# HANDBOOK



## Overhaul Instructions

**Propeller Models**

**HC-A2XF-2(and 2A)**
**HC-A2XK-2**
**HC-A2XL-2**

**2 BLADE, CONSTANT SPEED AND FEATHERING**

**DUA-FAA Approved**

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*NOTE: Installation, Operation and General Service are subjects which are covered in the Hartzell "Owner's Propeller Manual."*

# PART I-OVERHAUL

## SECTION I



## DESCRIPTION

The HC-A2X( )-2 Propeller is a 2-blade constant speed and feathering propeller designed for engines in the 150 to 300 H.P. class having "F," "K," or "L" type flange mounting shafts. The "F" flange utilizes six ½-inch bolts on a 4-inch bolt circle plus two ½-inch dowel pins. The "K" flange utilizes six ½-inch bolts on a 4¾-inch bolt circle. The "L" flange utilizes six 7/16-inch bolts on a 4¾-inch bolt circle.

The HC-A2X series propellers supersede the earlier HC-82X models. The HC-A2X series utilize split type blade retention bearings, together with a modified hub spider; whereas, the HC-82X series propellers utilized solid blade bearings retained by split rings. This change was made in order to stiffen the hub and thereby achieve greater smoothness.

The differences in the parts lists of the HC-A2XF-2 and HC-82XF-2B are given in Part II, Section III.

This propeller is designed to be controlled by a governor mounted on the engine supplying engine oil through the propeller shaft. Governor oil pressure (0 to 300 psi range) decreases the pitch while counterweights attached to the blade clamps increase pitch. A spring assists the counterweights during the feathering operation. Feathering the pitch is accomplished by opening a valve in the governor which allows the feathering spring to force the oil out of the propeller and back into the engine, thereby increasing the blade angle to the feathered position.

Centrifugal stops prevent feathering of the propeller, due to the action of the spring, when the engine is stopped. At speeds of over 500 RPM, the stops are removed by centrifugal force, allowing the propeller to be feathered at any time.

Unfeathering is accomplished by any of several methods as follows:

(a) Restarting the engine will provide oil pressure to unfeather the propeller.
(b) An oil-air accumulator, sealed by a valve when the propeller is feathered, can be utilized to provide pressure for unfeathering.
(c) An electric operated oil pump can be used to pump oil back into the propeller for unfeathering.

## SECTION II
## OVERHAUL INSTRUCTIONS

### Table I. - SPECIAL OVERHAUL TOOLS

| Part No. | Nomenclature |
|---|---|
| B-842-1 | Wrench for A-880-2 Nut on Spring Assembly |
| C-845 | Fixture for Assembly of Feathering Spring |
| ——— | Propeller Table |
| ——— | Balancing Equipment, Wire or Arbor |
| BT-222-1 | Assembly Tool for Pressing A-972 Ring on C-982 hub spider |
| BT-223-1 | Puller Tool for A-972 Ring |
| B-844 | Tool for Pressing Pilot Tube into Hub Spider |
| SK-274 | Piston Fixture Used for Balancing |

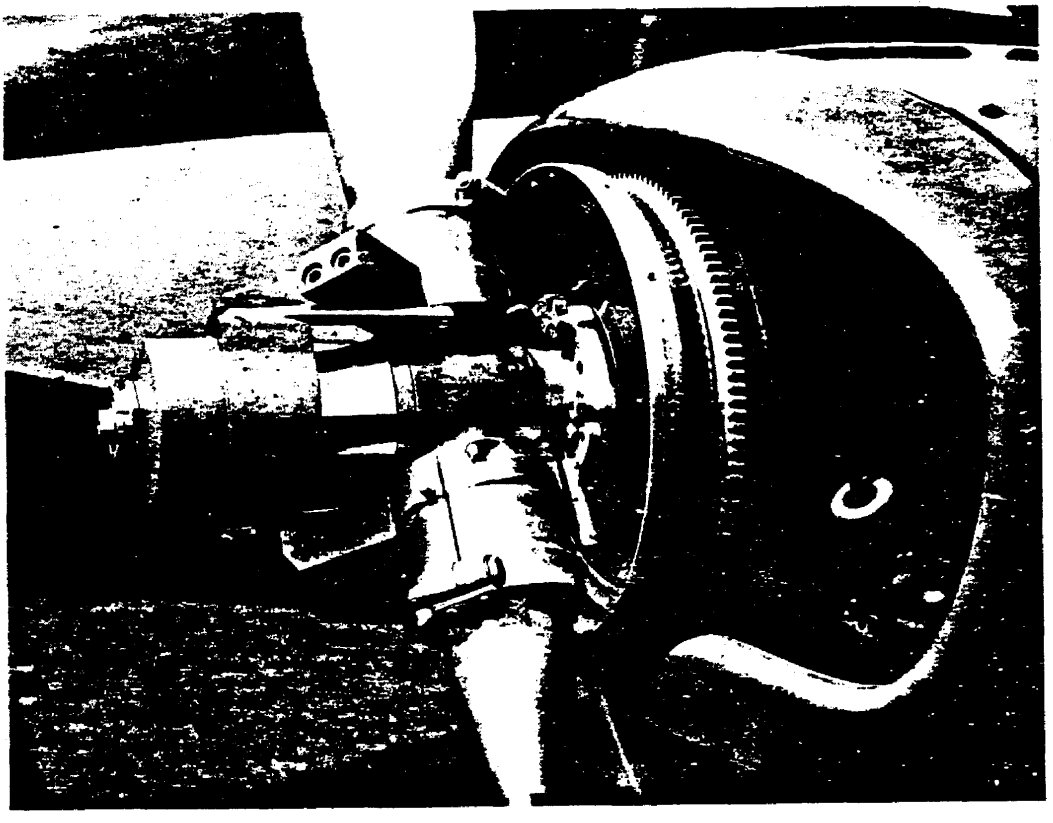

FIGURE 1—Model HC-A2X Series Propeller

## A-1. REMOVAL OF PROPELLER FROM ENGINE—MODEL HC-A2XF-2 (See Figure 2.)

(a) Remove spinner dome (80) by taking out screws (81).

**WARNING**

Feather propeller before removing high pitch stop sub-assembly (44). Use blade bars to compress feathering spring so that the high stop pin (47) can be pushed out to allow propeller to feather. An alternative method is to start the engine and feather the propeller.

(b) Disconnect the spinner bulkhead (82) by removing nuts (56), washers (55) and (54) and bolts (53).

(c) Remove the propeller from engine by removing bolts (12) from the engine-propeller flange. Work the propeller off the engine shaft (which is being held by the two dowel pins (11) by applying a forward thrust and a fore and aft motion of the blade tips. It may also be possible to drive the dowel pins back, using a punch. Remove "O" ring (9).

(d) Remove the spinner bulkhead from the engine flange.

