$4\frac{1}{2}$-INCH IMAGE ORTHICON
CAMERA TYPE 2115
AND
CONTROL EQUIPMENT

Part Numbers:-

Camera 842115
Camera Control Unit 842173
Power Unit 842402
Control Panel 842464

VOLUME 1 (of five volumes)

INITIAL INSTALLATION, SETTING-UP AND OPERATING INSTRUCTIONS

UAU

PYE T.V.T. LIMITED
CAMBRIDGE
ENGLAND

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VOLUME

1. General Description, Initial Installation, Setting-Up and Operating Instructions

2. Circuit Description, Maintenance Instructions and Parts Lists

3. Component Location Sheets, Waveform Analysis.

4. Circuit Diagrams (Functional).

5. Circuit Diagrams (Individual Units)

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SECTION 1 - GENERAL DESCRIPTION

1.1 GENERAL FEATURES

The primary aim in the design of this camera has been to provide the means of obtaining consistently the finest quality pictures for television broadcasts and recordings within a wide range of production conditions and complexity in the field or in the studio. To meet this aim the following features are outstanding:-

Pick-up Tube

Employs the $4\frac{1}{2}$" Image Orthicon which is noted for fine resolution, high signal-to-noise ratio, wide grey scale reproduction, and has sufficient sensitivity for outside broadcasts. A high performance yoke with temperature control has been developed to take full advantage of the capabilities of the tube.

Optical Performance

A four-lens turret of great strength supports the heaviest lenses, and is cone-shaped to take a cluster of widely different focal lengths of lenses without interference. An extensive range of high quality lenses is available, especially computed for television requirements.

Control

High-stability circuits have enabled operational controls to be reduced to a minimum, and segregated from setting-up controls, thus reducing the human error during programme time and releasing the cameraman's full attention for exacting and fast-action photography.

Turret Change

By rear-mounted handle and mechanical linkage. One turn of the handle per lens station. Quiet action and repeatable close registration.

Focus Control

By capstan knob with a range of adjustable positions to suit different camera attitudes. Focusing law may be linear or cosine.

Engineering and Setting-up Controls

On separate desk-mounted panel under a hinged flap.

Operational Controls

Iris and Black level by combined "joystick" grouped with other controls in the operational area of the desk-mounted panel.

Iris Control (Operational)

By sensitive remote servo system with fine operational control.

Black Level Control (Operational)

By ganged lift-and-gain control. Black level adjustable over a wide range without change in peak white level.

Viewfinder

Bright, artificially-sharpened picture with switching facility for registering superimposed pictures.

Co-ordination

Full and adaptable talkback, programme sound, and signalling facilities available to all operators, including studio-floor personnel. Bright or dim "on air" lamp illumination is available.

Processing Circuits and Power Unit

Housed in drawer-type cases, which may be rack-mounted or adapted for portable use.

Correction Circuits

Carefully designed aperture and gamma correction circuits compensate for inherent Image Orthicon grey scale characteristic and extend definition without noticeable fall-off to limit of the video bandwidth. Contrast law switchable to three preset curves and linear gamma.

Servicing

All electronic circuits instantly accessible, while operating. All chassis and sub-units are plug-in with quick-release fixings and interchangeable with similar spare units. Control unit and power unit may be worked upon, or changed, without service personnel intruding upon operational control area.

Tube Changing

Image Orthicon tubes fitted and removed from the rear of the camera by quick and simple method, without disturbing any optical arrangements.

Protection

Full Image Orthicon protection circuits, including image orbiting to reduce target burn. Image orbiting in all cameras may be synchronised.

Systems Change

Switch selection of 405, 525 or 625 line systems.

Transistors

Efficiency and reliability have been improved by extensive use of transistors and semiconductor devices.

1.2 EQUIPMENT ARRANGEMENT

A basic camera channel consists of:-

A camera containing the Image Orthicon and its yoke, the optical system, and electronic viewfinder, scanning generators for camera tube and viewfinder, a head amplifier and various auxiliary protection and signalling circuits, together with means to control the picture focus and lens angle.

A camera control unit (C.C.U.) containing the main processing amplifier, drive and pulse-timing circuits, and talkback amplifier, together with internal preset controls for the circuits.

A camera power unit containing: h.t. and focus current supply generators (using semiconductor rectifiers and regulators), feed-back stabilising amplifiers, the camera a.c. feed transformer, input supply voltage tap adjustment; metering, fuses and protection circuits.

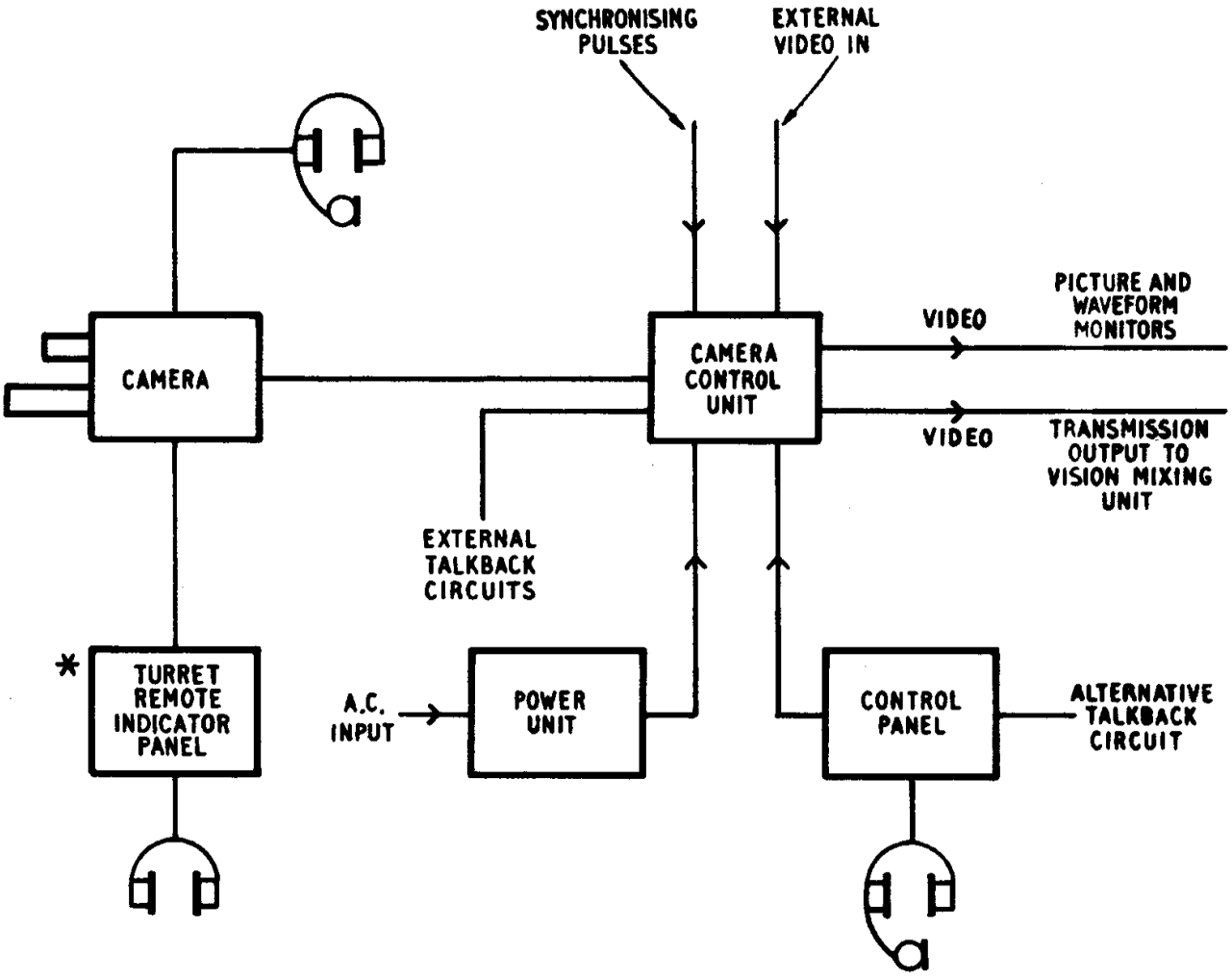
A control panel containing passive control circuits from which the whole channel may be set up, and including also the operational controls of iris and black level.

A Picture Monitor (To separate order).

A Waveform Monitor (To separate order).

Interconnecting Cables between the above units.

A detailed equipment schedule with accessories is given in Volume 2.



* OPTIONAL EXTRA

FIG.1 BLOCK SCHEMATIC

1.3 OPERATING ADVANTAGES

The extensive employment of feed-back stabilising circuits allows the operational controls to be reduced in number so that one duty operator and one duty engineer are fully capable of controlling the technical quality in a multi-camera unit; thus staffing may be reduced to a minimum.

Systems switching facility allows a performance to be repeated immediately and recorded in an alternative line standard for export, while the artists and studio set are available.

Throughout the channel only high-quality components and valves are used, none of which are operated close to their maximum rating. This makes for a high degree of reliability, but if a breakdown does occur, the chassis and sub-assembly interchange system reduces "off-air" time to a minimum. The robust construction of the camera makes it ideal for outside broadcast use and it can operate up to 2000 ft. (600m) away from its control equipment. The facility for switching a test signal through the complete channel enables a number of channels to be checked for performance specification and gain settings in a very short time.

1.4 TEST FACILITIES AND FUNCTION SWITCH

A coaxial socket terminated in 75 ohms and accepting standard level (0.7V) video is located on the head amplifier. From this point the full band-width performance of the channel may be checked, using a suitable test signal generator, the Image Orthicon tube with its output capacitance being left in circuit.

A test signal waveform at standard level can be fed into the rear of the camera control unit. By means of a switch on the rear panel of the C.C.U. this may be injected into the C.C.U. input in place of the camera signal. In addition to the normal output sockets, two musa test monitoring points are provided in the C.C.U.

When the function switch on the control panel is at TEST, the test signal may be routed down the camera cable via the viewfinder video line and there injected automatically into the head amplifier input. This checks the gain and general performance of the complete amplifier channel.

The function switch (Fig.11) has four positions as follows:-

(a) NORMAL

Full normal transmission is available in this position.

(b) CAP

In this position the image section is immobilised by taking the photocathode 23 volts positive to the target. Back-ground shading may be neutralised when in the cap position.

(c) CUT BEAM

In this position the image is suppressed and the beam switched off.

(d) TEST

In this position conditions are as for CUT BEAM and shading is removed from the signal. Because the viewfinder channel is utilised as a test signal carrier the camera selection switch is disabled.

1.5 SPECIFICATION

1.5.1 Physical Specification and Mechanical Arrangement of Camera

Construction

Electron castings and light alloy machined parts.

Weight

170 lb (77 kg) approximately (without lenses).

Dimensions

Height:	Case 19¼	inches	(49 cm)	- overall	22¼	inches	(57cm)
Width:	Case 12	"	(30.5 cm)	- overall	16¾	"	(43cm)
Length:	Case 28	"	(71 cm)	- overall	36	"	(92cm)

Finish

Hammer grey with black anodising and chrome.
Chassis white; orthicon yoke and optical channel matt black.

Turret

Heavy duty alloy machined casting running in peripheral sleeve bearing and distortion-free under the heaviest lens loads. Turned by handle driving a perimeter spur gear through a non-linear gearbox.

C.C.U. Cable Entry

Slightly forward of centre of tilt at lower left-hand side (viewed from rear) and at 45° to horizontal.

Sub-Assembly Build-up

(a) Camera Frame incorporating turret and its driving mechanism, and carriage for the Image Orthicon yoke with optical focusing mechanism. The camera frame also mounts a front junction box just behind the turret.

