND REPAIR.

a. CLEANING.—Wash all parts with gasoline or cleaning fluid and dry thoroughly before inspection. In order to prevent corrosion, apply a rust preventive lubricant to the bearings and all parts that are to be stored or set aside for any length of time.

b. INSPECTING.

(1) Examine the thrust bearings for rust spots or broken surfaces. Under normal operation the surfaces should be highly burnished within the range of the changing pitch travel.

(2) Check the condition of the preload screw and examine the radial bearing for free movement and for rust and cracks.

(3) See that the bushings in the synchronizer links are not excessively worn and that the studs on the flanges are in serviceable condition.

(4) Examine the edges of the flange lubricant seal packings for feathering or breaks. Make sure that the surfaces of the flanges where the packings make contact are smooth.

(5) Check the thrust bearing seal rings, and the flange sealing rings.

(6) Check to see that the synchronizer piston and shims are in good condition.

(7) Inspect all bolt, nut, and screw threads to see that they are not damaged.

(8) Check to see that the Allen head screws in the blade shanks are not loose. Tighten with a torque wrench to 150 inch-pounds maximum torque, if loose.

(9) Magnaflux all parts if possible. Closely inspect hub barrel and flanges.

c. TESTING, REPAIR AND PARTS REPLACEMENT.

(1) Magnaflux all parts for structural flaws.

(2) Replace all feathered, broken or otherwise damaged lubricant seals and shims and any other parts that are excessively worn.

(3) Use new seals and cotter pins for reassembly, if required.

4. REASSEMBLY.

a. The reassembly can be done on the protractor table by using the special adapter.

Note

The angular relationship between the blade and the hub, which is controlled by the position of the stop, is dependent upon a particular engine and airplane combination. In case this propeller is to be mounted on another type of airplane or another engine model, a new setting on the stop may be required for the propeller hub. This information will be provided by the manufacturer to assure the desired predetermined pitch change of the propeller during flight, as the automatic action of this propeller depends upon various forces acting upon the blades, the magnitudes of which are dependent upon the engine and airplane combination.

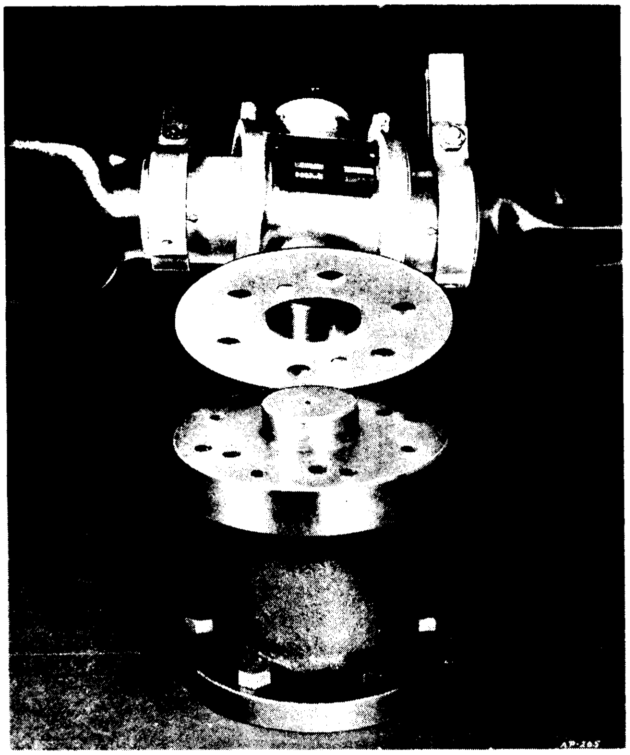


Figure 19. Protractor Table Mounting

b. PRELOAD PARTS. *(See figure 21.)*

(1) Insert the preload assembly into the bore in the center web of the hub.

c. BLADE FLANGE, BEARINGS, AND PACKING RETAINER.

(1) Place the radial bearing on the preload assembly.

(2) Before inserting either flange in the hub, assemble it on a bench with the thrust bearing. First place the thrust bearing over the flange with the large radius on the inside diameter of the inner bearing race against the flange shoulder. Insert No. 1 flange in hub barrel No. 1. While sliding this assembly into the hub, install the synchronizer link onto the flange stud through the synchronizer cylinder bore, with the large boss toward center of hub. Then locate flange solid against preload bearing. Install thrust ball wire cage assembly and outer bearing race.

(3) Next, place the lubricant seal ring in the groove between the outer bearing race and the hub bore, using grease to hold the lubricant seal ring in place. Stretch seal if necessary so that seal contacts bore of hub firmly. Then insert brass shim or shims, as required, over the flange followed by the flange seal packing with the feathered edge outward. Locate shims and packing firmly against thrust bearing and apply the coil retainer spring over the packing groove provided for this purpose. Add outer packing shim and apply the bearing retainer.

Note

In order to insure the proper compression load on the flange seal packing, the assembly should be first made on the bench with flange withdrawn from hub.

When the thrust bearing retainer is allowed to rest on the assembled seal, it should rest .015" to .020" off the face of the thrust bearing but can be made to contact it all around with a light squeeze of forefinger and thumb.

Repeat same operations on other end of hub.

