RESTRICTED

INSTRUCTIONS FOR FEATHERING AND UNFEATHERING HAMILTON STANDARD HYDROMATIC PROPELLERS

1. The following instructions will be adhered to by operating personnel when feathering or unfeathering Hamilton Standard hydromatic propellers. The detail procedures are covered by T. O. No. 03-2000-1.

a. Practice feathering and unfeathering will be performed between 5,000 and 10,000 feet above the surface over which the flight is being made.

b. Emergency feathering will be performed at any altitude including take-off and any flight condition.

c. Emergency unfeathering will only be performed when the use of the engine is needed for landing or continued flight. In case the propeller was feathered because of a damaged engine, its use may result in further damage. Every precaution must be taken to start and warm up the cold engine as outlined in T.O. No. 02-1-29.

d. The feathering switch used in connection with hydromatic propellers is released by hydraulic pressure built up in the system after the propeller has reached the full feathered position. Sometimes, however, due to viscous oil in the propeller system, the switch trip-out pressure is reached before the propeller assumes a fully feathered position. If this condition occures, the switch will be held in manually until the propeller is feathered.

e. Instances have been reported in which hydromatic propellers have begun to unfeather immediately after having reached the fully feathered position. That is, the switch was not automatically cut out after this position was reached. If this condition is encountered, the feathering switch button should be manually pulled out as soon as it is known that the propeller is unfeathering. It should be left out for a period of 2 to 3 seconds after which it should be closed again. After the second closing, the propeller will again feather. When the feathered position is reached as indicated by cessation of windmilling, the feather switch should be manually pulled out. This will prevent any further unfeathering action.

f. PREFLIGHT CHECK OF FEATHERING SYSTEM.

(1) After engines are warmed up set governor control for 1400 rpm on the engine being checked.

(2) Open throttle to a position where 1400 engine rpm is attained.

(3) Adjust one other engine to run at 1800 rpm. This will insure that one generator is charging sufficiently to furnish adequate electrical energy for the feathering operation.

(4) Close generator switch for engine which was adjusted to 1800 rpm.

(5) Depress feathering button on the engine being checked until a decrease in rpm is indicated.

(6) Release feathering button manually. The engine should then resume a speed of 1400 rpm after a short time.

(7) If the propeller does not respond in accordance with the foregoing procedure, the feathering system is not functioning properly and should be checked.

(8) Repeat this procedure for each engine.

2. Reports have been received of hydromatic propeller systems failing to operate properly at high altitude and failure of these propellers to feather.

a. Failure to feather may result from the engine oil being totally lost due to combat action or line failure in the engine oil system. If all the oil is lost or the propeller will not feather for any reason, an attempt will be made to windmill the propeller at lowest possible rpm. The propeller will windmill at a speed proportional to the air speed making it desirable to fly the airplane at an air speed of not more than 20 to 30 mph above the stalling speed. This will keep the windmilling rpm to a minimum. Controls should be placed in the following positions:

(1) Propeller controls: Low rpm position.

(2) Mixture control: Idle cut-off.

(3) Ignition switch: Off position.

(4) Throttle: Full closed position.

(5) Gasoline supply: Off.

(6) Cross-feed: Off.

b. If severe vibration exists, the tendency to vibrate can be reduced or minimized by flying at the absolute minimum air speed. Frequently the engine will seize and stop the windmilling. At other times when the engine seizes, the reduction gear housing will fail allowing the propeller, propeller shaft, and reduction gearing to be carried away. In other cases of engine seizure, only the reduction gearing will be wrecked which relieves the windmilling propeller of the engine drag and permits it to windmill faster.

c. When it is necessary to feather the propeller due to combat damage and still maintain position in formation for security reasons, air speeds higher than those listed above will be necessary. In such a case feathering the propeller will be attempted; if, however, the propeller cannot be feathered for any reason the operations listed in paragraph 2. a. will be accomplished with the exception of reducing the air speed.

3. Malfunction of hydromatic propellers at high altitude may result from the following conditions:

a. Insufficient supply of oil to the propeller or governor due to excessive leakage past bearings, transfer rings, and sliding parts in the engine.

b. Cavitation and foaming of the engine scavenger oil pump due to reduced pressure at high altitudes.

c. Total loss of engine oil.