(b) Transformer Panel Assembly which contains two mains transformers and unit interconnecting wiring. This drops into well at the rear of the base casting.

(c) Fan Assembly. This is mounted on the camera rear door and is wired by soldered connections to the transformer panel assembly.

(d) Focus Coil Assembly. This is fixed to the optical focusing carriage by four knurled screws. The carriage and coil are each jigged for correct alignment. The coil assembly contains a heater and blower and part of the control circuit for regulating the Image Orthicon tube temperature.

(e) Deflection Yoke Assembly which is inserted through the camera rear door and fits inside the focus coil.

(f) Control Panel Assembly mounted on the rear casting and containing viewfinder and talkback operational controls.

(g) Viewfinder Assembly comprising a 7" diagonal screen cathode-ray tube with its deflection yoke and video amplifier.

(h) Left-hand Side-panel Assembly, the lower part of which contains the external connectors to the C.C.U. commentator's monitor (video outlet), and the talkback jack-sockets. The upper section of the side-panel hinges outwards and supports a chassis frame.

(i) Regulator Unit fixed to the front of the chassis frame (left-hand side panel). This unit contains the focusing servo amplifier, 16 volts regulator, and part of the yoke temperature control circuits.

(j) Pulse Unit situated in the centre of the chassis frame. This unit processes all incoming pulses, generates various waveforms, and also contains the preliminary stages of the viewfinder video channel.

(k) Head Amplifier situated at the rear of the chassis frame. This also contains networks for feeding the dynodes and tube electrodes.

(l) Right-hand Side-panel Assembly, the lower part of which contains the mains outlet, hourmeter and suppression switches for "on air" lamps and image orbiting.

(m) Scan Generator Chassis which is fixed to the upper part of the right-hand panel and contains horizontal and vertical scanning generators for Image Orthicon and viewfinder tubes together with generators for Image Orthicon tube multiplier volts and viewfinder tube e.h.t.

All the above units have plug-in connections and are easily removable, and replaceable by other similar units.

External Accessory Attachments

Means are provided for fitting to the viewfinder either a tilting hood with detachable eye-piece, or a periscope hood enabling the viewfinder picture to be viewed normally at high angles of camera elevation or depression. Hinge supports at the rear left-hand side of the camera take a script card holder with paper clip. Each side cover has a holder for identification numbers size four inches by three inches. Tapped holes in the front casting are provided to fix supports for extra-heavy lenses and optical systems, or to fix visual prompters, etc. An Extension Turret Indicator Unit may also be used.

Mounting

Fitted wedge plate on a lockable sliding carriage enabling the camera to be balanced while mounted on its tripod and directly fitting to one of the following:-

(a) Vinten heavy duty pan and tilt head.

(b) Debrie head.

(c) Houston Fearless head (by using adaptor wedge).

Cooling

By forced air blown in from rear of camera. Air is passed through a dust extraction filter which is easily removed for cleaning or replacement.

Image Orthicon Tube Changing

By withdrawing tube with deflection yoke through the door in the rear casting. This assembly is held in place by two spring-loaded snap-fasteners and connected by two sockets on flying leads - one to the Image Orthicon base and one to the deflection yoke.

Lens Fixing

Automatically located, held by two spring loaded catches under captive knurled screws and provided with quick alignment markings for registration with iris drive gear.

Iris Drive

By servo induction motor mounted in centre of turret and in constant mesh with all lenses. Minimum torque capability 75 ounce inches.

Indicator Lamps

(a) On Air. 24 volt system with 6/24 watt, twin filament lamp on top of camera in removable bayonet fitting; one indicator adjacent to taking lens at front, and one above viewfinder picture and visible inside hood. External lamps may be suppressed.

(b) Turret position indicator. Four lamps above viewfinder picture and visible inside hood.

(c) Orbiting indicator. One lamp above viewfinder picture and visible inside hood. Lamp comes on when orbiting is off.

(d) Scan failure indicator lamp on rear panel.

(e) Lamp on rear panel to indicate yoke temperature.

Circuits (a) and (b) are paralleled to the turret extension indicator socket.

Operational Controls

(a) On rear control panel:

Turret handle. Viewfinder brightness and contrast. Viewfinder detail emphasis switch. Viewfinder video selector. Headset volume controls. Call C.C.U. key combined with microphone switch.

(b) External on Right-hand side:

Optical focus. Image Orbiting and cue light suppression switches, focus brake, focus lock.

(c) External on Left-hand side:

Filter turret and mechanical capping. Auxiliary talkback volume controls. Camera balance lock.

Internal Preset Controls

Head amplifier gain control, amplitude and centring controls for vertical and horizontal viewfinder scans, dynamic beam focus, G6, viewfinder focus, viewfinder AC/DC restorer switch. Iris control-range. Systems switch (405, 525, 625 lines). Test video injection switch. Cable compensation switch, viewfinder e.h.t., multiplier e.h.t., sensistivity controls for beam cut (protection) circuit, and Image Orthicon gun heater switch.

