FLIGHT CONTROLS

GENERAL

All aerodynamic controls, with the exception of the flaps, speed brakes and two-position stabilizer are mechanically actuated by cables. The ailerons, elevator and rudder have trimmed control surfaces and cockpit trim position indicators.

Flaps are hydraulically powered and can be operated to 15 degrees at 200 KIAS or below and 35 degrees (full travel) at 175 KIAS or below. Spoiler-type speed brakes are hydraulically actuated and electrically controlled and can be extended throughout the flight envelope.

AILERONS AND TRIM TAB

The ailerons provide excellent lateral control throughout the entire operating envelope. Full range of travel is 19 degrees, +1 or -1 degree up and 15 degrees, +1 or -1 degree down. One trim tab, located on the left aileron, is mechanically controlled by a knob on the center pedestal. An indicator on the pedestal shows the amount of trim selected in relation to a neutral position. Full travel of the tab is 20 degrees, +2 or -2 degree up and down.

ELEVATORS AND TRIM TABS

Elevator control is mechanical through four cable assemblies. Full elevator travel is through a range of 19 degrees, +1 or -0 degree up, to 15 degrees, +1 or -1 degree down. Elevator trim tabs installed on each elevator can be positioned electrically or mechanically through cockpit trim tab actuators. Full travel of the tabs is 5 degrees, +1 or -1 degrees up and 15 degrees, +1 or -1 degrees down. An elevator trim wheel on the pedestal provides manual trim control. A trim switch, located on the left side of the pilot's control wheel, controls an electric trim motor which in turn positions the elevator tabs. The copilot's trim switch is located on the right side of the copilot's control wheel. The pilot's trim switch has priority and will interrupt and override the copilot's control. If the electric trim malfunctions, it can be overridden by the manual trim system, or momentarily disabled by pressing the AP/TRIM DISC switch on the pilot's or copilot's yoke.