(e) Remove automatic high pitch stop sub-assembly (44) from propeller flange by removing bolts (52).

## A-2. REMOVAL OF PROPELLER FROM ENGINE — MODELS HC-A2XK and HC-A2XL (See Figure 2.)

(a) Remove spinner dome (84) by removing screws (81).

**WARNING**

Feather propeller before removing high pitch stop sub-assembly (45) as described under A-1 above.

(b) Remove high stop sub-assembly (45) by removing bolts (52).

(c) Remove mounting bolts (16) (17) (18) or (19) as the case may be.

(d) Remove propeller from engine, including "O" ring (10) and shim (13) or (14).

## B. DISASSEMBLY OF PROPELLER

Inasmuch as the only differences in the HC-A2XF, K, and L propellers are in the mounting flanges and spinners, the disassembly is identical, so all three models will be taken together.

Mount the propeller on a table, securing the mounting flange.

### REMOVAL OF PISTON ASSEMBLY (65)

(a) Unscrew nut (78) using wrench B-842-1. To keep pilot tube (58) from turning, use a socket wrench to apply torque in opposite direction.

(b) Slide piston (66) off pilot tube (58) by applying a force to the counterweights (26).

(c) Remove cotter pin (42) and link screw sleeve (41), both sides.

(d) Rotate piston assembly (65), uncoupling link arms (69) from the link screws (23). Remove piston assembly.

### PISTON ASSEMBLY (65)

(a) Take out screws (68) and remove link pin unit (67). Remove link arms (69).

(b) Remove "O" ring (75) and felt seal (76).

*NOTE: Do not attempt to remove plastic bushing from piston.*

### FEATHERING SPRING ASSEMBLY (57)

(a) Remove screws (74) and stops (73). Remove front split rings (72) by first sliding entire spring assembly further into the cylinder (70) by about ¼-inch. Remove spring assembly from cylinder.

**CAUTION**

Do not attempt to disassemble the feathering spring sub-assembly (57) unless special tool No. C-845, the fixture for assembly of the feathering springs, is available; or some equal device is used. If this feathering spring is defective and no fixture is available, a new one should be installed. Return the old one to the factory for repair or replacement.

(b) Place the assembly (57) in the fixture and compress the feathering springs (61) and (62). Slide the rear spring retainer (63) back on the pilot tube (58) and remove the rear spring split retainer (64). Slowly release the spring compression and remove the assembly from the fixture. Parts (63) (60) (62) (61) and (59) can be removed from the assembly. Remove "O" ring (77).

### CYLINDER (70)

(a) Unscrew cylinder (70) using a square bar inserted in the slots provided.

(b) Remove "O" ring (71).

### BLADES AND CLAMPS

(a) With ink and scale, mark matching lines on blades (1) and clamps (22). Record blade serial number with clamp number for each side of propeller.

(b) Remove the nuts (36) bolts (34) and (32) and remove the clamp halves (22). Remove gaskets (31). Remove blades (1).

(c) From the clamp (22) remove the lubricator fittings (25), and automatic high pitch stops (39) by removing screws (40).

(d) Remove cotter pins (33), and remove and discard counterweight mounting screws (29). These screws should be replaced immediately with new ones. Torque to 65 lb. ft. Safety with cotter pin (30).

**CAUTION**

In normal overhaul operations, it is not necessary to remove counterweights (26) or (27) from the assembly (20) or (21), unless the parts are to be replated, for which complete disassembly must be made. Since the counterweights are matched to the clamps (by virtue of the dowel pins) it is not possible to interchange these parts. If either is defective, replace the entire assembly (20) or (21).

### BLADE BEARINGS

(a) Remove the balls from the bearings.

(b) Remove the inner races (5) of the bearings by removing the wire ring from the groove.

(c) Using special tool BT-222-1, combined with BT-223-1, push guide ring (6) in slightly towards the center of the hub (3) only enough to uncover wire ring (7), which can then be removed. Using special tool BT-223-1, pull guide ring (6) from hub (3). Remove the outer two halves of bearing race (5).

(d) Remove "O" ring (8).

### HUB SPIDER ASSEMBLY (2)

(a) If inspection of the hub spider sub-assembly shows that the pilot tubes (4) require replacement, they may be pulled by means of an appropriate bearing puller. This usually necessitates the part being returned to the factory for this operation.

### AUTOMATIC HIGH PITCH STOP ASSEMBLY (44) or (45).

(a) Disassemble each high pitch stop assembly by removing cotter pin (49), washer (50) spring (48) and pin (47).

## C. CLEANING

(a) Wipe all dirt and grease off all parts.

(b) Clean all parts, except felt seal (76) with solvent, and dry.

(c) Apply a rust preventative compound on all parts which are to be stored for any length of time, or shipped.

(d) Keep in clean and dry place before reassembly.

## D. INSPECTION

(a) Inspect all wearing parts according to tolerances specified in TABLE II. Replace parts not coming within specified limits.

(b) Inspect the blades according to the tolerances in TABLE III. Replace a blade which falls below the listed minimum dimensions upon repair.

(c) Visually inspect all metal surfaces. Replace or refinish any bearing or wear surface which has a visible nick, dent or other distortion.

(d) Magnetically inspect all steel parts for cracks not visible to the eye.

(e) Visually inspect the blades for cracks, particularly around the shank retention area and at the leading edge near the tip.

(f) Inspect the bearings for excessive wear or chafing. A certain amount of marking of the balls and races is to be expected and is not necessarily a reason for replacement. Only when the bearings show pit marks which are .002" deep and definitely feel rough, are the balls or races to be replaced. Bearing life ordinarily is greater than 1000 hours.

(g) Inspect pilot tube (4) for slippage. The tube should extend out from hub 3¾ inches only. If this distance is greater, the indication is that the tube has slipped out of the hub spider. An oversize tube should replace the one which slipped.

## E. REPAIR AND REPLACEMENT

(a) Remove all rust, galling marks and nicks from the hub spider arms with crocus cloth or fine emery. Rust, galling and nicks are stress raisers which reduce the fatigue life of the hub. Do not polish unless necessary, as the spider arms have been rolled to improve the fatigue strength. (The roll marks are not tool marks and should not be removed.) If the blade pilot tube (4) is to be replaced in the hub, due either to excessive wear, or due to the fact that it has slipped out slightly from the spider, it is necessary to use a new tube having a .002" to .003" oversize diameter over the 2¼" length which presses into the hub spider hole. Press the new tube (4) into the hub spider (3) leaving exactly 3¾ inches of the length exposed. Be sure the heavy end of the tube is inserted into the hub. Test the tube for tightness by applying 5000 lb. force on the tube. If it slips with this force, it must be replaced with a larger tube of say .003" to .004" oversize.

(b) Replace the counterweight mounting screws (29) as noted above. Use only the specified parts as they are heat treated to a high strength.

(c) Replace all gaskets, "O" rings, and cotter pins.

