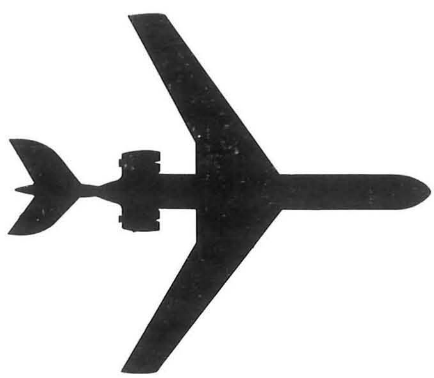

ELLIOTT

VC10 FLIGHT CONTROL SYSTEM

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Published by
Transport Aircraft Controls Division
Elliott Brothers (London) Ltd

INTRODUCTION

VC10 ELLIOTT AUTOMATIC Flight Control System

The VC 10 aircraft achieves overall reliability by duplication of the automatic pilot installation, the two systems being segregated to preclude common failures. This is an extension of the philosophy of duplication of electronic aids to navigation and communication which has been an arrangement adopted by airlines for many years. The purpose of this duplication is to ensure the availability of these facilities in the face of single, and sometimes multiple failures in equipment; even so, it is probable that such a step would not have been taken were it not for other significant advantages and the development potential in such an installation.

With duplicate automatic equipment on board there is sufficient redundancy to suffer a failure and yet to remain operational. This will permit round-the-world operation with a minimum of spares provisioning and service backing for the essential auto-control facilities.

To achieve the required structural protection, against autopilot failures, the authority of the autopilot must be restricted. The large ''stick force per g'' range encountered in high performance aircraft, will impose limitations on the autopilot authority in some flight conditions which will seriously detract from the adequacy of control. These limitations can, however, be reduced by the use of comparison monitoring techniques which provide adequate control authority compatible with structural protection over the whole flight range. These improvements in performance are accompanied by rapid fault detection and disconnection at the onset of a failure, thus reducing passenger discomfort and disturbance to the aircraft flight path.

The Air Registration Board impose certain reliability requirements for autoflare and these must be satisfied. With modern autopilot equipment this implies the necessity to survive one fault during the critical phase, i.e. below normal break off heights, without detriment to the system performance. The VC 10 automatic flight control system consisting of two independent monitored systems thus meets all these requirements.

DESCRIPTION

Item

- A Throttle Dual Controller
- B Autopilot Dual Controller
- C Throttle Dual Actuator
- D Three-Axis Trim Indicator
- E Three-Axis Rate Control
- F Vertical Gyro Transmitter
- G Vertical Gyro Transmitter Assembly
- H Air Data Sensor
- J Comparison Air Data Sensor
- K Longitudinal Amplifier & Computer
- L Lateral Amplifier & Computer
- M Comparison Monitor Computer
- N Dynamic Vertical Sensor
- O Power Junction Box

