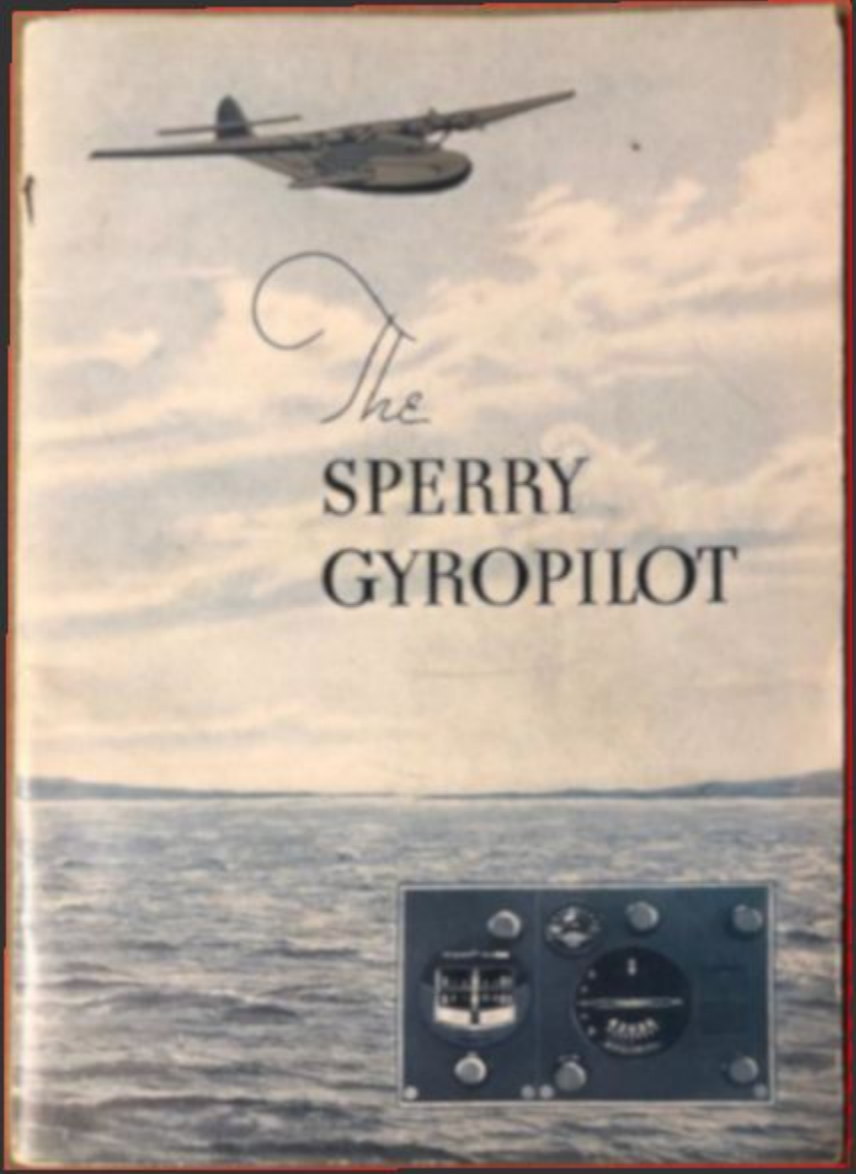
The
SPERRY
GYROPILOT

Sperry
Mark 4 (A-4)
Gyropilot
by
Humbug
Aeroworks

Rudder Calibration

Rudder Pointer

Rudder (heading)
Index Knob

Aileron Calibration

Elevator Calibration

Power Knob

Airplane

Aileron/
Elevator
Bar

Turn & Bank
Indicator

Directional
Gyro

Gyro Drift Adjustment

Aileron (turn)
Index Knob

Airplane
Adjustment

Elevator (pitch)
Index Knob

(FOR X-PLANE ONLY -- INOT FOR REAL WORLD NAVIGATION OR USE.)

Sperry Mark 4 (A-4) Gyropilot ("Automatic Pilot") System
by Humbug Aeroworks for X-Plane (Not for real-world instruction or use in any way.)

The following instructions are for use of the Sperry Mark 4 gyropilot included with the "vintage" X-Plane Lockheed Model 12. Included with this document are a few photos of historical interest. I could find no information on the use of the Sperry Mark 4, so some of the functions of this instrument are based on educated guesswork and what I could find out about other Sperry models, and a few non-historical functions are included for the convenience of the pilot in X-Plane. The Sperry literature stresses how easy the instrument is to use to make long distance flights less demanding on the pilot. However, this primitive autopilot will not make any automatic turns or adjust the power of the aircraft requiring some attention from the pilot at all times in flight.

The Sperry gyropilot is a vacuum powered instrument tied to the two vacuum pumps in the Lockheed (one connected to each engine). Only one of these pumps operates at any time, and the Lockheed POH directs that the right engine pump should normally be selected because the left engine also runs the electrical generator. If the right engine stops, be sure to switch to the left vacuum pump with the selector at the base of the panel center stand. There are two suction gauges on the left side of the vintage panel showing output of each vacuum pump.

The following explains the use of the gyropilot and its adjustments working clockwise around the "Sperry Mark Four" picture above.