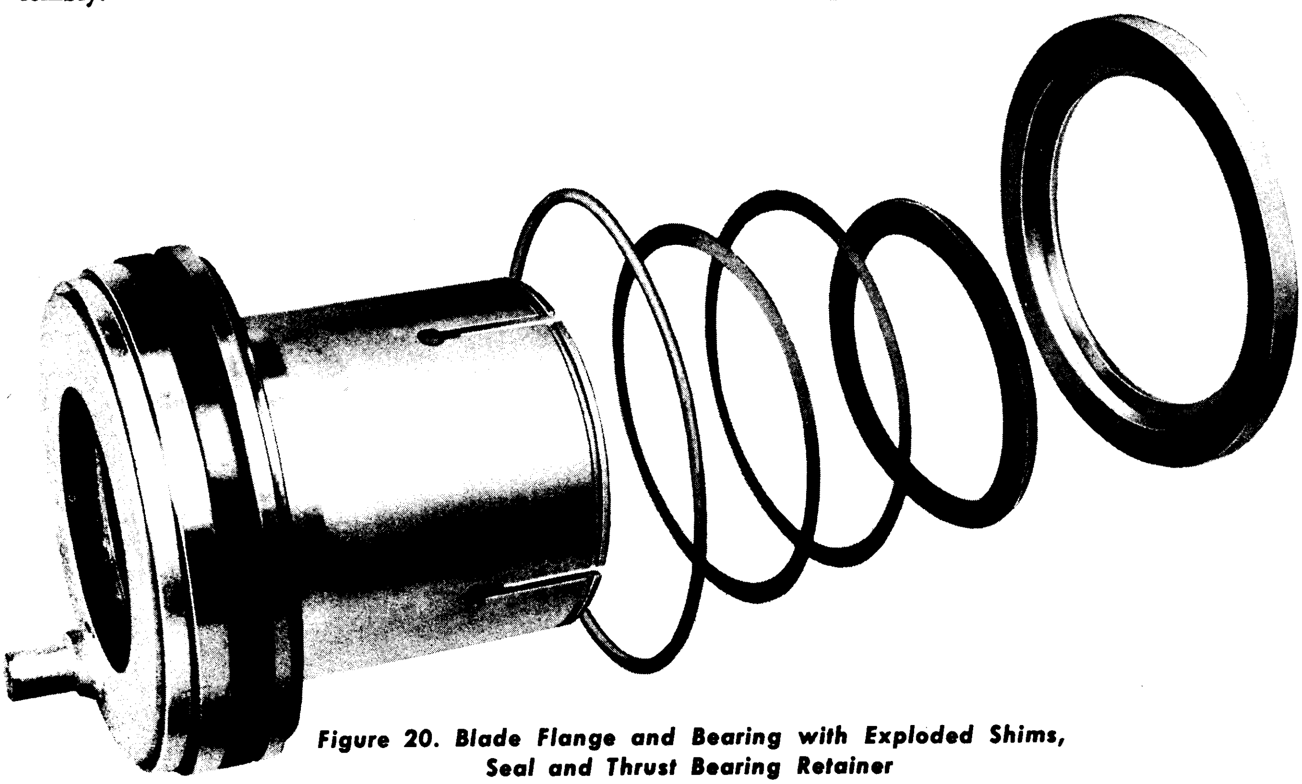


Figure 20. Blade Flange and Bearing with Exploded Shims, Seal and Thrust Bearing Retainer

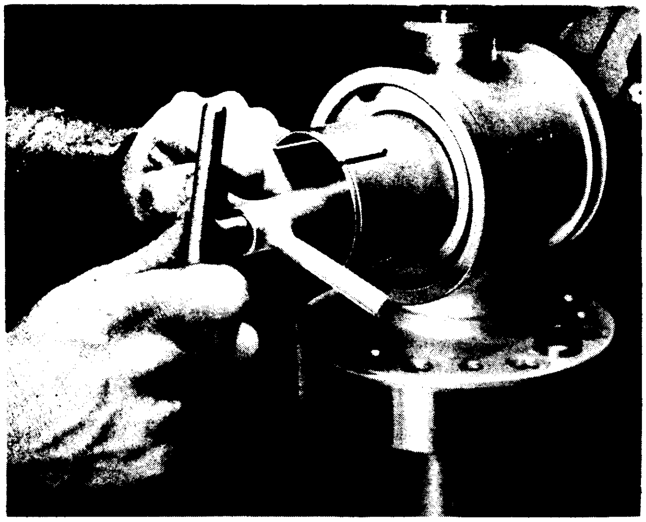


Figure 21. Preloading Flanges

d. THRUST BEARING RETAINER SNAP RING AND TIGHTENING PRELOAD.

(1) Push both flange assemblies toward center of hub as far as possible. Then place retainer snap ring in the hub groove by means of the special snap ring pliers No. 7. Place the snap ring opening at a 45° angle left of the upper center of the hub when facing the flange. This is the point of lowest stress on the retainer plate. *(See Fig. 22.).*

(2) Insert the preloading tool through flange No. 1, engaging the sleeve and preload screw. Turn the outer tool to the right until all play of the flange is taken out. Hold inner tool until a slight drag is felt when flanges are rotated, then back off about 1/8 of a turn or until the flanges feel free. If in doubt, before applying seal plate in flange, screw in a blade and test for excessive shake of flange in hub.

Lock the preload adjustment as follows: Place lockpin in serrated hole in center of preload assembly from No. 1 flange end until lugs of lockpin will fit into slots of preload device. This pin will lock relative movement between screw and sleeve.

Install small washer and self-locking nut, through No. 2 flange end, on threaded end of lock pin. Draw up snug, just enough to hold lock pin in position.

