

N18MD

HARTZELL

RIGHT

Propeller Owner's Manual & Log Book

HARTZELL PROPELLER INC.

One Propeller Place

Piqua, OH 45356-2634 U.S.A.

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F.A.A. Approved
Manual No. 115N
Revision 2
May 1992

HARTZELL PROPELLER INC.

CODE NO.

21C3F00170

115N

Manual No.

REVISION SERVICE

(Please Type or Print Clearly)

NAME

ADDRESS

Revision service is available for this manual upon request.

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Propeller Owner's Manual & Log Book

Installation Operation Service

All "Compact" Models

Series: ()HC — () (2, 3, 4)Y() — (1, 2, 4, 5, 7)()
Constant Speed, Feathering and Reversing

HARTZELL PROPELLER INC.

(2)

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CAUTION: KEEP THIS SERVICE RECORD WITH THE PROPELLER AT ALL TIMES WHEN THE PROPELLER IS INSTALLED AS PART OF AN AIRCRAFT OR ENGINE. THIS RECORD MUST BE MAINTAINED CONCURRENTLY WITH AND BECOME A PART OF THE AIRCRAFT AND ENGINE SERVICE RECORDS.

NOTE: Nearly all propeller models covered by this manual use aluminum propeller blades. There are, however, a few applications (such as the Porsche/Mooney propeller) which use composite blades. Composite blade information is not normally provided with this manual. A composite blade supplement to this manual is available upon request from the Hartzell Product Support Department.

For updated information and additional copies of the Log Book, contact:

Hartzell Propeller Inc.
Product Support Department
One Propeller Place
Piqua, OH 45356-2634 U.S.A.

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REVISION NO. 2 HIGHLIGHTS:

This revision adds information regarding the composite propeller blades at the end of this manual.

New forms have been added for records of composite blade damage repair on pages 25a and 25b.

Torque value was added for the feathering stop screw on HC-E2Y()-2.

Part number for the tool for charging the cylinder with dry air or nitrogen was added.

Special requirements were added for HC-C2YR-4()/B7422 and HC-C3YR-4()/B7466.

Caution was added to 100 Hour Inspection.

Information added on lubricating propeller assembly, adding pages 37a and 37b.

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LIST OF EFFECTIVE PAGES

Page	Original/ Revision	Date	Page	Original/ Revision	Date
Cover	Rev. 2	5/92			
ii - viii	Rev. 2	5/92			
Guide to Flying	Original	7/86			
1	Rev. 2	5/92			
2	Original	7/86			
3 - 4	Rev. 2	5/92			
5 - 25	Original	7/86			
25a, 25b	Rev. 2	5/92			
26 - 30	Original	7/86			
31	Rev. 2	5/92			
32 - 35	Original	7/86			
36	Rev. 2	5/92			
37, 37a, 37b	Rev. 2	5/92			
38 - 39	Rev. 2	5/92			
40	Original	7/86			
Announcement	Original	7/86			
*Composite Blade Section	Rev. 2	5/92			

*replaces pages 36-1 through 36-34,
dated 10/87

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Hartzell. . . A Guide to Better Flying

IMPORTANT

People who fly should recognize that various types of risks are involved; and they should take all precautions to minimize them, since they cannot be eliminated entirely. The propeller is a vital component of the aircraft. A mechanical failure could cause a forced landing or even create vibrations sufficiently severe as to damage the aircraft.

Propellers are subjected to constant vibration stresses coming from the engine and airstream, which are added to high bending and centrifugal stresses.

Before a propeller is certified as being safe to operate on an airplane, an adequate margin of safety must be demonstrated. Even though every conceivable precaution is taken in the design and manufacture of a propeller, history has revealed rare incidents of failures, particularly of the metal fatigue type.

It is essential that the propeller be properly maintained according to the recommended service procedures, and a close watch be exercised to detect impending problems before they become serious. Any unusual vibration should be investigated and eliminated as it could be a warning that something serious is wrong.

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Introduction

The purpose of this Manual is to enable one to properly install, operate and maintain a Hartzell Constant Speed or Feathering propeller. Separate handbooks are available for overhaul of Hub/Blades.

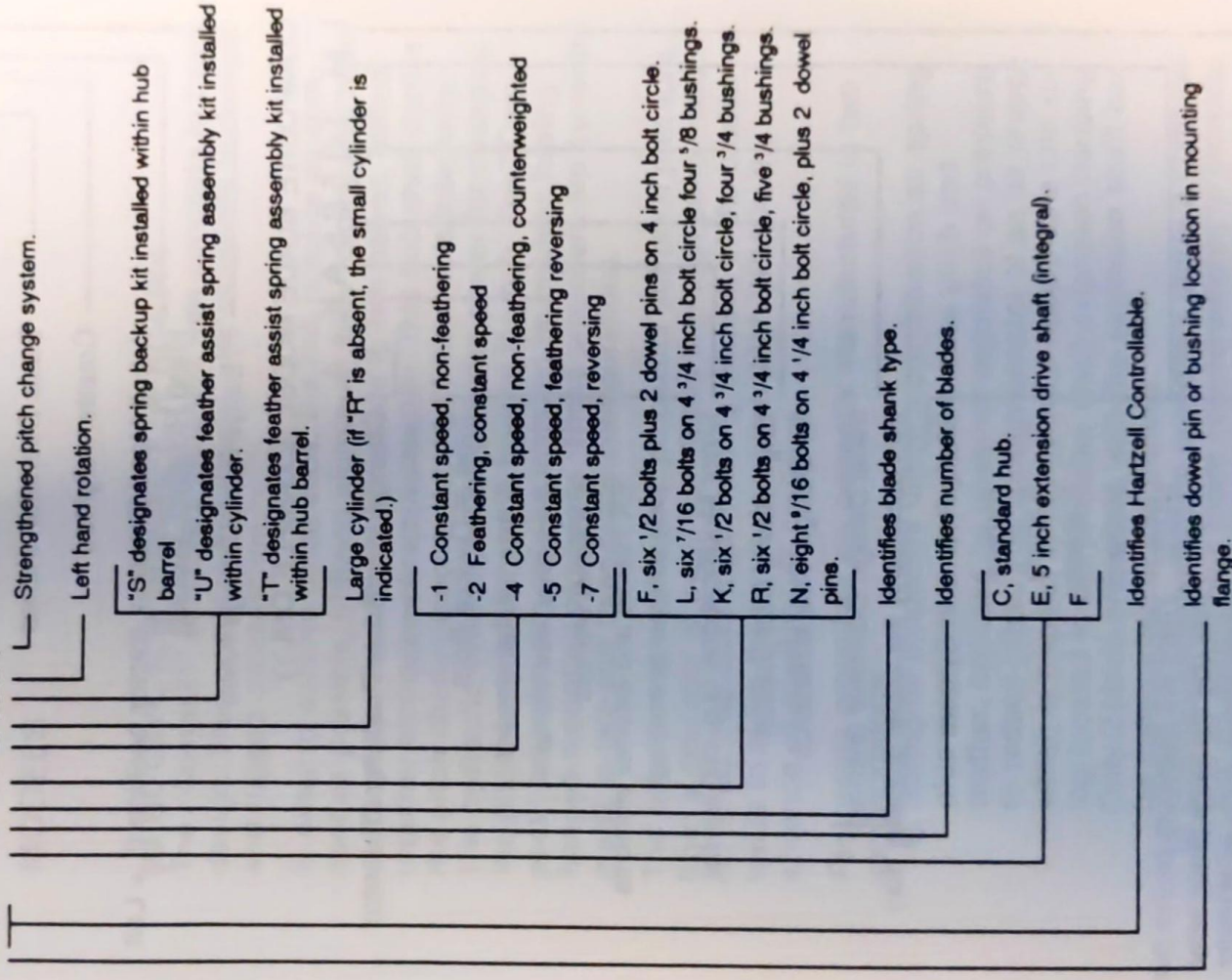
The present Manual covers several series of the design types being currently used in large numbers, viz., HC-C3Y, HC-C2Y, HC-E2Y, and HC-E3Y, 2-blade, 3-blade, and 4-blade constant speed and feathering propellers.