(d) Nicks or deep scratches in cylinder (70) may be cause for replacement, particularly if the marks are in the region of the piston "O" ring during normal cruise-flight. Scratches in the feathering region may be tolerated if not too deep.

(e) Replating (cadmium) of steel parts is recommended if the original plating has been worn off or if damaged by nicks or scratches.

**CAUTION**

The hub spider arms (3) and pilot tubes (4) should be masked. After plating the parts, they **must** be baked in an oven at 350° F. plus or minus 25° for 3 hours to eliminate possibility of hydrogen embrittlement. High strength bolts, hub and clamp parts are particularly susceptible to this effect. Failure of the part may result unless this baking is accomplished. If proper plating facilities are not available, the parts should be painted with a suitable aluminum or lacquer paint.

(f) Repair blades according to FAA Manual.

(g) Blade bushings. If the blade bushing is worn beyond specified tolerances, the blades should be returned to the factory to be rebushed. These bushings seldom wear, however, to the point where they must be replaced.

## F. ASSEMBLY

**(See Fig. 2.)**

Reassemble in reverse order of disassembly.

### AUTOMATIC HIGH PITCH STOP ASSEMBLY (44) OR (45).

(a) Assemble pin (47), spring (48), washer (50) and cotter pin (49) into high pitch stop bracket (46) or (51).

### ASSEMBLY OF BEARINGS ONTO HUB SPIDER

(a) Mount hub spider (2) on propeller table.

(b) Using special tool BT-222-1, combined with tool BT-223-1, push guide ring (6) onto hub spider bearing retention flange. The chamfered end of ring (6) must face the center of the hub, and the counterbored end face out. Push ring (6) until the inner edge overhangs the inner flange face of hub spider (3) by about 1/16-inch. This provides a nest to fit the two halves of outer bearing race (5). Unscrew tool BT-223-1 about ½ inch

to allow for inserting outer bearing race (5) in nest provided by ring (6). Adjust BT-223-1 so that fingers press against bearing race and BT-222-1 presses against ring (6). Screw ring (6) further onto hub and bearing race (5) until the groove in flange is uncovered.

**CAUTION**

It is important that the two bearing halves be matched perfectly at the fractured surfaces and held flat against the inner face of the hub flange when the ring (6) is forced into place.

(c) Insert wire ring (7) in groove.

(d) Remove tool BT-222-1 and install tool BT-223-1 so that fingers rest against inner edge of ring (6). Pull ring (6) out over the wire ring (7).

(e) Install "O" ring (8) over hub retention arm, in towards the center of the hub as far as possible.

(f) Install inner bearing race (5); hold halves together with wire ring.

**IMPORTANT: Locate bearing parting line fore and aft or parallel with hub shaft axis.**

(g) Fill bearings with balls. Pack with grease.

(h) Roll "O" ring (8) out against bearing race.

(i) Wrap masking tape around outside of bearing (5) and ring (6) so the balls will not fall out. This will be removed when clamps are installed.

## BLADES AND CLAMPS

*NOTE: In order to assemble the propeller and set pitch accurately, it is highly advantageous to use a special propeller table having a shaft which mates with the propeller hub flange. Air or oil pressure (100 psi min.) should be available in the shaft to actuate the piston.*

(a) Mount the hub on the propeller table shaft, sealing the flange with "O" ring (9) or (10). Fasten with bolts or clamps.

(b) Fill the blade pilot tube hole with a grease as specified under "Greases Recommended."

*NOTE: Be sure no air is trapped below the grease as this will upset the balance.*

(c) Install blade (1) on the same pilot tube (4) from which it was removed. Place a hardening gasket compound (commercial automotive type) around the blade shank in the shoulder radius.

(d) Install the correct matching clamp and counterweight sub-assembly (20) or (21) with new clamp gaskets (31).

*NOTE: This process can best be accomplished by peeling back the masking tape from about 180° of the bearing on the top side. Then install the one-half of clamp that has the counterweight. Then peel the tape from the lower half of the bearing which is exposed, and install the other clamp half. Slip the clamp gaskets (31) between the clamps at the parting line. This procedure will locate the inner bearing race parting line at right angles with the clamp parting line WHICH IS ESSENTIAL.*

Fasten the clamp halves together with socket screws (32), bolts (34), washers (35) and nuts (36). Tighten socket screws (32) and nuts (36) and check for friction of the blade when being rotated on the hub.

*NOTE: The pitch will be set after the propeller is completely assembled, after which the clamp bolts will be torqued and safetied.*

(e) Install the lubricator fittings (25) and high stop plates (39) using screws (40) and washers (43). Wire safety.

(f) Check for friction or binding of the blades when rotated about their axes. If the blades tend to bind after the bolts (32) and nuts (36) are tightened, it will be necessary to remove the clamps and blades and relieve the friction, whatever the cause; whether it be friction between blade and pilot tube (4) or friction between the end of the blade and the end of the hub spider arm.

## CYLINDER (70)

(a) Insert "O" ring (71) in the cylinder groove behind the threads. Apply non-hardening gasket compound to the threads. Screw cylinder (70) onto hub (3). Use a 1-inch square bar about 3-4 feet long as a wrench, applied to the slot in the cylinder. Tighten the cylinder hard against the hub (about 200 ft. lb. torque).

(b) Inspect inside of the cylinder to be sure the "O" ring (71) is still in place.

(c) Inspect around the slots to be sure the bar has not raised the edges which might cut the "O" ring. Peen edges if necessary.

## FEATHERING SPRING SUB-ASSEMBLY (57)

*NOTE: When assembling feathering spring sub-assembly (57), it is essential that a safe means of compressing the springs (61) and (62) be used. This is afforded by the use of a special tool No. C-845.*

(a) Assemble onto pilot tube (58) outer mushroom (59) springs (61) and (62) spacer tube (60), and spring retainer (63). Insert the above assembled parts in the spring compressing fixture (Tool C-845) and compress the springs until the rear split retainer (64) can be assembled in the groove provided in the end of pilot tube (58). Release spring compression so that retainer (64) fits into the nest machined in the end of retainer (63).

(b) Slide the feathering spring sub-assembly (57) into cylinder (70) and the bore of hub spider (3) until the grooves in the end of the cylinder (70) are exposed.

(c) Install front split rings (72) into the groove in the cylinder (70). Pull the feathering spring sub-assembly forward to lock the rings (72) in place.

(d) Secure the sub-assembly (57) and the rings (72) in place by means of feathering stop (73) and screws (74). Safety with wire.

(e) Install "O" ring (77) in groove at end of threads in pilot tube (58).

## PISTON (65)

(a) Install link arms (69) in piston (66). Install link pin unit (67) and safety screw (68). Wire safety the latter.

(b) Check link arms (69) for free movement in piston (66) slots.

(c) Install a new "O" ring (75) and felt seal (76) in the grooves in piston (66). Soak the felt seal in oil. Oil the "O" ring.

