LIST OF EFFECTIVE PAGES

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ENGINE FUEL AND CONTROL - DESCRIPTION AND OPERATION

1. Description (Ref. Figs.1 and 2)

A. PT6A-21 Engines

The fuel control system consists of an oil-to-fuel heater, fuel pump, fuel control unit, flow divider and dump or purge valve, dual fuel manifold with 14 simplex nozzles, fuel drain valves and interconnecting pneumatic sense lines. For purposes of description, the system also includes the power turbine governor, although further information relating to this component is contained in Chapter 76.

The fuel pump delivers fuel to the fuel control unit (FCU), which determines the correct fuel schedule for engine steady-state operation and acceleration. The flow divider supplies the metered fuel flow to the primary and secondary manifolds as required. Full propeller control during normal operation is provided by a governor which incorporates a propeller governor (CSU) section and a power turbine governor (Nf) section. The Nf governor section provides power turbine overspeed protection during normal operation. The propeller governor also contains a reversing valve; during propeller reverse thrust operation, the propeller governor section is inoperative and control of power turbine speed is accomplished by the Nf section.

The nomenclature used, in this manual, when referring to power lever and fuel condition lever positions is as follows:

(a) The minimum position for the power control lever is IDLE, and the maximum position is TAKEOFF. Angular position in degrees may also be referenced. REVERSE position is self-explanatory.

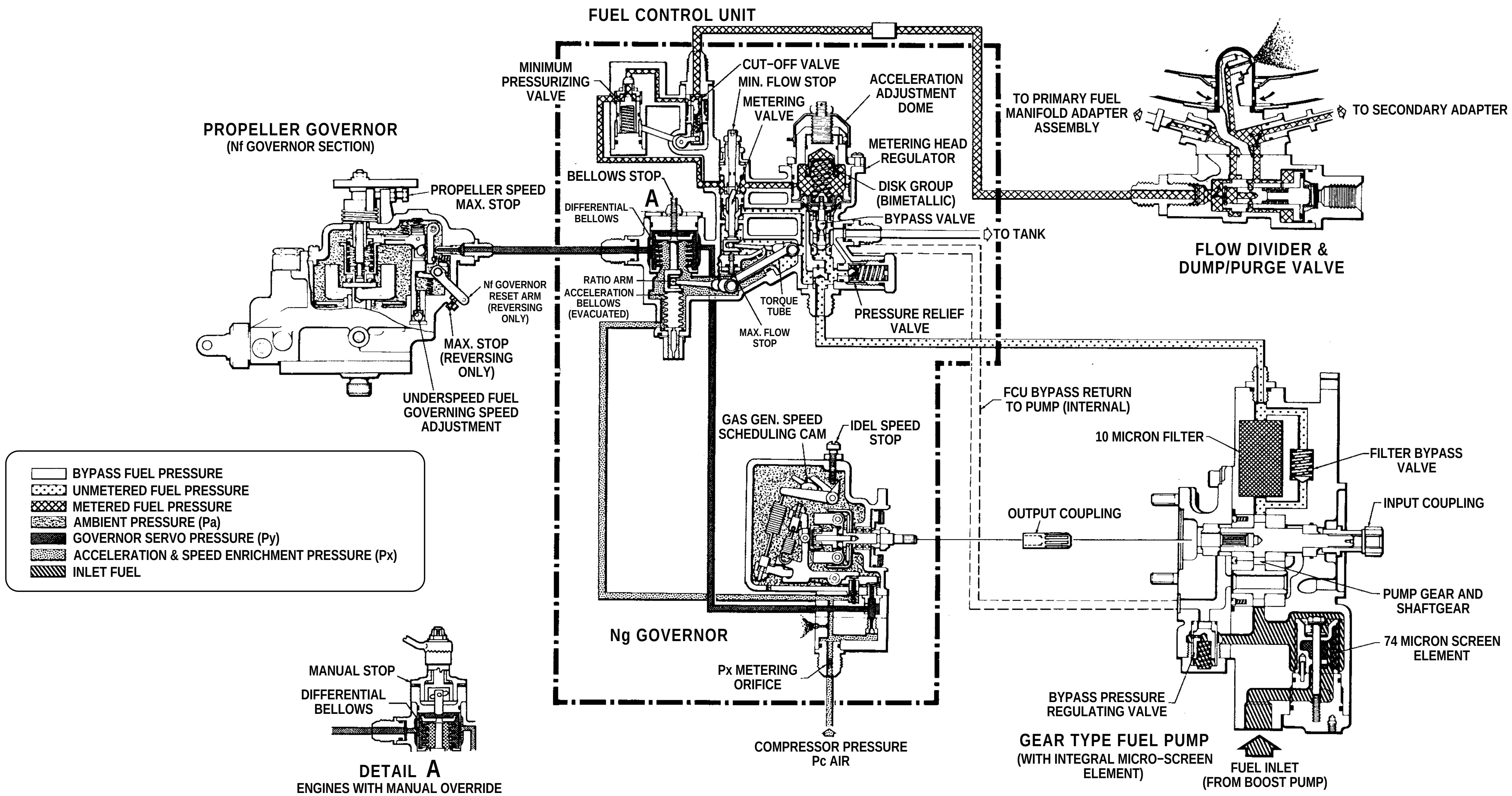
(b) The minimum position for the fuel condition lever is CUTOFF. The starting position is 30 degrees from CUTOFF. The maximum position, when used, is FLIGHT-IDLE or 90 degrees from CUTOFF.