1. Rudder calibration. Push this to calibrate the gyropilot directional gyro (the bottom ribbon only) with the magnetic compass to overcome gyro drift (gyroscopic precession). This is provided for the convenience of the pilot.

2. Rudder pointer. This simply points to the movement of the aircraft's two rudders. What it does on the real instrument is a mystery to me. It may possibly indicate the rudder trim position during the Sperry's operation, but X-Plane's autopilot system uses aileron trim not rudder trim to adjust the aircraft's heading so that would be useless.

3. Rudder (heading) Index Knob. The Sperry literature speaks of the rudder, aileron and elevator "indices" for the various indicators. Use the Rudder index knob to rotate the top ribbon on the directional gyro to line it up with the bottom gyrocompass ribbon before turning the gyropilot on ("Power Knob"). If this setting is not within 3 degrees of the aircraft's heading, the gyrocompass will not hold the heading, so turn off the gyropilot and re-adjust to get the two ribbons lined up. When set properly the gyropilot will hold the heading much like the directional gyro "heading bug" for a modern autopilot system.

The rudder knob will only make adjustments when the power is OFF. When the gyropilot is operational, the knob and top ribbon are fixed. The exception to this is that the top ribbon will follow the bottom compass ribbon when engaged in a turn initiated by the aileron index knob (below).

I find that the Lockheed Model 12 needs a little rudder bungee adjustment for level flight which does not affect the gyropilot except to level the horizon indicators. You may also need some elevator index adjustment depending on the trim and attitude of the aircraft when turning the Sperry gyropilot on.

(The Lockheed Model 12 vintage panel includes a separate Sperry C-1 directional

gyro. The "heading bug" on this instrument does not control this gyropilot. It is simply used to mark a heading for the pilot's visual reference as was the case with the real instrument.)

4. Aileron calibration. Push this to center the aileron/elevator bar and to return to heading index mode (i.e., the aircraft will follow the heading of the directional gyro compass).

5. Elevator calibration. Push this to center both the aileron/elevator bar and the elevator index knob to zero when the power is off. It is best practice to turn the elevator knob to zero before pressing the calibration knob.

6. Power knob. In the real-world instrument this is a cage/uncage selector for the turn and bank indicator and the gyropilot is turned on with a switch elsewhere. Here, this knob turns the gyropilot on and off. It is assumed that the Lockheed Model 12 will not be flown in extreme attitudes requiring a cage knob!

7. Airplane. Much like on a gyro horizon instrument, use the knob below to raise and lower the airplane.

8. Aileron/Elevator bar. This is the indicator for both aileron and elevator settings controlled by the two knobs below.

9. Turn & Bank Indicator. This is the gyro artificial horizon (but not known as that on a Sperry gyropilot).

10. Elevator (pitch) Index Knob. The included photo below of a page from the Sperry pamphlet* (dated 1936) says that the pilot can use the elevator index adjustment knob to climb after takeoff and to start a descent up to 100 miles from the destination. Therefore, this capability is built into the X-Plane model. The numbers around the knob (which match the original Mark 4) go up to 10 so I assume that this means 10 degrees either climb or descend, but it is probably best to keep both rates of climb and descent at around 500-600 FPM. This gauge will not level out at a set altitude like modern autopilots and the pilot is responsible for power and other settings.
[* I purchased this pamphlet and the 1936 copyright date means that it is now in the public domain.]

11. The Airplane Adjustment. This works like a normal artificial horizon knob.

12. Aileron (turn) Index Knob. Also noted in the Sperry literature, this knob allows the pilot to turn the aircraft up to 10 degrees bank angle left or right when the unit is powered ON. This adjustment does not level out automatically but is simply a way to make gradual turns when the gyropilot is still on. Turn the aileron knob back to zero and press the aileron calibration knob to return to the heading indicated by the directional gyrocompass.

13. The Gyro Drift Adjustment. This knob works like any directional gyro to set the bottom ribbon to the magnetic compass reading.

How the Gyropilot is Used

As soon as the aircraft is clear of the airport and on its course, the human pilot rotates the adjusting knobs on the Gyropilot control unit so that the three follow-up indicators match the gyro indications for direction, bank and climb. Then he moves the engaging lever "on" and takes his hands and feet from the controls. The climb knob is adjusted to obtain the desired rate of climb. Once this is set, the aircraft continues climbing steadily until the cruising altitude is reached, at which time another slight turn of the climb knob puts the plane in level flight.

For large turns the desired angle of bank is set in, and the turn knob rotated so as to turn the aircraft at the desired rate. If a small course change is desired, it is only necessary to rotate the turn knob slowly to the right or left. When flying on the radio beam the precision with which these small changes in heading can be made while the Gyropilot is in operation is an important factor in keeping the plane on course.

On long flights a glide is often started as much as one hundred miles from the airport. A slight turn of the knob for glide is all that is necessary in order to obtain the desired gliding angle, and the Gyropilot thereafter maintains a steady rate of descent until the human pilot is ready to take over the controls, and make his landing.

To disengage the Gyropilot, the human pilot takes over the controls and moves the engaging lever "off". If necessary he can overpower the Gyropilot while it is in operation.