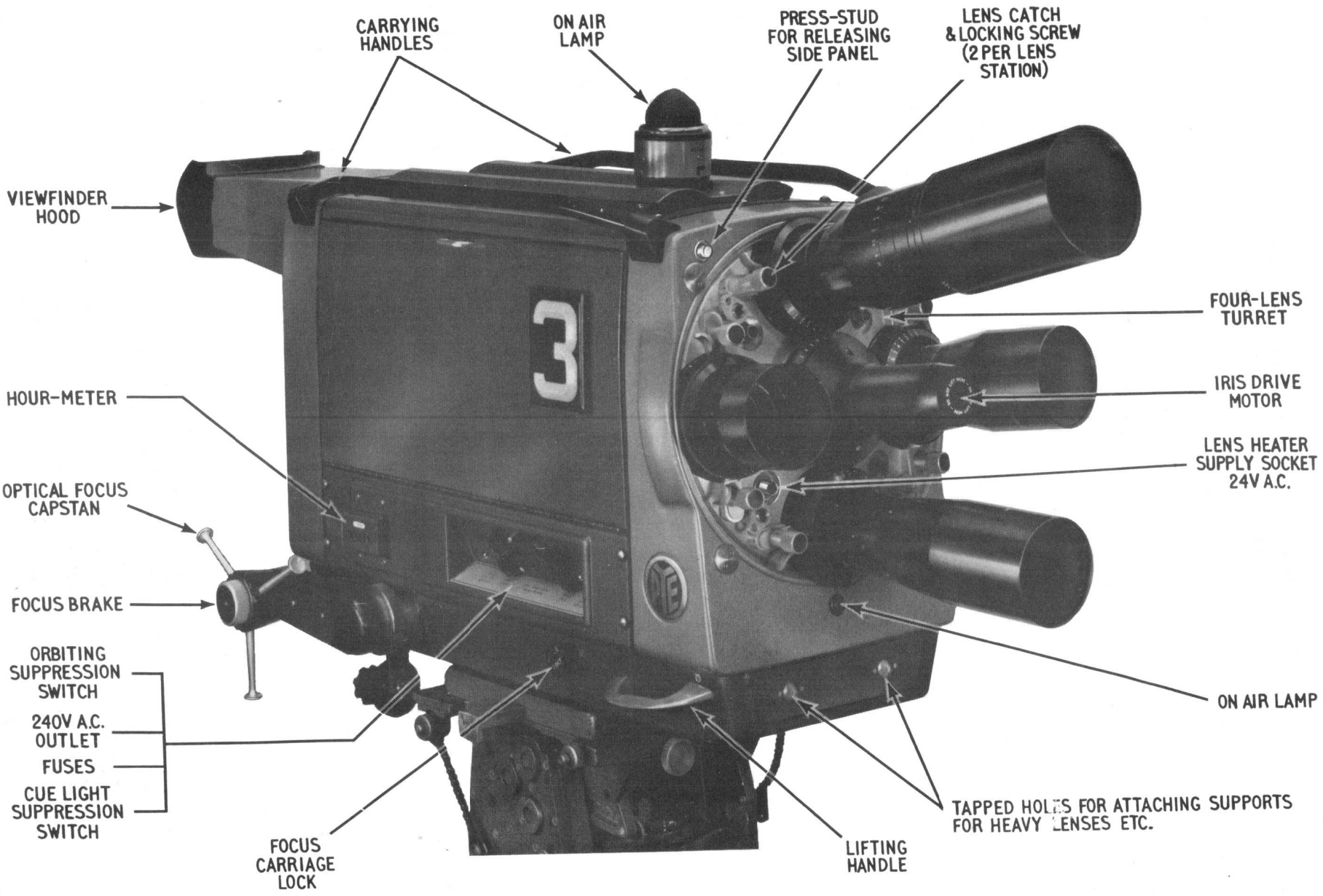


FIG.2 GENERAL VIEW OF THE CAMERA

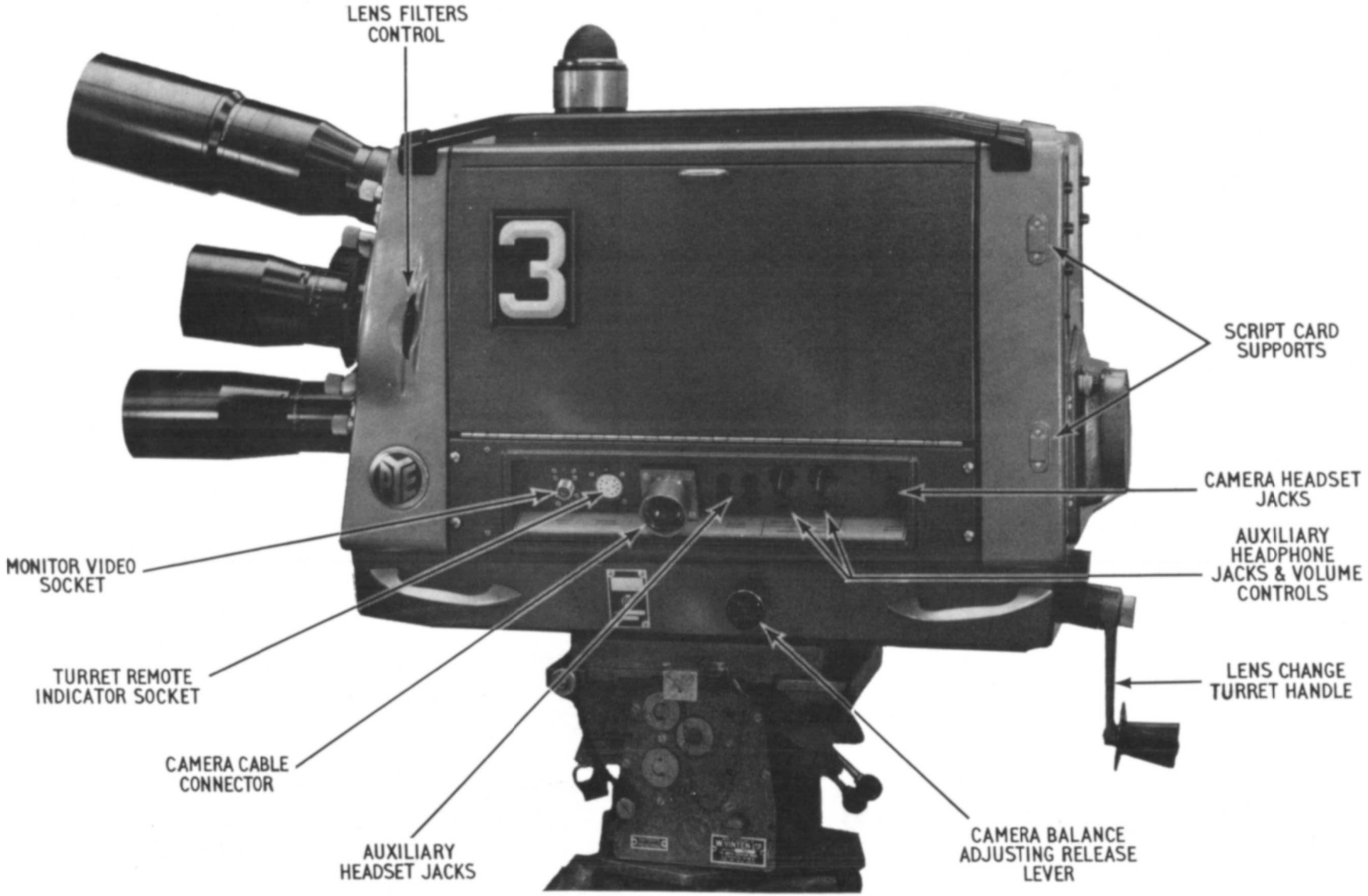


FIG.3 CAMERA (LEFT-HAND SIDE) SHOWING CONTROLS

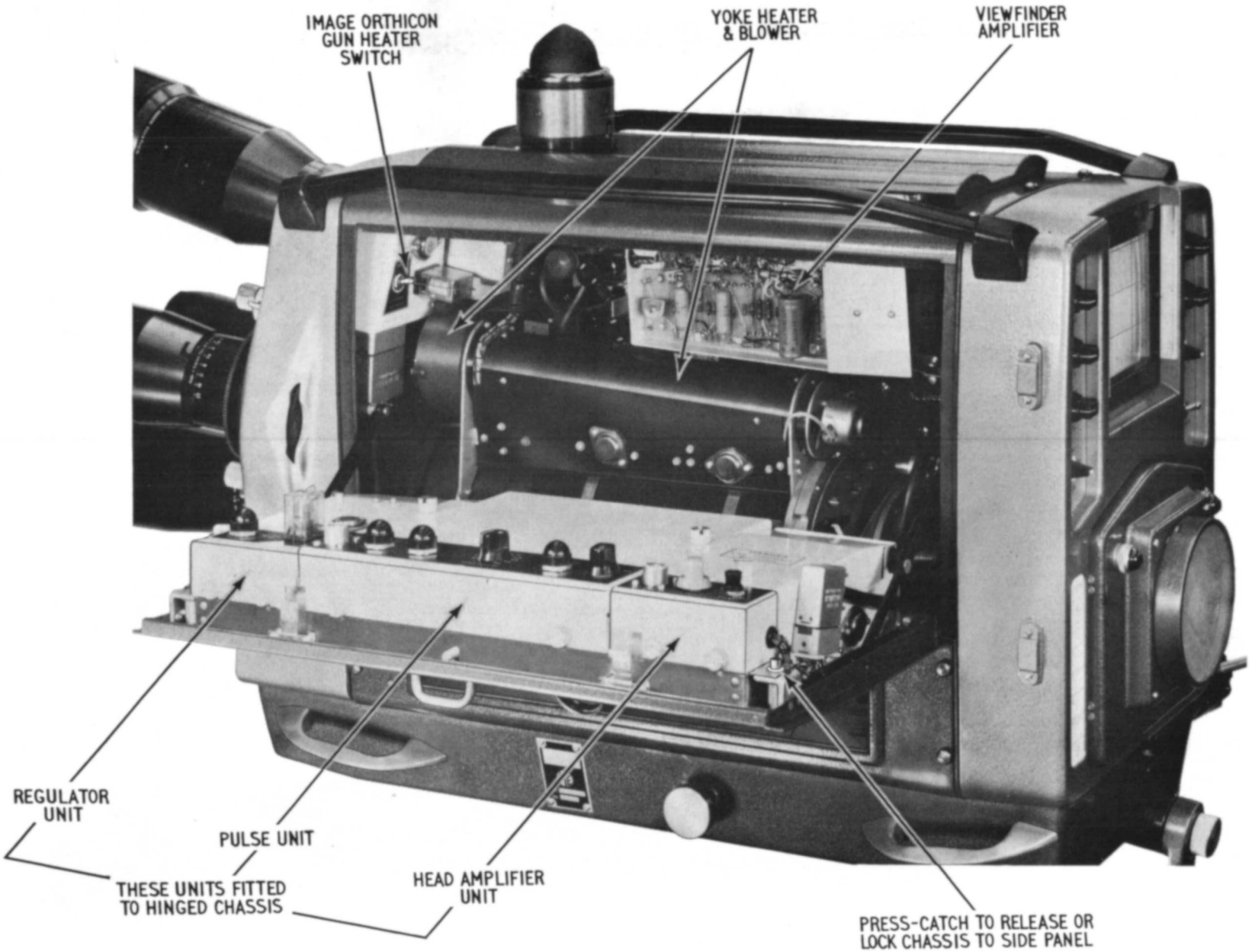


FIG.4 CAMERA WITH LEFT-HAND SIDE PANEL OPEN

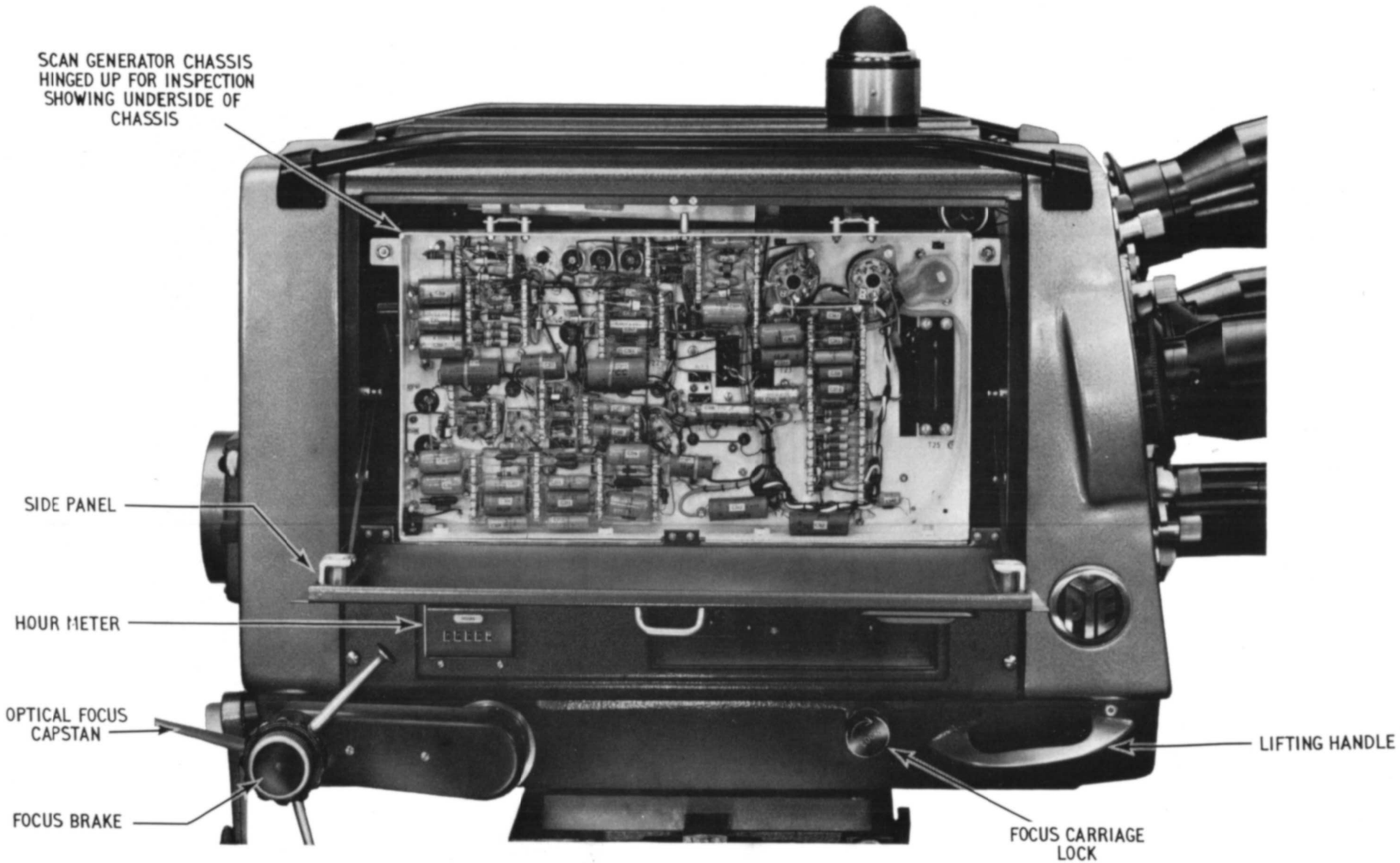


FIG.5 CAMERA WITH RIGHT-HAND SIDE PANEL OPEN

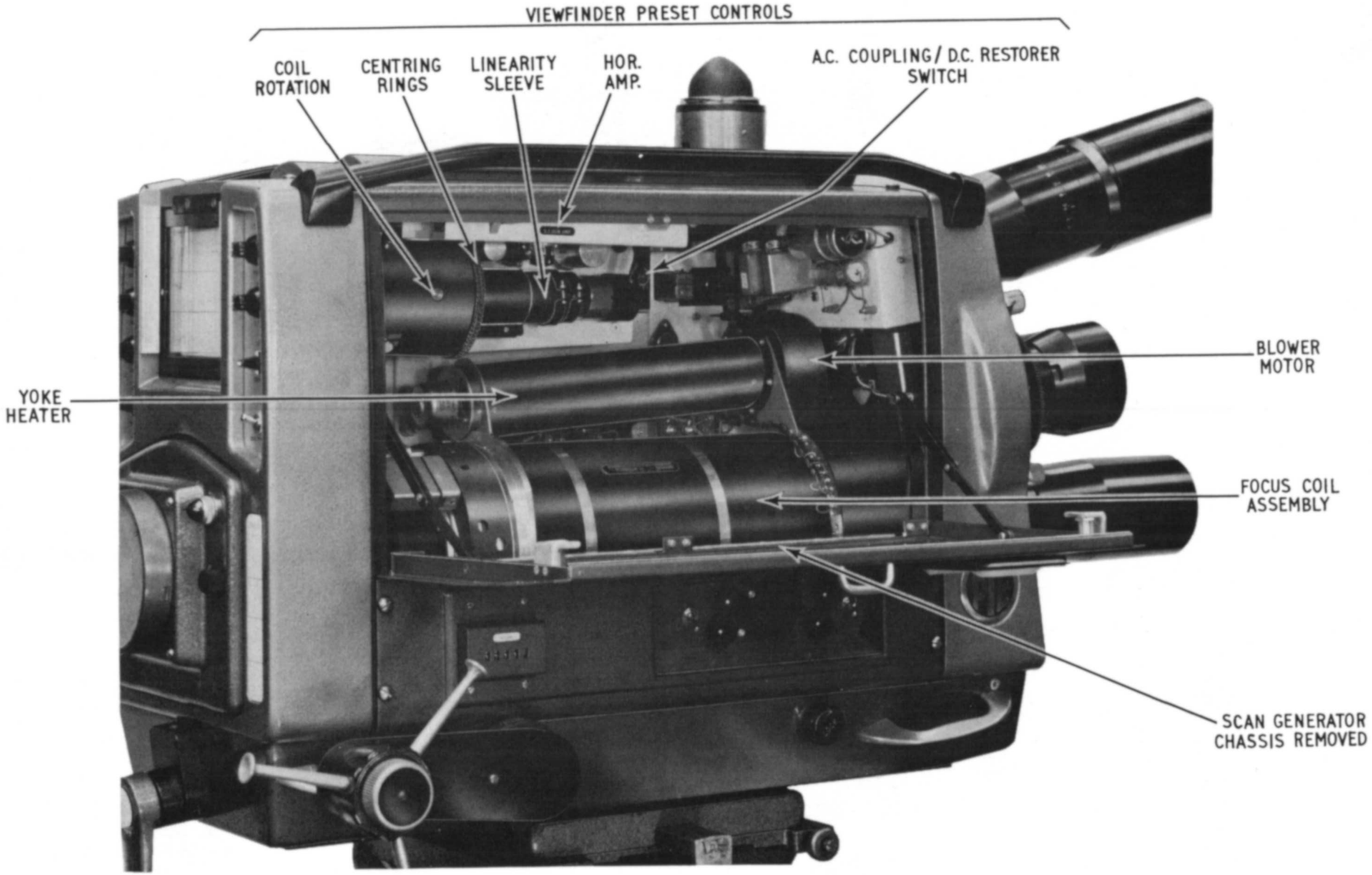


FIG.6 CAMERA WITH SCAN GENERATOR CHASSIS REMOVED

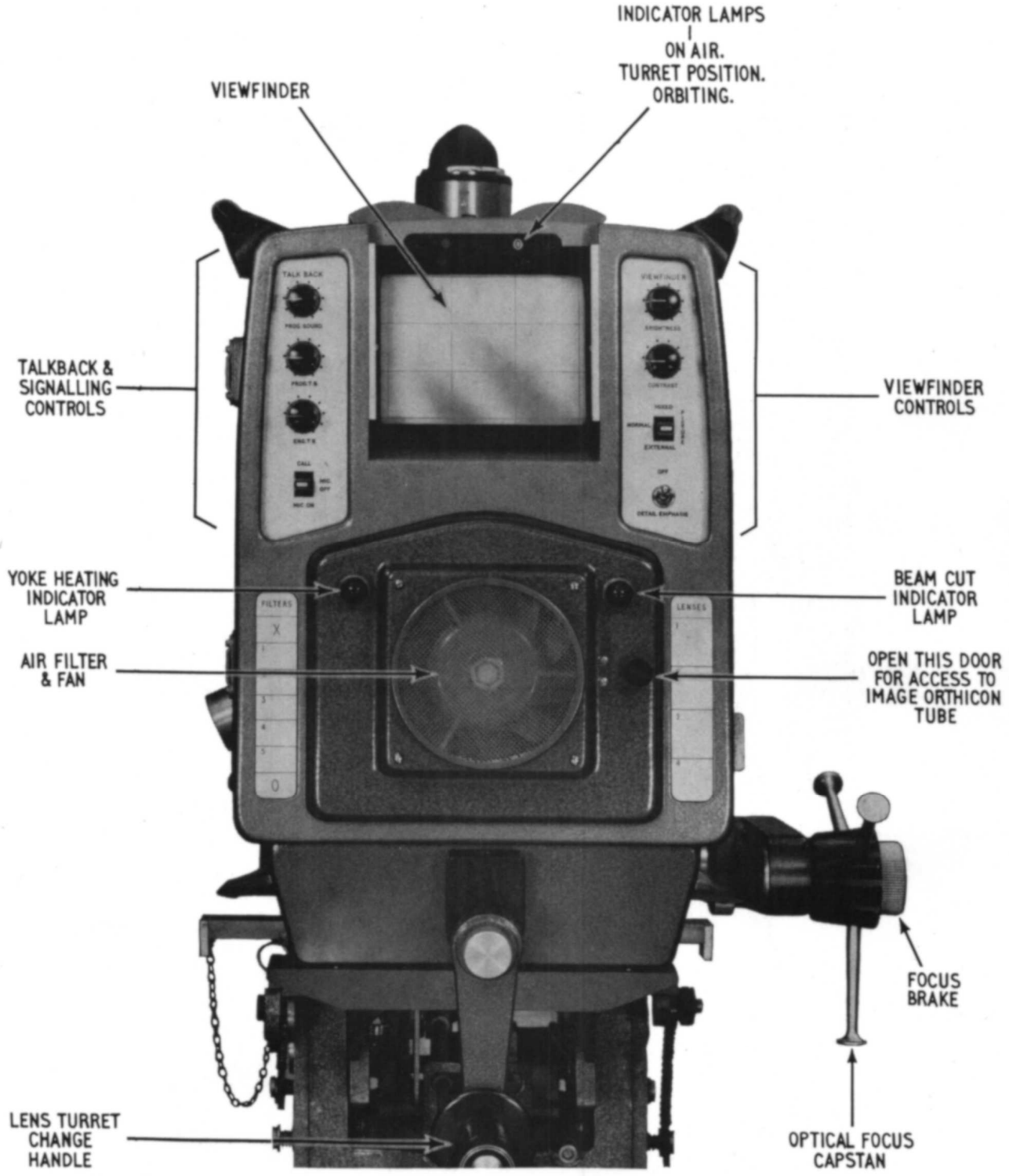


FIG.7 REAR OF CAMERA SHOWING CONTROLS

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1.5.2 Physical Specification and Mechanical Arrangement of Camera Control Unit

Construction

Aluminium end castings, steel end plates, fluted aluminium side-panels, telescopic runners and mild steel angle section support frame for chassis.

Weight

57 lb (26 kg)

Overall Dimensions

Height	$20\frac{1}{2}$" (52cm)
Width	9" (23cm)
Length	25" (64cm)

Build-up

Rack-mounting framework consisting of end castings with two side panels and rear panel. Within this framework is a pair of angle pieces mounted on ball bearing telescopic runners. Fitted to the angle pieces is the chassis-mounting frame; the latter carries the front panel and "plug-in" and "wired-in" boards as listed below. A single socket connector (75-way) with a swan neck lead connects the chassis assembly with the rear panel which mounts all incoming and outgoing connectors. The front panel with the chassis-mounting frame may be withdrawn clear of the rack for servicing while fully operational.

Plug-in Boards