Flight Control System

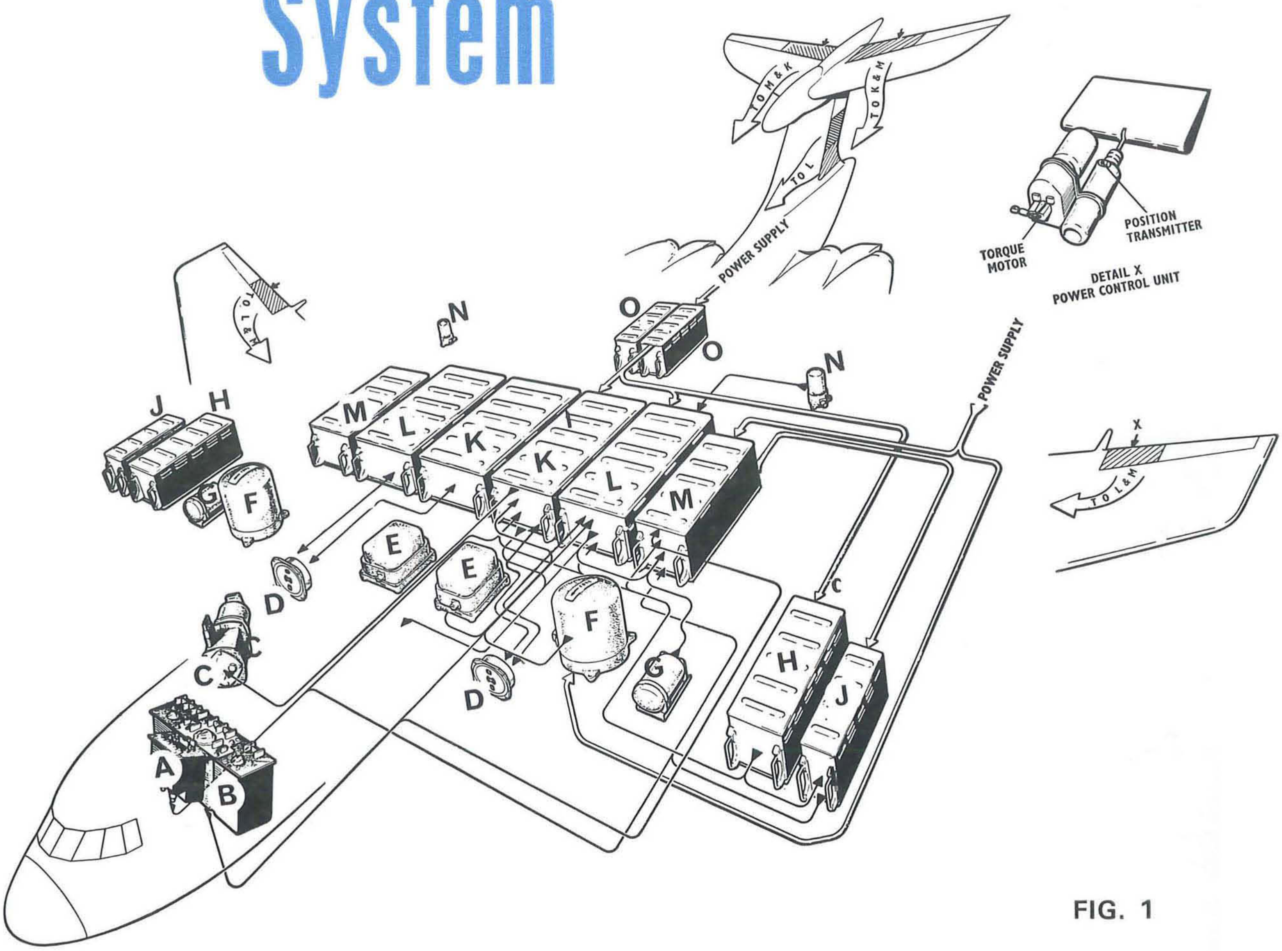


FIG. 1

FACILITIES

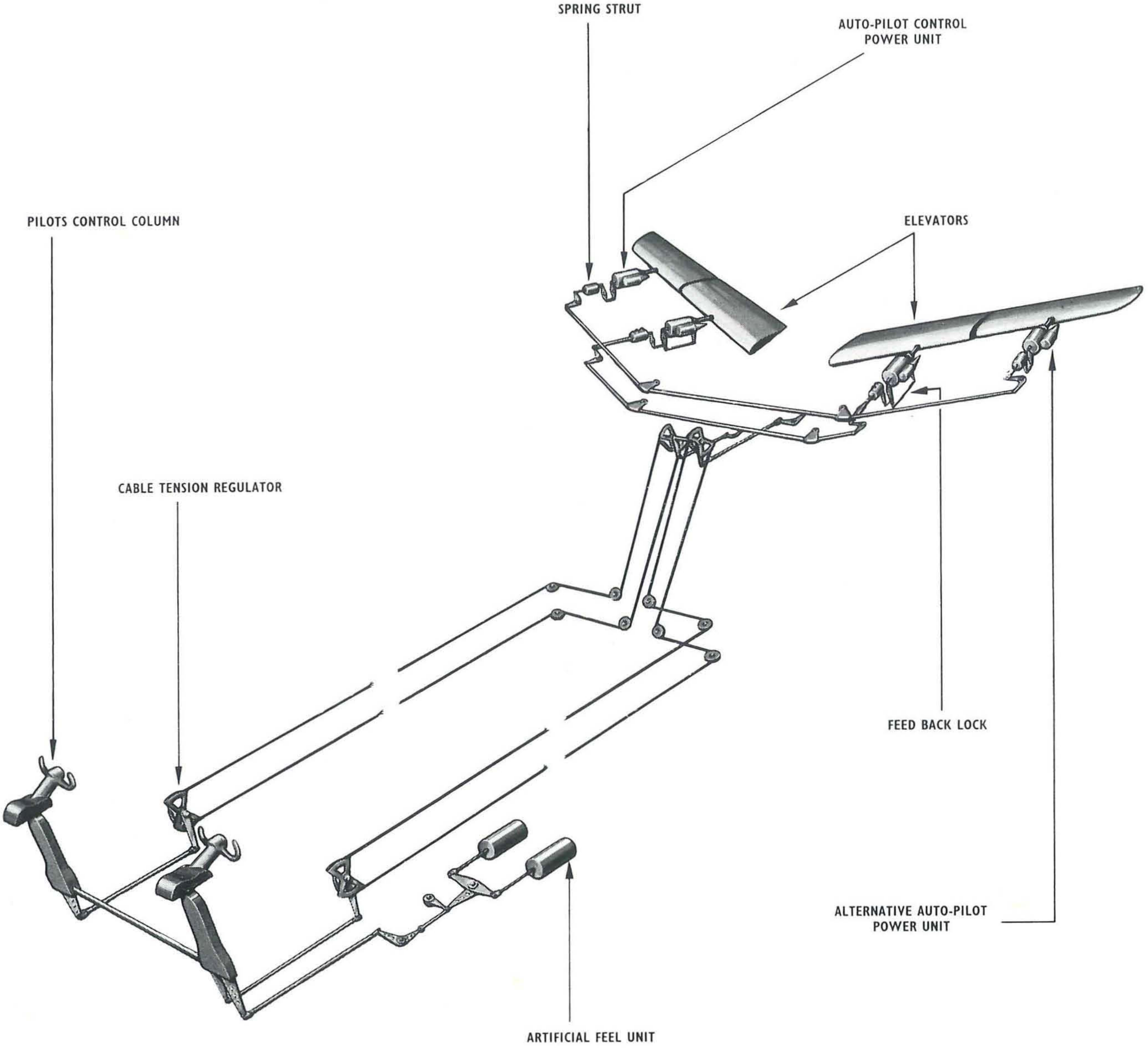
The automatic flight control system (AFCS) Fig.1, provides all the facilities expected in a modern autopilot, namely:

- Short term damping about the three axes of roll, pitch and yaw. Yaw damping can be engaged independently of autopilot.
- Attitude and heading hold.
- Altitude, airspeed or Mach No. holding, with the added feature of a datum adjust facility.
- Preselected heading hold, with the provision for Doppler track if required.
- Omni-range tracking.
- Automatic coupled I.L.S. approach, with auto-throttle control. (The ultimate aim is the termination of autoapproach by an autoflare facility which is to be incorporated at a later date.)

The autothrottle system provides speed control intended for use on the approach when the aircraft is being controlled by either pilot or the autopilot. The autothrottle controls engine thrust to maintain the airspeed to ± 2 knots of any demanded speed, within the range 100-180 knots. A tailplane trim (Autotrim) facility is included which relieves the pilot of a routine function when the aircraft is controlled by the autopilot and precludes the attendant disadvantages of the elevator out-of-trim during changeover to manual; the effectiveness of the autopilot control is also improved.

The system is automatically monitored by a comparison system and may also be visually monitored by the pilot through navigation instruments and indicators on the pilot's panels.