(d) Oil the cylinder (70) and "O" ring (77) at end of pilot tube.

(e) Slide the piston (65) onto cylinder (70).

(f) Rotate piston (65) so the free ends of the link arms (69) can be assembled over link screws (23).

(g) Insert link screw sleeve (41) between screw (23) nd hole in link arm (69). Insert cotter pin (42).

(h) Move piston (65) into full feathered position (back against the hub assembly) so that the threaded end of the pilot tube (58) protrudes thru the end of the piston (66). Screw the nut (78) onto pilot tube (58). Torque the nut (78) to 75-100 lb. ft. Restrain the pilot tube (58) from turning by applying a socket wrench to the hex located at the end.

## SETTING THE BLADE PITCH

a) Apply air or oil pressure through bore of the table spindle, to force the piston against the low pitch stop. Hold this position.

b) Loosen the outer clamp screws (34) only. Set each blade with a protractor located at the 30-inch radius. See airplane specification for low blade pitch setting. Tighten the blade clamps. Torque the outer clamp screws (34) to 30 ft. lb. torque and the inner screws 32) to 40 ft. lb. torque. Safety the latter with cotter key through hole drilled in head.

c) Check the blade against turning in the clamp by torquing the blade to 167 ft. lb. Use a blade bar and a weight. If blade moves in the clamp, the clamp must be removed and the clamp parting line at the outer corners filed slightly (remove .005"-.010" each surface), to allow the clamp to engage blade shoulders more firmly.

d) Check the blade angle again at the low pitch setting, as the torquing of the blade may have resulted in slight movement.

e) Check the feathering angle by allowing the feathering spring to feather the propeller. See airplane specification for correct feathering angle. In case the feathering angle is not within prescribed limits, the piston assembly (65) must be removed and the feathering stops 73) adjusted. If the feathering angle is greater than specified, add shims under the stops (73); 1/32-inch thick for 1° pitch change desired. If the feathering angle is less than specified, the feathering stops should be filed down 1/32 inch for 1° pitch change desired.

## CHECK FOR GENERAL OPERATION, FRICTION AND LEAKAGE

a) Cycle the propeller with air and note general operation for possible friction, etc.

b) Hold full pressure on piston and check for leakage past piston "O" ring (75), cylinder "O" ring (71), and guide rod "O" ring (77). Oil applied at these points will bubble if air is leaking out.

## INSTALLATION AUTOMATIC HIGH PITCH STOP ASSEMBLY (44) and (45)

a) Install automatic high pitch stop brackets (44) or 45) with bolts (52). Check operation of automatic stop mechanism by cycling propeller between low pitch and high pitch. Check engagement of stop pins (47) and stop plates (39). Both pins should engage plates at some time within .010 inch. File plates as required if necessary. Check feathering by holding stop pins (47) out so that plates (39) can pass. Check for clearance and possible friction between parts.

***NOTE: The automatic high pitch stop brackets (44) must be removed before installing the HC-A2XL,K propeller on the engine as two of the mounting screws are covered by these brackets. These brackets need not be removed before installing the HC-A2XF propeller, however.***



# SECTION III
# BALANCE

(a) Balance the propeller assembly before grease is added to the clamps, and check again after grease is added. Balance with pitch at high value-pins (47) engaged with plate (39).

(b) Either a suspension system or an arbor mounted on knife edges may be used for balancing. In event the suspension system is used, it is essential that the center of gravity of the propeller be located at or slightly below the pivot of the balance equipment; otherwise inaccuracies will result.

(c) Remove the end play from the blade clamp assemblies by driving identical small wedges between the blade clamps and hub spider, at identical locations.

(d) Bolt propeller to balance arbor, or wire balancer.

***NOTE: The following balance procedure applies only to balance arbor method.***

(e) Check horizontal balance by laying slugs (37) in corner of blade and clamp. Record number of slugs required for balance.

(f) With the propeller in horizontal position, apply 50-100 lb. downward force to each blade tip. This takes up the clearance between hub and blades in one direction.

(g) Check vertical balance with heavy blade up. Add weight slugs (37) to light side of clamps. Record number required for balance.

(h) Rotate blade 180° from horizontal position as noted in "f" above and apply 50-100 lb. to each blade tip. This takes up the clearance opposite to that noted under "f".

(i) Again check vertical balance. Record number of weight slugs.

(j) The final number of weight slugs can now be determined for vertical balance. If the slugs under "g" and "i" are added to the same side of the blade, the total slugs required for vertical balance is the average of "g" and "i." If the slugs under "g" and "i" are added to opposite sides of the blade the difference between the two numbers is added to the side requiring the greatest number.

(k) Horizontal balance determined under "e" must be maintained by properly dividing the slugs required under "j" between the two blades.

(l) Attach the slugs to the clamps with screws (38) and again check horizontal balance. Safety with wire. Do not attach more than 4 slugs with each pair of screws.

(m) Add equal amounts of grease to each blade, holding horizontal balance constant, until clamps are completely full, as evidenced by grease starting to come out around circumference of hub spider at "O" ring (8). Avoid blowing out "O" ring and gaskets (31) with excessive pressure.

# SECTION IV. WEAR TOLERANCES

## TABLE II. — TOLERANCES OF WEARING SURFACES

### MODELS HC-A2XF, L, K



| Item No. | Part or Description of Measurement | Specified | | Replace if dimension is above or below | |
|---|---|---|---|---|---|
| | | Max. | Min. | Max. | Min. |
| 1. | A-158 Pilot Tube O.D. | 1.4990 | 1.4987 | — — — | 1.4977 |
| 2. | A-158 Pilot Tube Assembly, length Extending beyond Hub Spider | 3¾ + 1/16 | 3¾ − 1/16 | 3¾ + 1/8 | — — — |
| 3. | Blade Bushing I.D. | 1.5015 | 1.5005 | 1.5030 | — — — |
| 4. | C-852-1 Piston, Plastic Bushing I.D. | 3.782 | 3.780 | 3.785 | — — — |
| 5. | C-852- Piston, Pin Hole Dia. | .3765 | .3755 | .3795 | — — — |
| 6. | B-854 Cylinder O.D. | 3.778 | 3.776 | — — — | 3.773 |
| 7. | B-855A Pilot Tube Dia. O.D. | .985 | .984 | — — — | .981 |
| 8. | A-856 Mushroom Bore | .988 | .986 | .993 | — — — |
| 9. | A-857 Spring Retainer O.D. | 2.243 | 2.241 | — — — | 2.235 |
| 10. | A-961-3 Link Arms I.D. Small End | .3755 | .3750 | .3785 | — — — |
| 11. | A-961-3 Link Arms I.D. Large End | .5635 | .5625 | .5645 | — — — |
| 12. | A-944 Bushings I.D. | .502 | .501 | .504 | — — — |
| 13. | A-944 Bushings O.D. | .5620 | .5615 | — — — | .5600 |
| 14. | A-304 Link Screw O.D. | .5005 | .4995 | — — — | .4970 |
| 15. | Feathering Spring Assembly, Compression Load | 440 Extended | 600 Compr'ed | 400 Extended | 550 Compr'ed |
| 16. | Blade End Play | .060 | | | |
| 17. | Fore and Aft Movement of Blade Tip (98" Dia.) | .068 | .100 | | |
| 18. | Blade Track | ±1/16 or 1/8 Between Blades. | | | |
| 19. | Balance Tolerance | 1 Slug A-48 | | | |