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PROPELLER HUB MODEL (EXAMPLE ONLY)

BHC - C2YK 2RSL F



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ALUMINUM BLADE MODEL (EXAMPLE ONLY)

F JC8475-3

_____ Basic Diameter Reduction, *inches*

_____ Design Number

_____ Basic Diameter, *inches*

_____ Counterweighted

_____ J, Left Hand Rotation, tractor position (L = Left
Hand Rotation, pusher)

_____ F, Large Pitch Change Knob

COMPOSITE BLADE MODEL (EXAMPLE ONLY)

L M - 1 0 5 8 5 A K + 4

_____ Change from Basic Propeller Diameter
(inches plus or minus)

_____ Type of De-Icer Boot

K external, foil element

B external, wire element

E internal element

EK internal and external elements
(only external is working)

_____ Minor Modifications (e.g. cuff shape)

_____ Engineering Designation
for Design Characteristics

_____ Initial Design Diameter (inches)
(Not necessarily the actual propeller dia.)

_____ Blade Retention System

A shank

B shank

E shank

M shank

NOTE: There are aluminum blades that
may use the same prefix letter
designations, such as M10282.
There are no model designation
letters which clearly indicate
whether a blade is composite or
aluminum)

_____ Direction of Rotation (L = Lefthand Blade)

Descri
MODELS

(a) HC-C2V
The "Comp
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and rugged

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the pitch c
The hydrat
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b) Spr
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Description OF VARIOUS PROPELLER MODELS

(a) HC-C2YL, K, R; HC-E2YL, K, R; HC-E3YR

The "Compact" propellers represent new concepts in basic design. They combine low weight with simplicity in design and rugged construction.

In order to achieve these ends, the hub is made as compact as possible, utilizing aluminum alloy forgings for most of the parts. The hub shell is made in two halves, bolted together along the plane of rotation. This hub shell carries the pitch change mechanism and blade roots internally. The hydraulic cylinder, which provides power for changing the pitch, is mounted at the front of the hub. The "Compact" propeller can only be installed on engines having flanged mounting provisions. These propellers are currently made in two-and three-blade configurations.

The constant speed, dash 1, propellers utilize oil pressure from a governor to move the blades into high pitch (reduced RPM). The centrifugal twisting moment of the blades tends to move them into low pitch (high RPM) in the absence of governor oil pressure.

Feathering propellers are currently manufactured in two configurations:

- a) Spring-oil propellers utilize a combination air spring plus mechanical spring to increase pitch and feather, opposed by governor regulated oil pressure to reduce pitch. The springs consist of an air charge which is trapped in the cylinder head plus a coil spring located in the propeller shaft extension housing. Only 2-blade propellers with the extension shaft can be constructed in this manner.
- b) Spring-counterweight-oil propellers utilize a combination air spring plus blade counterweights to increase pitch and feather, opposed by governor regulated oil pressure to reduce pitch. All 3-blade feathering propellers are constructed in this manner.

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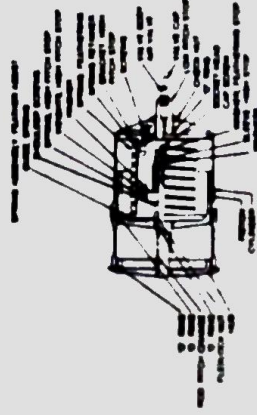
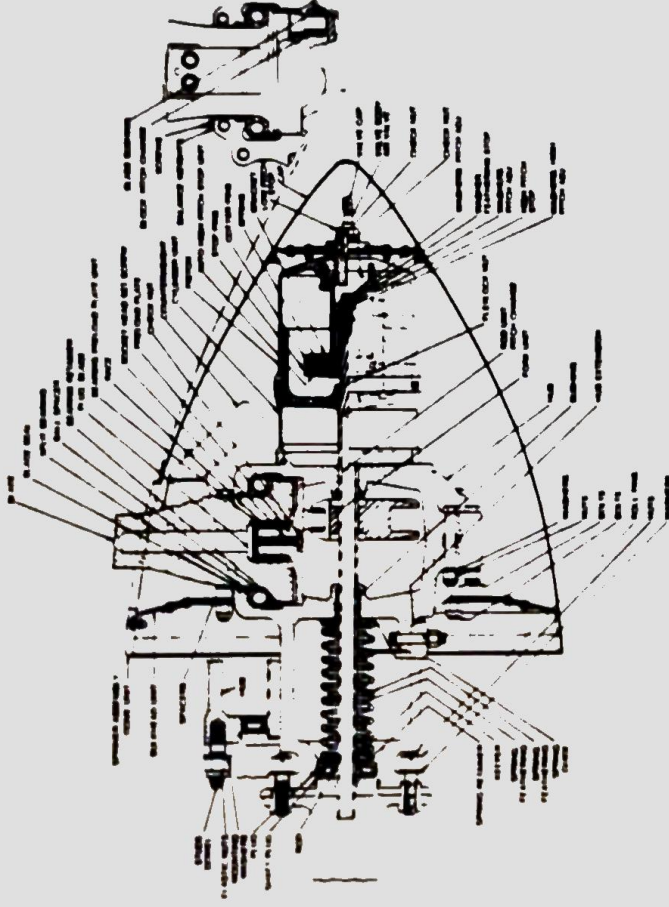
(b) Operation of Counterweight Propellers (Non-Feathering)