FIG. 2—ELEVATOR CONTROL SYSTEM



DESCRIPTION

AUTOPILOT AND POWER CONTROL INTEGRATION

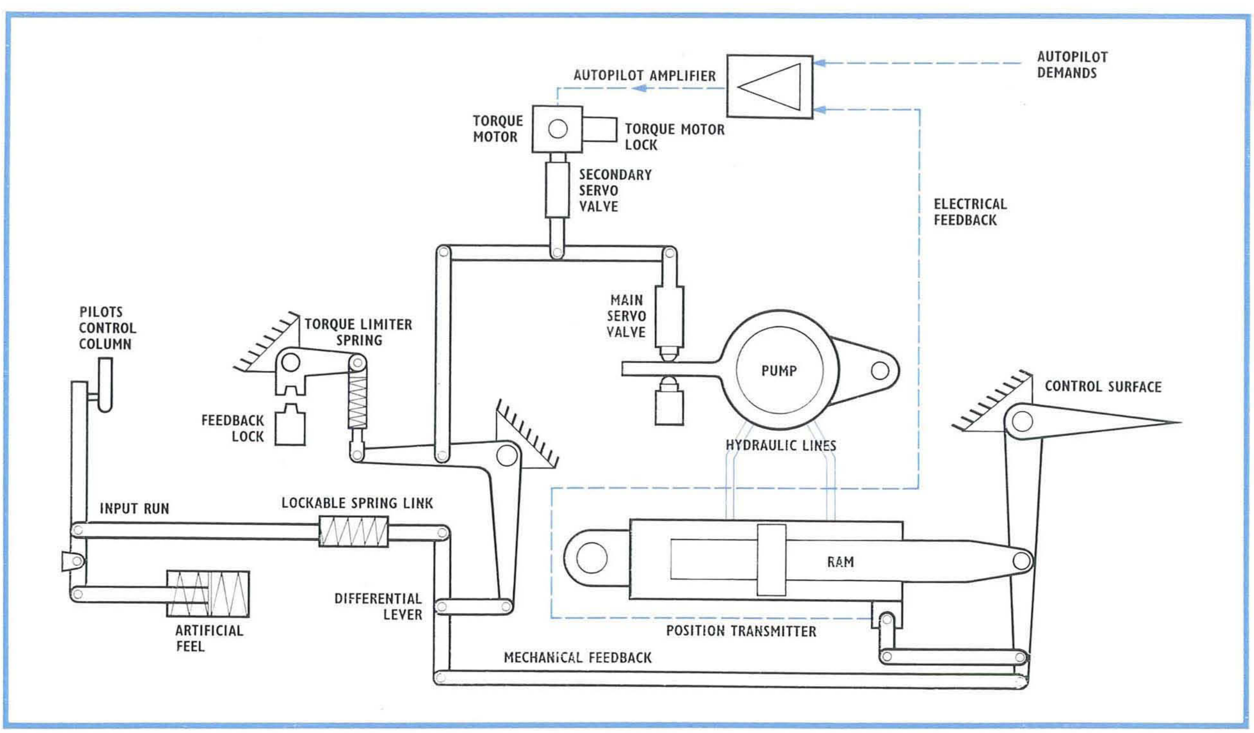
Autopilot authority over the aircraft control-surfaces, e.g. inboard units of the aileron and elevator and middle and lower rudder, is effected by torquemotors attached, one to each Power Control Unit (P.C.U.) Fig. 2. These torquemotors position the piston of a secondary hydraulic servo-valve. The sleeve of the valve is mechanically coupled to the main hydraulic servo-valve of the power flying control unit. The main hydraulic servo-valve positions the pump case within the power control unit to determine the rate and direction of control-surface movement.

Two lock solenoids are incorporated in the P.C.U. (Fig. 3) which determine the location of fulcrum points of the power control linkage. The torquemotor lock holds the torquemotor shaft and linkage in a neutral position when neither autopilot nor damper is engaged. When the former is engaged, the solenoid is energized to release the torquemotor shaft and linkage so as to permit the torquemotor to transmit movement through mechanical linkage to the piston of the secondary servo-valve. The second lock solenoid—the torque limiter—is energized only when the autopilot is engaged; it fixes the location of the torque limiter mechanical linkage thus bringing the torque limiter into full operation.

Note: The torque limiter is not operative when the damper is engaged.

Since only one P.C.U. in each control axis is under autopilot authority—the remaining sections being operated as slave units—it becomes a master unit and is capable of positive transmission of its movement to the remaining P.C.U.'s and also to the pilot's controls through the feel simulator. This is effected by locking the master P.C.U. spring strut in the control run, thereby transforming this normally compressible component into a solid link. The spring strut is locked by two solenoids which are actuated when the autopilot is engaged.

FIG. 3—AP DISENGAGED



AUTOTRIM

The pitch trim of the VC 10 aircraft is effected by a variable incidence tailplane, its angle being determined by the positioning of a screw jack mechanism driven by two hydraulic motors supplied from the independent hydraulic systems. Each autopilot has an autotrim facility which has authority over its respective hydraulic system and associated motor. Elevator out-of-trim is detected by electrical pick-offs on the control runs in the vicinity of the artificial feel unit.

Pick-off signals are processed by the autopilot and used to energise either of two hydraulic control valves (autotrim rate valves), one for "up trim" and the other for "down trim", providing a fixed rate of tailplane movement in the requisite direction to return the elevators to a trimmed condition, and thereby removing any steady load held by the autopilot in the elevator channel.

The autotrim system associated with each autopilot and primary hydraulic system is isolated from the alternative system and is considered part of its respective autopilot. Interlocking with related systems ensures that any malfunction of the autotrim will effect a disengagement of the autopilot.

An override facility allows the pilot to assume control by instinctive reaction on the manual controls of the primary system, apart from the conventional disconnect method. A further precautionary factor is the introduction of a short time delay between sensing and control which also has the advantage of reducing the operating frequency of the primary system with its attendant benefit to the wear rate and reliability.

An autotrim monitor is included to indicate the presence of long term out-of-trim such as would be due to a passive failure of the autotrim system.

The monitor measures the out-of-trim and switches a voltage to operate a warning lamp if the out-of-trim persists for longer than a predetermined time.

COMPARISON MONITOR

To monitor each system by the comparison principle, it is necessary to develop comparison signals separate from the demand signals with the minimum of additional equipment. In the A.F.C.S., these comparison signals are derived from independent sources which are less complex than the autopilot demand sources. Comparison signals are constantly compared with the autopilot response signals and the autopilot is automatically disconnected, and the pilot warned, if their difference exceeds a predetermined threshold.

PRIMARY SENSORS (REF. FIG. 4)

The primary sensors of each autopilot include a Three-Axis Rate Transmitter, a Vertical Gyro Transmitter (shared with the Flight Director System) and an Air Data Sensor. In addition, to detect lateral accelerations, a Dynamic Vertical Sensor is employed.

Heading information for each autopilot is derived from an associated Polar Path Compass System (which is integrated with the Flight Director) while radio information is obtained from associated ILS and VOR receivers.

The Three-Axis Rate Transmitter senses the rate of angular displacement about each of the three axes and generates proportionate electrical signals. These signals are amplified and applied to the surface servos to damp out any oscillation or disturbance.

The Dynamic Vertical Sensor detects lateral accelerations, i.e. slip c. skid. The sensor furnishes electrical signals, resulting from lateral accelerations, to the surface servo which applies automatic correction to slip or skid tendencies.

