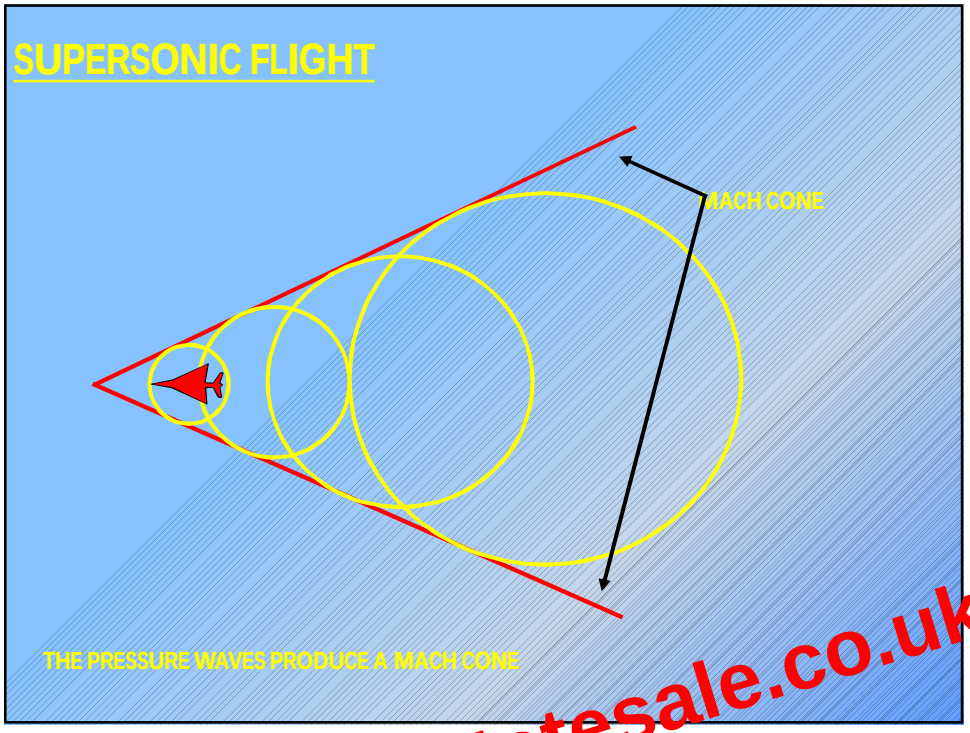
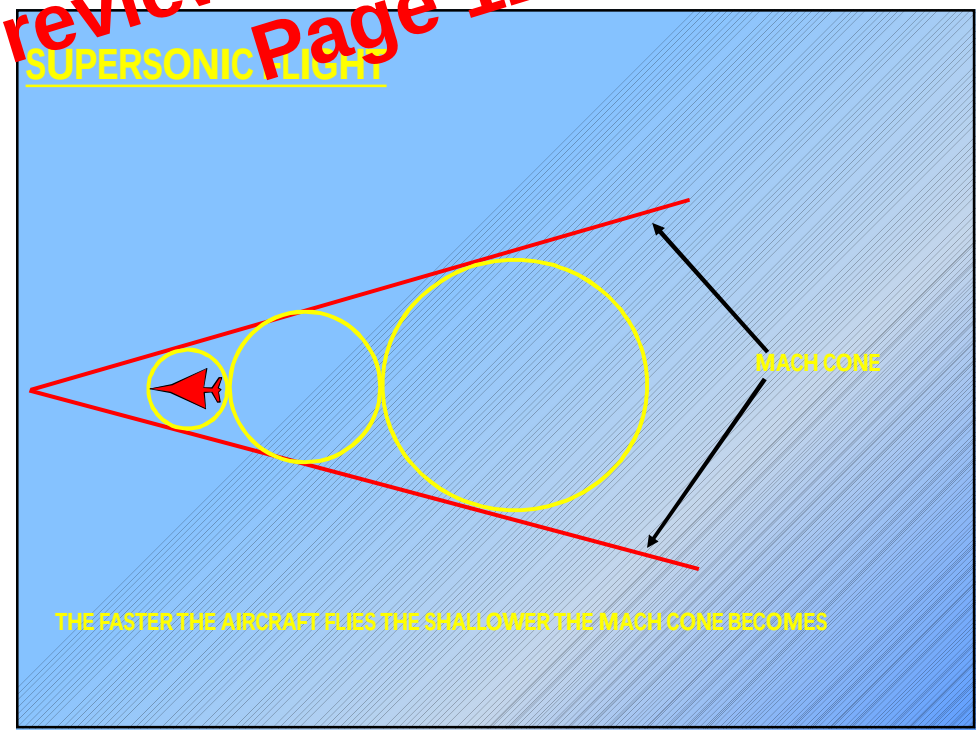
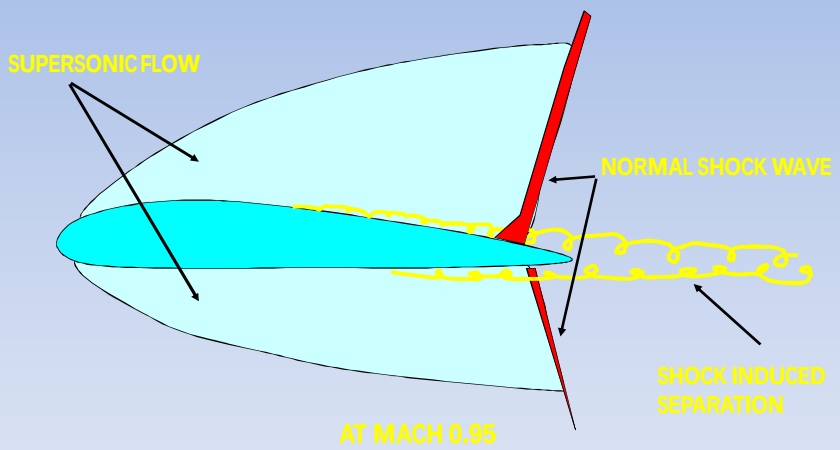