If the engine speed drops below the RPM for which the governor is set, the rotational force on the engine driven governor flyweights becomes less. This allows the speeder spring to move the pilot valve downward. With the pilot valve in the downward position, oil from the gear type pump flows through passage to the propeller and moves the cylinder outward. This, in turn, decreases the blade angle and permits the engine to return to the on-speed setting.

If the engine speed increases above the RPM for which the governor is set, the flyweights move against the force of the speeder spring and raise the pilot valve. This permits the oil in the propeller to drain out through the governor drive shaft. As the oil leaves the propeller, the centrifugal force acting on the counterweights turns the blades to a higher angle, which decreases the engine RPM. When the engine is exactly at the RPM set by the governor, the centrifugal reaction of the flyweights balances the force of the speeder spring, positioning the pilot valve so that oil is neither supplied to nor drained from the propeller. With this condition, propeller blade angle does not change. Note that the RPM setting is made by varying the amount of compression in the speeder spring. Positioning of the speeder rack is the only action controlled manually, all others being controlled automatically within the governor.

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FEATHERING ASSIST SPRINGS ARE ILLUSTRATED IN BOTH HUB AND CYLINDER AREAS TO SHOW EITHER LOCATION



FOR INFORMATION ONLY -- NOT TO BE USED AS SPECIFIC PART REFERENCES

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(c) Operation of Non-Counterweight Constant Speed Propellers (Non-Feathering)

The operation of the propeller and governor is reversed from the case of the counterweight propellers. Blade centrifugal twisting movement tends to reduce pitch and the governor oil pressure increases pitch; which is the opposite of that for counterweight propellers.

(d) Operation of Feathering Propellers, Counterweight Type; Also Compact Types

*The feathering propellers operate similarly to the non-feathering ones except the feathering spring assists the counterweights to increase the pitch.

Feathering is accomplished by releasing the governor oil pressure, allowing counterweights and feathering spring to feather the blades. This is done by pulling the governor pitch control back to the limit of its travel, which opens up a port in the governor allowing the oil from the propeller to drain back into the engine. The time necessary to feather depends upon the size of the oil passage from the propeller to the engine, and the force exerted by the spring and counterweights. The larger the passages through the governor and the heavier the spring, the quicker is the feathering action. Elapsed time for feathering, between three and ten seconds, is usual with this system.

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The ability to unfeather the blades, or reestablish normal pitch, within the same elapsed time is not considered important for the light twin-engine airplane. The possibility of feathering the wrong propeller in an emergency is remote, as the wrong action will become apparent in ample time to be corrected. Furthermore, there is no need to restart the dead engine for landing, as the light twin can be easily landed with the one engine. About the only requirement for unfeathering is for demonstration purposes.

Unfeathering is accomplished by repositioning the governor control to the normal flight range, and restarting the engine. As soon as the engine cranks over a few turns the governor starts to unfeather the blades and soon windmilling takes place, which speeds up the process of unfeathering. In order to facilitate cranking of the engine, the feathering blade angle is set at 80 to 85 degrees at the $\frac{3}{4}$ point on the blade, allowing the air to assist the engine starter. In general, restarting and unfeathering can be accomplished within a few seconds.

Special unfeathering systems are available for certain aircraft, for which restarting the engine is difficult, or for demonstrators. The system consists of an oil accumulator connected to the governor through a valve.

In order to prevent the feathering spring from feathering the propeller when the airplane is on the ground and the engine stopped, automatically removable high-pitch stops were incorporated in the design. These consist of spring-loaded latches fastened to the stationary hub which engage high-pitch stop-plates bolted to the movable blade clamps. As long as the propeller is in rotation at speeds over 800 RPM, centrifugal force acts to disengage the latches from the high-pitch stop-plates so that the propeller pitch may be increased to the feathering position. At lower RPMs, or when the engine is stopped, the latch springs engage the latches with the high-pitch stops, preventing the pitch from increasing further due to the action of the feathering spring.

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One safety feature inherent in this method of feathering is that the propeller will feather if the governor oil pressure drops to zero for any reason. As the governor obtains its supply of oil from the engine lubricating system, it follows that, if the engine runs out of oil or if oil pressure falls due to breakage of a part in the engine, the propeller will feather automatically. This action may save the engine from further damage in case the pilot is not aware of trouble.

***NOTE:** The HC-C()Y() and HC-E()Y() models utilize compressed air plus a mechanical spring or counterweight to feather the blades.

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OPERATING ADVISORY FOR AIR-CHARGED PROPELLERS

The purpose of these instructions is to advise pilots of indications of loss of air in air charged propellers. Since in most cases the operation of propeller is unaffected by loss of air charge, it is advisable to maintain the recommended pressures at all times. The aircraft flight manual has precedence over these instructions.