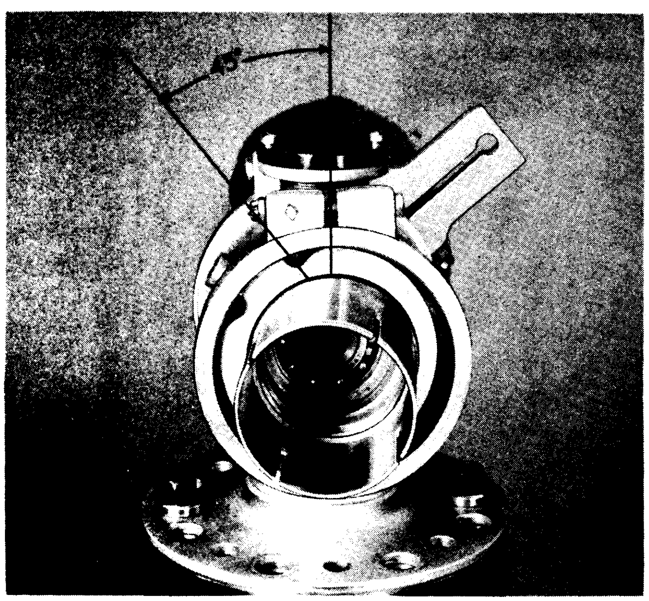


Figure 22. Position of Snap Ring Ends

CAUTION

If drawn too tight, the lugs on the lock pin will bend or shear off.

e. FLANGE PLATE. *(See figure 23.)*

(1) Coat the flange sealing ring with heavy grease and install it in the inner end of the flange bore. If required, stretch the seal so that its outer circumference fits against the bore all around.

(2) Install the flange plate against the sealing ring, button outward, and attach the flange seal plate assembly tool. Compress the sealing ring sufficiently for the flange plate to clear the snap ring groove and insert the snap ring in the flange with the opening of the snap ring placed on the leading side of the flange. *(See figure 14.)*

(3) Likewise, install the seal and plate in flange number two.

f. COUNTERWEIGHT ARM.

(1) Lubricate all counterweight arm bolt and nut threads with anti-sieze compound, mixture by volume of 70 percent pure white lead and 30 percent clean engine lubricant.

(2) Place counterweight arm number one on the end of flange number one. Push it back on the flange so that the counterweight arm retainer snap ring can be installed in the groove on the end of the flange. With the snap ring in position on the flange, move the counterweight arm back to the end of the flange covering the snap ring.

(3) If the weights have been removed from the counterweight arm, insert the bolt and install the correct weights on the side of the arm facing toward the center of the hub unless otherwise specified. The threaded end of the bolt and nut should be toward the hub. If more than one weight is used, place the heavier weight next to the arm. Check to see that the number one weights and number one arm are assembled to the number one flange in hub barrel number one. Safety the nut with the cotter pin.

(4) Insert the clamp bolt in the counterweight arm with the threaded end toward the side marked "Nut." Lubricate and place the castellated nut loosely on the bolt until counterweight arm is set at proper angle.

g. BALANCING WEIGHT.—In replacing weight band assembly, install the corresponding lead washers and spring in the counterbores of the band assembly lugs, insert the bolt through the washers and spring, attach the nut loosely and place the assembly around the end of the correct hub barrel in the previously marked position. Tighten the bolt with the 7/16" hex socket wrench and install the cotter pin.

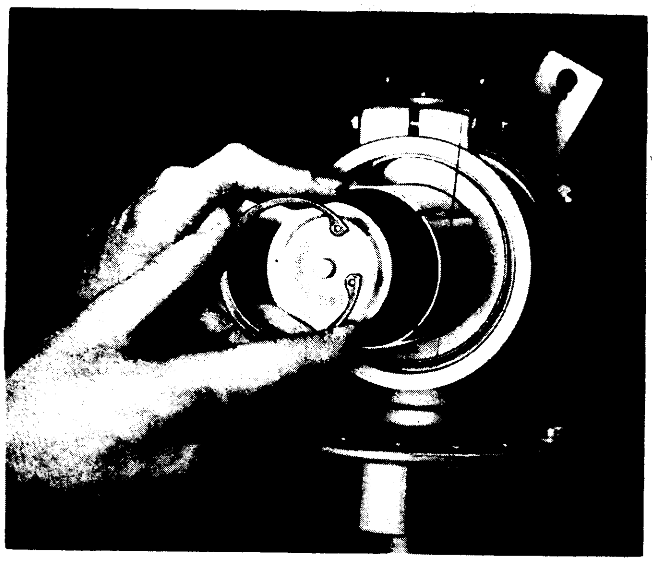


Figure 23. Installing Flange Seal Plate

h. BLADE.—After assembling both flanges and counterweight arms, screw the blades into the corresponding flanges as recorded before disassembly.

CAUTION

Do not make this blade assembly under any circumstances without first lubricating the blade threads thoroughly with a mixture by volume of 70% pure white lead and 30% clean engine lubricant.

i. BLADE ADJUSTMENT.—Before the blades are clamped in position, the blade phase angle must be set according to the date recorded before disassembly. Use the fixed-pitch piston to lock the flanges in the center position and use the protractor at the datum station to reset the blade accurately to the previously recorded blade angle. Check this setting. Be sure that each blade is screwed into the flange deep enough to reach the recorded propeller radius. Do not use the high and low pitch data for setting the blade phase angles.