(c) For individual engine operating procedures, markings and item nomenclature for specific aircraft installations, refer to relevant Specific Operating Instructions (S.O.I.) for applicable engine model and the Aircraft Operating Manual.

B. PT6A-27 and PT6A-28 Engines

The fuel control system consists of an oil-to-fuel heater, fuel pump, fuel control unit, starting flow control, dual fuel manifold with 14 simplex nozzles, fuel drain valves and interconnecting fuel and pneumatic sense lines. For purposes of description and operation, the system also includes a power turbine governor, although further information relating to this component is contained in Chapter 76.

The fuel pump delivers fuel to the fuel control unit (FCU), which determines the correct fuel schedule for engine steady-state operation and acceleration. The starting flow control, which acts as a mechanically-operated flow divider and dump valve, directs the metered fuel from the FCU to primary fuel manifold or to both primary and secondary manifolds as required. Full propeller control during forward and reverse thrust operation is provided by the propeller governor package which contains a normal propeller governor (CSU) section, a reverse valve and a power turbine governor section (Nf). The



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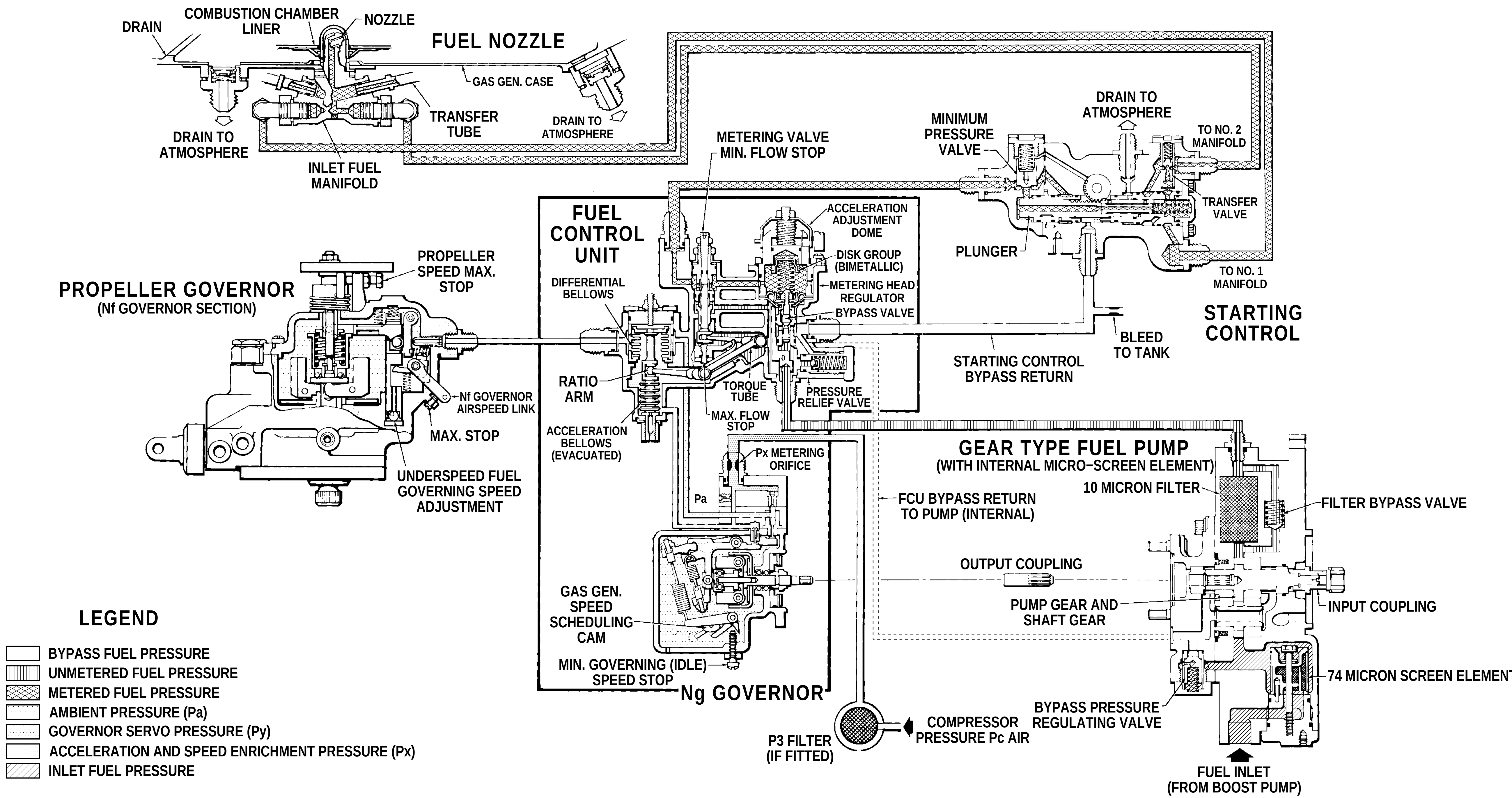
Fuel Control System Schematic - Flow Divider Installation
Figure 1