1. Propellers having air charge to feather using counterweights or spring assist to high pitch, ()HC-() (2,3) Y (K,R,F)-2()C (X X X); letter "S" after -2 suffix in hub model designates spring; letter "C" in prefix of blade model designates counterweights.

a. If the air charge is lost, or low, the pilot may notice the following:

- 1) Preflight feathering check will be sluggish or slow.
- 2) RPM control may be sluggish in flight, particularly in the direction of reducing RPM.
- 3) Slight overspeed or poor synchronization at the upper end of the cruising speed range.
- 4) Propeller overspeed with throttle burst, poor RPM recovery.

b. In the event of lost air charge the pilot should:

- 1) In the event of any of the above signs, reference Propeller Service Manual for corrective action.
- 2) In case of propeller overspeed in flight, the throttle should be reduced first and then the airspeed reduced to the point where RPM control is regained, but not below the best single-engine rate of climb speed as published in the aircraft's flight manual. Slowly add throttle to regain power without overspeeding the propeller. Once proper RPM and power is recovered, hold the airspeed well below that at which overspeed occurred. Flight can be continued at reduced speed without further incident, except feathering capability is lost in the case of the "C" prefix.

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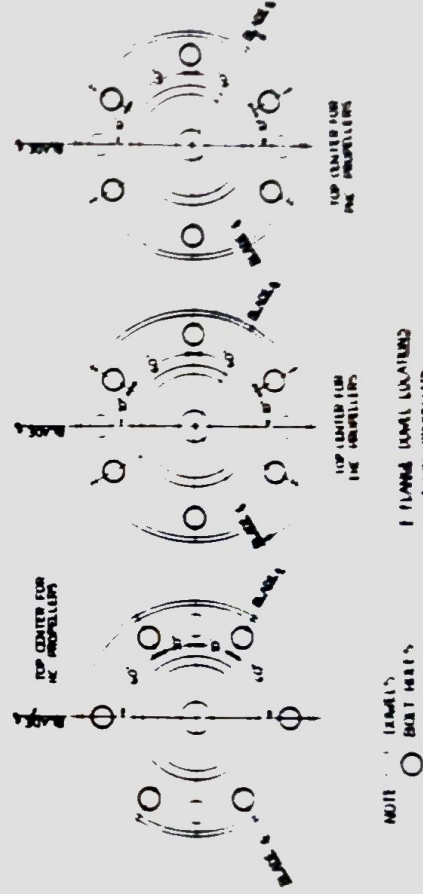
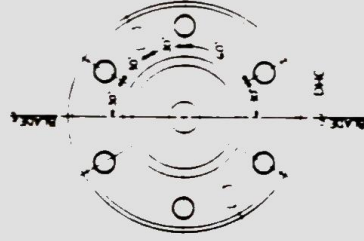
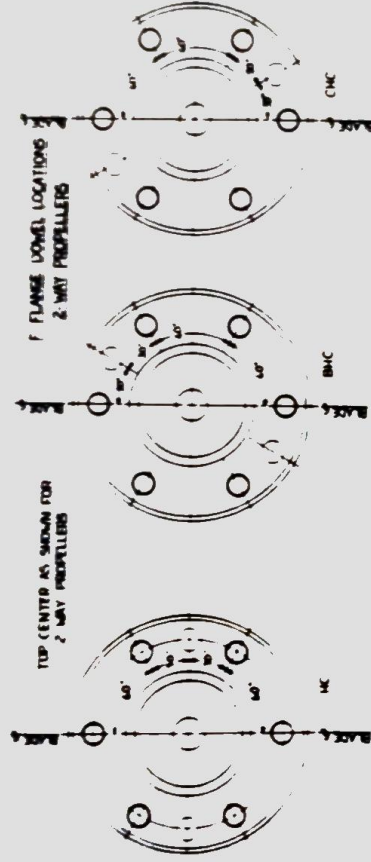
2. Propellers having air charge to feather **without counterweights** and **with spring assist** will be identified with the letter "S" following the -2 suffix in the propeller model number. The **absence** of the "S" indicates the air charge only is employed to feather or move the propeller servo system to a higher pitch.
3. Propellers having air charge to feather **with counterweights** and **spring assist** will be identified with the letters "T" or "U" following the -2 suffix in the propeller model number. The absence of the "T" or "U" indicates the air charge and counterweights only are employed to feather or move the propeller servo system to a higher pitch.

The following are control procedures to follow in case air charge is inadvertently lost:

- a. If air charge is lost, the pilot may notice the following:
 - 1) The propeller will not change pitch on preflight feathering check.
 - 2) RPM will increase in flight as power and airspeed are increased, and propeller RPM control has no effect.
- b. In the event of lost air charge, the pilot should:
 - 1) Check air charge pressure if propeller does not change pitch on the ground feathering check.
 - 2) In case of a propeller overspeed in flight, the throttle should be reduced first, then maintain an airspeed at which RPM will not exceed rated. Keep the airspeed at or above the best single-engine rate of climb airspeed as published in the aircraft's flight manual.
The propeller will operate at a fixed low pitch blade angle with no feathering capability. Control RPM with throttle and airspeed. Only a slight amount of throttle may be added without overspeeding the propeller.
Flight can be continued to nearest airport.

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NOTE: 1. BOLT HOLE
2. BOLT HOLE

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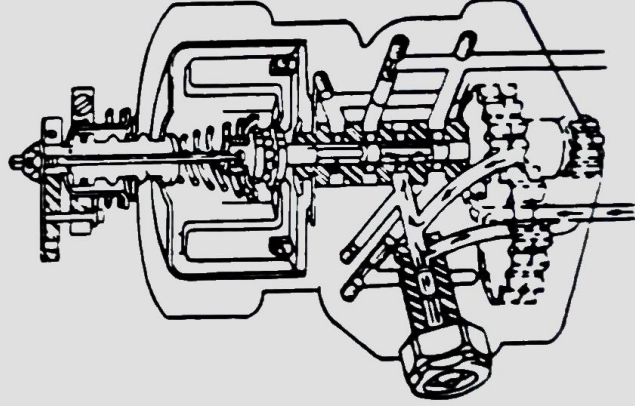
Governor Description

(b) Woodward Governors

The Woodward X210XXX series governor, used on many of the Hartzell propeller installations, is shown cutaway in illustration. This governor is arranged for single acting operation in either direction or double action. This means that the governor pressure can be used either to decrease pitch or to increase pitch, or both.

For dash 1 models, oil from the governor is used to increase pitch opposing the centrifugal twisting movement of the blades themselves to decrease pitch.

The Woodward governors generally are adjusted to produce about 275 p.s.i. when installed on an engine having a lubricating oil pressure of about 60 p.s.i.