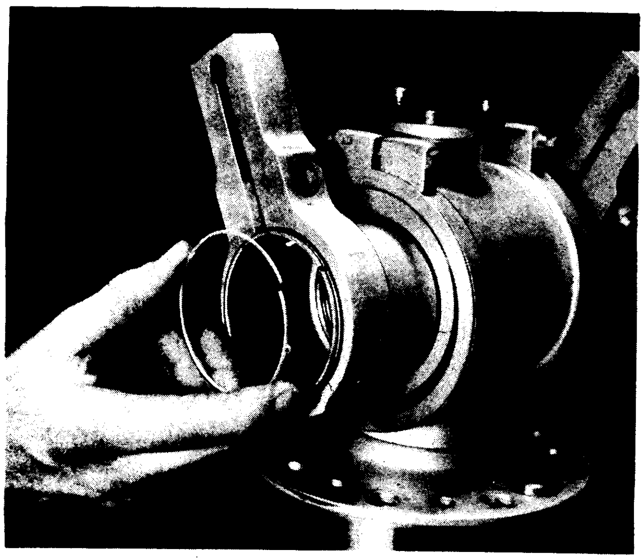


Figure 24. Installing Counterweight Arm

j. SETTING COUNTERWEIGHT ARM ANGLE.

(1) Place the protractor against each counterweight arm and carefully set each to the previously recorded position. Use side of counterweight arm with flats ground on it.

Note

When replacing the same blades and counterweight arms, the above procedure of setting the blade and counterweight arm angles may be simplified by aligning the holes in counterweight arm, flange, and blade shank and assembling the counterweight arm lockscrew. —Check balance *(See Section VII, paragraph 2.)*

(2) Use a torque wrench with a load of 45-foot pounds to tighten the nut, while bracing the bolt head with a box wrench. Secure the tightened nut with a cotter pin. Install the counterweight arm lockscrew and lock wire it to the safety screw.

CAUTION

An excessive amount of friction on the nut seat or thread may cause a false torque reading. Bear in mind that the clamp has a dual purpose—that of holding the counterweight arm in position and holding the propeller blade against rotation in the flange.

k. CHECKING HIGH AND LOW PITCH STOP ANGLES.—Remove the fixed-pitch assembly piston. Install synchronizer piston, shims and cover plate and check the high and low pitch stop readings with the protractor. If the readings do not correspond with the previously recorded figures, recheck the phase angle. If the phase angle is correct but the high or low pitch stop readings are still inaccurate, make sure the number one flange is in the number one barrel; then, if necessary, add or remove shims to the synchronizer cylinder to correct the error.

l. TESTS.—Conduct the alignment and balancing tests as described in Section VII.

m. LUBRICATION.—To fill the hub with lubricant, place the propeller in a horizontal position with the 1/8" filler plug up. Remove the filler plug. Insert extension of grease gun to bottom of hub barrel *(See figure 8).* Fill hub until lubricant comes out filler hole around extension tube of grease gun. The clearance between filler tube and hole will allow air to escape as it is displaced by lubricant, thereby insuring a completely filled hub. Replace filler plug.

n. REPLACING BLADES.

(1) If new blades are to be installed in the propeller hub, remove the counterweight arm lockscrew and

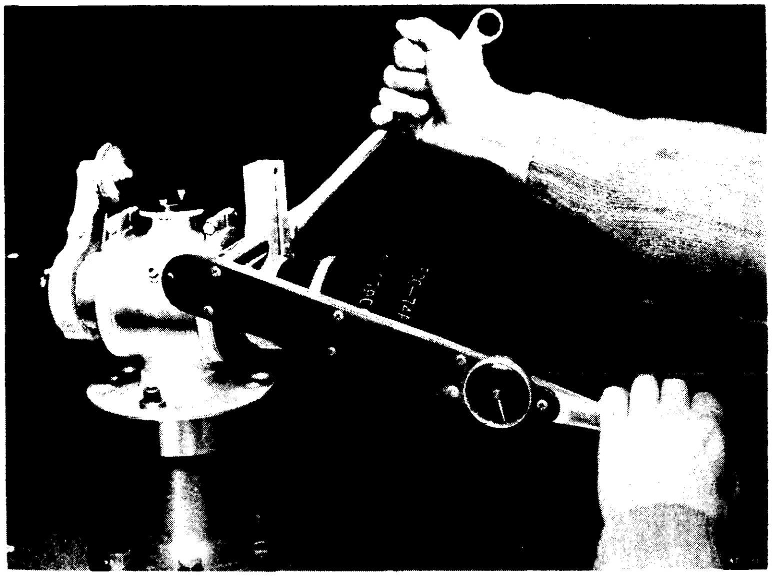


Figure 25. Tightening Counterweight Clamp Nut

follow the disassembly and reassembly instructions found in this section, paragraphs 2. a. to f. and 4. h. to n., inclusive, and Section VII.

(2) Screw the new blades into the flanges far enough to obtain the same propeller radius as the original set of blades or screw blades into flanges until they bottom on the threads then back out part of a turn until desired phase angle is obtained.

(3) Adjust the blades and counterweight arms according to the markings on the blades or the data card. Make sure the counterweight arm hole lines up with the flange hole as follows:

(a) Screw drill bushing into counterweight arm hole.

(b) Place the shank of a drill, number 13, through the bushing hole and into the flange hole.