FLIGHT CONTROLS

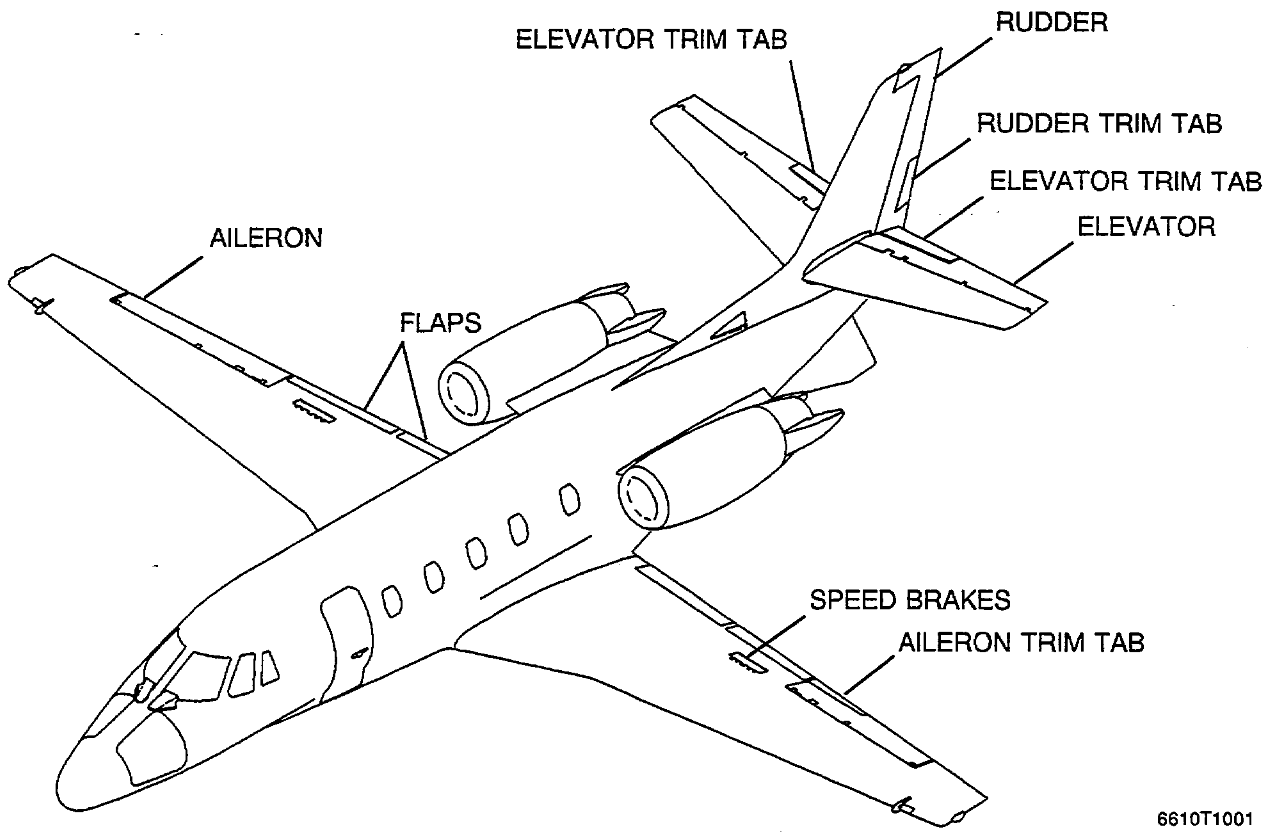

Figure 2-12

RUDDER AND TRIM TAB

The rudder is activated by dual left and right rudder pedals located just aft of the forward pressure bulkhead. Full rudder deflection is 22 degrees, +1 or -0 degrees either side of center. A single rudder trim is provided at the trailing edge. With the rudder in the trail position, the trim tab will deflect 11.5 degrees, +1 or -1 degrees left and right. The rudder trim is mechanically operated by the rudder trim wheel on the center pedestal. An indicator on the pedestal shows trim tab position relative to neutral. In addition to mechanical actuation, the rudder trim is servo-connected to follow assist in rudder movement. When the trailing edge of the rudder moves to the left, the rudder trim tab trailing edge will servo to the right, assisting in pushing the rudder trailing edge to the left. When the trailing edge of the rudder moves to the right, the rudder trim tab trailing edge will servo to the left, assisting in pushing the rudder trailing edge to the right.

RUDDER/AILERON INTERCONNECT

The interconnect operates in conjunction with the primary controls. When the pilot inputs a left rudder command through the pedals, the torsion bungee imposes a left roll torque to the aileron system. A left roll input likewise produces a left yaw response. Right inputs produce right responses.

NOSE GEAR STEERING

The nose gear is mechanically steered by the rudder pedals to 20 degrees either side of center. Steering is accomplished through mechanical linkage with a bungee that allows the nose gear to center before entering the wheel well on retraction. Additional castering of the nose wheel can be achieved against the bungee by application of differential power and braking. For ground handling and towing, maximum deflection of the nose wheel is 90 degrees either side of center.

SPEED BRAKES

The speed brakes are installed on the upper and lower surfaces of each wing to permit rapid rates of descent without exceeding V_{MO}/M_{MO} and to spoil lift during landing roll. The speed brakes are electrically controlled and hydraulically actuated by a switch located on the throttle quadrant and may be selected to the fully extended or fully retracted positions. The angular travel for the upper speed brake panels is 65 degrees, +2 or -2 degrees. The lower speed brake panels extend and retract through interconnecting linkage with the upper panels.

When the speed brakes switch is positioned to EXTEND, electrical power is applied to close the bypass valve in the hydraulic system return line and open the speed brake control valve. This allows hydraulic fluid at 1500 PSI to flow to the extend side of the speed brake actuators. Once the speed brakes are extended, the speed brake control valve closes to create a hydraulic lock and hold the speed brakes extended. The bypass valve opens and the hydraulic system returns to an open center condition. Moving the speed brakes switch to RETRACT again pressurizes the system, and the speed brake control valve allows fluid to go to the retract side of the speed brake actuators.

When the speed brakes are fully retracted, the control valve closes, the hydraulic system bypass valve opens and open center operation resumes.

Microswitches in the tailcone prevent speed brakes extension at engine power settings above approximately 85 percent N_2. If the speed brakes are extended at lower power settings and the throttles are subsequently advanced above 85 percent, the speed brakes will retract and the switch will return to the RETRACT position.

In the event of an electrical failure while the speed brakes are extended, the control valve fails to the open position and the speed brakes will trail. If a dual hydraulic pump failure or fluid loss should occur with the speed brakes extended, moving the switch to RETRACT will deenergize the speed brake control valve and the speed brakes will trail.

FLAPS

The trailing edge flaps are constructed of graphite composite laminates and consist of two segments on each wing. They are electrically controlled and hydraulically actuated and operate through a range of 0 to 35 degrees of travel. A mechanical detent is installed at the T.O. (7-degree) and T.O. & APPR (15-degree) positions of the flaps lever. The FULL or UP flaps positions are reached by pushing down on the flaps lever when passing through the T.O. and/or T.O. & APPR detents. Any intermediate position can be selected throughout the range of travel.