## TABLE III. — BLADE REPAIR TOLERANCES

| Rad. | Angle Min. | Angle Max. | Face Alignment Min. | Face Alignment Max. | Width (Min.) | Thickness (Min.) |
|---|---|---|---|---|---|---|
| **7636D Blade** | | | | | | |
| 9 | | | | | 4.700 | 1.980 |
| 12 | | | | | 5.572 | 1.095 |
| 18 | 41° | 42° | .138 | .202 | 5.702 | .666 |
| 24 | 37° | 37.6° | −.072 | .008 | 5.312 | .449 |
| 30 | 33.2° | Setup | −.192 | −.128 | 4.450 | .319 |
| 36 | 29.8° | 30.2° | −.242 | −.178 | No Limit | No Limit |
| **8433-6 Blade -12** | | | | | | |
| 9 | | | | | 4.700 | 1.980 |
| 12 | | | | | 5.720 | 1.095 |
| 18 | 41° | 42° | .138 | .202 | 6.200 | .625 |
| 24 | 37° | 37.6° | −.072 | −.008 | 5.985 | .471 |
| 30 | 33.2° | Setup | −.192 | −.128 | 5.380 | .337 |
| 36 | 29.8° | 30.2° | −.242 | −.178 | No Limit | No Limit |
| **8433 Blade 8433-2 and -4** | | | | | | |
| 9 | | | | | 4.700 | 1.980 |
| 12 | | | | | 5.720 | 1.095 |
| 18 | 41° | 42° | .138 | .202 | 6.200 | .625 |
| 24 | 37° | 37.6° | −.072 | −.008 | 6.000 | .473 |
| 30 | 33.2° | Setup | −.192 | −.128 | 5.460 | .341 |
| 36 | 29.8° | 30.2° | −.242 | −.178 | 4.200 | .234 |
| **8833 Blade** | | | | | | |
| 9 | | | | | 4.700 | 1.980 |
| 12 | | | | | 5.726 | 1.095 |
| 18 | 31.1° | 32.1° | .103 | .167 | 6.310 | .692 |
| 26 | 24° | 24.6° | .082 | .018 | 6.070 | .472 |
| 32 | 20° | Setup | −.164 | −.098 | 5.450 | .340 |
| 38 | 16.8° | 17.2° | −.242 | −.178 | 4.190 | .233 |
| **9333C and 9333C-3 Blade** | | | | | | |
| 9½ | | | | | 4.704 | 1.980 |
| 13 | | | | | 5.720 | 1.095 |
| 20 | 41° | 42° | −.122 | −.058 | 6.307 | .693 |
| 28 | 36.5° | 37.1° | −.472 | −.408 | 6.070 | .472 |
| 34 | 33.2° | Setup | −.682 | −.618 | 5.450 | .376 |
| 40 | 29.8° | 30.2° | −.832 | −.768 | 4.200 | .286 |

## TABLE IV. — Torque Valves
### Model HC-A2X Series

| Part or Bolt Size | Location on Hub | Torque Lb. Ft. | Torque Lb. In. |
|---|---|---|---|
| 7/16–20 | "L" flange mounting | 40 | 480 |
| 1/2–20 | "F" and "K" flange mounting | 60-70 | 720-840 |
| 3/8–24 | Outer blade clamp bolts | 22 | 360 |
| 3/8–24 | Inner blade clamp socket screw | 40 | 480 |
| 7/16–20 | Counterweight socket screw | 65 | 780 |
| 1/2–20 | A-304 Link Screw | 45-50 | 540-6 |
| A-880-2 | Nut, front of piston—feathering | 75-100 | 800-1200 |
| Blade | Blade installed in Blade Clamp | 167 | 2000 |

# SECTION V
# LUBRICATION

## A. General Properties of Grease Required.

Any grease used must have the following properties:

(a). Waterproof.

(b). Temperature range between -15° F and 150° F; or -40° to 100° F if operation is in cold climate.

(c). Freedom from separating oil from soap base due to centrifugal force or high temperature.

(d). Low Friction.

## B. List of Approved Greases, by Spec. or Name.

1. Hartzell DG Grease.
2. Stroma HT-1 (Z-801 Grease)
   Union Oil Co. of California.
3. Gulflex Moly for blade bushings
4. Gulflex A.
   This grease is recommended for the blade ball bearings as it will not bleed oil in hot weather.
5. RPM Aviation Grease No. 2
   Standard Oil Co. of California.
6. Stroma LT-1 (Z-815 Grease)
   Union Oil Co. of California.
7. Lubriplate 630 AA
   Fiske Brothers, Toledo, Ohio.
   This grease will bleed oil in hot weather. It is recommended only for lubrication of the blade pilot tubes but not the blade bearings.
8. RPM Aviation Grease No. 1
   Standard Oil Co. of California.
9. Lubriplate 707
   Fiske Brothers, Toledo, Ohio.
10. Mobilgrease Aero Lo-Hi PD-535-K
    Socony Vacuum Oil Co.
11. No. 84 Medium Grease
    Keystone Lubricating Co.
12. Texaco Regal Starfax Special.
13. Molub-Alloy No. 2 Grease -10° F.
    No. 1 Grease -25° F.
    Imperial Oil & Grease Co.
    Los Angeles, California.
14. Germany - Calypsol H729
    German Calypsol Company, Dusseldorf.