(c) Tighten the counterweight arm clamp bolt nut with the drill shank in position, using a torque wrench with a load of 45-foot pounds, while bracing the bolt head with a box wrench. *(See figure 25.)* Secure the tightened nut with a cotter pin.

(d) Remove the drill shank.

(e) Drill the blade shank, using the number 13 drill, to a depth of 3/16 inch.

(f) Remove drill bushing, install and safety lockscrew.

(4) Place the propeller on the balance ways, using the special flange type balancing arbor.

(5) The propeller assembly with a new set of blades may require slight changes for either horizontal or vertical balance, as determined on the balancing arbor *(See Section VII, paragraph 2)*. Accomplish the required balancing by increasing or decreasing the lead washers in the balance weight band assembly or assemblies on the hub. *(See figure 18.)*

(6) If replacement of blades is required due to breakage, a complete tear-down and inspection of the hub is recommended.

(7) Next, check the engine rpm on the ground at full throttle. This should come up to the specified rpm. If not correct, changes in ground rpm may be obtained by either reducing or increasing the thickness of stop shims on low pitch side. (Front of synchronizer cylinder.)

Note

The recorded weight on the arm always includes the weight of the bolt, nut, and cotter pin which are used to fasten the weights to the counterweight arm.

(8) Next check the engine rpm in flight at full throttle. This should come up to specified rpm. If not correct, changes in flight rpm may be obtained by either adding or removing counterweights under the nut on the outer end of the counterweight arm. Always place counterweights toward the crankshaft under the nut end of the bolt. The relation generally to be expected is: removing one counterweight 1/32" thick, part No. 2721-1, will increase the speed of the propeller approximately 50 rpm; adding one counterweight 1/32" thick will decrease the speed of the propeller approximately 50 rpm.

WARNING

Be sure to follow instructions carefully and lock blades in position before flight test.

SECTION VII

TEST PROCEDURE

1. CHECKING ALIGNMENT.

(See figure 26.)

a. TRACK.—With the blades set to the correct phase angle as indicated on the protractor at the datum station, measure the height of corresponding marks on the tip of each blade with the machinist's square or a surface gauge. Both blades should be the same height from the protractor table. If either mark is out of line vertically with the other more than one-eighth-inch, the blades must be replaced.

b. INDEX.—Check the alignment of the leading edge of both blades as follows: Place the machinist's square at the datum station on the center line of the table. Bring the leading edge of the blade against the machinist's square. Lock the propeller on the arbor and move the machinist's square to the other blade at the same station. Both blades should be the same with respect to the center line of the table within one-sixteenth-inch each. If not, replace the blades. This test can be done only on a table with the arbor in the center.