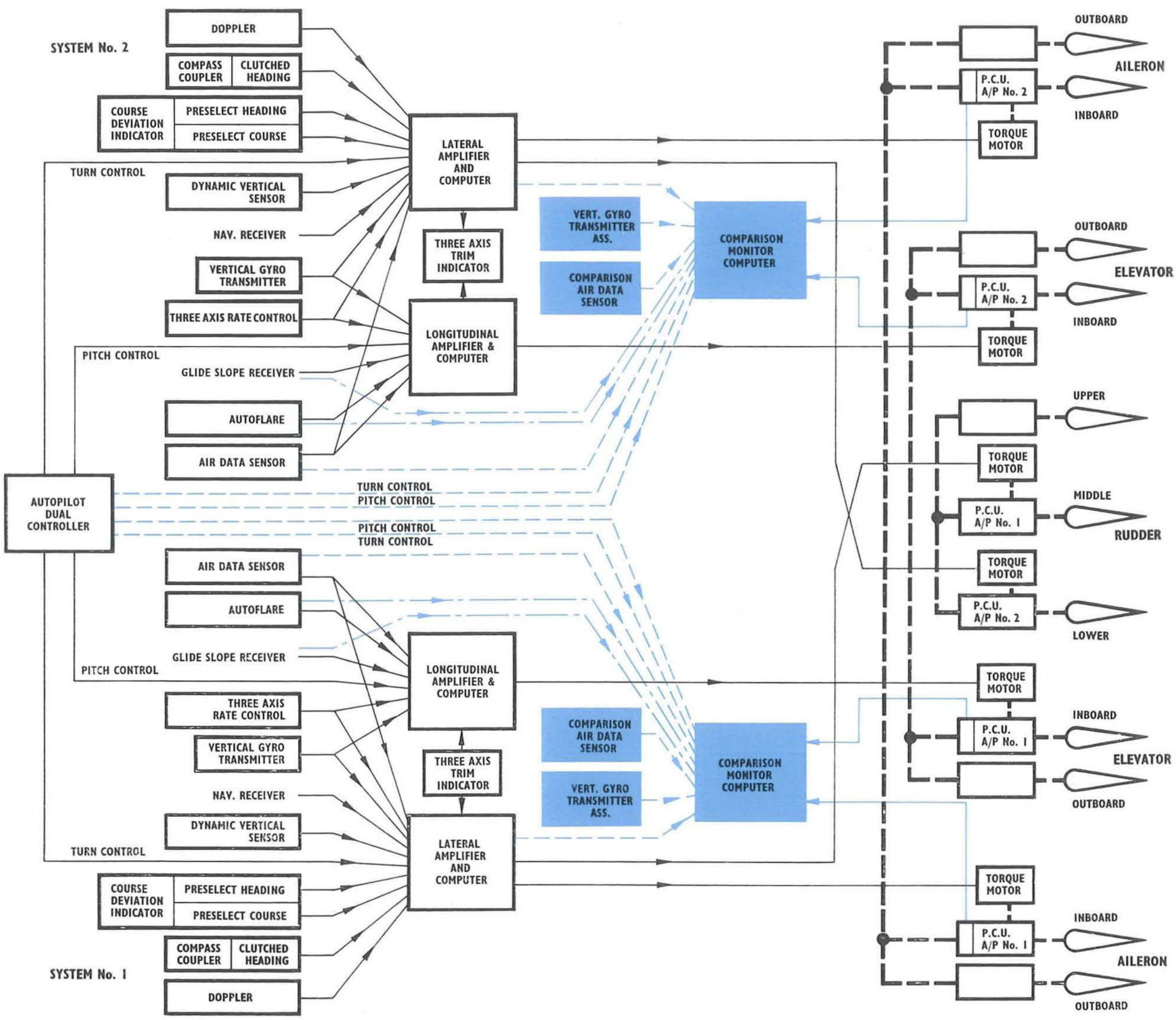
The Vertical Gyro Transmitter is an electrically driven gyro that forms the main vertical reference for the autopilot. In addition to providing pitch and roll attitude information, it also provides a signal which is used to give "up elevator" during turns. An interlock switch is included in the vertical gyro to prevent autopilot engagement before the gyro is erected.

In the Air Data Sensor static and dynamic pressure (S and P-S) are sensed by capsules from which position follow-up servos drive two shafts representing log S and log P-S values. These are mechanically subtracted to provide the third required value, log P-S/S (Mach No.). According to the manometric lock selected, one or other of these outputs is connected by an electromagnetic clutch to the output gearing and the other to the comparison computer. Individual synchros in the datum adjust selector on the pilot's control panel are used to alter the datum of these synchros as required.

While the main outputs from the Air Data Sensor are duplicated for overall monitoring purposes, the outputs of the capsule servos themselves are compared with identical outputs from a Comparison Air Data Sensor. The alarm and disconnect circuits are activated when a discrepancy between the two signals exists.

The Air Data Sensor also provides signals for the autopilot system and the facility to adjust autopilot gains when flying on manometric lock heading and automatic coupled approaches.

FIG. 4—AUTOPILOT BLOCK DIAGRAM



CONTROLS AND INDICATORS

CONTROLS

The Automatic Flight Control System is manually controlled from six units, all of which are located in the flight deck as follows :—

- Autopilot master switches
- Autopilot Dual Controller
- Autothrottle Dual Controller
- Course Deviation Indicator (Flight Director System)
- Two disconnect button switches on the pilot's handwheels.

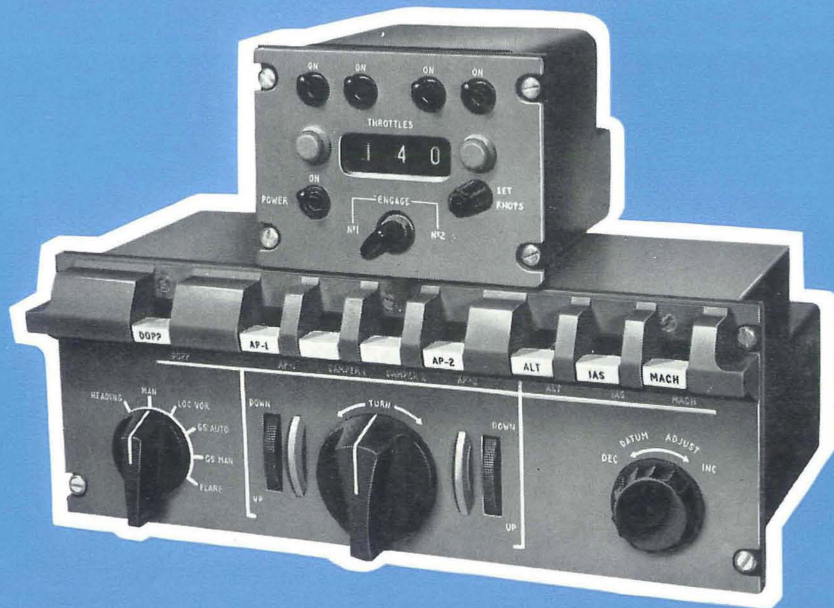
MASTER SWITCHES

Two 4-pole toggle switches are mounted side-by-side on the centre console in the flight deck, engraved AUTOPILOT MASTER. Each switch controls the power to one autopilot. The left-hand switch controls 200V 3-phase a.c. and 28V d.c. power to No. 1 autopilot from panels J and U; the right-hand switch controls 200V 3-phase a.c. and 28V d.c. power to No. 2 autopilot from panels K and Z.