4. When the conditions outlined in paragraph 3. are encountered, the following procedure will be adhered to with a view of correcting the difficulty.

a. A slow increase in rpm is indicative of insufficient oil supply. When this condition is noted, the manifold pressure and speed of the airplane will be reduced to prevent further increase in rpm and overspeeding of the propeller. If reducing the manifold pressure does not prevent an increase in rpm, the propeller will be feathered and the altitude of the airplane will be decreased to the level where proper propeller governor functioning last occurred.

b. Discharge, usually at altitude of a large quantity of oil through the engine breather is indicative of cavitation of the engine oil pump. If this occurs, an attempt will immediately be made to feather the propeller and the altitude of the airplane will be decreased to the level where proper functioning of the propeller last occurred. The loss of a small quantity of oil through the engine breather sometimes occurs under normal operation, and is not necessarily an indication of scavenger pump cavitation. If the discharge of engine oil does assume appreciable quantities or if a small quantity discharges for a long period of time, the altitude of the airplane will be decreased to the level to where proper functioning of the equipment last occurred.

RESTRICTED

WAR DEPARTMENT
Headquarters of the Army Air Forces
WASHINGTON

TECHNICAL ORDER
No.01-1-146

Dist: 2,3,4.
FILE: BEHT

AIRPLANES AND MAINTENANCE PARTS

GENERAL - OPERATION OF MINNEAPOLIS - HONEYWELL TURBOSUPERCHARGER CONTROL SYSTEM - B-17 SERIES, B-24 SERIES, B-29, and C-87

1. To insure the proper operation of the Type B-3 control system for turbo superchargers now being installed in the production models of subject airplanes the instructions contained in Par.2. will be adhered to by operating personnel.

2. The operating instructions, a summary of which is contained on ASC Forms No. 3092 dated November 4, 1943, titled "Pilot's Operating Instructions - Type B Control System for Furbosuperchargers," are as follows:

a. BEFORE STARTING ENGINES.- Set turbo boost selector at "0". Turn on auxiliary power unit.

b. SYSTEM AUTOMATICALLY ENERGIZED BY INVERTERS. - After turning on the airplane's battery switches, master switch, and the inverter switch, allow 2 minutes for the amplifiers to warm up. The control system will then respond to the setting of the turbo boost selector.

NOTE: Never turn inverter off while engines are running, due to the fact that the control system is dependent on the a-c power for operation.

c. TAXIING. - Set dial at "0" unless turbo boost is needed.

d. BEFORE TAKE-OFF. - Set propeller governors for take-off rpm and check manifold pressure on each engine separately by advancing throttle to full open position and then turning dial of turbo boost selector clockwise to "8". If the manifold pressure on any engine fails to come up to within 1-inch of take-off pressure with full rpm, turn dial to "0" and check the engine rpm and manifold pressure without turbo boost. This will show whether the low manifold pressure is caused by faulty engine operation or by insufficient turbo boost. Also check d-c voltage on voltmeter, with generators on.

e. TAKE-OFF.- Turn dial to "8" and then open throttles.

NOTE: Be sure generators are on and operating during take-off.

f. CLIMBING.- After take-off, turn knob counter-clockwise until desired manifold pressure is reached. Decrease rpm to desired value.Reset manifold pressure with turbo boost selector if necessary. Adjust intercooler shutters to maintain proper carburetor air temperature. For climbing, after cruising, increase rpm first; then advance throttles and increase manifold pressure to desired value by turning turbo boost selector clockwise.

g. CRUISING.- Use dial to select manifold pressure. If manifold pressure cannot be lowered sufficiently with the knob, pull back on the throttle. Decrease rpm to desired value, and then if necessary reset the manifold pressure with throttles and dial.

NOTE: If atmospheric conditions are such that carburetor icing may occur; maintain at least 4-inches of turbo boost and adjust intercoolers to maintain proper carburetor air temperatures. If engine operation does not require this amount of boost, reduce manifold pressure 4-inches by retarding throttles and bring manifold pressure back up 4-inches by increasing dial setting.

h. EMERGENCY POWER.-(To be used only with 100-octane fuel). Increase rpm to maximum. Press dial stop release and turn dial clockwise toward "10".

i. FORMATION FLYING.- The throttles, the turbo boost selector knob, or the throttles and the knob combined, may be used in formation flying, depending on the tightness of the formation, the position of the plane in the formation, and the altitude. In all cases, the setting of the turbo boost selector must be such that the manifold pressure will not exceed the recommended limit for the rpm being used, even with throttles full open. At altitudes in the turbo overspeed range (where governor limits rpm of turbosupercharger) the turbo boost selector should be held to a setting below the point where the overspeed control begins to "cut in" on any engine, and the throttles should then be used to vary the power. Below 6,000 feet, the throttles must be used, as the effective range of the control system is limited at low altitudes.

j. DESCENDING.- Maintain some turbo boost. Use the dial to select manifold pressure until throttle range is reached. For further reduction, use throttles.

k. LANDING. - Set props at maximum cruise rpm. Set dial for maximum cruise manifold pressure. Pull back on throttles.

l. STOPPING ENGINES. - When stopping engines, turn dial of turbo boost selector to "0" before turning off inverter.