## C. Proper times and amounts of grease are mentioned during assembly procedures.



# SECTION VI SERVICE TROUBLES AND REMEDIES

| Trouble | Probable Cause | Remedy |
|---|---|---|
| FAILURE OF PITCH TO CHANGE | If rpm fails to increase but will reduce: Low oil pressure. | Set relief valve in governor to provide necessary pressure, up to 275 psi. |
| | If rpm change in both directions is sluggish: Excessive friction in hub mechanism. | See "Excessive Friction in Hub Mechanism," below. Isolate friction in each blade by uncoupling piston and testing each blade separately, before tearing propeller down. |
| | Newly-installed governor has wrong direction of rotation, or has bypass plug in wrong hole. | Check and correct. |
| EXCESSIVE FRICTION IN HUB MECHANISM | Pilot tube has slipped out slightly and is rubbing hard against end of hole in blade. | Tear down and check distance pilot tube extends from hub spider. Should be 3¾ inches. If more, remove pilot tube and replace with a tube .002 in. oversize at hub end. |
| | Blade bushing seized on pilot tube. | Polish pilot tube and blade bushing with fine emery paper and reassemble. |
| | Blade ball bearings unusually rough or broken. | Replace bearing. |
| | Friction in various moving parts of pitch control mechanism. | Check parts individually. If tightness is encountered in sliding parts, increase clearances slightly. Apply oil externally to moving parts. |
| IMPROPER RPM | Static rpm too low. | Governor has high rpm stop, as well as propeller low pitch stop. Either the governor or the propeller stop may limit maximum rpm. To determine which is causing trouble, open the throttle and move governor control back and forth slowly.<br>If maximum rpm is reached BEFORE governor stop is reached, propeller stop is probably limiting rpm. If this is the case, loosen blade clamp outer bolts and rotate blades in clamps. Reduce blade angle about 1° for each 100 rpm increase. (1° equals ½ inch circumference at blade root.)<br>If maximum rpm is reached AT SAME TIME as governor stop is reached, governor stop is probably limiting the maximum rpm. Readjust governor stop to obtain proper rpm. One turn of governor stop screw equals about 17 rpm. Turn stop screw out to increase rpm.<br>Governor stop should limit high rpm, with propeller stop reached at 50 to 100 rpm beyond. This allows for variations in engine power without affecting maximum rpm. |

| Trouble | Probable Cause | Remedy |
|---|---|---|
| | Static rpm too high | Reduce by screwing governor stop in, one turn for each 17 rpm reduction. |
| FAILURE TO FEATHER | Governor control does not provide enough travel to allow governor to move hard against high pitch stop. | Provide sufficient travel in governor control. Governor must drain oil out of propeller during feathering. |
| | Excessive friction. | See "Excessive Friction in Hub Mechanism." |
| | High pitch stop pin fails to slide out at feathering rpm. | Check for burrs on pins. Check for stiffness of spring. If propeller feathers at high rpm's but fails to feather at low rpm's, too-stiff spring is indicated. Reduce length of spring by one or two turns. |
| | Weak or broken feathering spring. | Replace. |
| SURGING (When governor control is changed rapidly or rough air is encountered.) | Air trapped in propeller actuating piston or in engine shaft. | Provision should be incorporated in engine to allow trapped air to escape from system during one half of the pitch change cycle. Exercise propeller by changing pitch or feathering before each flight. |
| | Governor pressure too low. | Adjust governor relief pressure so that rate of pitch change is the same in both directions. |
| | Excessive friction in pitch change mechanism. | See "Excessive Friction in Hub Mechanism." |
| | Governor lacks sufficient dampening. | Change or adjust speeder spring. This gives governor more stability, but makes pitch control more sensitive, which, may in turn require re-rigging of control to offset higher spring rate. Changing to stiffer speeder spring should be done only after all other factors are checked and corrected. |
| OIL LEAKAGE | Faulty "O" ring seals as follows: Front of rear cone between engine shaft and hub. Between hub and cylinder. Between piston and cylinder at front of piston. | Disassemble and inspect "O" rings and the surfaces they seal. Replace "O" rings if defective. Replace cylinder if surface is scratched or nicked in area where "O" ring slides. Use gasket compound on cylinder threads when replacing. Peen down raised places caused by tightening of cylinder with bar. |
| GREASE LEAKAGE (Only source of grease leakage is blade bearings.) | Grease leaks past clamp seal gaskets. | Loosen clamp bolts and replace gaskets. Standard thickness of gasket is .050, but .060 gaskets are available in case .050 gaskets are not compressed sufficiently to hold. |
| | Grease leaks from between blade and clamp. | Inscribe blade with ink or pencil to assure correct blade angle on re-assembly, and remove blade and clamp. Add gasket compound in radius of blade butt. Replace blade and clamp. |
| END PLAY IN BLADES | Buildup of manufacturing tolerances. | Total end play of .060 is permissible. |
| BLADE TRACK | | Tolerance of ⅛ inch is allowed. |
| BLADE FIT ON HUB PILOT TUBE | | With manufacturing tolerances, the maximum that the blade tip can be moved fore and aft is .068, without grease in blade clamps and bearings. With grease, the movement is nil. If blade tip fore-and-aft movement increases to .100 dry, blade requires factory re-bushing. |



# PART II – PARTS LIST

## SECTION I

## INTRODUCTION

The first column in each parts list is the figure and index number. This refers to the illustration and index number of each part. For example, if you are ordering a blade clamp assembly and want to see how and where it locates on the general assembly, this column indicates Figure 2, index number 20. Looking at Figure 2 in the group assembly Parts List, index number 20, the appearance and location of the clamp assembly may be easily found, also the details of all parts contained in this sub-assembly.

If you do not know the part number, you may refer to the applicable illustration and then find the index number assigned to it (20). Look in the parts listing, and read the part number, 838-10.

## HOW TO ORDER.

It is important that the Part Number, Part Name and Model Number be given when ordering parts.