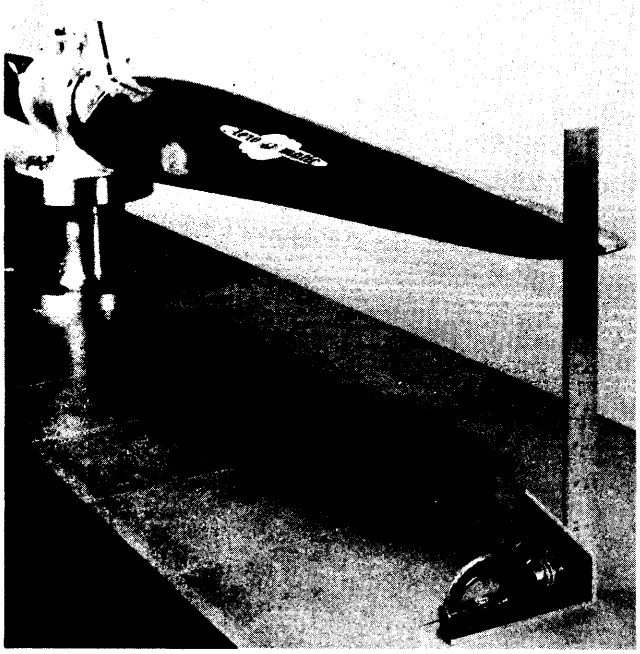


Figure 26. Checking Blade Track

2. STATIC BALANCING.

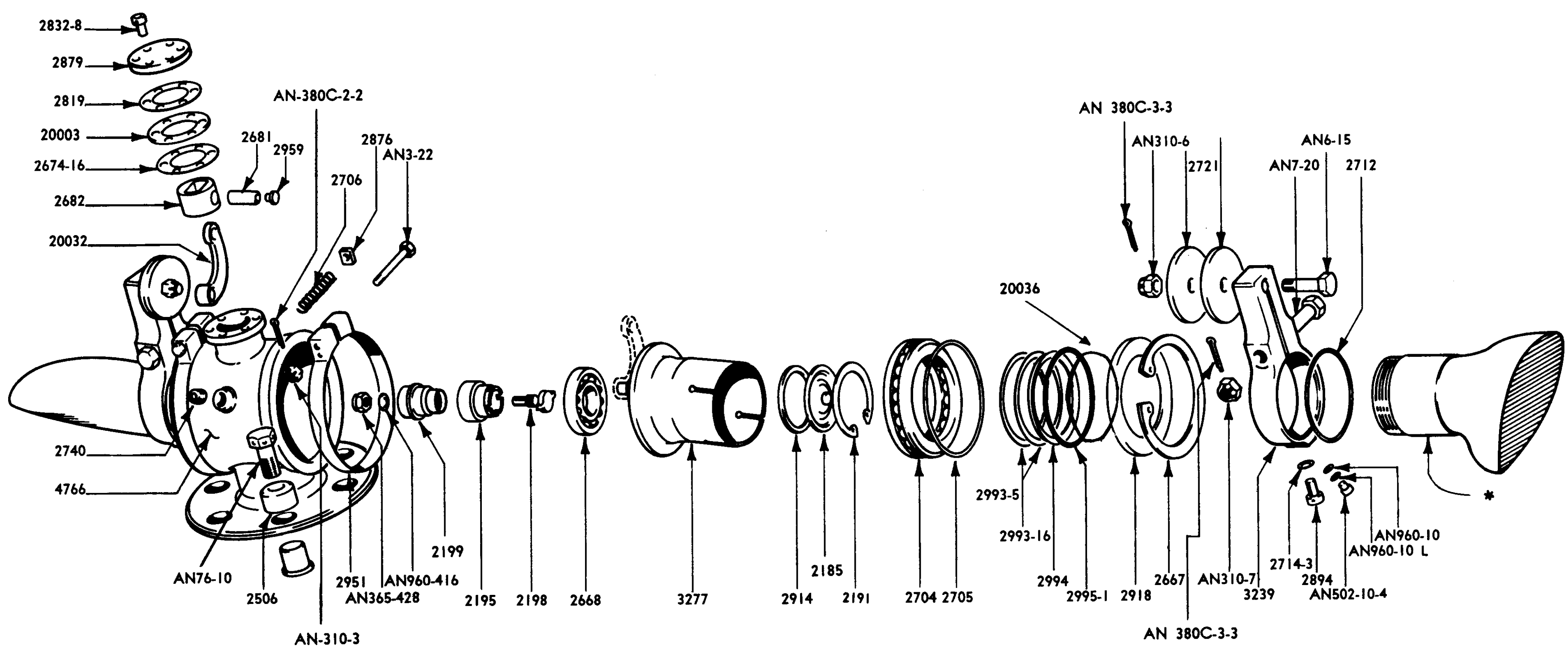
a. Before filling the hub with lubricant, install the grease plug in the hole and place the propeller assembly on a balancing arbor to check it for static balance in the vertical, horizontal, and 45-degree positions. Hold both blades against the low pitch stop during this operation.

b. If the assembly is found to be out of balance horizontally for any reason, small corrections can be made by adding or removing the required amount of lead washers in the balancing weight band assembly or assemblies on the outer end of the hub barrels *(See figure 18.)*

c. If the assembly is found to be out of balance vertically, corrections can be made by shifting both balancing weight band assemblies in the same direction around the hub barrel to obtain the desired effect. This operation will not affect the horizontal balance already accomplished.

d. Refill the hub with lubricant according to the instructions found in Section VI, paragraph 4. m.

Figure 27. Checking Static Balance



* Order by model and serial numbers.

Figure 28. Exploded View of Aeromatic Propeller Hub Model F200

PARTS CATALOG

SECTION VIII

INTRODUCTION

1. This is the Parts Catalog for the Aeromatic variable-pitch propeller hub Model F200, manufactured by the ***Universal Aircraft Industries, Aeromatic Propeller Dept., Denver, Colorado.***

2. The Catalog consists of a Parts List under which each part is individually listed in chronological assembly sequence, followed by an illustrated Service And Overhaul Tools List.

3. All separately procurable items are illustrated in the accompanying exploded view and assigned individual index numbers which appear in numerical sequence on the parts list for quick reference.

GROUP ASSEMBLY PARTS LIST

Part Number	*Nomenclature*
20032	Synchronizer Link
2681	Synchronizer Piston Pin
2959	Synchronizer Piston Pin Plug
2682	Synchronizer Piston
20003-1	Low Pitch Adjustment Spacer
20003-2	Low Pitch Adjustment Spacer
2819	Synchronizer Cover Plate Seal
2674-16	Low Pitch Adjustment Shim
2879	Synchronizer Cover Plate
2832-8	Synchronizer Cover Plate Screw
2832-10	Synchronizer Cover Plate Screw
2740	Filler Plug
2195	Bearing Preload Sleeve
2199	Bearing Preload Pilot
2668	Preload Bearing
2198	Preload Lock Pin
AN960-416	Preload Lock Pin Washer
AN365-428	Preload Lock Pin Nut
3277	Flange (Blade)
2914	Flange Plate Seal
2185	Flange Plate
2191	Flange Plate Snap Ring
2994	Flange Seal Packing
2995-1	Flange Seal Packing Spring
2993-5	Flange Seal Packing Shim (Inner)
20101	Flange Seal Packing Shim (Flared)
20036	Flange Seal Packing Shim (Outer)
2704	Thrust Bearing
2705	Thrust Bearing Retainer Seals
2918	Thrust Bearing Retainer Plate
2667	Thrust Bearing Retainer Snap Ring
3239	Counterweight Arm
2712	Counterweight Arm Snap Ring
AN7-20	Counterweight Arm Clamp Bolt
AN310-7	Counterweight Arm Clamp Nut
2721-1	Counterweight
2721-2	Counterweight
2721-3	Counterweight
2721-4	Counterweight
2721-7	Counterweight
2721-9	Counterweight
2894	Counterweight Arm Lock Screw
AN502-10-4	Counterweight Arm Safety Screw
2714-3	Counterweight Arm Lock Screw Washer
*AN6-16-17-20	Counterweight Bolt
AN310-6	Counterweight Bolt Nut

*Specify bolt length when ordering.