NOTE: In emergencies, retard throttles to prevent excessive manifold pressures.

3. The ASC Form referred to in Par. 2, may be obtained by requisition as follows:

ASC Form No.	NOMENCLATURE	CLASS	SOURCE
3092	Pilot's Operating Instructions Type B Control System for Turbosupercharger.	30	AF Stock

By Command of General ARNOLD:

WALTER H. FRANK
Major General, U. S. A.
Commanding General, Air Service Command.

RESTRICTED.

OPERATION & FLIGHT INSTRUCTIONS FOR GYRO FLUX GATE COMPASS

1:- OPERATION OF THE GYRO FLUX GATE COMPASS:

a. Leave the toggle switch on the flux gate amplifier "ON" at all times so that the compass will start as soon as the plane's inverter is turned "ON"

b. Leave the caging switch in the "UNCAGED" position at all times except when running through the caging cycle.

c. About 5 minutes after starting engines, throw the caging switch to "CAGE" position. Leave it there about 30 seconds and then throw to "UNCAGED" again.

d. With the new push-button type caging switch, depress it for a few seconds until a red signal light is lit. Then release the switch and the caging cycle is automatically completed, at which time the red light will go out.

e. Set in the local variation on the master indicator if you wish the pointer to read true heading.

f. If at any time during flight the compass indicates in such a way that you suspect the gyro to be off vertical , run through the caging cycle when the airplane is in normal flight attitude.

2:- GENERAL INFORMATION:

a. The gyro must be running before the caging system operates.

b. A maneuver, during which the plane exceeds a 65 degree angle with respect to normal attitude, tumbles the gyro and it must be run through the caging cycle before correct compass indication are obtainable.

c. Compass indications are meaningless and erroneous whenever the gyro is in any position other than true vertical. The gyro has a built-in self-erection system which will keep it vertical automatically once it is placed near the vertical while it is running.

d. Operation described in par 1c, 1d is known as the "CAGING CYCLE" and mechanically erects the gyro to the current attitude of the aircraft. If the aircraft is not in normal flying attitude at the time, the compass indication will be erroneous until the gyro can erect itself to the true vertical.

e. The gain control on the flux gate amplifier should be set at the highest position which will not produce indication oscillation.

3:-COMPENSATION AND SWINGING PROCEDURE:

(a) Ground Swinging

1. Tow or taxie the airplane to an open piece of ground of concret (preferable not reinforced concrete). See that there is no large mass of metal within 100 yds of the site while you are taxing the airplane turn the compass on so that the gyro will have time to come up to speed (5 to 10) minutes).

2. When the airplane is ready, run through the caging cycle and notice that the master indicator pointer will turn and come to rest. With tail wheel airplanes like the B-17 it is necessary to wait about 10 minutes while the automatic erection system pulls the gyro to the true vertical as the gyro erects itself you will observe the compass pointer to turn slowly until it finally comes to rest. The amount the pointer will turn depends on your location and the airplane involved, but you can expect it to change 10 to 15 degrees.

(b) After the gyro is erect, one observer must read the uncorrected dial of the master indicator while another observer reads the magnetic heading on the compass swinging sight according to T.O. 05-15-3.

3.a. With the variation index at "Zero" on the master indicator.

b. Swing the plane on the four cardinal readings and determine coefficient A. If the coefficient A is greater than ± 3 degrees it is necessary to turn the transmitter of the Gyro Flux Gate Compass to correct for lubber line error. This is accomplished by turning the transmitter housing the required amount after loosening the bolts which hold it to the mounting bracket.

c. Remember the deviation is obtained by the algebraic difference between the magnetic heading of the airplane and the uncorrected dial reading. Thus if the magnetic heading was 95 degrees and the uncorrected dial reads 90 degrees, the deviation would be 95 minus 90 equals + 5 degrees. The "deviation correction" in this instance would be - 5 degrees.

d. If the coefficient A is found to be positive, the transmitter must be turned an equal number of degrees in a clockwise direction. If the coefficient A is negative, the transmitter housing must be turned counterclockwise for compensation.