The following plug-in boards are mounted on the chassis:-

Talkback Amplifier
A.C. Pre-amplifier
Frame Pulse Processor
Line " "
Pulse Clipping and Mixing
On Air/Call/Alignment
Shading Generator
Voltage Regulator
Viewfinder Video Switcher
Main Output Amplifier
Black Stretch Correction (2 units)
Black Crush "
Linear Gamma Matching

Wired-in Board

Heater Regulator

Mounting

The camera control unit is designed to mount on two slides which are firmly secured in the mobile control room. The unit is held in position by two knurled screws.

Cooling

Blower attachment with air filter.

Controls

Internally mounted knob or screwdriver adjustments of:-

Cable Compensation (timing) on Line Processor Board
Gain 2
Black Level Tracking
Gain Balance
Video Gain
Cable Compensation (Video)
Pedestal
Black Stretch (slopes and knees)
Black Crush " " "
H.T. switch for servicing purposes

Front Panel

Mounts an "on air" indicator lamp and an a.c. supply indicator lamp and also an identification card holder.

Rear Panel

This panel mounts the following items:-

Video Isolation Amplifier Unit
Pulse " " "
System Switch 405 or 525/625
C.C.U. Input Video Switch

Connectors:-

B.I.C.C. 37-way quick release socket to camera
Elco 75-way socket to control panel
Pye 28-way plug to power unit
Cannon 8-way plug to synchronising pulse generator
Pye 12-way socket to talkback system
Pye 4-way socket to on air lamp system
Jones 2-way socket to iris meter
Coaxial socket - transmission video out
" " - monitor video out
" " - external video in
Cinch 15-way connector for filter/fan base unit, (fitted internally)