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PROPELLER MAINTENANCE RECORD

LEFT ENGINE

Hub Model PHC-C3YF-24F 7663-2R

Blade Design FC 7663-2R

Diameter _____

Hub Ser. No. EB3410A

Blade Ser. Nos. _____

No. 1 H53223

No. 2 H53230

No. 3 H53227

No. 4 _____

PITCH RANGE

High _____ Low _____

Feather _____ Reverse _____

Governor Model _____

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CODE NO. 211-1130
7-2A-93

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~~LEFT~~
RIGHT ENGINE

Hub Model

PHC-C 38F - 20F/PC 7663AR

Blade Design

PC 7663-2R

Diameter

Hub Ser. No.

EB 3410R

Blade Ser. Nos.

No. 1 H 53 223

No. 2 H 53 230

No. 3 H 53 227

No. 4

PITCH RANGE

High

17.5

Low

13.0

Feather

81.5

Reverse

Governor Model

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DESCRIPTION OF ALL OPERATIONS PERTAINING TO AIRWORTHINESS DIRECTIVES, SERVICE BULLETINS, SERVICE LETTERS, & MINOR ADJUSTMENTS

DATE	TACH TIME	DESCRIPTION OF WORK	SIGNATURE
1-21-93		PROP SN FB3410A INSTALLED NEW	
		CA131-3 DE-ICE BOOTS AND STATIC	
		BALANCED	
		REF: w/o # 9300130	
		Alennis Pittsberger	
		CERTIFICATE # 2424305	
		HARTZELL SERVICE CENTER	
		REPAIR STATION # SJ3R843L	
02-16-93		Prop installed on aircraft	
		Bech D-55 N18MD	
		Delroy Sandlin AP429642582	
3-26-93		Tach 252.7 Reinstalled this Propeller in	
		AC N18MD after STC	
		SA32545 ~~was removed~~ 8-1-98	
		~~New Propeller is on file~~	
		Book entering from Detroit.	
		— end — Jerry Jones	
		AP411376849	

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Hobbs

DATE	TACH TIME	DESCRIPTION OF WORK	SIGNATURE
6-29-93	2208.1	Dynamic Balanced & Vibration Trashed This A/C Spinner - Propeller - Engine Comb. as per "spec". See Aircraft Log for Complete Entry. Linda J. Hicks F.A.A. Repairman 427882813 <i>[Signature]</i> N5P428682644	
		I CERTIFY THAT THIS <u>PROP</u> WAS BEEN INSPECTED IN ACCORDANCE WITH A <u>1</u> INSPECTION AND WAS DETERMINED TO BE IN AIRWORTHY CONDITION	
		REPAIR CLEVELAND, MISSISSIPPI	<i>[Signature]</i> ADP757019
11-1-94	Hobbs 2368	I CERTIFY THAT THIS <u>Propeller</u> WAS BEEN INSPECTED IN ACCORDANCE WITH A <u>1</u> INSPECTION AND WAS DETERMINED TO BE AIRWORTHY CONDITION	<i>[Signature]</i> ADP587786743

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DESCRIPTION OF ALL OPERATIONS PERTAINING TO AIRWORTHINESS DIRECTIVES, SERVICE BULLETINS, SERVICE LETTERS, & MINOR ADJUSTMENTS

DATE	TACH TIME	DESCRIPTION OF WORK	SIGNATURE
D-5-95 (old Wbr 2398.7)	00.0	(new hour meter installed)	
		I CERTIFY THAT THIS Propeller HAS BEEN INSPECTED IN ACCORDANCE WITH A DOCK INSPECTION AND IS FOUND TO BE IN GOOD CONDITION.	Steve A. Hall AP 581786743
5-22-96	H0805	24.7	
	AFTT	2979.4	
		I certify that this propeller has been inspected now a 109 hour inspection and is considered to be in an airworthy condition Jim Hall AP 257198580	

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DESCRIPTION OF ALL OPERATIONS PERTAINING TO AIRWORTHINESS DIRECTIVES, SERVICE BULLETINS, SERVICE LETTERS, & MINOR ADJUSTMENTS

DATE	TACH TIME	DESCRIPTION OF WORK	SIGNATURE
2-15-03	850 HOBBS	inspected 1A w 100FH / annual inspection and determined this propeller to be in an airworthy condition for service	<i>[Signature]</i> 11/13/03
7/03/03		Evaluate blade S/N #153230 for previous prop blend - blade determined to be within min chord and thickness limits as per Hartzell S/D 61-13-33	<i>[Signature]</i> 7/03/03
		Page 1111 7663E blades ok for service	
Hartzell (Left) 8/25/2004			SER# EB3410R SPOH 17081

This date performed an annual inspection on this Propeller. Removed all nicks and painted back of blades flat black. I have inspected and determined that this prop has been found to be in airworthy condition.

11/20/04
[Signature]

11/2/2007 HOBBS: 1153.1 1369.1
Make: Hartzell PHC-C3YF-2 TSPOH: 1986.1 N18MD
Hub Ser# EB3410R Left Propeller

Performed 100 hour inspection and lubrication in accordance with Hartzell
Manual 115N.

I certify that this propeller has been inspected in accordance with a 100 hour
inspection and was determined to be in an airworthy condition.

Douglas Durning A&P 116503811

[Signature]

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Blade Serial Number

[illegible]

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Propeller Installation Instructions

The Compact propellers are manufactured with five basic flange mountings: "F" flange, "L" flange, "K" flange, "R", and "N".

The "F" flange has six $\frac{1}{2}$ -inch studs on a 4-inch bolt circle, plus two $\frac{1}{2}$ -inch dowel pins. These dowel pins are located to provide a specific angular relationship of the propeller with respect to the crankshaft, made necessary by the vibrational characteristics of the combination. The particular dowel pin location is identified by the first letter in the hub model designation, such as BHC-C2YF.

The "L" flange is an SAE No. 2 flange with $\frac{7}{16}$ -inch studs; while the "K" flange is also SAE No. 2 flange with $\frac{1}{2}$ -inch studs. The "R" is same as "K" except it has 5 drive bushings, instead of 4.

Propeller models HC-F4Y(R,F,N)-2 are similar in construction and operation to models HC-F(2,3)Y(R,F,N)-2()UF previously described in this manual.

Please note these propellers utilize an air charge and counterweights and a feather spring assist although the letter "U" is not incorporated in the model design. Refer to the section covering "Operating Advisory for Air-Charged Propellers" for control procedures.