e. Upon removal of the lubber line error, the aircraft should be swung on 24 headings to determine deviation every 15 degrees. It is not necessary to set the aircraft on an exact heading, but the observer should correct the pilot if the plane is more than 2 or 3 degrees from the required heading.

f. On some types of aircraft it is unnecessary to run the engines and the complete swing can be made by towing. On the B-17 running the No. 1 and No. 4 engines is sufficient. Usually it is desired to operate the engines at approximately cruising rpm when the compass is swung. Obviously it is impossible to duplicate flying conditions exactly and it is not unlikely that you may find discrepancies of 2 or 3 degrees between an air and ground swing.

g. When the airplane has been swung on all 24 headings, you can plot a deviation curve. During the swing you need pay no attention to the master indicator readings although it is a good idea to see that no large deviations have been set into the can. . . The pointer should agree with the uncorrected dial with ± 2 degrees before compensation.

NOTE: A Compass Rose may be used for swinging the aircraft if one is available. The aircraft should be set on 24 headings at 15 degree intervals and the readings of the uncorrected dial recorded. By comparing the magnetic heading (obtained from the compass rose) with the compass heading (uncorrected dial reading) proceed to determine the deviations and plot a curve as in the preceding type of compass swing.

b. AIR SWINGING.

1. When it is suspected that deviations as determined by ground swinging and air swinging methods are not identical, it may be necessary to swing the plane in flight.

2. It is imperative that air swinging be performed in calm weather and in level flying position. Wheels, guns, controls and equipment should be in flying position. Bearings should be taken with an astro-compass on a body below 50° altitude if possible.

3. With the aircraft heading north by the astro-compass set the [illegible] to "Zero". Make turns to the [illegible]

plane to a steady straight and level flight attitude before reading the directional gyro and uncorrected dial of the compass. Proceed around all 24 headings and duplicate the first heading. Read the astro compass every 90 degrees and determine the procession of the directional gyro between these points. Average out the precession for each quadrant and apply a correction to the headings recorded to determine the actual magnetic heading flown.

4. During the process of swinging by this method it should be borne in mind that the bearing of the celestial body selected is the primary reference point and that the directional gyro only provides a means of steering the aircraft upon the desired magnetic heading by averaging out the error due to procession between check points.

5. Although this method is fast and reliable it requires that the sun or stars are visible. The second method can be accomplished by setting the directional gyro according to the pilot's compass if the weather is not clear enough to make celestial observations.

4. TO COMPENSATE THE MASTER INDICATOR.- The ease with which this can be accomplished depends largely upon the accessibility of the master indicator. If you can remove the cover of the indicator from its case without removing the instrument from the panel, you will have little difficulty using the method described below. If necessary, the instrument can be removed from the panel, taken to the instrument shop for compensation and then replaced in the airplane. This should always be done if it is not possible to protect the master indicator from dust and dampness when the case has been removed. Having turned off the compass remove the 14-prong plug to the master indicator, break the seal and loosen the three cover screws by the socket. You can now slide the case off the back of the indicator and you will have access to the shaft on the small induction motor. At the back of the frame you will see the induction motor which drives the indicator, the coupling Autosyn which controls the motor and the transmitting Magnesyn which drives the repeater indicators. These units are in round cases of similar appearance. The motor can be identified, however, as it is the only one of the three units which has a small knurled shaft protruding from the back. If you turn this shaft with your fingers, you will find that the pointer will be driven. It is a simple matter to compensate the compass by setting the pointer to every 15-degree heading and adjust the cam. To use the compensation cam, the following procedure is recommended:

(a) Be sure that the variation setting on the Master indicator is at "ZERO".

(b) Turn the small shaft of the induction motor and set the compass pointer exactly on any 15-degree heading, say 45 degrees and hold it there.

(c) Place the adjusting wrench in the screw hold directly opposite the pointer.

(d) Referring to the deviation curve determine the compass heading corresponding to this magnetic heading.

(e) Make the uncorrected dial read the correct compass heading by turning the adjusting screw. You will notice that the uncorrected dial will turn in the same direction that you turn the screw.

(f) Repeat this procedure for 24 headings at 15-degree intervals. If it is necessary to set more than 3-degree deviation change over a 15-degree interval you should check the previous heading to make sure that it remains set correctly.

(g) When compensation is complete, the pointer of the compass will then read MAGNETIC heading and the uncorrected dial will read compass heading. From now on you can disregard the uncorrected dial readings and will read only the pointer.

