OVERHAUL (600 Hours)

It is recommended that the governor unit and pitch motor be returned after 600 hours of operation to Flight Research Engineering Corporation for overhaul.

The governor unit is a highly technical instrument and special equipment and training are required for adjusting, repairing, and testing it. For this reason, it is recommended that no attempt be made to adjust or overhaul this unit in the field. If trouble is traced to the governor unit, it should be returned to Flight Research Engineering Corporation, Richmond, Virginia, for repair. The following brief description of the governor unit is not intended to provide information for servicing it in the field. It is intended only to give the mechanic a general idea of how the unit functions so that he may more accurately diagnose any trouble that may be experienced with the automatic propeller control installation.

The speed sensor is driven by a flexible shaft connected to the tachometer adapter on the engine. The flexible shaft rotates a permanent magnet inside the eddy current cup, which tends to turn with the magnet. The eddy current cup is restrained by hair springs controlled by the governor control knob (speed knob) on the instrument panel. Movement of the speed knob deflects the hair springs, thereby changing the restraining torque on the eddy current cup, thus establishing an equilibrium position. The functioning of the eddy current cup and the rotating magnet is somewhat similar in principle to an automobile speedometer.

The speed sensor is connected to a movable vane, which under certain conditions is affected by the interrupter magnet. The interrupter magnet is energized through the divider circuit whenever either control relay is energized. When the engine off-speed is considerable, the vane is fully deflected and the interrupter magnet has no effect so a full correction signal is transmitted to the propeller pitch motor relay. However, in cases of minor correction, the magnet acts as a follow-up to apply a restoring torque on the speed sensor after it has been applied for the proper duration. This follow-up action is necessary because of time lags in the engine-propeller combination.

The vane controls the direct light beam from the lamp to the photo tube. In the on-speed condition, no light passes, therefore, neither the increase or decrease circuits are energized. In cases of under or over speed conditions, however, the speed sensor moves the vane, permitting light to pass, thus energizing the circuit to vary propeller pitch in accordance with the speed requirement.

In order to fully clarify the function of the circuit, it is considered necessary to review the characteristics of the tubes. The photo tubes are vacuum tubes, usually containing inert gas. Mounted inside the tube is a vertical plate coated with a special light-sensitive material, facing a vertical rod. In effect, the tubes are similar to the "electric eye" in automatic burglar alarms, door controls, and similar automatic devices.

Both photo tubes are in series with the control circuit but function only when movement of the vane permits a direct beam of light to fall upon it. When the beam strikes the tube, free electrons are released from the light-sensitive plate, permitting current to flow from the 14-volt line through the grid resistor. This

flow of current through the photo-tube circuit creates a positive voltage which cancels the existing negative grid voltage in the connecting section of the double-section pentode tube, thus causing the connecting propeller pitch relay in the governor unit to be energized.