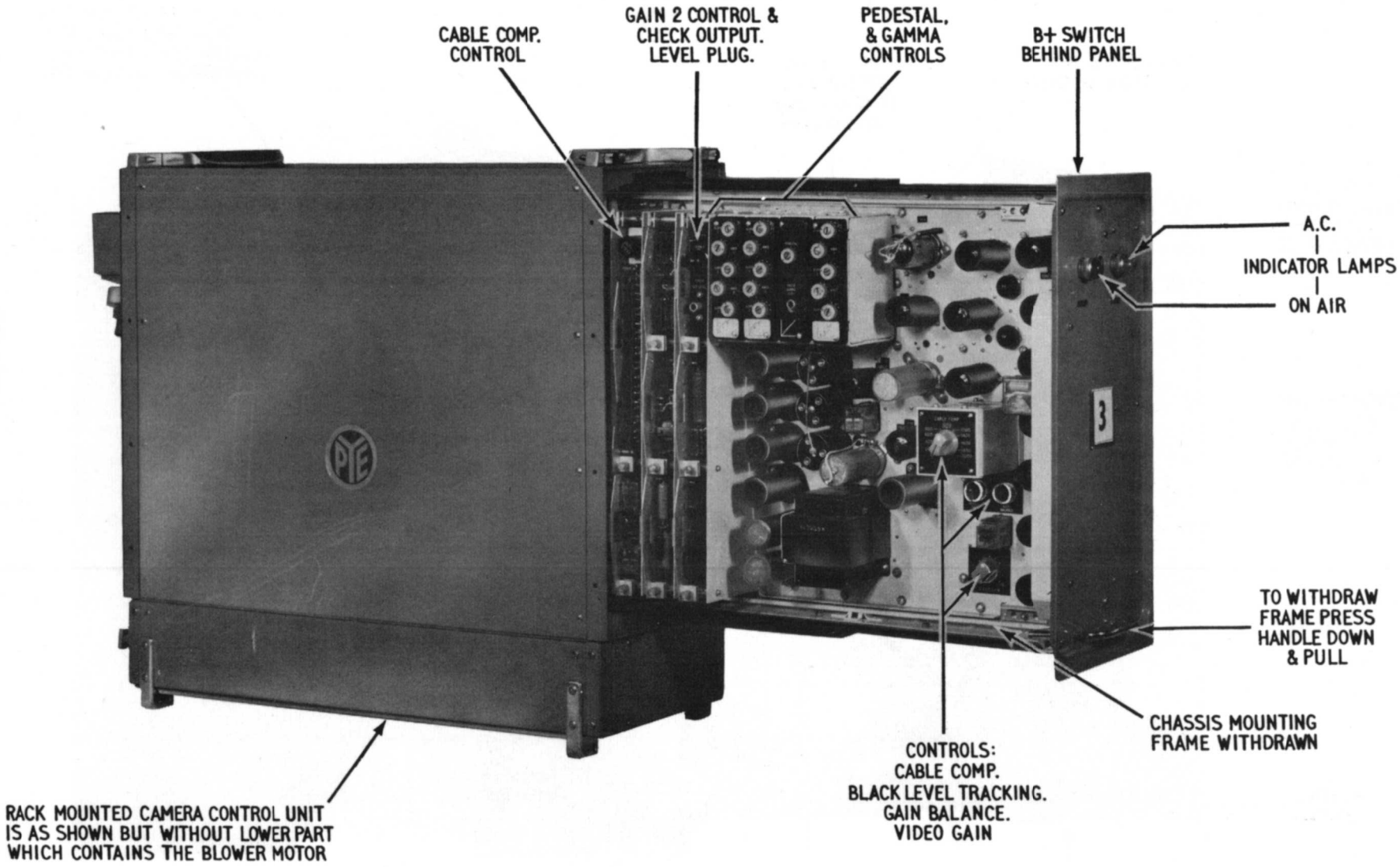


FIG.8 PORTABLE CAMERA CONTROL UNIT

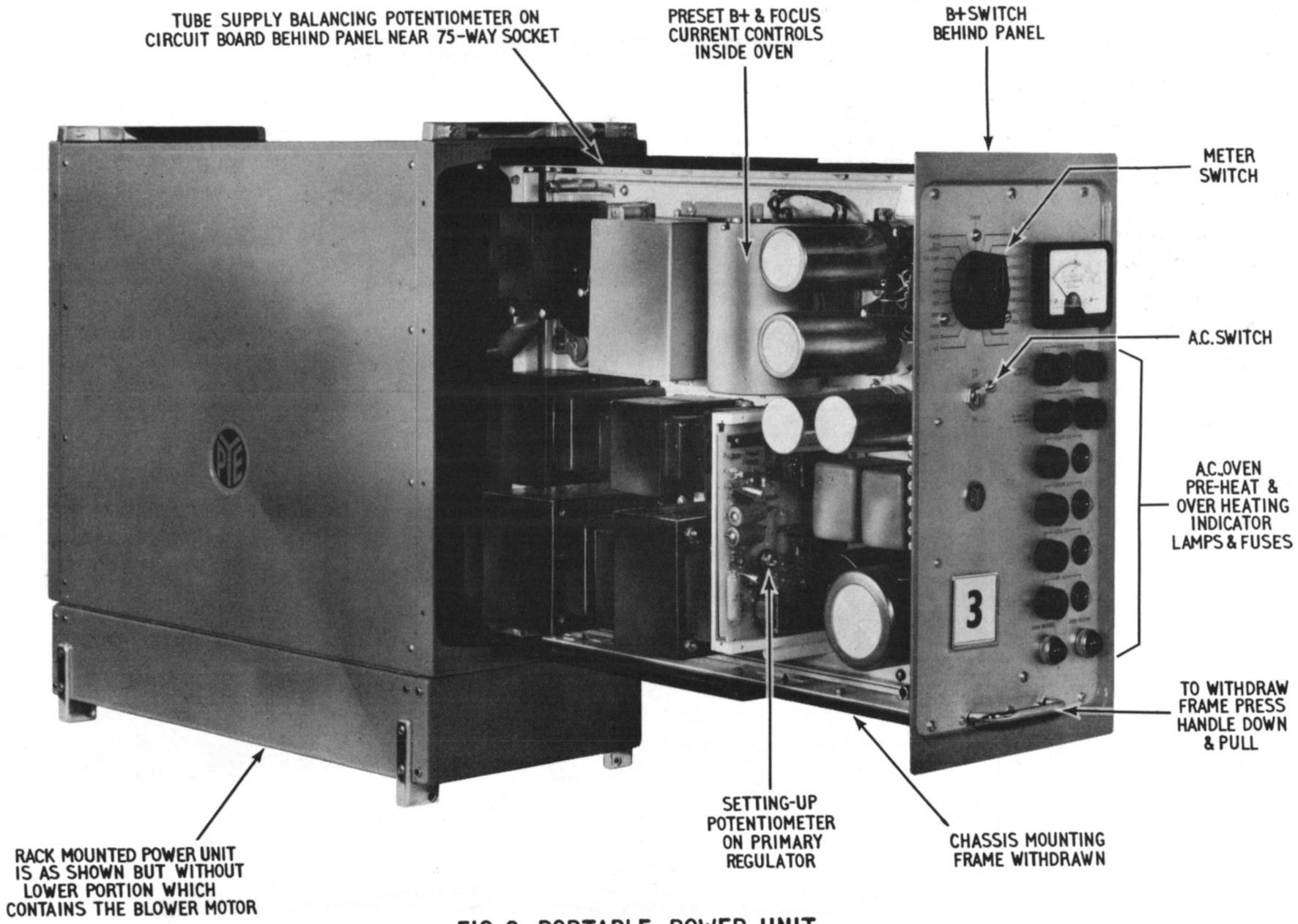


FIG. 9 PORTABLE POWER UNIT

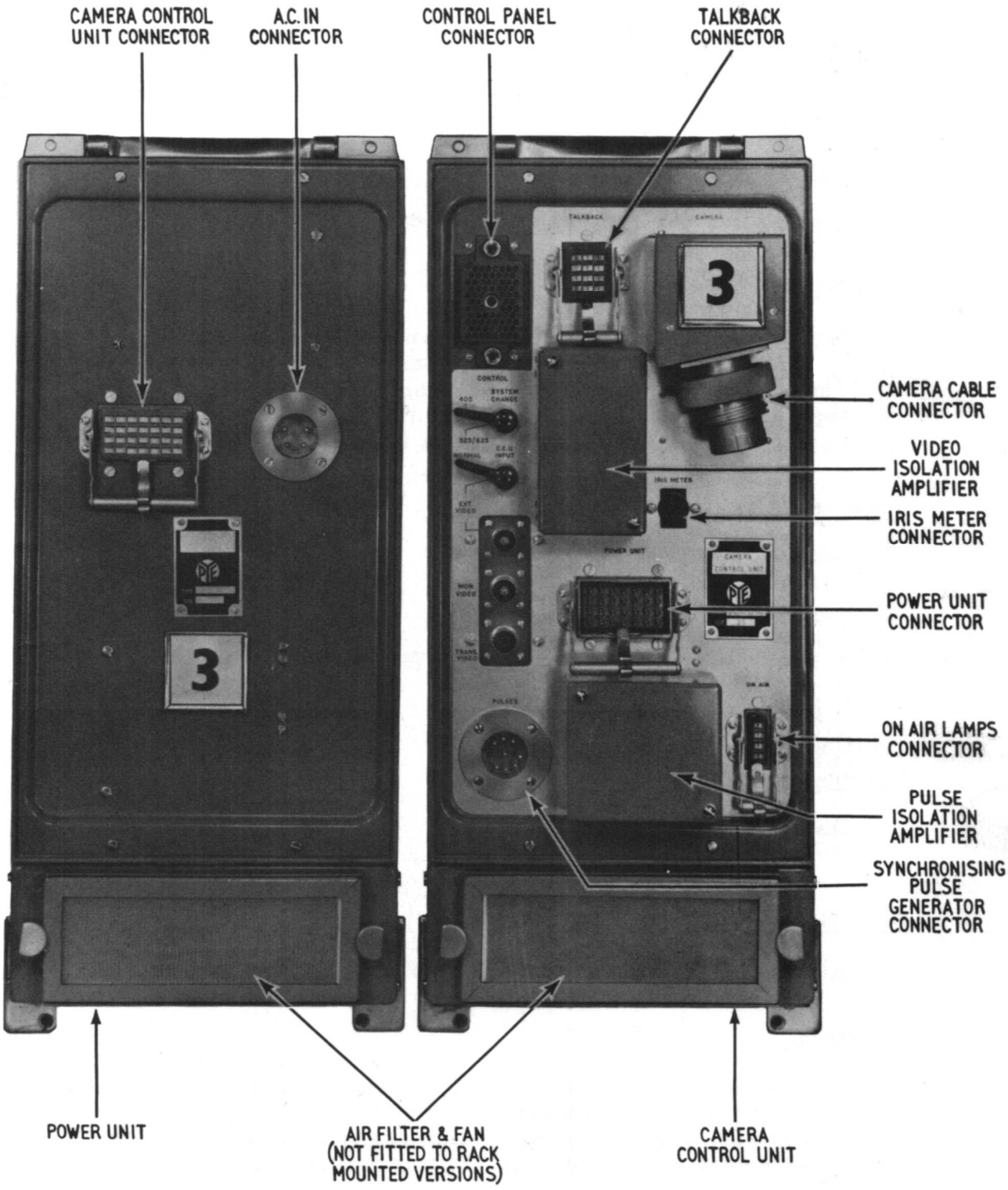


FIG.10 REAR OF POWER UNIT & CAMERA CONTROL UNIT (PORTABLE VERSIONS)

1.5.3 Physical Specification and Mechanical Arrangement of Power Unit

Construction

As detailed for camera control unit.

Weight

99 lb (45 kg)

Overall Dimensions

As detailed for camera control unit.

Build-up

Similar to the build-up for the camera control unit except that the chassis-mounting frame contains: transformers, large capacitors, the oven and tube supply generator, and voltage tapping plates. The chassis also carries plug-in units with heat sinks, and wired-in units as follows.

Plug-in Units

+200V Regulator
-100V "
- 16V "
Focus "
Silicon Control Rectifier Bridge (2 units)
Primary Regulator
Tagboard in oven

Screw-in and wired-in units

Inverter
Oven Temperature Control

Mounting and Cooling

As detailed for the camera control unit.

Controls

Internal h.t. switch for servicing purposes, preset h.t. and focus current controls inside oven, primary regulator setting-up control, and tube supply balancing potentiometer on the inverter circuit board near 75-way chassis connector.

Front Panel

Multi-range meter with 23-way switch, all circuit fuses and neon indicators, and channel a.c. master switch. Oven heat and over-heat indicator lamps.

Rear Panel Connectors

Power in - Cannon 4-way plug
Supply to C.C.U. - Pye 28-way socket
Internal 15-way Cinch connector for supply to fan in base

Tapping Plates for Supply Voltage

Two plates are provided, mounted on right-hand side of the chassis, towards the rear.

1.5.4 Physical Specification and Mechanical Arrangement of Control Panel

General

The control panel is a desk-mounted unit with a hinged panel on which the controls are fitted:

(a) Operational controls

(b) Setting-up controls. Protected by a hinged cover.

Overall Dimensions

15" x 9" x 9½" (38 x 23 x 24 cm)

Weight

23 lb (10.5 kg)

Operational Controls

Pre-heat On/Off, A.C. On/Off, Producer's Talkback, Programme Sound, Call Camera/Microphone Key Switch, Camera Talkback, Gain, A.G.C., Overscan, Video Polarity, Contrast Correction, Function Switch, Black Level, Iris.

Setting-Up Controls

Horizontal Scan Centring and Vertical Scan Centring (normal and reverse), Horizontal Scan Amplitude, Vertical Scan Amplitude, Alignment, Image Focus, Beam Focus, G5, Multi-focus, Target Bias, Beam Current, Dynode Gain, Field Mesh, Shading (horizontal and vertical with on/off switch), Lift (normal and negative), Aperture Correction, Set A.G.C., White Clip, Sync Amplitude.