The pair of switches are fitted with a common spring-loaded bar which when actuated, moves the two switches simultaneously to the OFF position. When the bar is released it returns automatically to the ON position to permit individual operation of the two toggle switches to ON.

Note:
These switches are sometimes referred to as "kill" switches.

FIG. 5—AUTOPILOT DUAL CONTROLLER AND AUTOTHROTTLE DUAL CONTROLLER



AUTOPILOT DUAL CONTROLLER (FIGURE 5)

The Autopilot Dual Controller is a single panel unit horizontally mounted on the flight deck centre console. It carries the switches and controls necessary for setting up modes and facilities for either autopilot No. 1 or No. 2.

AUTOTHROTTLE DUAL CONTROLLER (FIGURE 5)

The Autothrottle Dual Controller is a single panel unit horizontally mounted on the flight deck centre console. It carries the switches and controls necessary for selection and engagement of the dual throttle system. (System No. 1 or No. 2.)

COURSE DEVIATION INDICATOR

The Course Deviation Indicator provides a pictorial presentation of aircraft displacement with reference to an omni-range radial or localizer, with glideslope deviation superimposed.

Omni-range radial selection is made by turning the COURSE setting knob on the bottom left-hand corner of the instrument, which rotates the beam deviation needle with respect to aircraft heading and drives a numerical counter for accurate reading of selected radial or QDM.

Another knob marked HDG, on the opposite side of the instrument face, controls the position of an arrowhead cursor on the compass dial for selection of desired heading.

FIG. 6—COURSE DEVIATION INDICATOR

DISCONNECT BUTTONS

A switch in the form of a press button is mounted on the outboard horn of each pilot's handwheel. Either button, when pressed, will cause an instantaneous disengagement of the autopilot and autothrottle operative at the time.

CONTROLS AND INDICATORS

INDICATORS

In the Automatic Flight Control System, the two autopilots are equipped with separate but identical sets of indicators and warning lamps to keep the pilots visually informed of operating and fault conditions. These items are located on the respective pilot's instrument panels.

Each set of devices comprises the following:

- Three-Axis Trim Indicator to display trim conditions.
- Autopilot Press-to-Test warning lamp to indicate system failure.
- Autothrottle warning lamp to indicate airspeed signal errors and autothrottle failure.
- Glideslope ARMing indicator lamp and glideslope ENGAGED indicator lamp.
- Autotrim monitor lamp described previously.
- Triple Yaw Damper Indicator for the three yaw dampers.

The Three-Axis Trim Indicator has a dual function:

- To display any commands held in the system in the form of a signal applied to the torquemotors prior to the autopilot engagement.
- To show "feel" out-of-trim condition of the aircraft while under autopilot control. (Reference Figure 9.)

Automatic disconnection of an autopilot system is indicated by a flashing red lamp. The power for this lamp is normally derived from the aircraft 28V d.c. supply. In the event of failure of this (normal) 28V d.c. supply, the warning lamp circuit is automatically transferred to the autopilot internal 28V d.c. (unfiltered) supply.

Under this alternative supply condition, the warning lamp changes its role and operates as an indicator; it provides a steady red light when the autopilot is engaged and is extinguished in the event of autopilot failure.

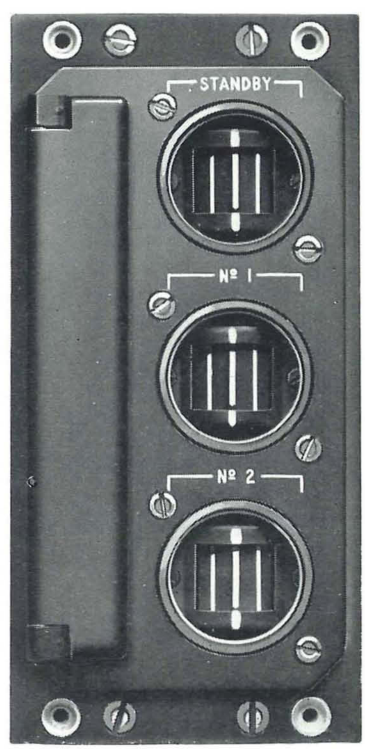
The autothrottle warning lamp provides a steady amber light when an unacceptable difference exists between the Air Data Sensor signal and the Comparison Air Data Sensor monitoring signal or when the difference between the incoming airspeed signal varies more than 8 knots from the selected speed on the autothrottle controller. This warning signal also appears when the power switch is on and the selector switch is off.

The glideslope arming indicator lamp shows a blue light when the glideslope system is armed. A steady amber light from the glideslope ENGAGED lamp indicates that the glideslope signal has been captured and held.

The Triple Yaw Damper Indicator comprises three meters each providing the pilot with an indication of surface activity due to its associated yaw damper. A preflight test facility is incorporated in the indicator unit.