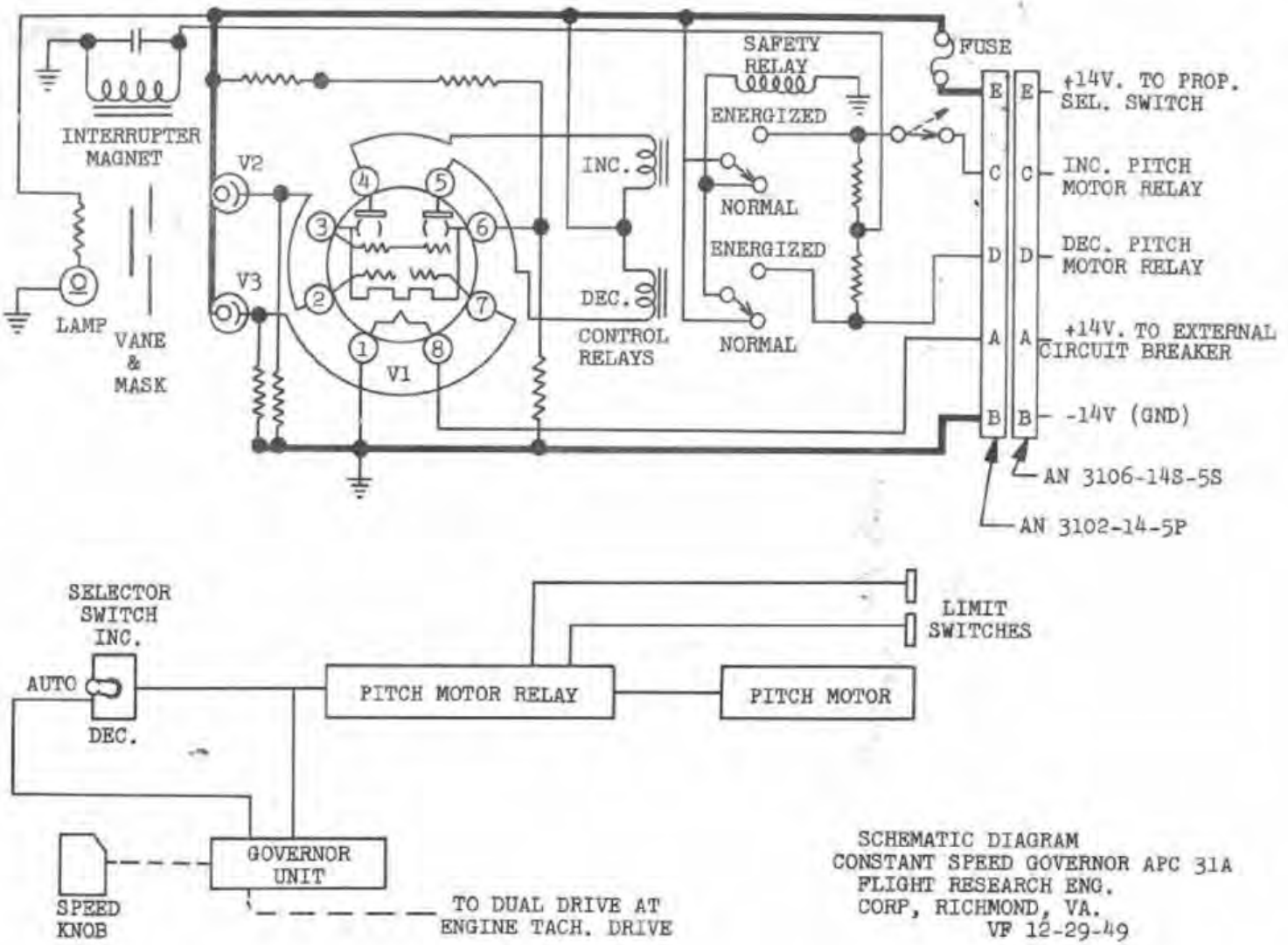
The vacuum tube is a pentode tube of the double section type to provide for energizing the increase and decrease pitch relay circuits separately. It contains a heater element which is continuously energized directly through the external propeller circuit to insure that the tube will always be heated in advance of need, to eliminate heating lag.

The term "pentode" is derived from each section containing five working elements; namely, heater, cathode, control grid, screen grid, and plate. The function of the cathode is to supply electrons. The heater element vastly increases the flow of electrons emitted. The plate is provided to attract these electrons - the higher the plate voltage, the greater the attraction. The control grid is closely located to the cathode and will considerably affect the flow of electrons by either accelerating or retarding the flow with a positive or negative voltage. In the "on-speed" condition, the negative voltage is sufficient to stop the major electron flow because the resistor bridge is connected across the plus 14V and minus 14V leads and is connected to the cathode. When the light beam strikes either photo tube, the positive voltage which flows through tne photo-tube circuit will cancel the negative voltage on the control grid and cause the connecting relay circuit to be energized. The function of the screen grid is to speed up the electrons between the cathode and the plate to increase the efficiency of the tube. An additional shield is connected to the cathode to "funnel" the stream of electrons toward the plate. Circuit protection is provided by means of the neutral position of the control switch, a two- or four-ampere fuse, and a safety relay in the governor unit.

When the switch is in the neutral position, the plus 14V lead through the connector is open; therefore, current will flow only in the separate pentode heater circuit. The heater circuit is protected by the external propeller circuit breaker.

The two- or four-ampere fuse is in series with the governor unit and its rating is well below the value of the external circuit breaker. In case of a short circuit in the governor circuit, the fuse should blow and the external circuit breaker should not trip, thus permitting the propeller to be operated with the manual electric control.

While the propeller control switch is in "auto" position and the system is functioning normally, the safety relay coil will be energized through the set of points in the pitch relays in the governor unit. If a malfunction should occur which would energize the second relay while the first was functioning, the flow of current through the safety relay coil would be interrupted causing the safety relay points to open and break the circuit to the governor unit. In order to fully visualize this "fail-safe" provision, it is suggested that the safety relay coil line current be traced through singular and dual pitch relay operation. It can be seen that in event of malfunction of the governor unit, no interference with manual electric control will be experienced. The propeller pitch may be controlled manually by flipping the switch to high or low rpm positions momentarily as in the standard Beech controllable installation.



SCHEMATIC DIAGRAM
CONSTANT SPEED GOVERNOR APC 31A
FLIGHT RESEARCH ENG.
CORP, RICHMOND, VA.
VF 12-29-49

Section VI
Figure 48