(h) Reassemble the master indicator and connect the plug to the amplifier. You have compensated the Gyro Flux Gate Compass with the exception of the repeater indicators. To obtain the correction cards for the repeaters, it is necessary to reswing the airplane. Usually, however, the repeaters will agree with the master indicator to within ± 3 degrees and the navigator can correct the pilot the required amount at the beginning of a mission. You will have no difficulty checking the repeaters on eight headings against the master indicator and this can be done in the air or on the ground at the first opportunity.

NOTE 1: You should note that the latest model master indicator has a compensation knob on the back which eliminates the necessity of removing the cover of the instrument. To compensate the compass, this knob is depressed to engage the shaft of the small induction motor. By turning the pointer in this manner compensation can be efficiently and rapidly accomplished.

NOTE 2: An additional method which is convenient for compensating the GYRO Flux Gate Compass is described in detail in AN 05-15-16. This can only be used when a Test Transmitter is available. The unit is inserted in the cable to the master indicator and the pointer set to the required heading by turning the knob on the test transmitter.

5.a. In the event the Gyro Flux Gate Compass caging switch is put in the "CAGE" position before the power is turned on, the following is a description of what occurs.

(1) Throwing the caging switch will cause the caging motor to drive the caging mechanism to the "CAGED" position. The gyro in the transmitter, however, is not running as the power at the amplifier is off. Therefore, throwing the switch to the "CAGED" position will NOT erect the gyro. If you now turn on the amplifier of the Gyro Flux Gate Compass, the gyro will run, but will remain tumbled on its side. As a result, the readings of the master indicator will be meaningless, because the flux gate is not held in a horizontal plane.

(2) If you wish to make the compass work correctly, throw the caging switch to the "UNCAGE" position and leave it there about 30 seconds while the caging motor drives the caging mechanism to the "UNCAGED" position. After the gyro has been running about 5 minutes, throw the caging switch to the "CAGE" position. The gyro will be erected to the current attitude of the aircraft. Leave the switch in this position about 30 seconds, and then return it to the "UNCAGE" position. The gyro will now be erect and uncaged, and the compass will operate correctly. Do not turn off the compass at the amplifier. If at any time the compass does not operate, begin by making the following checks.

(a) Check the amplifier to see:

1. That the switch is "ON."

2. That the fuse has not blown.

3. That the signal light has not burned out.

4. That the tubes glow and become warm.

5. That the plane's inverter is operating.

6. That there are no loose plugs.

(b) If the amplifier appears to be satisfactory, inspect the transmitter to see whether the gyro is running. On the ground, you can hear the gyro when it is running up to speed, or you can look through the inspection window of the transmitter to see whether the erection system operates.

(c) If you cannot locate the fault, and an experienced instrument mechanic is not available, you may try replacing each unit by a new one from stock. You may find that a new amplifier, master indicator, or transmitter will fix the compass. Having located the faulty unit, it should be forwarded to an overhaul station for repair. Recompensation is necessary if the transmitter or master indicator is replaced.

CARBURETOR AIR FILTERS

B-17 F and B-17 G

I. Maintenance

A. Inspect daily for dirt or dryness.

B. If dirty or dry:
1. Remove and wash with gasoline or any good solvent.
2. Dry thoroughly.
3. Immerse in a solution of one part corrosion preventative compound AN-VV-C-576 and three parts oil, spec. AN-VV-O-446, grade 1120.
4. Let drain thoroughly. Two hours is recommended as a minimum and over-night is suggested if possible.

C. To re-install:
1. Check arrows stamped on upper case of each filter to make sure units are properly installed.
2. Each filter case rests on four bolts. Raise or lower case by adding or removing washers to bolts. Each case must rest snugly against the cover door.

NOTE:
It is suggested that the airplane number and position of each unit be stamped on the case; thus obviating the need for adjusting or shifting the filters each cleaning.

II. Operation

A. Turn filters on before starting engines and leave on for all ground operations and up to 8,000 feet.

B. Amber lights burning on the right side of the 2nd pilot's panel (just forward of the starter switches) indicates that the filter doors are in the open position (filter operating). Green lights indicate that the filter is not operating (unfiltered air).

C. For unusual dust conditions the filters may be left on up to 15,000. This is not recommended, however, because of the possibility of overheating the carburetor inlet air and causing detonation.

D. Under icing conditions carburetor filters may be left on up to 20,000 feet. WARNING: This is a dangerous procedure and is to be followed only under icing condition.