SHOCK WAVE



SHOCK WAVE

THE EXTRA DRAG IS CALLED 'SHOCK DRAG'.

AS THE AIRCRAFT'S SPEED INCREASES THE SHOCK WAVE MOVES AFT. A SECOND WAVE FORMS ON THE LOWER SURFACE.

AS THE AIRCRAFT REACHES THE UPPER TRANSONIC RANGE BOTH SHOCK WAVES MOVE AFT AND ATTACH AT THE TRAILING EDGE.

A FURTHER INCREASE IN SPEED WILL RESULT IN THE BOW WAVE FORMING AHEAD OF THE AEROFOIL AND THE AIRFLOW OVER THE WING BECOMES SUPERSONIC.

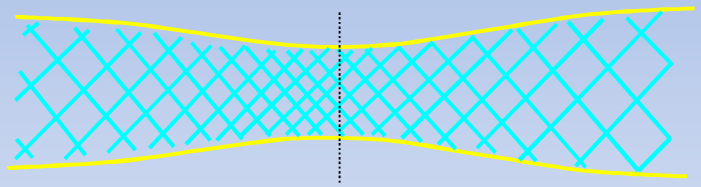
THE ADVERSE TRANSONIC EFFECTS WILL BE ELIMINATED.

SHOCK WAVE

SHOCK WAVE

SUPERSONIC FLOW

SUPERSONIC AIRFLOW THROUGH A VENTURI



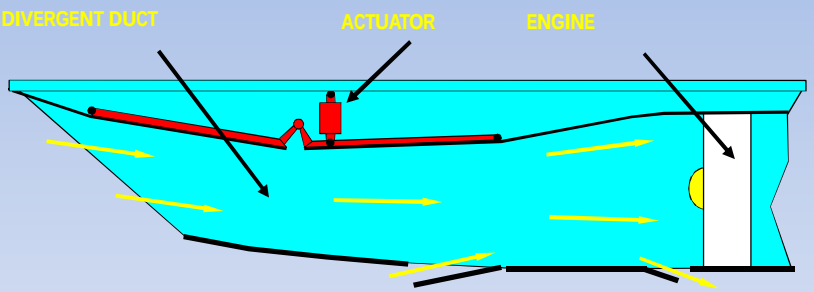
CONVERGING	DIVERGING
DECREASING VELOCITY	INCREASING VELOCITY
INCREASING PRESSURE	DECREASING PRESSURE
INCREASING DENSITY	DECREASING DENSITY

AIRFLOW FACTORS ON ENGINES

ONE WAY OF DOING THIS IS, IS TO HAVE AN ADJUSTABLE INTAKE WHICH CHANGES FROM DIVERGENT TO CONVERGENT AS THE AIRCARFT PASSES THROUGH MACH 1.0.