Fuel Control System Schematic - Starting Control Installation
Figure 2

Nf section provides power turbine overspeed protection during normal operation. During reverse thrust operation the propeller governor is inoperative and control of power turbine speed is accomplished by the Nf governor section.

The nomenclature used in manuals for these particular enginemodels, when referring to power lever and starting flow control lever positions, varies considerably. For example, the RUN position on the starting flow control has been referred to as IDLE, LO-IDLE and GROUND IDLE. For purposes of this manual, the following should be noted:

(a) The minimum position for the power control lever is IDLE, and the maximum position is TAKEOFF. Angular position in degrees may also be referenced. REVERSE position is self-explanatory.

(b) The minimum position for the starting flow control lever is CUTOFF or CUTOFF AND DUMP. The starting position is RUN (either 45 degrees or 72 degrees from CUTOFF). The maximum position, when used, is FLIGHT-IDLE which is 90 degrees from CUTOFF.

(c) For individual engine operating procedures, markings and item nomenclature for specific aircraft installations, refer to relevant Specific Operating Instructions (S.O.I.) and the Aircraft Operating Manual.

2. Operation

NOTE: For particular engine starting procedures on specific aircraft installations, refer to the relevant Aircraft Maintenance Manual.

A. Engine Starting

The engine starting cycle is initiated with the power control lever placed in the IDLE position and the fuel condition or starting control lever in CUTOFF. The ignition and starter are switched on and, when the required Ng ignition speed is attained, the fuel condition or starting control lever is advanced to RUN position. Following ignition, the engine accelerates to idle speed.

During the starting sequence, the metering valve in the FCU is in a low flow position. As the compressor accelerates, the discharge pressure (P3) increases. This creates an increase in Px pressure, which is modified P3 acting on one side of the bellows assembly and Py, which is modified Px, on the opposite side. Py is the governing pressure and acts on a greater surface area of the bellows. The increase in pressure sensed by the bellows causes the metering valve to move in an opening direction. Excess fuel supplied by the fuel pump will pass via the bypass valve back to the tank. When the Ng approaches idle speed, the centrifugal force of the Ng governor flyweights begins to overcome the governor spring force and opens the governor valve, bleeding off Py pressure. This creates a Px-Py differential which causes the metering valve to move in a closing direction until the required-to-run idle speed fuel flow is obtained. Any variation in engine speed from the selected (idle) speed will be sensed by the Ng governor flyweights and will result in increased or decreased weight force. This change will cause movement of the governor valve which will then be reflected by a differing Px to Py relationship and cause the metering valve to move to re-establish the correct fuel flow and hence Ng speed.

B. Acceleration

As the power control lever is advanced above idle setting, the speed scheduling cam is repositioned, moving the cam follower lever to increase the governor spring force. The governor spring then overcomes the flyweights and moves the lever, closing the governor valve. Px and Py pressures immediately increase, causing the metering valve to move in an opening direction. Acceleration is then a function of increasing Px (Px=Py).