The letter "F" which normally designates the pitch change knob design is approved for use. The "F" is still required on the blade design to distinguish between large and small knob blades. Only the large knob blade is approved for use in the HC-F4Y(R,F,N)-2 propeller.

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5. Install spinner dome. The spinner nose is supported by the cylinder, only for the feathering models. Wire safety the nut used to secure the nose in place.

NOTE: When installing the HC-E2YL-2BS propellers (which have spring kits installed) on the PA-30 or PA-39 aircraft, be sure that the front inside of the **engine** shaft does **not** contain the spring assembly, consisting of: A-2488 sleeve, 9-2410-31 spring, A-2487 thimble, and A-2496 shim. These parts are no longer needed.

C. Installation of Models (B)HC-I2YF-1()F

These models are identical to the (B)HC-C2YF-1()F except for the location of the blade centerline with respect to the shaft mounting surface. This is a solid metal 2 inch extension.

(B)HC-C2YF-1() - 3.25 inches

(B)HC-I2YF-1() - 5.25 inches

D. Installation of Models (B)HC-I2YF-4()F

These models are identical to the (B)HC-C2YF-4()F except for the location of the blade centerline with respect to the shaft mounting surface. This is a solid metal 2 inch extension.

(B)HC-C2YF-4() - 3.25 inches

(B)HC-I2YF-4() - 5.25 inches

E. Adjustments

1.STATIC RPM

The low pitch stop on the propeller should be set to obtain take-off RPM, or about 50 RPM below, during engine runup on the ground. This stop is normally set for each application at the factory. In the event that an adjustment is required, this can be accomplished by adjusting the screw in the nose of the cylinder. Backing the screw out 1/2 turn will increase the static RPM about 100; or vice versa.

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CAUTION

Before adjusting the low stop screw on the Feathering Propeller, the air pressure must be dropped to zero. Unless this is done, it is possible to unscrew the low stop far enough to disengage the threads, allowing the pressure to blow the low stop screw out with great force. There must be at least four threads engaged during normal operation. Replace air as per applicable charging instructions.

The high RPM stop on the governor should be set for take-off RPM.

2. There is no high pitch stop adjustment for either the constant speed or feathering propellers.
3. The feathered blade angle for the dash 2 propellers can be adjusted by adding or removing shims. Adding shims increases the feathered angle.

In order to test whether the governor or the propeller low stop is limiting the static RPM, the operator can run the engine up on the ground. With the throttle wide open, increase RPM slowly with the RPM control. If the propeller low stop is limiting the RPM, the RPM will stabilize before the RPM control reaches the limit of its travel. If the RPM increases continuously during the entire movement of the RPM control, the governor is limiting the static RPM and not the propeller low stop. As mentioned above, it is desirable that the propeller stop limit the RPM to about 50 below the engine rating, so that in the event the governor malfunctions during takeoff, the propeller will overspeed a minimum amount.

(b) High Pitch Stop

The high pitch stop is of significance only for non-feathering propellers. This stop is set at the factory and cannot be adjusted for this model.

(c) Feathering Pitch Stop

The feathering stop should be adjusted such that the propeller will stop turning when the propeller is feathered.

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For the "Compact" air feathering propeller HC-E2Y()-2, the feathering stop can be adjusted by adding or removing shims in the location shown. Adding shims increases the feathering angle. In order to make this adjustment, first let out the air from the cylinder, then remove the low stop adjusting screw. Use a socket key wrench to remove the feathering stop screw. After the adjustment has been made, reinstall the feathering stop screw with "Locktite #222" on the screw threads. Torque to 19 - 23 ft lb.

(d) Charging the Feathering Propeller with Air

Using proper control, charge the cylinder with dry air or nitrogen to a pressure according to table which is on the spinner cap or side of the cylinder. (Hartzell tool part no. BST-2806 is available for this purpose.) The basic pressures are:

- (a) HC-()2Y(L, K)-2 which do not have spring kits, 175 PSI at 70°F.
- (b) HC-()2Y()-2U()S which have spring kits, 50 PSI at 70°F.
- (c) HC-()2Y(K, R)-2RBS which have spring kits, 70 PSI at 70°F, which do not have spring kits.
- (d) All propellers having blade counterweights, 80 PSI at 70°F, which do not have spring kits.
- (e) HC-C3YN-2()() on Piper PA-31P aircraft with feather assist spring assembly kit A-1588A, 41 PSI at 70°F.
- (f) All ()HC-E()Y()-2()S counterweighted propellers with feather assist spring assembly kit A-1587 or A-1587-1, 41 PSI at 70°F.
- (g) All ()HC-(*)2, 3)Y()-2()() counterweighted propellers; (*) except "E" extension; with feather assist spring assembly kit A-1588A, 41 PSI at 70°F.
- (h) BHC-C2YF-2C(L)KUF on Piper PA-34-200T with feather assist spring assembly kit A-1588A, 22 PSI at 70°F.

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Operating Instructions

(a) Normal Control

1. The governor control is arranged to provide HIGH RPM when full forward and LOW RPM when pulled back. The governor will control over a certain RPM band, which can be covered by moving the control through a portion of its travel at the forward end of its range when the throttle is well forward.
2. Most ground operation of the aircraft is done with full forward position of the governor, so starting and stopping should likewise be done in low pitch, although there is no reason why other settings could not be used.
3. An operational check of the governor and propeller should be made during run up.
4. Take-off should be made with propeller setting FULL IN to obtain take-off RPM.
5. During landing the propeller control should be FULL IN so that propeller will act as a brake and be in position for immediate take-off if necessary.

(b) Feathering Procedure

1. Feather the propeller several times after installation is made in order to purge air from the system. Partially feather each propeller during each pre-flight check; but feathering action should be stopped when 500 RPM is lost.
2. Feathering on the ground is accomplished by reducing RPM with throttle to 1000-1500 propeller speed and pulling propeller control FULL BACK against the stop. Do not feather when operating at high manifold pressure. Unfeathering is accomplished by returning propeller control to normal range with engine running.
3. Emergency feathering in flight is accomplished by pulling back on propeller control to limit of travel.
4. Unfeathering in flight is accomplished by starting the engine with propeller control in low RPM range, or about halfway between each end of travel. Engine should be idled until it becomes warm before increasing power.