FIG. 7—THREE-AXIS TRIM INDICATOR

FIG. 8—
TRIPLE YAW DAMPER INDICATOR



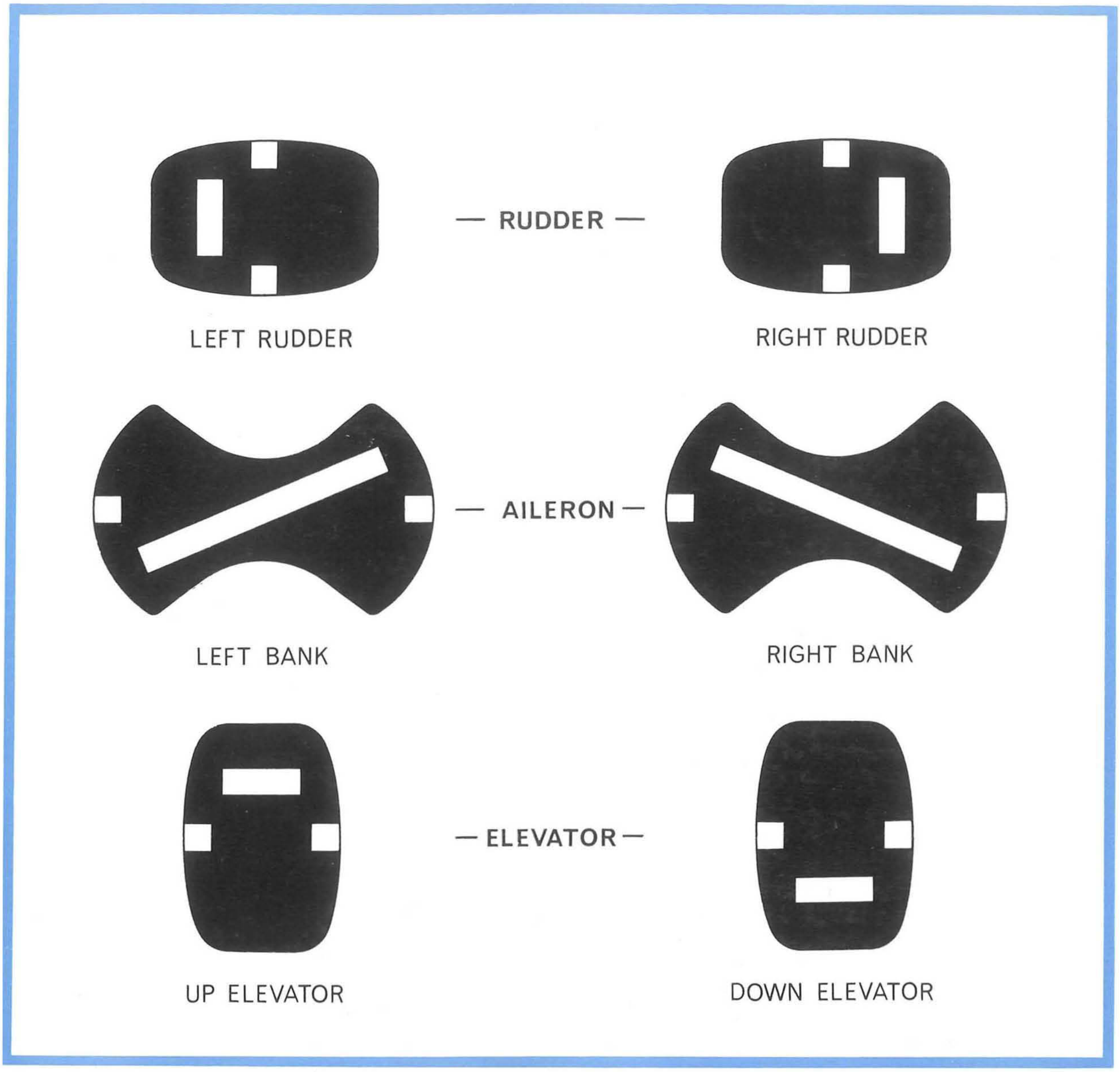


FIG. 9—OUT OF TRIM INDICATIONS

1 Before engagement of Autopilot, the Trim Indicator should be approximately at the zero position for each display (Figure 7). Any displacement is proportional to the surface movement that would result should the Autopilot be engaged.

2 With damper in operation, the aileron and elevator indications should remain at the zero position. Corrective action of the rudder against disturbances will result in corresponding, small deflections of the indicator. Any constant deflection from the zero position is due to the setting of the manual trim controls.

3 After engagement of the Autopilot, the same small deviations will ensue. However, a mean static deflection cannot occur with the elevator indicator, since the trim control must be in detent before the Autopilot will engage.

AUTOPILOT FUNCTIONS AND MODES OF OPERATION

The aerodynamic behaviour of the aircraft can, without significant error, be divided into two modes:—

(a) Lateral

(b) Longitudinal

The autopilot equipment is also split in a similar manner—comprising a lateral Computer for control of ailerons and rudder e.g. yaw damping, heading and omni-range; and a longitudinal computer for control of elevators, e.g. pitch control, manometric locks and glideslope.

LATERAL

YAW DAMPING

In order to enhance the basic stability of the aircraft against dutch roll, each autopilot system incorporates a yaw damper which is operative when the autopilot is engaged. When the autopilot disengages the yaw damping remains operative until it is switched off. The yaw damper may be engaged separately, and both dampers may be engaged at the same time.

In the event of failure of both dampers, a third completely independent (standby) yaw damper is available, which may be engaged at any time.

Damper system No. 1 drives the middle rudder surface.

Damper system No. 2 drives the lower rudder surface.

Standby Damper drives the upper rudder surface, and is available under "ELRAT" conditions.

AUTOPILOT

When the mode selector is in the MANual position heading hold is the control provided by initial autopilot engagement. In this mode the aircraft is controlled to the compass heading existing at the moment of engagement. Command turns may be initiated by rotating the Turn Control, the law of which is set to give smooth entry into turns. In this case, as the Turn Control leaves the detent position, the heading mode is disconnected and a bank angle is commanded which is proportional to knob displacement. Upon return of the Turn Control to detent position, the heading mode is re-engaged regardless of the mode established prior to the command.

Should the autopilot be engaged during a banked turn the aircraft will be automatically "rolled out" to level flight.

Note:

The Turn Control must be in detent before the autopilot can be engaged.

Since an aircraft may lose height when turning, a command proportional to bank angle is fed to the elevators to demand a "nose-up".

PRE-SELECT HEADING

The pre-selected heading mode enables the pilot to establish a heading reference other than the initial engage reference. This command is preset via the Flight Director System—Course Deviation Indicator. In this mode any commands from the Turn Control will automatically return the system to MANual.

LOCALISER AND VOR

In the localiser/VOR modes the aircraft is manoeuvred to assume a 45° intercept with respect to the selected course. After the aircraft closes on the beam centre and completes the capture, an accurate track is thereafter maintained with automatic corrections for steady or changing wind conditions.

LONGITUDINAL

PITCH ATTITUDE CONTROL

The elevators maintain short and long term stability by following error signals derived from pitch rate and attitude gyroscopes respectively—this stabilisation being the basis of all pitch modes.

When the autopilot is engaged, the aircraft is held to the attitude at the instant of engagement. Subsequent changes to the pitch attitude are commanded by pitch wheels located on the controller panel.

MANOMETRIC LOCKS

The manometric locks of altitude, airspeed and Mach No. are effected through the elevators from signals derived from the Air Data Sensor. Operation of any one of the three engage switches (Autopilot Dual Controller) will lock the aircraft on to the altitude, airspeed or Mach No. existing at the time.

Note:
It is only possible to make one selection at a time.

The three modes all employ the DATUM ADJUST knob for limited alterations of the engaged datum. The DATUM ADJUST knob has 'click-stops' which allow equal adjustment in any particular condition. While it is possible to select any of these models (IAS, MACH or ALT) without the need for settling speed or altitude first, a reasonably settled condition of airspeed, height or Mach number will allow the autopilot to produce a much smoother performance.

GLIDESLOPE

Glideslope can be engaged at any altitude required by operational procedures when the Autopilot is in the Localiser mode.