As the Ng, and consequently the Nf, increase, the propeller governor increases the pitch of the propeller blades to control the Nf at the selected speed and applies the increased power as additional thrust. Acceleration is complete when the centrifugal force of the governor flyweight again overcomes the governor spring and opens the governor valve.

C. Governing

Once the acceleration cycle has been established, any variation in engine speed from the selected speed will be sensed by the Ng governor flyweights and will result in increased or decreased weight force. This change in weight force will cause the governor valve to either open or close; this will then be reflected by the change in fuel flow necessary to re-establish the selected speed. When the FCU is governing, the governor valve will be maintained in a regulating or floating position.

D. Altitude Compensation

Altitude compensation is automatic since the acceleration bellows assembly in the FCU computing section is evacuated and affords an absolute pressure reference. Compressor discharge air (P3) is a measurement of engine speed and air density. Px is proportional to P3, so it will decrease with a decrease in air density. This is sensed by the acceleration bellows which act to reduce fuel flow on acceleration at altitude.

E. Deceleration

When the engine power control lever is retarded, the speed scheduling cam is rotated to a lower point on the cam rise. This reduces the governor spring force and allows the governor valve to move in an opening direction. The resulting drop in Py pressure moves the metering valve in a closing direction until it contacts the Wf minimum flow stop. This stop ensures sufficient metered fuel flow to the engine to prevent flameout. The engine continues to decelerate until the governor flyweight force decreases to balance the governor spring force at the set governing position.

F. Reverse Thrust

Reverse thrust can be obtained at any propeller speed provided that the forward speed of the aircraft after landing or during taxiing is not high enough to cause propeller windmilling at speeds near the selected rpm.

The idle reset has two settings; low idle and high idle. The high idle setting permits acceleration to maximum rpm to be accomplished in minimum time. The idle setting and fuel cut-off is controlled by the fuel cut-off lever in the cockpit. The power lever linkage is used only to increase or decrease power.

The FCU speed scheduling cam has a single contoured lobe operated through a cam box which permits the scheduling of full power at each end of the power control lever travel. When the power control lever is moved to the REVERSE THRUST position, the propeller pitch control and the FCU are integrated. Increased power control lever movement toward FULL REVERSE position will increase compressor turbine speed (Ng) and propeller (reverse) pitch. The propeller governor is maintained in an underspeed condition in the reverse thrust range by controlling propeller speed with the Nf governing section of the propeller control.

If the Nf exceeds the desired speed, the Nf governing orifice will open to decrease the Py pressure in the computing section of the FCU and cause a reduction in fuel flow and Nf speed, thereby limiting the propeller speed and maintaining the CSU in an underspeed condition.

G. Manual Override System (Post-SB1469, PT6A-27 Engines)

On FCU's incorporating the manual override system, the retaining plate and cover containing the governor bellows stop are replaced by a shaft and stop assembly, which, if operated after a pneumatic failure, pushes against the end of the governor bellows to increase fuel flow.

The shaft and stop assembly consists of an actuating shaft incorporating spiral slots; a driving pin fits in the slots, passing through and activating an operating pin. When the actuating shaft is turned, the driving pin, which cannot rotate, moves in or out dependant on the slot position. Subsequent movement of the perating pin against the end of governor bellows opens the metering valve and increases fuel flow. In the OFF position, the operating pin acts as bellows travel stop.

H. Power Turbine Limiting

The Nf governing section of the propeller governor senses Py pressure via an external line from the computing section of the FCU. If a power turbine overspeed should occur during forward thrust operation, the Nf governing orifice will be opened, under the influence of the governor flyweights and lever movement, to bleed off Py pressure. This causes a decrease in Py pressure at the computing section of the FCU causing the metering valve to move in a closing direction, thus reducing fuel flow and consequently Ng and Nf speeds.

I. Engine Shutdown (PT6A-21 Engines)

The integral cutoff valve in the FCU provides a positive means of shutting off fuel flow to the engine. During normal engine operation the valve is fully open and offers no restriction to the metered fuel flow to the engine. The engine is shut down by moving the fuel condition lever in the cockpit to CUTOFF. Fuel is returned to the fuel pump inlet via the internal bypass passages and ports in the FCU and pump. Fuel in the primary and secondary manifolds is drained via the dump valve ports in the flow divider and dump valve, or for flow divider and purge valve installations, purged by compressed air into the combustion chamber and burned.

3. <u>Fault Isolation</u>

For detailed procedures refer to Chapter 72-00-00, FAULT ISOLATION.