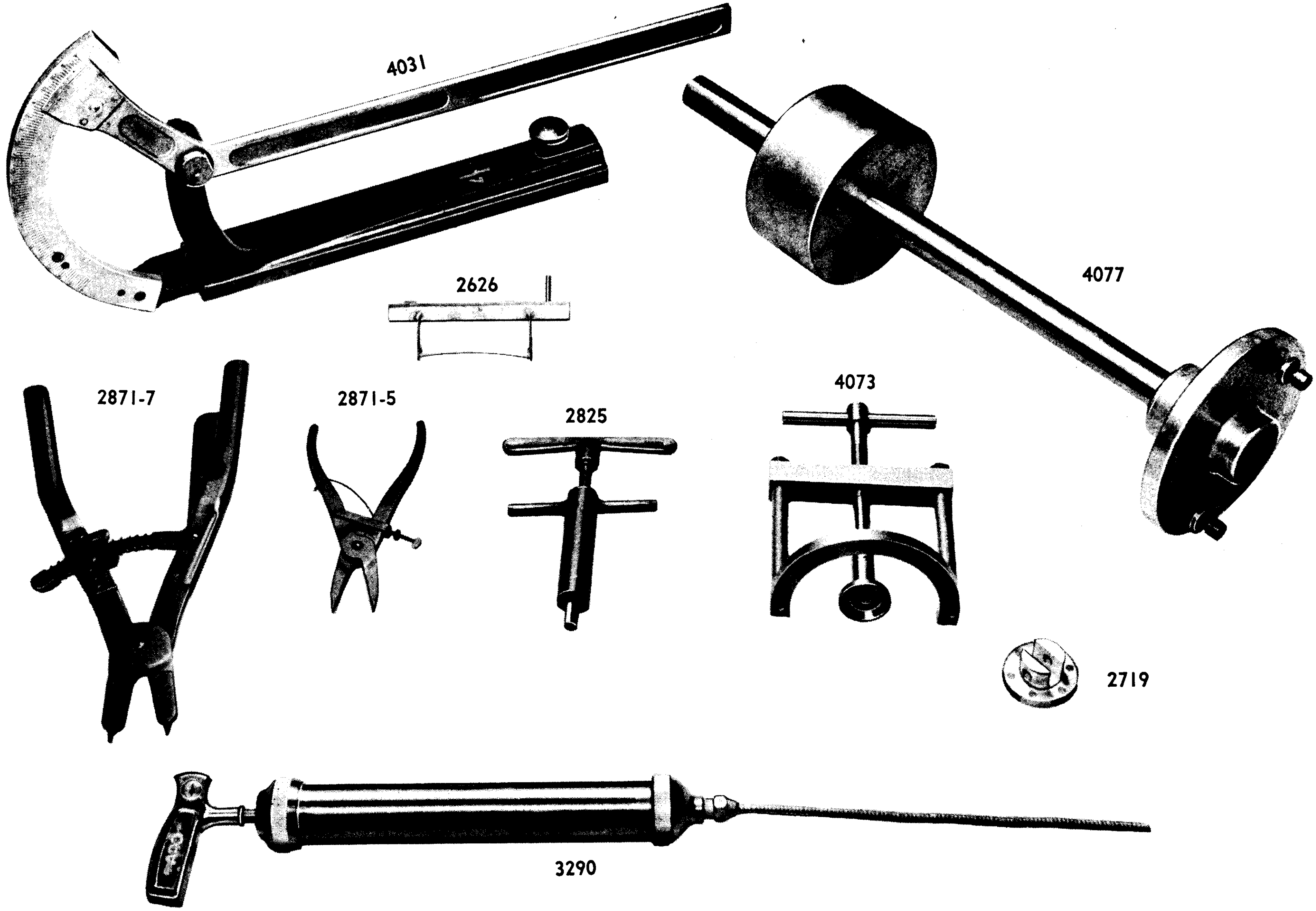


Figure 29. Model F200 Service Tools

GROUP ASSEMBLY PARTS LIST (Continued)

AN502-10-4	Counterweight Arm Safety Screw
2951	Balance Weight Band
2876	Balance Weight
2706	Balance Weight Spring
AN3-22	Balance Weight Bolt
AN310-3	Balance Weight Nut
AN76-10	Attaching Bolt
2506	Attaching Bolt Washer
20029	Field Service Instructions
4766	Hub (Only)
20011	Plastic Repair Kit
2999-1	Lubricant Aeromatic 7F (1 Pt.)
2999-8	Lubricant Aeromatic 7F (1 Gal.)

SECTION IX

SERVICE AND OVERHAUL TOOLS LIST

Tool Number		
	Pliers	Installing lock wires
	Socket Wrench, Hex. 5/8"	Tightening counterweight arm bolts and nuts
	Machinist's Square	Checking blade track and edge alignment
	Torque Wrench	Tightening counterweight arm bolts and nuts
2719	Assembly Fixed-Pitch Piston	Fixing position of flanges for angle measurements.
3290	Grease Gun with 5/16" Extension	Filling hub with lubricant
4031	Protractor	Measuring blade angles Measuring counterweight arm angles
4073	Flange Plate Assembly Tool	Compression flange seal rings while assembling snap rings
2626	Protractor Adapter	Used with protractor for measuring blade angles
2871–7	Retainer Snap Ring Pliers	Removing and assembling retainer snap rings
2871–5	Flange Plate Snap Ring Pliers	Removing and assembling flange plate snap ring
	Socket Wrench, 7/16", Hex.	Adjusting balancing weight assemblies Removal and assembly of nut from preload lock pin
	Screw Driver	Installing counterweight arm safety screws
	Allen Head Wrench, 3/16", Hex.	Installing lubricant filler plug
2913	Drill Bushing	Drilling counterweight arm lockscrew holes in new blades
4077	Balance Arbor	Checking static balance
20011	Plastic Repair Kit	Repairing small holes and scratches on plastic blade covering
2999–1	Aeromatic 7F Lubricant	(1 Pint)
2999–8	Aeromatic 7F Lubricant	(1 Gal.)
2825	Preloading Tool	Adjusting bearing preload pressure
4083	Propeller Table Flange Adapter	To fit customer's protractor table