Engaging the G/S mode couples the beam signal to the pitch channel. Thereafter the G/S signal is attenuated to provide stable glide slope tracking with beam convergence.

There are two mode selector switch positions for the acquisition of glideslope:

GS Auto

GS Man

GS Auto can be selected whilst in attitude or altitude hold prior to reaching the glidepath, and henceforth capture and tracking will occur automatically. On initial selection a glideslope ARM indicator lamp is switched on, and when changing from capture to track the lamp is extinguished and an ENGAGE lamp is switched on.

The GS MAN position covers the track phase only and is engaged when the C.D.I. glideslope deviation bar indicates that the aircraft is about to reach beam centre. This mode is available when automatic glideslope capture is not practicable.

When the glideslope is engaged the pitch wheels are deactivated, and if the altitude hold is engaged it is disconnected. In addition to give greater lateral control during the approach, the demand to the ailerons is also cross-fed to the rudders.

AUTOTRIM

The purpose of pitch trimming is to maintain constant elevator authority by removing any load from the stick, and reduce unnecessary drag by streamlining the elevators with the tail plane. It also ensures that the aircraft is in trim when reverting to manual control. A sensor on the elevator control run adjacent to the feel unit detects displacement, i.e. effective force, and the autopilot trims when the sensor output exceeds a "threshold". Thus the tailplane moves until the elevator deflection returns almost to zero. A delay of 5 seconds is introduced into the system to cater for over activity under turbulent conditions.

Note:
Operation of the pilot's manual trim lever in conjunction with the autopilot in use will disconnect the autopilot.

AUTOTHROTTLE

The autothrottle system is a dual system, either half of which can be engaged independantly of the autopilot and can be used with either autopilot. The pilot's instinctive disconnect button will, however, disengage the system in use.

The throttle system drives the four throttle levers and controls the engine thrust in accordance with the required speed dialled on a digital counter located on the throttle dual controller.

Caution:
To avoid violent throttle movement upon engagement, the counter should indicate within 10 knots of the actual IAS.

The airspeed warning light will glow amber if the counter differs from the actual IAS by more than eight knots and also, in the event of failure of the Air Data Sensor. Should one engine or its associated control run give trouble, the throttle actuator can be declutched from it by operating the appropriate isolation switch (THROTTLES 1, 2, 3 and 4); the pilot can override the actuator by moving the throttle levers himself, but the effort required will be greater than when under normal manual control because of the 'breakout' load of the friction clutches between the actuator and the levers. The levers are driven from an error signal generated in the ADS. A pitch term derived from the Vertical Gyro Transmitter is also included in order to provide some phase advance.

If the combined signals are such as to drive the levers against their stops, the four clutches are de-energised until the demand is reversed.

Note:
Autothrottle must not be engaged if IAS lock is selected as this will cause an unstable situation.

PROCEDURES

POWER SUPPLIES

Aircraft electrical supplies are made available to the automatic flight control system as listed in Table 1.

YAW DAMPER

Before take off, the pilot must utilise the test facility, and no flight should be attempted if more than one system fails the test, or if No. 3 (Standby) Damper fails the test alone. The three meters are labelled TOP, MIDDLE and BOTTOM and refer to the STAND-BY, DAMPER 1 and DAMPER 2 systems, respectively. To check surface activity, engage each damper and press the corresponding button for at least 30 seconds: if the meter bar stands still or goes into the red, instead of swinging within the white bank, the damper is not working correctly. When the tests are completed, the cover must be replaced over the buttons as they must not be used in flight.

Note:
In flight, the bars show surface deflection due to yaw rate only and will move into the red whenever the deflection exceeds $2\frac{3}{4}°$ (as it can do when autopilot is engaged).

The damper is normally disengaged by operation of the appropriate engage switch.

ENGAGE PROCEDURE

AUTOPILOT

Before engaging the autopilot by the appropriate engage switch, the following procedure should be effected:

(*a*) Switch on electrical power supplies as required (ref. Table 1) and operate autopilot master "kill switches".

(*b*) Switch on hydraulic power and check that pressure is normal.

(*c*) Switch on Compass Systems—check that compass failure flag (CDI) is not visible.

(*d*) Switch on Vertical Gyro—check that Gyro flag on the Flight Director, Horizon Director Indicator is not visible.

(*e*) Set the Turn Control knob to detent.

(*f*) Check that autopilot warning lamp is off—use the press-to-test facility to check that the lamp is in working order.

(*g*) Check that aircraft is in trim.

TABLE 1—POWER SUPPLIES

Power Supply	From	To
200-volt a.c. 3-phase	Generator bus-bar on panel J	Comparison monitor computer of autopilot No. 1
200-volt a.c. 3-phase	Generator bus-bar on panel J	Power Junction box of autopilot No. 1
28-volt d.c.	Essential supply bus-bar on panel U	Longitudinal amplifier and computer of autopilot No. 1
200-volt a.c. 3-phase	Generator bus-bar on panel K	Comparison monitor computer of autopilot No. 2
200-volt a.c. 3-phase	Generator bus-bar on panel K	Power Junction box of autopilot No. 2
28-volt d.c.	Essential supply bus-bar on panel Z	Longitudinal amplifier and computer of autopilot No. 2

PSH MODE

(*a*) Select the desired heading by means of Course Deviation Indicator HDG knob.

(*b*) Engage preselected heading by rotating mode selector to PSH.

Note:
Subsequent changes in heading can be made by rotating the HDG knob to the desired new heading.

LOC/VOR

(*a*) Tune to the appropriate frequency on the navigation receiver.

(*b*) Set the radial or runway QDM on the CDI by means of the COURSE knob.

(*c*) Wait for the CDI LOC flag to clear.

(*d*) Rotate mode selector to LOC/VOR.

Note:
(*i*) Rotation of Turn Control will cause mode selector to revert to MAN.

MANOMETRIC LOCKS

To engage the manometric Locks operate the appropriate selector switch as required—this action will cause the pitch wheels to be disconnected.

Warning: Do not engage I.A.S. at the same time as autothrottle, otherwise an unstable condition will occur.

GLIDESLOPE

(*a*) Tune receiver, and establish the quality of the glideslope signals by the behaviour of CDI GS flag. The flag should disappear completely for a serviceable received signal.

Note:
(*i*) An unserviceable signal subsequent to glideslope engagement will cause the autopilot to disengage.

(*ii*) Subsequent loss or unreliable localiser signal will cause LOC flag to become visible and at the same time cause the autopilot to disconnect after selection of GS AUTO.

(*iii*) The pitch wheels are inoperative and all manometric locks disconnected in GS MAN; and after beam capture in the GS AUTO mode.