# SECTION II

# GROUP ASSEMBLY PARTS LIST

## Models HC-A2XF, K, and L-2

### Feathering



| Code No. | Part No. | Description | No. Required F-2 | K-2 | L-2 |
|---|---|---|---|---|---|
| 1 | | Blade | 2 | 2 | 2 |
| 2F | 840-52 | HUB SPIDER UNIT (840-37 interchangeable) | 1 | | |
| 3F | C-981-3 | Hub Spider | 1 | | |
| 4 | A-158L | Pilot Tube | 2 | | |
| 2L | 840-39 | HUB SPIDER UNIT | | | 1 |
| 3L | C-982-1 | Hub Spider | | | 1 |
| 4 | A-158L | Pilot Tube | | | 2 |
| 2K | 840-40 | HUB SPIDER UNIT | | 1 | |
| 3K | C-982-2 | Hub Spider | | 1 | |
| 4 | A-158L | Pilot Tube | | 2 | |
| | A-2027 | Wire Rings, Bearing | 2 | 2 | 2 |
| | A-311 | Ball Spacers, Bearing | 2 | 2 | 2 |
| — | | HUB ASSOCIATED PARTS | | | |
| 5 | A-971 | Split Bearing | 2 | 2 | 2 |
| 6 | A-972 | Guide Ring | 2 | 2 | 2 |
| 7 | A-974 | Wire Ring, Retainer | 2 | 2 | 2 |
| 8 | PRP-909-8 | Blade "O" Ring | 2 | 2 | 2 |
| 9 | PRP-909-6 | "O" Ring, Hub Mounting | 1 | | |
| 10 | PRP-902-32 | "O" Ring, Hub Mounting | | 1 | 1 |
| 11 | .5002 × 1 | D. Dowel Pin | 2 | | |
| 12 | A-1328-1 | 12 Point Bolt (A-2040 or A-1333-4 Opt.) | 6 | | |
| 13 | B-933-1 | Shim, L Flange | | | 1 |
| 14 | B-1322 | Shim, K Flange | | 1 | |
| 15 | A-898-2 | Washer | | | 4 |
| 16 | A-988 | Bolt | | | 4 |
| 17 | A-988-1 | Bolt | | | 2 |
| 18 | A-1333 or -3 | Ferry Screw | | 2 | |
| 19 | A-1328 | Ferry Screw | | 4 | |
| | A-1381 | Washers (AN960-816 Opt.) | 6 | | |
| 20 | 838-10 (Alternate Depending On Blades Used) | CLAMP AND COUNTERWEIGHT SUB-ASSEMBLY (For 8433 and 8833 Blades) | 2 | 2 | 2 |
| 21 | 838-11 (Alternate Depending On Blades Used) | CLAMP AND COUNTERWEIGHT SUB-ASSEMBLY (For 7636 and 8433-12 Blades) *(838-11 same as 838-10 except on 838-10 add A-890-1 slug to B-271 counterweight, making 833-2 Counterweight Assembly)* | 2 | 2 | 2 |
| 22 | C-3-5A | Clamps | | | |
| 23 | A-304 | Link Screw | | | |
| 24 | A-285 | Staking Pin | | | |
| 25 | MS15001-1 | Clamp Zerk Fitting | 4 | 4 | 4 |
| 26 | B-271-1 | Counterweight | | | 2 |
| 27 | 833-2 | Counterweight | 2 | 2 | |
| 28 | A-65 | Counterweight Staking Pins | 2 | 2 | 2 |
| 29 | A-2036-30 | Socket Head Cap Screw | 4 | 4 | 4 |
| 30 | A-285 | Staking Pins (AN380-3-2 Opt.) | 4 | 4 | 4 |
| 31 | A-47-1 | Clamp Gaskets | 4 | 4 | 4 |
| 32 | A-282 | Clamp Mounting Socket Screws | 4 | 4 | 4 |
| 33 | AN380-3-2 | Cotter Pins | 4 | 4 | 4 |
| 34 | A-2017 | Clamp Bolts, 12 Point | 4 | 4 | 4 |
| 35 | AN960-616 | Clamp Mounting Washers | 4 | 4 | 4 |
| 36 | A-2043 | Clamp Nuts | 4 | 4 | 4 |
| | No. 3 | Lubricaps | 4 | 4 | 4 |
| — | | CLAMP ASSOCIATED PARTS | | | |
| 37 | A-48 | Balance Weight | - - - As Needed - - - | | |
| 38 | AN501A10-6 | Weight Screw | - - - As Needed - - - | | |
| 39 | A-881 | Stop Plate | 2 | 2 | 2 |
| 40 | AN501A10-6 or -5 | Stop Screws | 4 | 4 | 4 |
| 41 | A-944 | Sleeve, Link Screw | 2 | 2 | 2 |
| 42 | AN380-3-3 | Sleeve, Cotter Pin | 2 | 2 | 2 |
| 44 | 830-2A | AUTOMATIC HIGH PITCH STOP SUB-ASSEMBLY | 2 | | |
| 46 | B-882-1A | High Pitch Stop Bracket | 2 | | |
| 47 | A-883 | High Pitch Stop Pin | 2 | | |
| 48 | A-884 | High Pitch Stop Spring | 2 | | |
| 49 | AN380-3-3 | Spring Mounting Cotter Pins | 2 | | |
| 50 | AN936A10 | Washer, Internal Lock | 2 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 45 | | 830-9 | AUTOMATIC HIGH PITCH STOP SUB-ASSEMBLY | | | 2 |
| | 51 | B-984 | Bracket, High Pitch Stop | | | 2 |
| | 48 | A-884 | High Pitch Stop Spring | | | 2 |
| | 47 | A-883 | High Pitch Stop Pin | | | 2 |
| | 49 | AN380-3-3 | Cotter Pin | | | 2 |
| | 50 | AN936A10 | Washer, Internal Lock | | | 2 |
| | | 830-9A | AUTOMATIC HIGH PITCH STOP UNITS | | 2 | |
| | | B-984-1 | Bracket | | 2 | |
| | | A-883 | Pin | | 2 | |
| | | A-884 | Spring | | 2 | |
| | | AN936A10 | Washer | | 2 | |
| | | AN380-3-3 | Cotter Pin | | 2 | |
| — | | | AUTOMATIC HIGH PITCH STOP ASSOCIATED PARTS | | | |
| | 52 | AN5H4A | Mounting Bolt | 4 | | |
| | 53 | AN415A | Mounting Bolt | 4 | | |
| | 54 | AN960-416 | Mounting Washer | 4 | 8 | |
| | 55 | AN960-416L | Mounting Washer | 4 | | |
| | 56 | AN363-428 | Mounting Nut (H10-4 Alternate) | 4 | | |
| | | AN74-5 | Hex Head Bolts | | 4 | 4 |
| 57 | | 831-5A | FEATHERING SPRING SUB-ASSEMBLY | 1 | 1 | 1 |
| | 58 | B-855A | Pilot Tube | 1 | 1 | 1 |
| | 59 | A-856 | Outer Mushroom | 1 | 1 | 1 |
| | 60 | A-860-1 | Feathering Spacer Tube | 1 | 1 | 1 |
| | 61 | B-953 | Feathering Spring Inner (Heavy) | 1 | 1 | 1 |
| | 62 | B-853 | Feathering Spring Outer | 1 | 1 | 1 |
| | 63 | A-857 | Rear Retainer, Spring | 1 | 1 | 1 |
| | 64 | A-858 | Rear Split Retainer, Spring | 1 | 1 | 1 |
| 65 | | 832-24 | PISTON ASSEMBLY | 1 | 1 | 1 |
| | 66 | C-852-6 | Piston Jack Unit | 1 | 1 | 1 |
| | 67 | A-1464 | Link Pin Unit | 2 | 2 | 2 |
| | 68 | AN501A10-6 | Safety Bar Mounting Screws | 2 | 2 | 2 |
| | 69 | A-861-3 | Link Arms | 2 | 2 | 2 |
| — | | | HYDRAULIC ASSOCIATED PARTS | | | |
| | 70 | B-854 | Cylinder | 1 | 1 | 1 |
| | 71 | PRP-909-13 | Cylinder "O" Rings | 1 | 1 | 1 |
| | 72 | A-859 | Split Retainer Front | 1 | 1 | 1 |
| | 73 | A-899 | Feathering Stop | 2 | 2 | 2 |
| | 74 | AN501A10-6 | Stop Screw | 4 | 4 | 4 |
| | 75 | PRP-902-46 | "O" Ring | 1 | 1 | 1 |
| | 76 | A-863 | Dust Seal | 1 | 1 | 1 |
| | 77 | PRP-914-12 | "O" Ring, Pilot Tube | 1 | 1 | 1 |
| | 78 | A-880-2 | Piston Nut | 1 | 1 | 1 |
| 79 | | 835-13 | SPINNER SUB-ASSEMBLY | 1 | | |
| | 80 | C-888-4 | Spinner Dome | 1 | | |
| | 81 | AN526C1032R7 | Screws | 14 | | |
| | 82 | C-807-1 | Bulkhead | 1 | | |
| 83 | | 835-6P | SPINNER SUB-ASSEMBLY | | 1 | 1 |
| | 84 | C-888-4P | Spinner Dome | | 1 | 1 |
| | 81 | AN526C1032R7 | Screws | | 14 | 14 |
| | 85 | C-885P | Bulkhead Adaptor | | 1 | 1 |
| | | 835-16 | SPINNER ASSEMBLY | | 1 | 1 |
| | | C-888-4 | Dome, Spinner | | 1 | 1 |
| | | AN526C1032R7 | Screws, Dome Mounting | | 14 | 14 |
| | | C-885 | Adapter Ring Unit | | 1 | 1 |