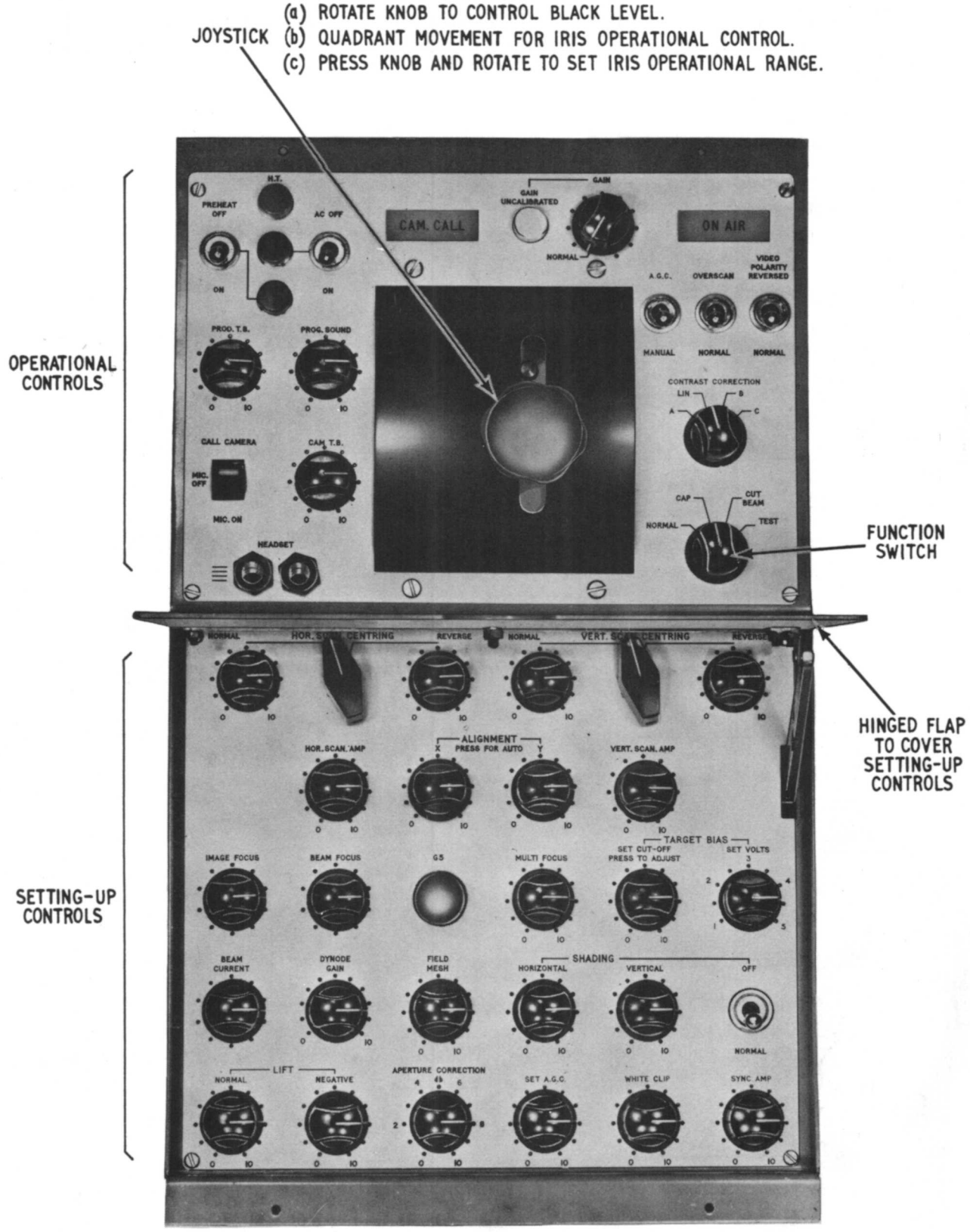


FIG.11 THE CONTROL PANEL

Rear Panel

Set Overscan Controls (horizontal and vertical).
Miniature loudspeaker for camera call signal.
Pye 20-way socket, talkback to C.C.U.
Elco 75-way plug to C.C.U.

Wired-in Board

Talkback isolation amplifier.

1.5.5 General Specification

(a) Systems, Output Signals and Camera Cable

405 lines 50 fields, 525 lines 60 fields,
625 lines 50 fields, per second, switchable.

Output Signal

Two outputs composite video, or two outputs non-composite video, or one output composite video with one output non-composite, selected by internal link. Synchronising pulses negative.

Output Signal Amplitude

1 volt peak-to-peak composite or 0.7 volt peak-to-peak non-composite, into 75 ohms.

Camera Cable

B.I.C.C., T1869 or T1871 with D37S/40/12 coupler system, maximum length 2000 feet (600 m).

(b) Supply Requirements

Power

800 VA approximately, at 95-130 volts, or 190-260 volts a.c., 47-65 c/s.
Power factor better than 0.9.

System Waveform

Vertical drive, horizontal drive, complete sync., and complete blanking. Pulses negative-going and between 1.5 and 5 volts amplitude. High impedance input.
Horizontal drive pulse to be 8 microseconds in advance of sync.

Test Video and Viewfinder Effects Signal

1 volt peak-to-peak composite. High impedance bridging input.

Systems Switching

One switch at rear of C.C.U. and one inside the camera.

(c) Optical Specification and Control

Lenses

Standard range to B.B.C. specification TV.88 and TV.88/2, 1.1 inch (28 mm) to 22 inches. Extended focal lengths, folded lenses and zoom lenses to special order. Lenses by Taylor, Taylor and Hobson to above specification may be mounted on the turret in the following ways:-

	TURRET POSITIONS			
	1	2	3	4
LENSES (FOCAL LENGTHS)	$1\frac{3}{8}$	2	$3, 5, 8, 12\frac{1}{2}$	3, 5, 8
	$1\frac{3}{8}$	3	$5, 8, 12\frac{1}{2}, 16$	5, 8
	2	3	$5, 8, 12\frac{1}{2}, 16, 22$	$5, 8, 12\frac{1}{2}$
	3	5	$8, 12\frac{1}{2}, 16, 22$	$8, 12\frac{1}{2}, 16, 22$

Turret

Four-lens, supported by strong peripheral bearing. Pitch circle radius of lens centres, $4\frac{1}{2}$ inches (10.8 cm). Cone angle between facets of opposite lenses, 15°. Turret registration repeatable to within 1% of picture width. Turret control handle mounted at lower rear of the camera.

Filters

Six filter positions plus blank (for capping) are provided on a filter turret between the lens and the image plane. One or two filters can be accommodated together at each position. Filter diameter $2\frac{3}{8}$ inches (7 cm), total thickness (double filter) $\frac{1}{8}$ inch (3 mm). Operation by edge knob at front left-hand side of camera.

Iris Control

Servo motor drive in constant mesh with all four lenses. Total aperture range (for shorter focal length lenses), f2 to f22. Time required to drive over full range, less than

3 seconds. Control sensitivity better than 20 increments per stop. Range of fine operational control (joystick lever) two stops on either side of preset control setting. Control law, linear. Socket on back of C.C.U. for feed to iris indicator meter.

Optical Focus

Fixed lens and sliding tube carriage via mechanical linkage to capstan control at rear lower right-hand side of camera, Capstan diameter 2 inches (5 cm), with three detachable 3 inch (7.6 cm) spokes, and adjustable in position. Direction of control: capstan clockwise for close-up (British home market), capstan anti-clockwise for close-up (export market). Mechanism incorporates adjustable friction brake and carriage lock. Carriage movement against capstan rotation may be set to be linear or to follow a part-cosine law giving expanded control over the range used by short focal length lenses. Total carriage movement is $2\frac{5}{8}$ inches (6.7 cm) from infinity focus to extreme close-up position, with 720° rotation of capstan.

Image Size

1.6 inch (40.6 mm) diagonal at photocathode. A rectangular mask of 4:3 aspect ratio and 1.68" (42.5 mm) diagonal is fitted in contact with the photocathode face plate.

Light Box (for test slides)

Supplied as optional extra. Power supply via slip-ring and contact on turret at 24 volts, or via utility socket at 240 volts.

(d) Picture Geometry, Scanning Specification and Viewfinder Display

Camera Picture Geometry and Scanning Linearity

Geometry within ±1% within a central circular portion of the raster of a diameter equal to picture width.
Within ±2% in remaining areas.
Differential velocity error of scanning not greater than 2% over distance greater than 1/25 picture width or height.
Aspect ration 4:3.

Overscan Amplitude

Adjustable up to 5% increase on normal scan amplitudes.

Scan Amplitude Range (Camera and Viewfinder)

Horizontal and vertical: minimum range ±10% of normal amplitude.

Scan Centring Range

Horizontal and vertical: ±10% of width and height from mid-range position, separately adjustable for normal and reverse scans.

Camera and Viewfinder Scan Stability

Within ±0.5% of picture width and height for 1% long term a.c. power supply voltage change, or short term 6% power supply change, after a 30 minute warming-up period.

Scan Direction

Horizontal and vertical independently reversible from control panel position.

Viewfinder Geometry and Scanning Linearity

Geometry within ±1% within a central circular portion of the raster having a diameter equal to picture width. Within ±2% in remaining areas. Linearity within $1\frac{1}{2}$% distortion evenly distributed.

Viewfinder Scan Centring Range

Horizontal and vertical: ±10% of width and height from mid-range position.

Viewfinder Display Size

$4\frac{7}{8}$ x $3\frac{5}{8}$ inches (12.4 x 9.2 cm)

Viewfinder Brightness

100 foot-lamberts, maximum. Peak white better than 50 foot-lamberts with 6dB in hand at contrast control.

Viewfinder E.H.T. Stability

Less than 2% change in raster size for a brightness change of 0 to 50 foot-lamberts.

(e) Video Amplifier Channel Specification

Channel Gain

Sufficient to give standard output level for an Image Orthicon signal current of 4 micro-amps with 6dB of gain in hand.

Channel Linearity

Differential gain distortion less then 5% for any duty cycle.

Channel Frequency Response

Pulse and bar waveform on all systems and all cable lengths 0 to 2000 ft 2T pulse K rating better than 0.5%, pulse/bar ratio between 0.98 and 1.02 and bar degradation not worse than 0.5%. Pulse/bar ratio for 1T pulse (low pass filter out of circuit) between 0.85 and 1.0. K_T rating better than 4%.

L.F. Response

Tilt on a 50 c/s square wave less than $\frac{1}{4}$% of total amplitude per milli-second.

Stability

Black level within ±1%, white level clipper within ±2%. Overall video gain ±0.5dB for extended periods after 30 minute warm-up and including mains change of up to 6% surge and 1% long term.

Signal-to-Noise Ratio

Better than 86dB/kc/sec for 4μA input and 0.7V output signal (excluding Image Orthicon noise).

Aperture Correction

Maximum 10dB boost at end of passband, switched between 405 and 525/625, adjustable from control panel. Maintains satisfactory phase response.

Gamma Correction

Black stretch:

Maximum black gain: not less than 8.5dB
Minimum black gain: nearly zero (i.e. linear response)
Lower knee: 0-35%
Upper knee: 0-55%

Intermediate and upper slope gain adjustable to normal correction curves from linear to 0.5 power law.

Black crush:

Maximum black crush not less than 8dB.
Adjustable to nearly linear response
Knees: 0-30%

White Clipper

Adjustable between at least 80% and 120% of standard level.

Black Level Control

Black level adjustable between at least -30% and +30% of video range, with whites at 100% stable to within 3% with variations of black level.

Video Polarity

Positive or negative video, switchable from control panel. Separate preset adjustment of negative video lift.

Shading Correction

Horizontal and vertical shading sawtooth signal adjustable in amplitude through zero to full video amplitude in either direction, from the control panel. Shading injection is switched so that its polarity remains correct for reversal of scans and for negative picture. Shading adjustment does not affect Lift level. Shading on/off switch on control panel (test video switch removes shading).

Pedestal

By internal link 15% pedestal may be added to the viewfinder video feed. Adjustable pedestal between 0 and 15% peak white is available on the main channel.

Hum and Spurious Signals

Peak-to-peak amplitude hum 60dB down on peak video. Positional hum less than $\pm\frac{1}{8}$ picture element.

(f) Talkback and Communications Facilities

Headsets

Separate channel ear-pieces with attached carbon microphone to Pye specification 715551.

Channels

Three Channels:-

(a) Production talkback on one earpiece

(b) Engineering talkback and

(c) Programme Sound mixed on the other earpiece

Controls

Separate volume controls for each channel and combined microphone switch with call keys on the camera rear panel and on the control panel. Separate sets of volume controls for cameraman and for studio floor personnel.

Headset Outlets

(1) Camera:
(a) One pair of jack sockets for cameraman.
(b) Two pairs of jack sockets for floor personnel.
(c) Two single jack sockets for floor personnel. Extension socket on base of camera for taking production talkback and programme sound to extension indicator unit.

(2) C.C.U.: Pye 12-way socket on rear panel for connection into studio or mobile control room (M.C.R.) system.

(3) Control Panel: One pair of jack sockets plus Pye 20-way socket for extension services.

Call C.C.U.

Key on camera rear panel to call C.C.U. operator's attention by latching warning light on the control panel accompanied by time-limited audible warning note. This is cancelled by switching on the microphone key at the control panel.