ANOTHER METHOD IS TO HAVE A MOVEABLE BULLET FAIRING IN THE CENTRE OF THE INTAKE WHICH EXTENDS OUTWARDS AS THE AIRCRAFT PASSES THROUGH MACH 1.0. THIS METHOD REPOSITIONS THE SHOCK WAVE AROUND THE INTAKE

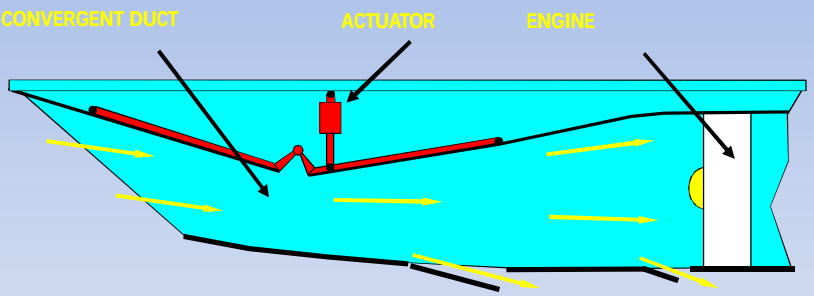
SUBSONIC AIR INTAKE



DUMP VALVE - USED AS AIR SCOOP

SPILL VALVE - TO PREVENT TURBULENCE

SUPERSONIC AIR INTAKE



DUMP VALVE - OPEN

SPILL VALVE - TO VENT EXCESS AIRFLOW

FLIGHT CONTROL SYSTEMS

FLIGHT CONTROL OPERATION

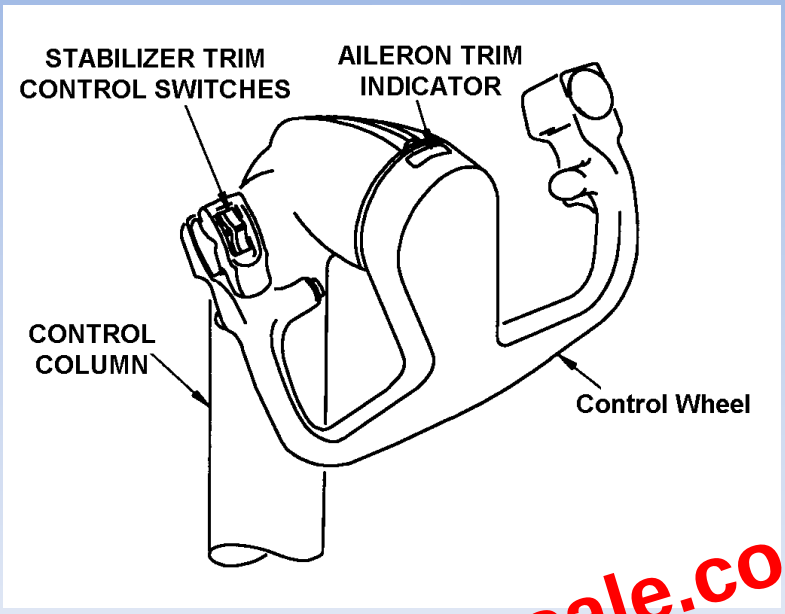
ON LIGHT AIRCRAFT FLIGHT CONTROL OPERATION IS NORMALLY ACTUATED BY A SYSTEM OF CABLES, PULLEYS, FIXED AND ADJUSTABLE CONTROL RODS BELLCRANKS LEVERS AND TORQUE TUBES.

ON LIGHT AIRCRAFT THE CONTROL LOADS ARE RELATIVELY LIGHT THEREFORE THE CONTROL INPUTS REQUIRE LITTLE EFFORT.

ON LARGER MORE COMPLEX AIRCRAFT THIS SYSTEM IS SUPPLEMENTED BY A SYSTEM OF HYDRAULICALLY OPERATED SERVO JACKS WHICH ACTUATE THE CONTROLS.
THIS IS CALLED POWER ASSISTED.