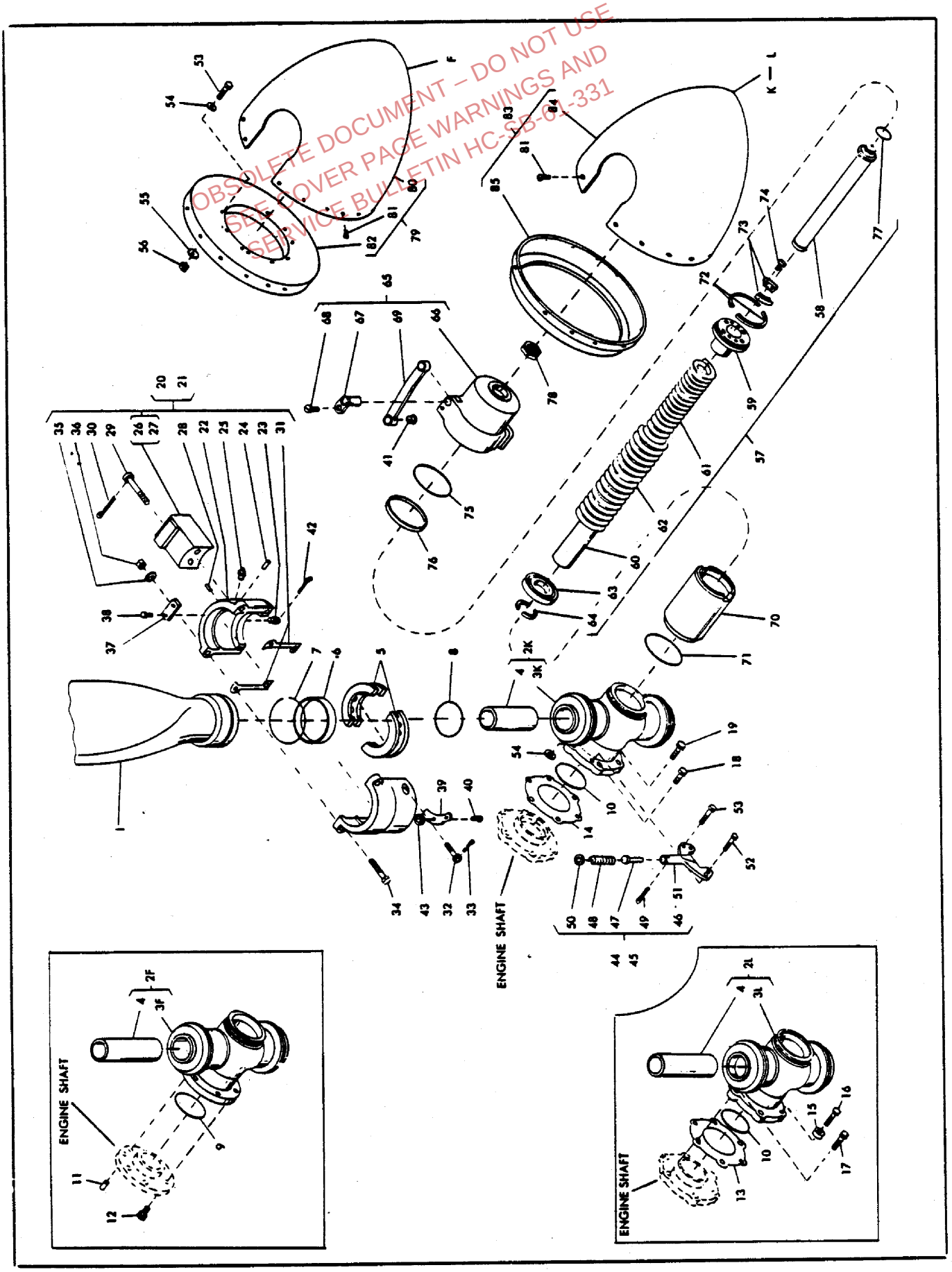


FIGURE 2—Models HC-A2XF-2 (and 2A), HC-A2XK-2 and HC-A2XL-2 Propellers, Exploded Views

# SECTION III



## PARTS LIST DIFFERENTIATING BETWEEN HC-A2XF-2 AND HC-82XF-2B

| Code | Part No. | Nomenclature | HC-A2XF-2 | HC-82XF-2B |
|---|---|---|---|---|
| 2F | 840-37 | Hub Spider Unit | 1 | |
| 3F | C-981 | Hub Spider | 1 | |
| 2F | 840-3 | Hub Spider Unit | | 1 |
| 3F | C-801-2 | Hub Spider | | 1 |
| 5 | A-971 | Split Bearing | 2 | |
| 5 | A-14-A | Blade Bearing | | 2 |
| 6 | A-972 | Guide Ring | 2 | |
| – | A-159 | Split Ring | | 2 |
| 7 | A-974 | Wire Ring Retainer | 2 | |

*All other parts are common to both designs.*

## PARTS LIST DIFFERENTIATING BETWEEN HC-A2XF-2 AND HC-A2XF-2A

| Code | Part No. | Nomenclature | HC-A2XF-2 | HC-A2XF-2A |
|---|---|---|---|---|
| 56 | 831-5A | Feathering Spring Sub-Assembly | 1 | |
| 57 | 855A | Pilot Tube | 1 | |
| 62 | 857 | Rear Retainer, Spring | 1 | |
| 56 | 831-1A | Feathering Spring Sub-Assembly | | 1 |
| 57 | 855-2A | Pilot Tube | | 1 |
| 62 | 857-1 | Rear Retainer, Spring | | 1 |

*All other parts are common to both designs.*

*NOTE: The HC-A2XF-2A Propeller is used only on McDermott Widgeon Conversion. It corresponds to the old HC-82XF-2C Model.*