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Service Instructions

(a) Propeller Care

1. Avoid operation of aircraft in areas with loose stone or gravel that could be pulled into the blades, causing damage to the blade face or leading edge. When initiating take-off from a non-hard surface runway, allow the aircraft to build up speed prior to opening the throttle. Keep blade clean of stains and foreign matter. DO NOT move aircraft by pulling on propeller blades.

2. IMPORTANT - Nicks, gouges, and scratches in the leading or trailing edge and on the blade surfaces, both face and camber sections, must all be removed prior to flight. Operating in conditions as this may produce a condition in which fatigue cracks will start and blade failure will occur. A small nick may be as detrimental as a larger one. It is extremely important that all nicks be removed prior to each aircraft operational period. Nicks in the outer 18 inches of the propeller diameter must be treated as critical. This is the area of highest vibratory blade stress.

3. How to Properly Repair Nicked Blades - Tools Required:

Fine cut round and flat files

Emery tape or cloth

10X magnifying glass

Crocus cloth

Dye penetrant

Propeller blades with nicks, gouges, scratches, and leading edge pitting can be repaired most often by a qualified mechanic in the field. Blades with larger nicks, gouges, etc. that may affect the structure, balance, or operation of the propeller should be referred to a qualified propeller repair station for repair or replacement. There is normally sufficient material available to allow a number of repairs prior to replacement.

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Local Repairs: This repair may be made using files, small air or electrical powered equipment with suitable grinding and polishing attachments. All repairs must be accomplished parallel to the blade axis.

- a) For damaged areas in the leading or trailing edge, begin with a round file removing damaged material to the bottom of the damaged area. Remove material from this point out on both sides, providing a smooth faired depression, maintaining the original airfoil concept. Using emery cloth, the area must now be smoothly faired, removing all traces of initial filling and rework. Crocus cloth may then be used to polish the area. When all rework has been completed, inspect the reworked area with a 10X magnifying glass and dye penetrant, assuring no indications of damage or cracks remain.
- b) Damaged areas on the face of camber sections of the blade are to be reworked employing the same methods as the leading edge. However, repairs that form a continuous line across the blade section are **not acceptable**.
- c) All repaired areas are to be chemically treated to prevent corrosion. Alodine or Hartzell Polane paint must be properly applied to the repaired area prior to return to service.

CAUTION

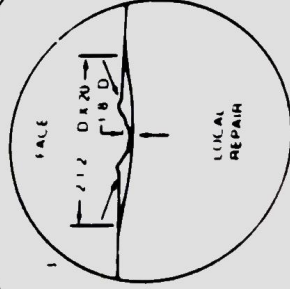
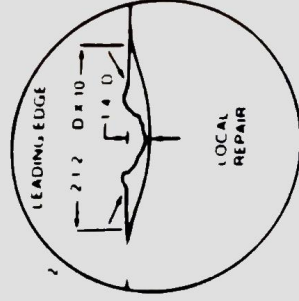
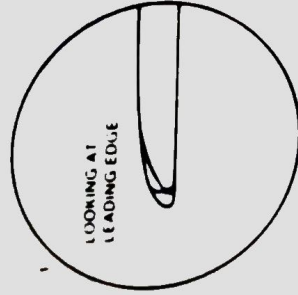
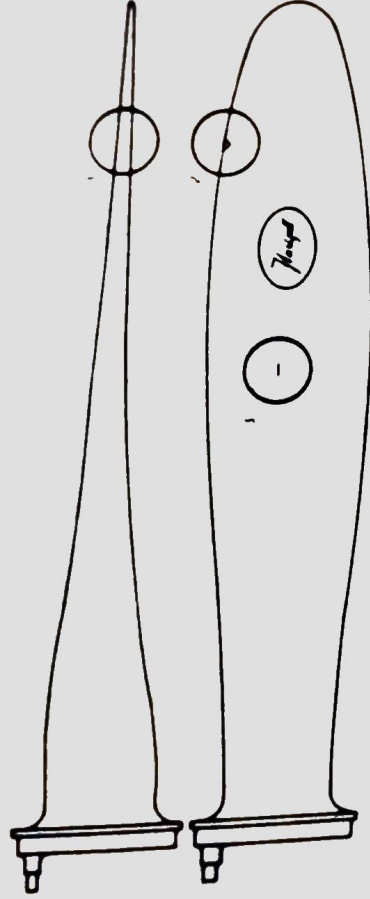
All methods such as leading edge rolling or cold working which will result in **moving** metal covering and possibly concealing damage are not acceptable.

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CAUTION

Small nicks and gouges are just as detrimental as large ones. Repairs must be made immediately to prevent propeller failure.



TO DETERMINE THE NEEDED AMOUNT OF REWORK, USE THE FOLLOWING FORMULA

- LEADING AND TRAILING EDGE DEPTH OF NICK $\times 10$
- FACE AND CAMBER DEPTH OF NICK $\times 20$

NOTE: LOCAL WIDTH OF THE NICK ≤ 55 REPAIR DEPTH MAY NOT EXCEED THE MANUFACTURERS MINIMUM REPAIR TOLERANCE.

Repair Limitations

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4. Steel hub parts must not be permitted to rust. When the cadmium plating is worn off, the surface should be cleaned, treated, and Hartzell polane paint applied. Replate and bake parts at overhaul. Inspect all parts for wear or fretting and lubricate as per inspection procedure.

(b) Daily Inspection Procedure

1. Inspect blades for nicks, gouges, etc., spinner and visible hub parts for damage or cracks. Repair prior to next flight.
2. Inspect for grease or oil leakage.
3. Special requirement for HC-C2YR-4()/B7421 and HC-C3YR-4()/B7466.
 - a. These propellers have composite blades and are used on acrobatic aircraft. This design requires a relatively high air pressure in the propeller cylinder which is critical for proper function of the propeller.
 - b. These propellers should have the air charge inspected daily:

HC-C2YR-4()/B7421 is to be charged $178 \text{ psi} \pm 10 \text{ psi}$.

HC-C3YR-4()/B7466 is to be charged $200 \text{ psi} \pm 10 \text{ psi}$.