ATA Chapter 27

WHEEL AND CONTROL COLUMN (BOEING)



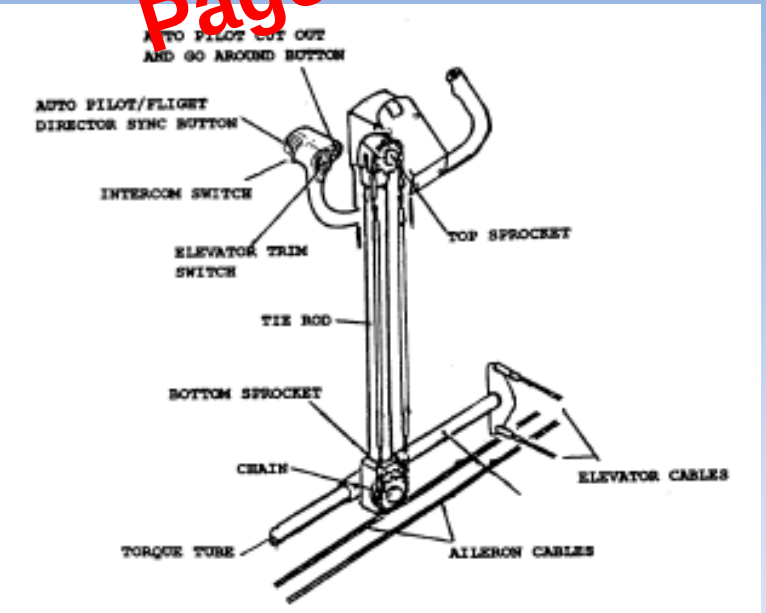


Fig. 11 CONTROL COLUMN

SIDE STICK CONTROL (AIRBUS)

THE SIDE STICK CONTROLLER IS GENERALLY USED TO CONTROL FLY BY WIRE AIRCRAFT.

THE SMALL SIDE STICK TAKES UP LITTLE ROOM AND CAN BE OPERATED BY ONE HAND.