A gear warning horn will sound any time the flaps are selected past the T.O. & APPR position with the gear not down and locked and both throttles set at less than 70% N_2. The horn cannot be silenced until the condition which caused the horn to activate are removed.

TWO-POSITION STABILIZER

The two-position stabilizer utilizes a hydraulic pump coupled to a jack screw to provide takeoff/landing setting (nose down 2 degrees) or cruise setting (nose up 1 degree) for the horizontal stabilizer. The pump and jack screw assembly are located at the horizontal/vertical stabilizer intersection, and drive the leading edge of the horizontal stabilizer up or down based on flap handle position. Cycle time for the stabilizer to move from one position to another is approximately 25 seconds.

With the flap handle in the 0 degree position, the leading edge of the horizontal stabilizer assumes a 1 degree nose up position. When the flap handle is moved out of the 0 degree position, a microswitch inside the pedestal commands a hydraulic valve to open, allowing fluid to actuate the pump and jack screw assembly. The jack screw drives the leading edge of the horizontal stabilizer to the 2 degree nose down position. This nose down position will remain as long as the flap handle is out of the 0 degree position.

After takeoff, when the flap handle is moved back to the 0 degree position, the microswitch will activate and allow the jack screw to move the horizontal stabilizer to the 1 degree nose up (cruise) position.

NOTE

A pneumatic switch installed in the backup pitot-static line prevents inadvertent movement of the actuator anytime airspeed is above 205 KIAS regardless of flap handle position.

When the airplane is configured for landing and the flap handle is moved out of the 0 degree position, the microswitch will again activate and allow the jack screw to move the horizontal stabilizer to the takeoff/landing setting (nose down 2 degrees).

CONTROL LOCK

The control lock is mechanically operated and, when engaged, locks the ailerons, elevators and rudder in the neutral position and the throttles in the OFF position. The control lock handle, located below the instrument panel on the left side, controls the system. When the handle is pulled straight aft to the detent, the flight controls and throttles are locked. To release the control lock system, rotate the T-handle 45 degrees clockwise and push it in. With the control lock engaged, the maximum deflection of the nosewheel is restricted to 60 degrees either side of center. Exceeding the degree of turn will cause excessive force to be placed on the control lock mechanism and rudder control cables. Towing the airplane with the control lock engaged should be avoided. The controls should be neutralized before engaging the lock.

STALL WARNING - STICK SHAKER

Stall warning is achieved by the use of a stick shaker mounted on the forward side of the pilot's and co-pilot's control column. An electric motor with rotating weights induces a vibration feel to the control column. The pilot is alerted to impending stall by the vibration of the control column which occurs approximately 8% to 10% above the actual stall speed. Stick shaker activation will occur before stall buffet. The stick shaker is energized by inputs from the angle-of-attack system. The rotary test switch located on the center pedestal provides a means of checking the shaker prior to flight.

ELECTRICAL

GENERAL

Electrical power for the Excel comes primarily from DC sources originating with the starter/generators or the battery. A receptacle below the left engine pylon is provided for connection of a 28 VDC external power unit.

ALTERNATING CURRENT (AC) POWER

The Excel utilizes a single alternating current (AC) inverter to power the electroluminescent panel lighting. In addition, AC power from engine-driven alternators is used to power the electrically-heated windshield. For a complete system description, refer to Anti-Ice/Deice description in this section.

NOTE

Avionics equipment in the Excel is DC-powered, and therefore does not require the use of AC inverters.

DIRECT CURRENT (DC) POWER

The direct current (DC) power distribution system contains of two separate and independent DC power sources which supply the system. In the event these DC power sources fail, the battery system will supply emergency power to selected systems. The direct current (DC) power distribution system consists of a battery system, two 300 amp starter/generators, two Generator Control Units (GCUs), a distribution system, a battery switch, an avionics switch, two generator control switches, two ammeters and a voltmeter with a selector switch. A description of various components follows.

BATTERY SYSTEM

The battery system consists of the battery, the battery disconnect relay and associated switches. The 40-amp battery is used to provide power for engine starting, and to provide power to the emergency battery bus in the event of a dual generator failure.

The battery is located in the left hand aft fairing and has an overboard vent. A battery disconnect relay is provided for the battery. During normal operation, the relay remains in a de-energized position. During a battery overtemp condition, the battery may be disconnected by operating the BATTERY DISCONNECT switch on the pilot's circuit breaker sub-panel. The switch is also intended for ground operation in the event a starter relay becomes welded closed.