Call Camera

In the CALL CAMERA position the microphone key on the control panel operates the "on air" lamp flasher circuit to call camera operator's attention.

(g) Viewfinder Video Amplifier and Facilities

Video Feed

Fully processed composite signal fed from camera control unit with correction in camera for cable loss switched in steps of 200 feet (60 m). Added pedestal (by internal link) 15% peak white. This enables the picture edges to be determined on captions which have been set down below picture black.

Picture Source

Switchable by key on rear of camera to originate from:

(a) Its own camera
(b) An external source
(c) A mixture of (a) and (b)

Provided the external source is composite and at standard level there is no change in amplitude when switching between sources (a) (b) or (c).

Amplifier Gain

Sufficient to modulate cathode-ray tube to give high-lights of 50 foot-lamberts with 6dB of gain in hand and controllable down to zero by contrast control on camera rear panel.

Amplifier Linearity

Amplitude non-linearity less than 2%. Differential gain distortion for any duty cycle less than 20%.

Amplifier Bandwidth

Flat ±1dB to 7 Mc/s

Low Frequency Response

Less than 5% tilt of 50 c/s square wave.

Detail Emphasis

Brought in by switch on camera rear panel. Gives 10dB boost at upper end of band on all systems.

Black Reference

By switch selection picture may be d.c. restored or may be a.c. coupled.

(h) Image Orthicon Operating Conditions

Total Operating Life

Indicated by hour-meter fitted to camera and switched on with gun heater.

Warm-up Time

Rehearsal quality pictures after 15 minutes. Temperature performance stability reached 30 minutes after switching on. In very cold ambient temperatures these times are extended by 15 minutes.

Temperature Control

Thermostatically controlled heater mounted on focus coil assembly with separate fan blowing temperature regulated air onto the tube around the target region. The air flows along the tube surface towards the photocathode and gun ends.

Target region temperature maintained between 40° C and 45° C with no other part of the glass envelope more than 5° hotter than the target region. Preset adjustment to change operating temperature if desired. Target temperature calibrator available as optional extra.

Image Capping

Physical capping by shutter built into filter turret. Electronic capping by switch at control panel which holds photocathode 23 volts positive to target.

Image Magnification

1:1.46

Target Voltage

Accurate setting by calibrated scale on control panel to any potential between 1 and 5 volts above cut-off. Target cut-off point adjusted independently from calibrated setting control.

Focus Field

Focus current maintained constant by high gain d.c. feedback amplifier against extended operation and up to 6% short term mains voltage fluctuations. High efficienty magnetic screening of yoke reduces focus variation due to panning in the earth's magnetic field to less than 1dB change on a 400 line resolution pattern.

Scan Failure Protection

By search coils integral with the tube yoke to detect presence of deflecting fields. Reduction of either vertical or horizontal scanning below 50% causes Image Orthicon beam to be cut and brings on a warning indicator lamp on the rear of the camera. Individual adjustment of cut-off sensitivity is provided.

Orientation of Verticals

Adjustment is provided to set verticals by rotating the tube with deflection yoke up to ±30° from normally correct orientation. This setting may be locked.

Alignment

Adjustment of beam alignment is provided by two knobs on the control panel. By pressing either knob, a very low frequency wobulation is applied to beam focus as an aid to alignment.

Image and Beam Focus

Three-turn potentiometer focus controls and field mesh control on the control panel with preset G6 (accelerator) adjustment in the camera to correct image plane focus curvature, and dynamic focus preset to correct for scanning field curvature

Beam Current

Three-turn potentiometer control at the control panel with switch to cut beam while leaving all other controls set.

Multiplier

Supplied with stabilised 1.6kV, generated at the camera. Multiplier gain adjustable over a range of 18dB at the control panel (this control together with a three-position attenuator in the camera forms the setting-up gain control for the channel).

SECTION 2 - INSTALLING THE EQUIPMENT

2.1 INSTALLING THE POWER UNIT

2.1.1 Mounting the Power Unit

Slide the power unit on to its mounting in the control room and secure it by the two knurled screws on the mounting slides.

2.1.2 Inspection and Setting up of Voltage Taps

When installing the power unit for the first time after shipment, an internal inspection should be made as follows:-

(a) Withdraw the unit on its runners by pressing down on the handle at the bottom of the front panel.

(b) Carefully examine all components for signs of damage. Check that screws are tight and that the plug-in units are in place.

(c) Check that both voltage tapping plugs are inserted with their arrows pointing to the voltage of the mains to be used.

2.2 INSTALLING THE CAMERA CONTROL UNIT (C.C.U.)

2.2.1 Mounting the C.C.U.

As detailed for the power unit (Section 2.1.1).

2.2.2 Inspection

When installing a C.C.U. for the first time after shipment an internal inspection should be made as follows:-

(a) Withdraw the unit on its runners by pressing down on the handle at the bottom of the front panel.

(b) Carefully examine the whole of the unit for any sign of damage, loose screws etc., and check that all valves and plug-in units are in place.

2.2.3 Cabling (Fig.12)

Make the following cable connections to the appropriate connectors on the back panels of the C.C.U. and power unit.

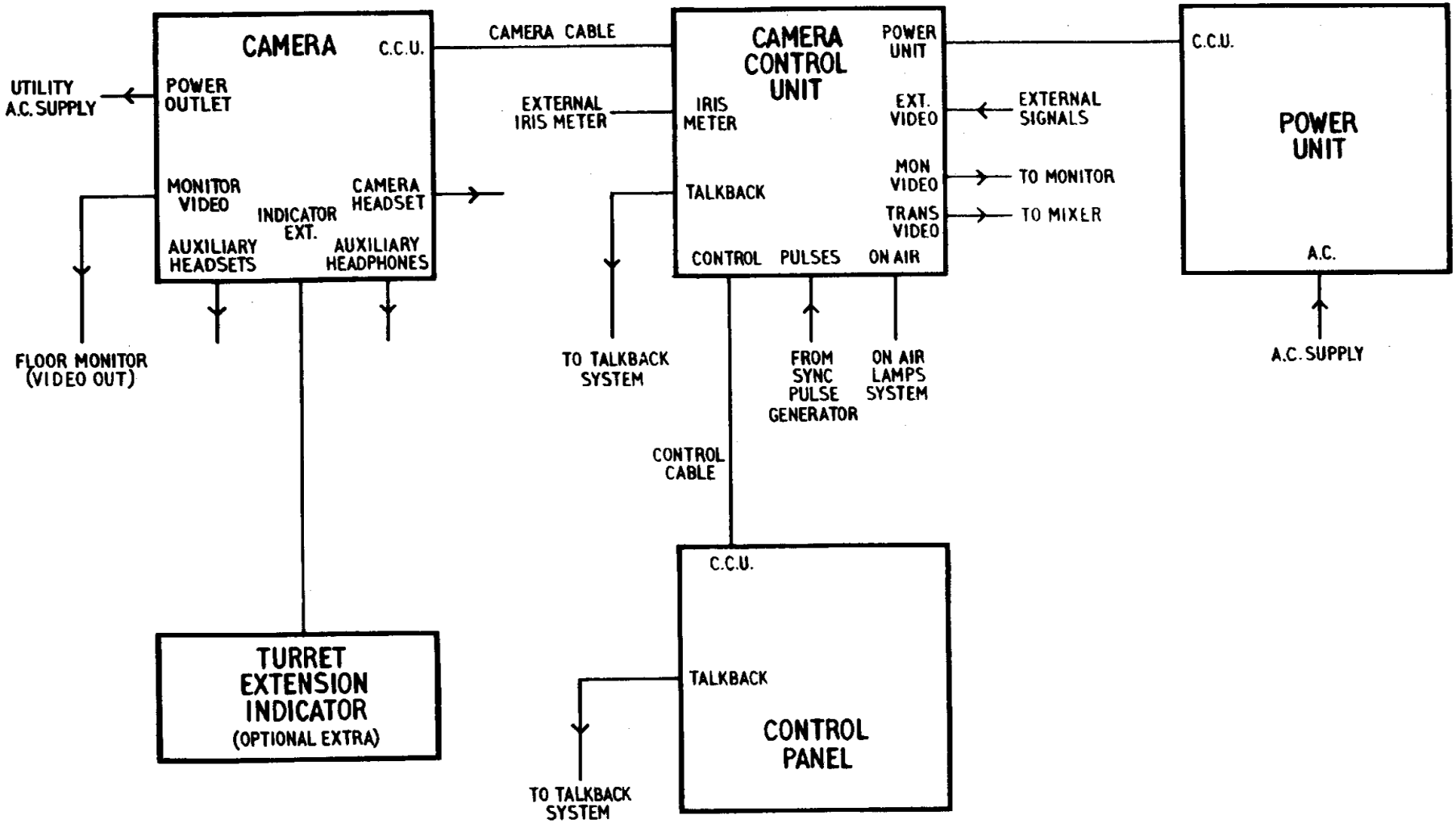


FIG.12 INTERCONNECTION OF UNITS

(a) A.C. power supply of approximately 1kW capacity via a Cannon four-pin socket to A.C. on the power unit. It is important that the following connections are observed.

Pin No.1 Live mains supply
Pin No.2 Neutral mains supply
Pins No.3 and No.4 Ground.

(b) Waveform supplies from the standard system to the 8-way PULSES plug on the C.C.U. as follows:-

Pin No.1 Horizontal Drive
Pin No.3 Complete Sync
Pin No.5 Complete Blanking
Pin No.7 Vertical Drive
Pins Nos. 2, 4, 6, 8 Braid outers of all coaxial cables.

The waveform supplies are fed through a T adaptor and may be bridged to another unit by taking a second sync. lead from the adaptor output socket. If no bridging is required the waveform supply system should be terminated by fitting the special 75 ohm terminating plug to the adaptor output socket.

(c) Coaxial cable (75 ohms) from the MON. VIDEO output socket on the C.C.U. to the video input of a picture monitor. This output provides video at standard level with mixed sync. pulses for internal locking of the monitor scans.

(d) Connection to the control panel via the 75-way cable from CONTROL on the C.C.U.

(e) Connection to the camera via the B.I.C.C. multi-way cable from CAMERA on the C.C.U.

(f) Connection from POWER UNIT (28-way plug) on the C.C.U. to the power unit.

(g) TRANS. VIDEO on the C.C.U. This is a coaxial socket which provides the main channel output (75 ohms). The output at this point is normally composite video but non-composite video can be obtained by an internal connection change.

(h) EXT. VIDEO on the C.C.U. This is a video input socket and accepts composite or non-composite signals which may be a test signal waveform for engineering purposes or may be a picture from an external source which can be superimposed on the camera viewfinder picture for the accurate alignment of super-imposition shots. The test signal may be bridged at this socket but if not it must be terminated in 75 ohms.

(i) Connection from TALKBACK on the C.C.U. to the talkback system.

(j) Connection from IRIS METER on the C.C.U. to the external iris meter (if fitted).