A320 Cockpit

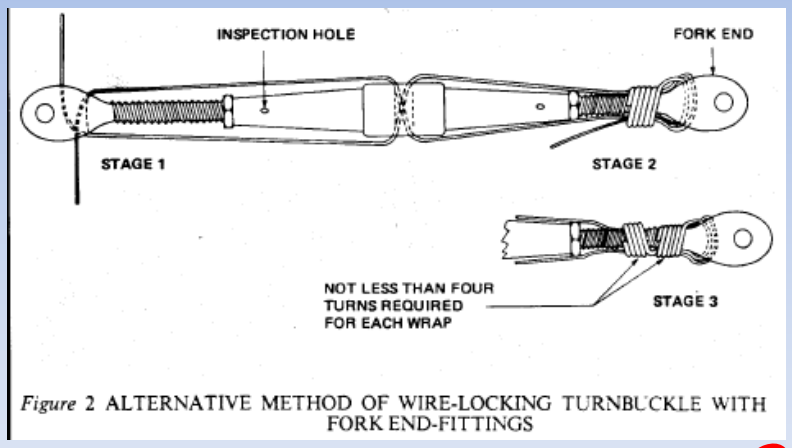


Figure 2 ALTERNATIVE METHOD OF WIRE-LOCKING TURNBUCKLE WITH FORK END-FITTINGS

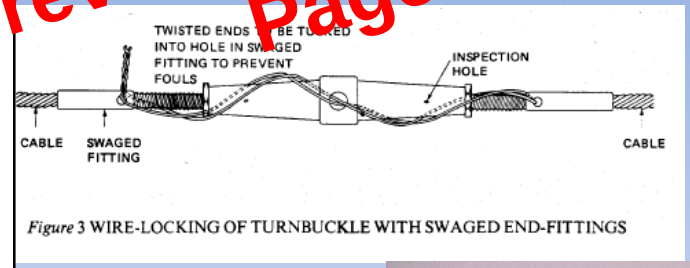
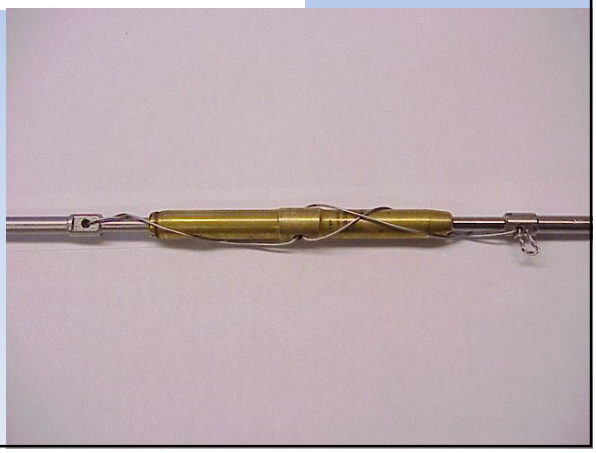
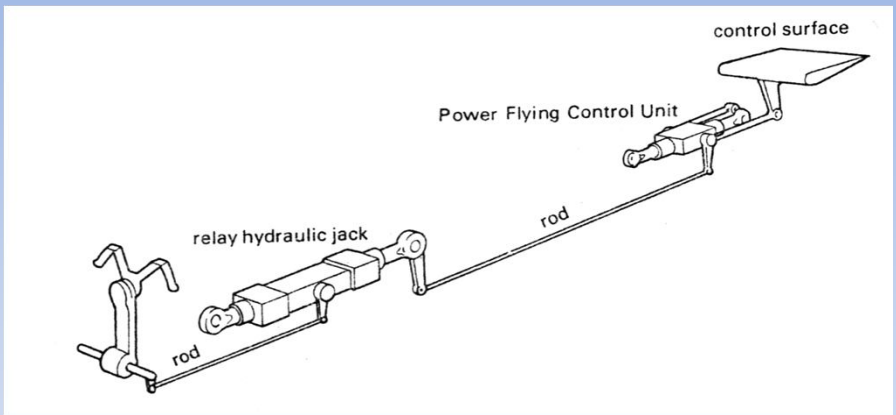


Figure 3 WIRE-LOCKING OF TURNBUCKLE WITH SWAGED END-FITTINGS



POWER ASSISTED FLYING CONTROLS

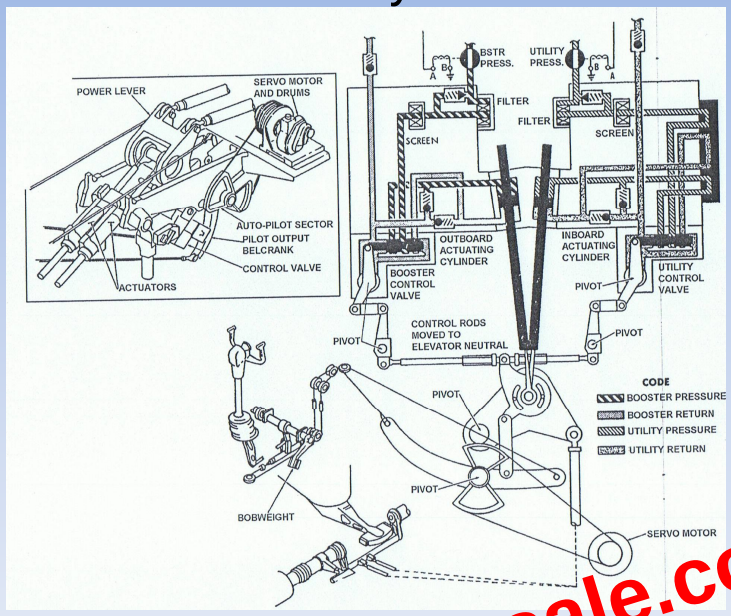


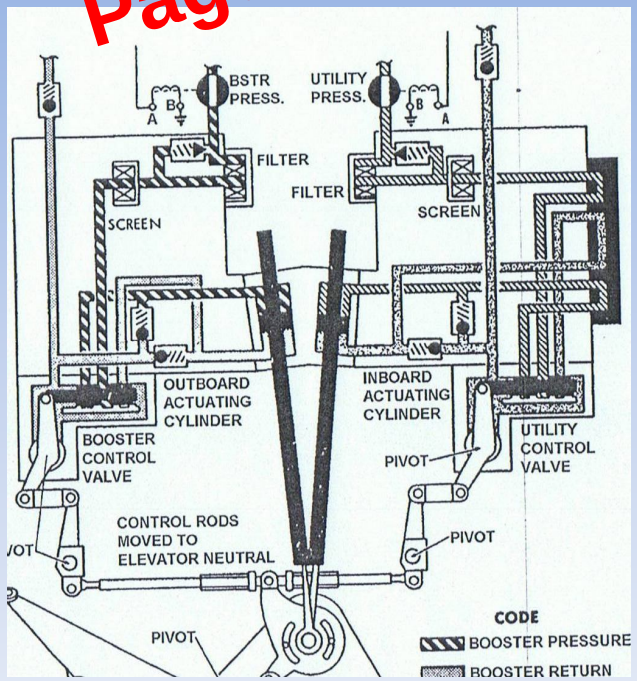
POWER ASSISTED FLYING CONTROLS USE HYDRAULICS TO ASSIST THE PILOT IN MOVING THE CONTROL SURFACES, REDUCING PILOT FATIGUE