Inquiries regarding parts, service and overhaul tools and repair materials should be directed to the attention of the SERVICE SECTION,

UNIVERSAL AIRCRAFT INDUSTRIES
Aeromatic Propeller Dept.
Denver, Colorado.

TABLE OF CONTENTS

TABLE OF CONTENTS--Continued

The Propeller With A Brain

Air-controlled automatic propeller

Aero matic

Licensed under patents of EVEREL Propeller Corp.

UNIVERSAL AIRCRAFT INDUSTRIES

FIELD, OFFICES AND WAREHOUSES: SKY RANCH AIRPORT

POST OFFICE BOX 5306 — *Telephone: EMpire 6-1591* — DENVER 17, COLORADO

UNIVAIR

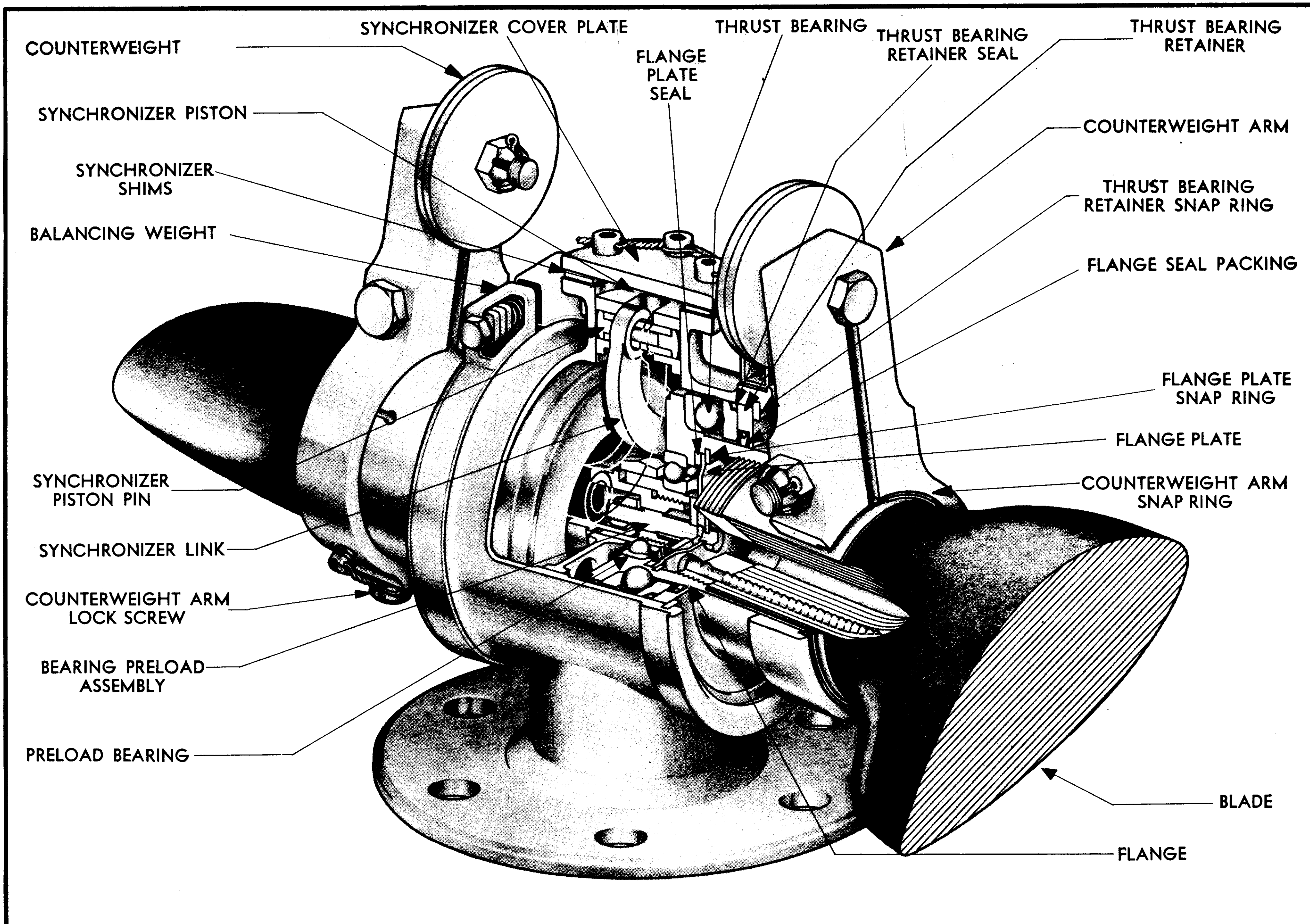


Figure 1. Sectional View of Model F200 Hub