(c) 100 Hour Inspection

CAUTION: LUBRICATION PROCEDURES MUST BE FOLLOWED CORRECTLY TO MAINTAIN ACCURATE DYNAMIC BALANCE OF THE PROPELLER BLADE ASSEMBLIES AND HUB ASSEMBLY.

1. Remove spinner.
2. Inspect blades for nicks and cracks. Remove all nicks, gouges, etc.
3. Inspect hub parts for cracks, or wear.
4. Check all visible parts for wear and safety.
5. Check for oil and grease leaks.
6. Lubricate the propeller assembly:

CAUTION: REMOVE THE LUBRICATION FITTINGS ON ONE HALF OF THE HUB UNIT BEFORE ADDING GREASE THROUGH THE LUBRICATION FITTINGS ON THE OTHER HALF OF THE HUB.

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CAUTION: USE HARTZELL APPROVED LUBRICANTS ONLY.

- a. Remove the grease fittings from the engine-half of the hub unit.
- b. Add an equal number of pumps of grease, a maximum of one (1) ounce, through each of the grease fittings on the cylinder-half of the hub unit.

NOTE: 1 ounce is approximately 6 pumps with a hand held grease gun.

- c. If necessary, work a probe (such as a loop of wire) in and out of the open holes in the engine-half of the hub to help release air pockets in the grease.

NOTE: Make sure the ball of each lubrication fitting is properly seated.

NOTE: The above procedure differs slightly from that for Hartzell steel hub propellers. This procedure is important because if excessive grease is used, the hub cavity may unknowingly be filled with grease.

- d. Make an entry in the Log Book verifying that this inspection has been completed.

7. For feathering propellers which incorporate an air charge in the cylinder, check air pressure each 100 hours or one time each month, whichever comes first (except for -4 composite blade propellers which are to be checked daily).

8. Make an entry in this log book verifying this inspection.

(d) Overhaul Inspection (See Service Letter 61() for overhaul periods for specific propeller-engine/governor combinations).

1. Remove propeller and completely overhaul as per Hartzell overhaul manual and other applicable service requirements. Overhaul is to be accomplished only by a FAA (or foreign equivalent) approved propeller repair station.

NOTE: Governor overhaul is recommended at same time intervals as engine.

2. Make an entry in this log book verifying that this inspection has been accomplished.

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RECOMMENDED GREASES

The following greases are approved by Hartzell Propeller Inc.:

Aeroshell 5 with certain limitations, see Bulletin 159()

Aeroshell 6

Aeroshell 7

Aeroshell 22

Exxon 5114EP

Royco 22C

NOTE: Other, previously issued, Hartzell documents indicate additional greases by brand name and/or MIL-specification. Not all of these greases meet our current performance standards. Hartzell has chosen to specify only those greases which have sufficient testing or field experience to establish that they are acceptable.

NOTE: For further information, see Service Advisory 17().

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HARTZELL SYNCHROPHASERS

All Hartzell synchrophasers operate in basically the same manner regardless of the synchrophaser model or the type of aircraft on which it is installed. The synchrophaser is designed to hold the engines in sync and phase after the pilot has manually synchronized the engines in the conventional manner.

Most installations have only two positions on the switch, Phase or Sync and Manual. The Manual position should be used for take-off, landing, single-engine operation, and while manually syncing the engines.

IMPORTANT

To attain a quick and positive response when operating this system, the engines should be synchronized by the pilot as close as possible with the Phase switch in the Manual position.

NOTE: Errors in tachometer readings and sound levels must be carefully considered when establishing the initial settings.

By establishing this setting the system will be in its center-most position and allow for the automatic in-flight adjustment to attain synchronization and phasing of the engine firing order. These two features combined provide an ultra-smooth operation.

It is generally not necessary to return the switch to the Manual position during in-flight power changes after the initial cruise settings have been made. However, if an out of sync condition should occur that the system does not seem to be able to correct, go to the Manual position for 30 to 45 seconds and resync the engines in the conventional manner. Then return the switch to the Phase or Sync position. Normal synchrophaser operation should resume. Field test equipment available from factory.

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Service Policy

It is the policy of Hartzell Propeller Inc. to provide a capable service organization throughout the world where Hartzell propellers are used, which can maintain propellers at maximum efficiency and with minimum cost and inconvenience.

A. Field Service Organizations

There are a number of Hartzell Propeller Distributors strategically located throughout the United States and the world. These distributors are carefully selected on their merits from the standpoint of having available:

1. Propeller service facilities.
2. Extensive Hartzell propeller service experience.
3. Spare propellers and parts maintained in inventory.

The distributor organization is being encouraged to set up exchange systems.

B. Other Aircraft and Propeller Service Organizations

There are a great number of service organizations that are capable of servicing Hartzell propellers in addition to the appointed distributors. These organizations deal directly with the nearest distributor for parts, new or reconditioned propellers, etc.

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—NOTES—

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IMPORTANT ANNOUNCEMENT

We wish to announce that Hartzell Propeller, Inc., Product Support, has placed into service for your convenience an after-hours telephone answering system.

When you use this system you will get a taped announcement after which you will be asked to leave your message. After doing so you may hang up and be assured your message has been recorded.

We invite you to use this system and appreciate the opportunity of being able to provide you with continuous service.

Our direct number is (513) 778-4376.

1. The first part of the paper is devoted to a discussion of the general principles of the theory of the structure of the atom.

2. THE THEORY OF THE STRUCTURE OF THE ATOM

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HARTZELL PROPELLER INC.

CODE NO. 21-2100

DATE 1-28-73

INSPECTION C 174190

☒ NEW ☐ REPAIR

HARTZELL ORDER NO. <u>300226</u>	PART NUMBER <u>PHC-103A-24F/FC7663-2R</u>	VALVE NO.
HUB NO. <u>EC3411A</u>	GOV. NO.	BULKHEAD NO.

BLADE NUMBERS			
1	2	3	4
<u>1153231</u>	<u>1153220</u>	<u>1153224</u>	<u>4</u>
5	6		

CARTON NO.	LBS.	WEIGHT	KILOS	HEIGHT	WIDTH	LENGTH	PACKING
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COMMENTS: <u>A 2476-9 prop. out. kit installed</u>
CUSTOMER ORDER NO. <u>7777</u>
INS'P. BY <u>[Signature]</u>
SOLD TO: <u>[Signature]</u>