POWERED ASSISTED CONTROLS

- FLIGHT CONTROLS ARE HYDRAULICALLY ACTUATED.
- HYDRAULIC PRESSURE IS SUPPLIED FROM AT LEAST 2 SYSTEMS FOR REDUNDANCY
- MAY ALSO BE ASSISTED BY BALANCE PANELS AND BALANCE TABS.
- TRIM TAB CAN MOVE CONTROL SURFACES IF HYDRAULIC FAILS

Dual Assy PFCU





SELF CONTAINED PFCU

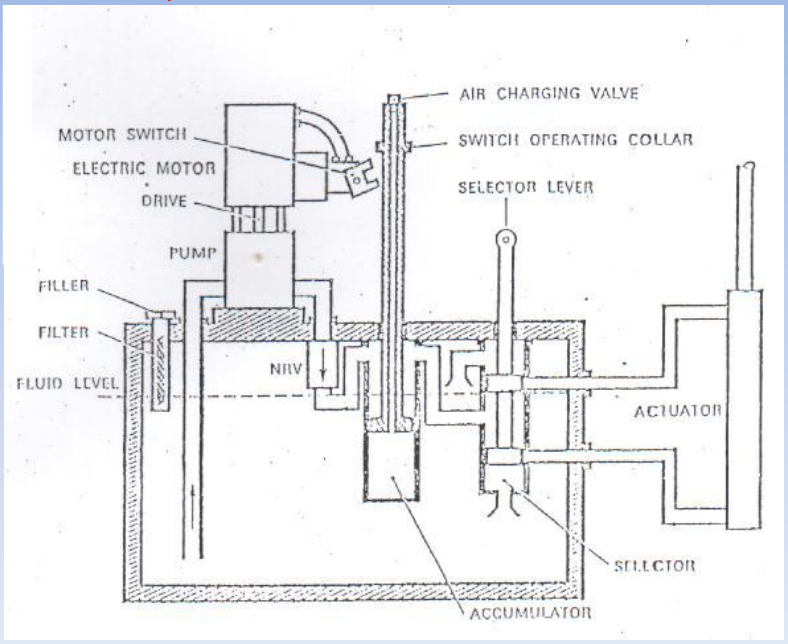
THE ELECTRIC PUMP WILL ROTATE AND THE PISTONS WILL START TO PROVIDE HYDRAULIC PRESSURE, THEREFORE MOVING THE JACK RAM.

THIS TYPE OF PFCU WILL BE DUPLICATED AND EACH MAY DRIVE A DUPLICATE AND INDEPENDENT CONTROL SURFACE.

ON PFCU OR ELECTRICAL FAILURE THE PCFU WILL REVERT BACK AND LOCK TO A NEUTRAL POSITION. FURTHER INPUTS ARE ABSORBED BY SPRING UNITS WHICH ALLOW THE OTHER PFCU'S TO CONTINUE OPERATING.

TO MAINTAIN REDUNDANCY EACH PFCU WILL BE FED ELECTRICALLY FROM DIFFERENT BUS BARS.