AUTOTHROTTLE

ENGAGE

To engage autothrottle make the following selection on the Throttle Dual Controller:

(*a*) Switch POWER switch on.

(*b*) Switch THROTTLES 1, 2, 3 and 4.

(*c*) Dial the required speed with the SET KNOTS knob (preferably within a maximum of 10 knots).

(*d*) ENGAGE 1 or 2 system.

(*e*) Subsequent desired speed changes may be dialled with system engaged.

DISENGAGEMENT PROCEDURES

DAMPER MODE DISCONNECT

The damper is normally disengaged by operation of the appropriate engage switch.

AUTOPILOT MODE DISCONNECT

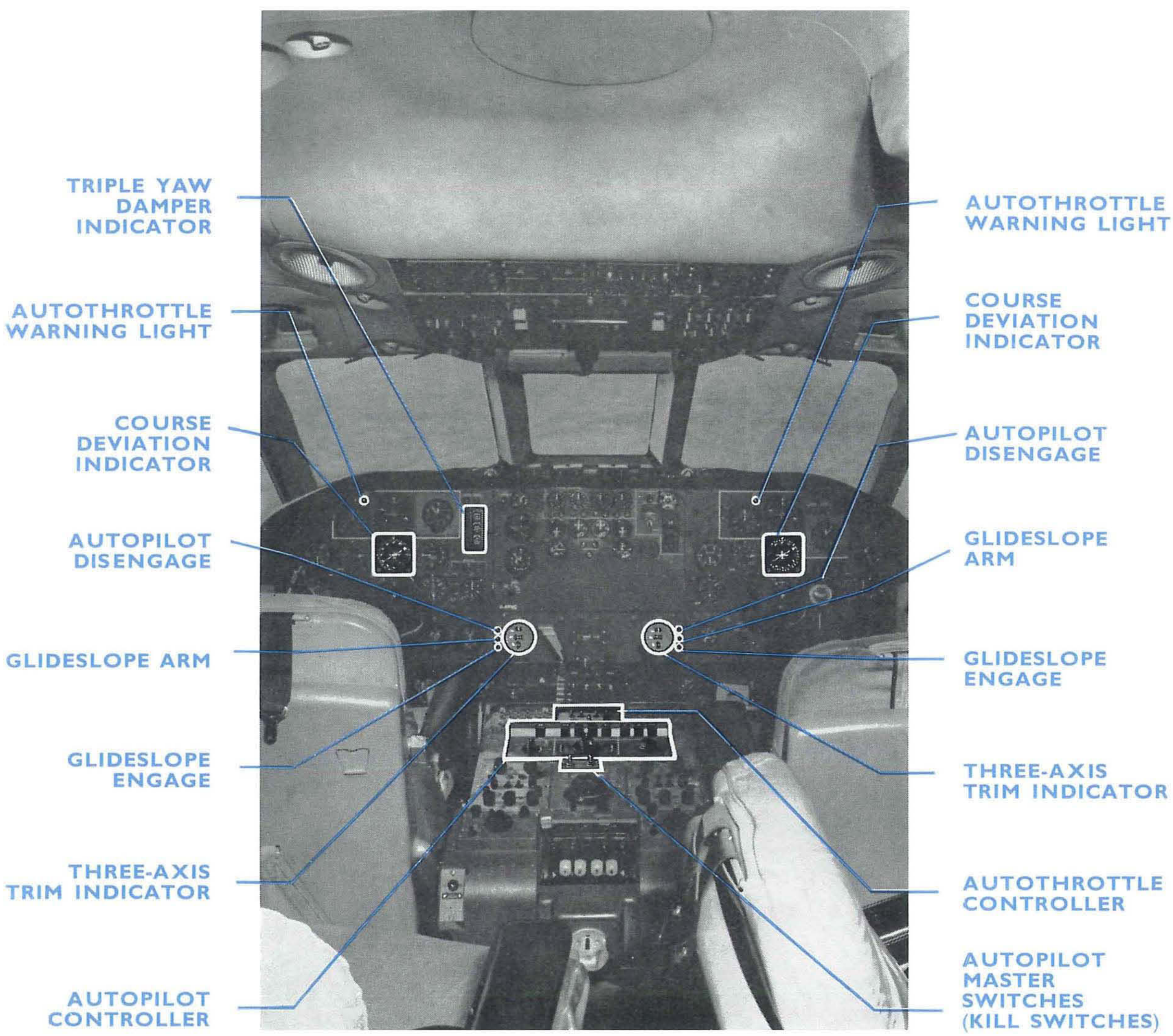
Any autopilot facility can be disconnected by returning the appropriate engage switch to OFF. AP-1 to AP-2 are normally disengaged by operation of the pilot's instinctive disconnect-button (this action, however, does not disconnect any engaged damper), the kill switches (which also disengage yaw dampers), or by manually overpowering the autopilot system.

Note:
If the autopilot is disconnected by means of the ENGAGE switch, it will be necessary to extinguish the warning lamp by means of the instinctive disconnect-button before re-engagement can take place.

AUTOTHROTTLE DISENGAGE

The autothrottle system can be disengaged by the ENGAGE switch, the instinctive disconnect-button, throttle POWER switch, or the kill switches.

FIG. 10—VC 10 FLIGHT DECK EQUIPMENT LOCATION



SYSTEM FAILURES

YAW DAMPER

Two yaw dampers are normally in circuit together at any one time; additionally the standby system is available in the event of an emergency.

Hence, should a damper or damper/autopilot failure occur, the failed system should be disconnected and the standby damper system engaged.

AUTOPILOT

Autopilot failures are detected by the monitoring system and a disconnect occurs before a dangerous situation can develop—the pilot being free to engage the alternative system immediately.

If a trim runaway is noticed by the pilot (and this can only occur through a double fault), the pilot may relieve the load on the elevators by use of the alternative trim system before manually disconnecting by use of the trim indicator.

In case of failure of an engine or its control run, operation of the appropriate throttle isolation switch will de-clutch the actuator from that run. The whole system should be disengaged by means of the engage switch if the autothrottle warning light stays on for more than a few seconds and the levers do not move to correct the error. The pilot can always override the actuator by applying sufficient pressure to the levers.

IF ANY MODE CANNOT BE DISENGAGED BY THE APPROPRIATE ENGAGE SWITCH, THE "KILL" SWITCH WILL DISCONNECT THE AUTOPILOT, AUTOTHROTTLE AND YAW DAMPERS, EXCEPT FOR THE STANDBY DAMPER.

transport aircraft controls division

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a Member of the ELLIOTT-AUTOMATION GROUP

Printed in England · Chichester Press Ltd, Chichester, Sussex—2633