SELF CONTAINED PFCU



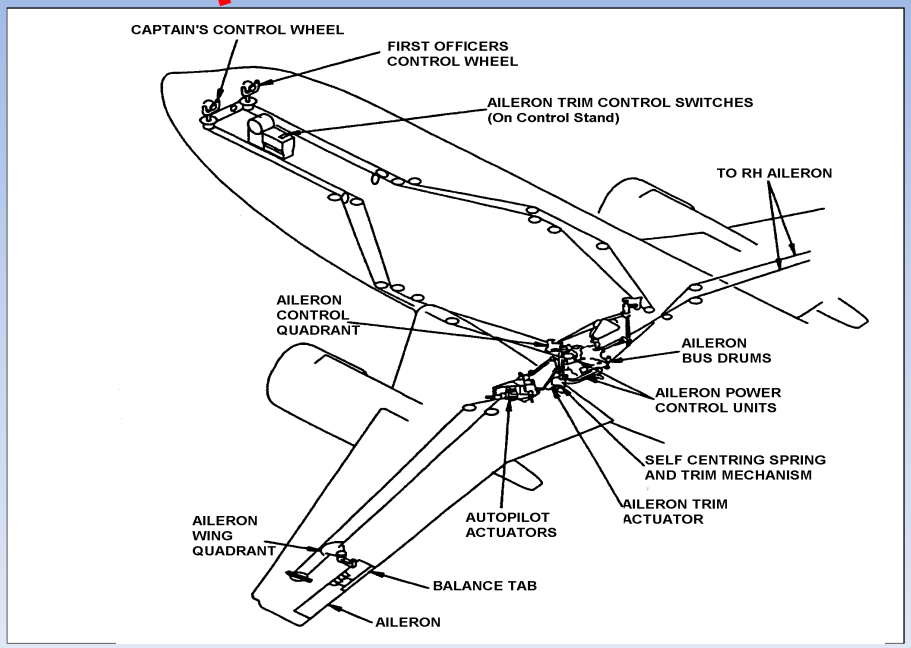
INPUT SYSTEMS

GENERALLY THE INPUT SYSTEMS ARE PRIMARILY EITHER CABLE OR ROD, WITH RELATED QUADRANTS BELLCRANKS, PULLEYS AND FAIRLEADS.

TO GUARD AGAINST CABLE BREAKAGE THE CABLE SYSTEM IS DUPLICATED AND ARE ROUTED SEPARATELY THROUGH THE AIRCRAFT.

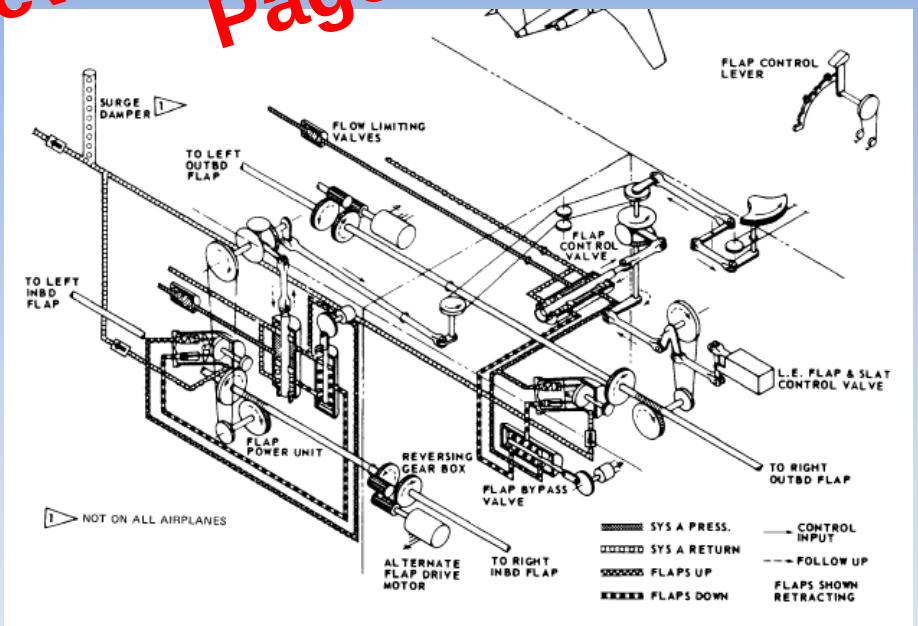
THE CABLE SYSTEMS MEET AT A COMMON INPUT TO THE CONTROLS AND MAY BE INTERCONNECTED THROUGH TORQUE TUBES (OR A CHAIN) AT THE CONTROL COLUMN AND TO THE LINKAGES TO THE PFCU.

INPUT SYSTEMS

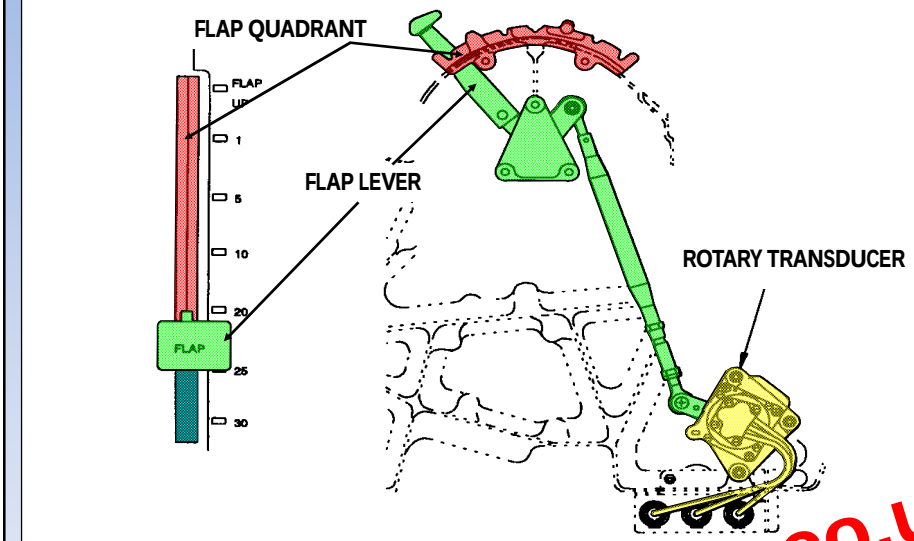


FLAP HYDRAULIC SYSTEM

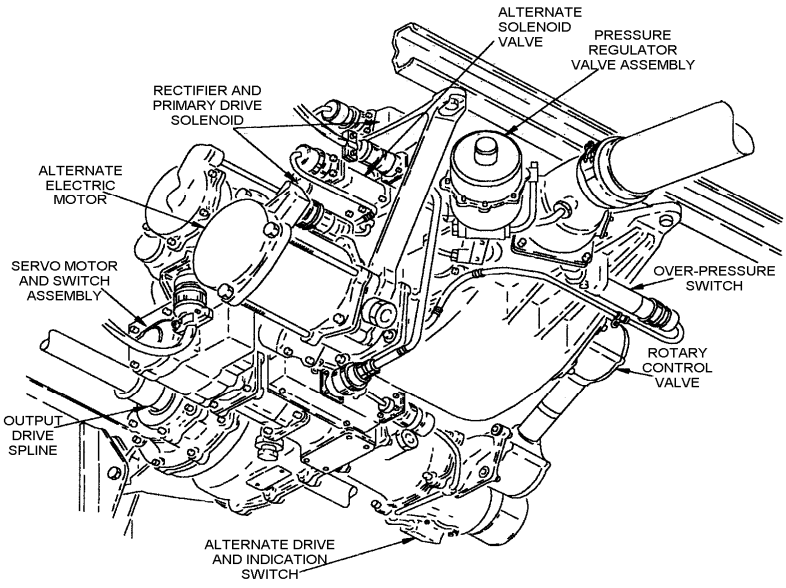
- For redundancy the flaps are supplied by two independent systems.
- Movement of the flap selector lever energises the appropriate solenoid selector valve to allow pressurised fluid to pass to the hydraulic motor.
- A flow control valve controls the rate at which the flaps deploy.
- When the flaps reach the selected setting the solenoid selector valve is de-energised by operation of the selector drum microswitches.



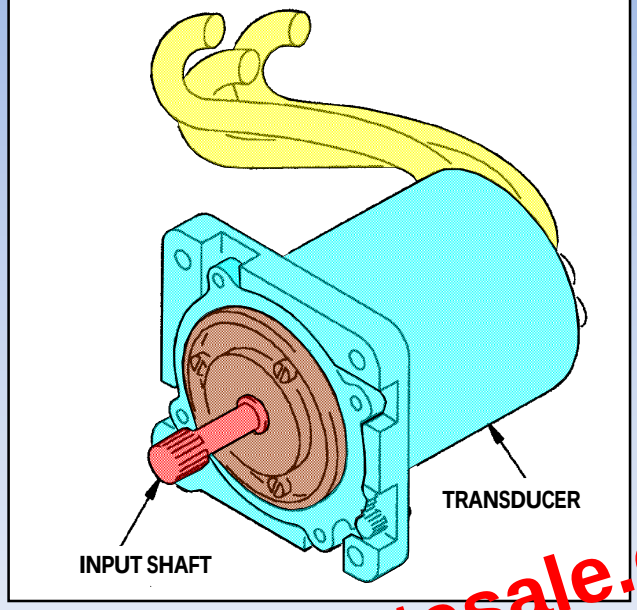
FLAP OPERATION LEVERS



TYPICAL LARGE AIRCRAFT FLAP DRIVE



ROTARY TRANSDUCER



ROTARY TRANSDUCER