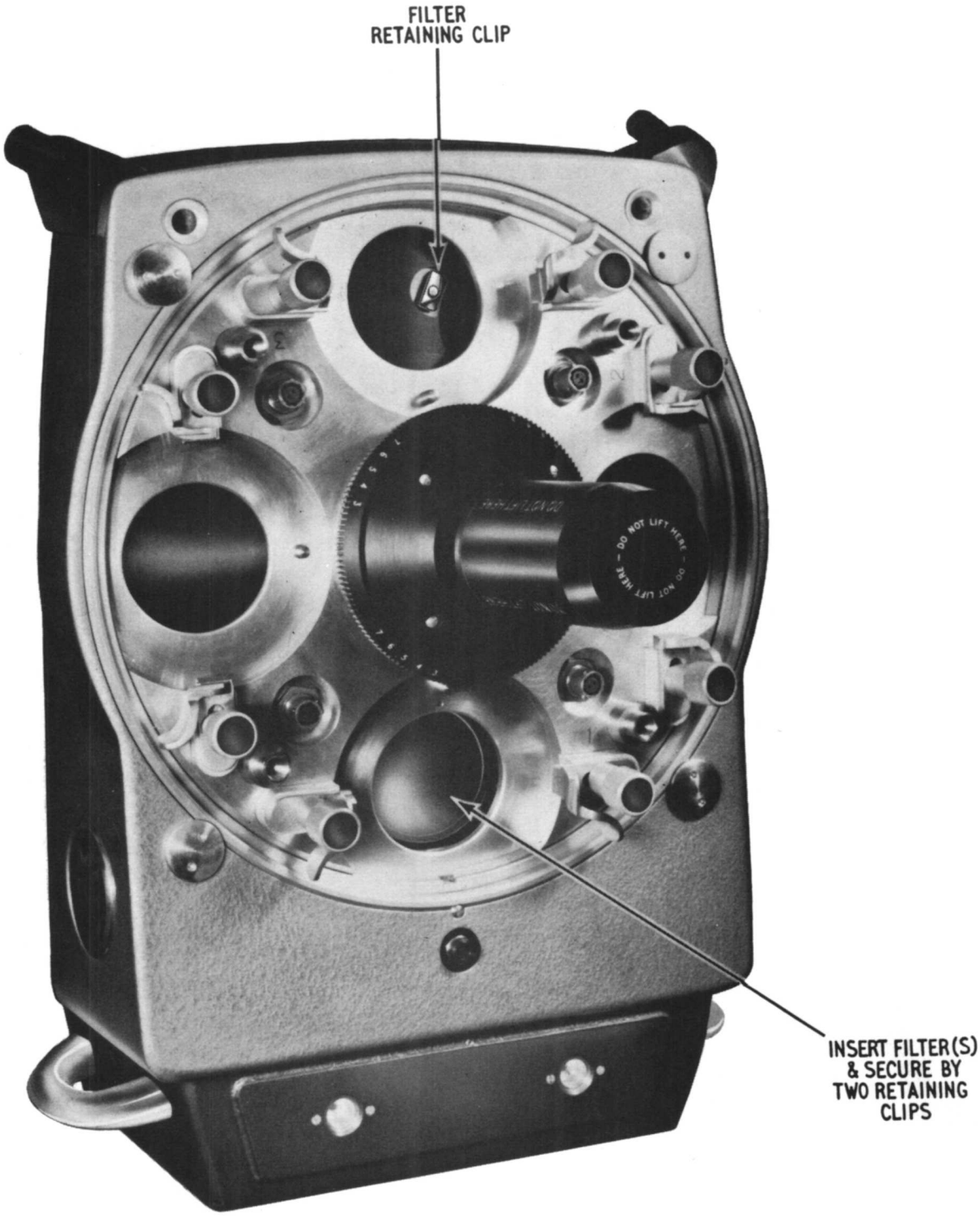


FIG.13 TO FIT FIXED FILTERS

2.3 INSTALLING THE CONTROL PANEL

This unit is normally mounted on a control desk. Connection is made to the C.C.U. via the 75-way cable from the plug marked C.C.U., and to the talkback system from the 20-way socket, TALK-BACK (Fig.12).

2.4 INSTALLING THE CAMERA

2.4.1 Protection and Fitting of Filters

The four lens stations on the turret are protected during transit by cover plates. In order to protect the filters and the turret from damage and dirt, it is strongly advised that no lens station be left vacant; all stations should be fitted with either a lens, or a cover plate at all times. In addition, during operation, the picture may be impaired by stray light entering through a vacant lens station.

The filters are fitted, one or two per station, as shown in Fig.13 and secured by two retaining clips.

2.4.2 Mounting and Assembling the Camera

(a) Fit the camera to a suitable tripod, pedestal or other mounting with a head fitted with a Vinten wedge plate (heavy duty) and lock the wedge.

(b) Fit the focus capstan arm by first removing the protection cover, fitting the arm in the most convenient position, and screwing home the outer ring. Finally tighten the ring with the C-spanner provided.

(c) Fit the turret handle in a similar manner. (See (b) above).

(d) Pull out the wedge plate lock PULL TO RELEASE, at the bottom left-hand side of the camera and slide the camera to the point of optimum balance on the pedestal head. Lock the wedge plate slide at the nearest position to this point.

2.4.3 Inspection of the Camera

When installing a camera for the first time after shipment an inspection should be made as follows:-

(a) Hinge down the side covers by pressing in the two studs, in turn, at the top of the turret and pull the side covers outwards.

(b) On the left-hand side of the camera is a chassis frame containing three plug-in units. This is supported on a hinge at the bottom and held by a spring catch at each top corner. Press the catches down and hinge back the chassis frame to obtain access to its underside.

(c) The scan chassis at the right-hand side of the camera may also be hinged back in a similar manner.

(d) Carefully examine the whole camera for any sign of damage. Check that all valves and their cap connectors are in place and all flying lead connectors tightly home.

(e) Operate the focus control and check that a smooth, free movement of the carriage of $2\frac{1}{2}$ inches or 6.5 cm is obtainable.

(f) Remove the cover plate from the operational lens position and operate the filter control. If filters are fitted (Section 2.4.1) see that they are clean and undamaged.

(g) Turn the turret handle and check that the turret can be turned smoothly and indents correctly.

2.4.4 Fitting the Lenses (Fig.14)

Since all four lens irises are driven at the same time by means of the servo-control, it is essential that they are mounted with their irises correctly registered with the driving gear and with each other. It will be seen that the rotating part of the iris boss is engraved with the figures "4, 5, 6" in four positions, fit the individual lenses so that the numbers on the iris boss mate with the same numbers on their iris gears. The lenses are located by means of a stud on the turret engaging in a slot in the lens base plate. They are held in position by two sliding catches. Before fitting a lens slacken off the thumb-screw. A lens is fitted by sliding it into position towards the turret centre in such a way that the lens base pushes the retaining catches apart, the catches will automatically move back into position when the lens is home. Finally tighten up the thumb screw. Adjust camera balance (see Section 2.4.2(d)).

2.4.5 Capping

Turn the filter control to the position indicated by "X" on its edge, and check that this brings into position a shutter between the lens and the Image Orthicon face plate. This is the capped position. The shutter should be left in this position until a picture is required.

Engage the left-hand and right-hand chassis with their side panels. (The panels may be left open at this stage if proceeding to INITIAL SETTING-UP).

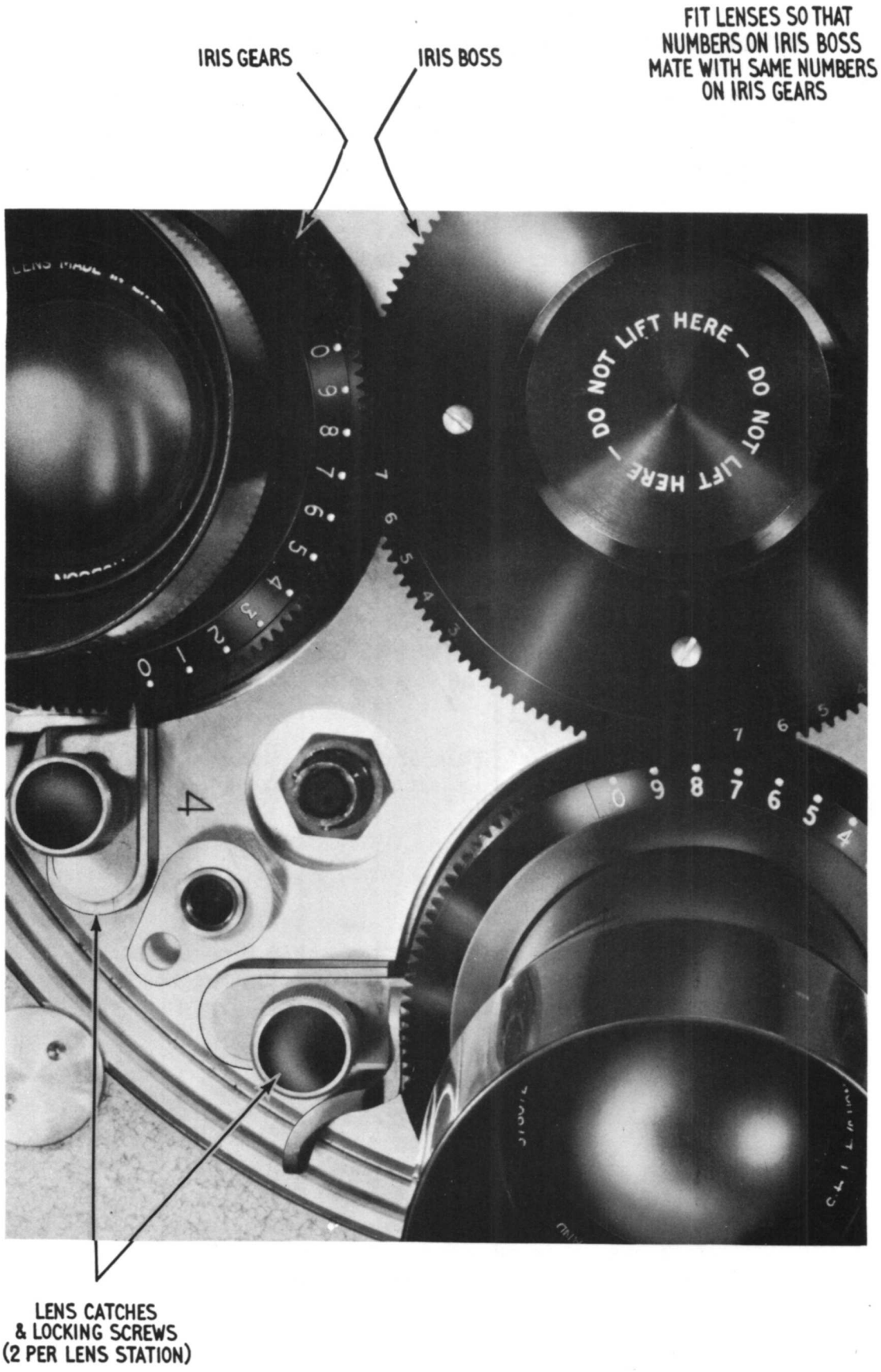


FIG. 14 TO FIT LENSES TO TURRET

2.4.6 Accessories

Fit accessories as required:

(a) "On Air" Cue Light This contains a 24 volt 6/20 watt dual filament lamp which may be connected in one of two ways to give either a BRIGHT light or DIM light as viewed by the camera operator.

(b) Viewfinder Visor This slides into guides behind the viewfinder screen and may be a straight tiltable hood or a reversible periscope visor.

(c) Telephone Headsets These plug into jack sockets at the lower left-hand side according to the label plate.

(d) Visual Prompter This may be fitted to the two holes provided in the bottom of the camera front casting.

(e) Extension Indicator Unit This plugs into the 11-way socket marked INDICATOR EXTENSION and displays the turret station in use "on air" cue, and extends talkback listening facility.

(f) Cue Card Holder This fits in the two brackets on the rear casting and can be used to hold the camera operator's instruction sheets.

(g) Waterproof Cover This should be fitted in rainy weather and will also help to maintain operating temperature in very cold weather.

2.4.7 Camera Cable

Connect a suitable length of camera cable type B.I.C.C. T1869 or T1871 (up to a maximum of 2000 feet or 600m) to the 37-way plug at the left-hand side of the camera and connect the other end to the camera control unit.

2.4.8 Fitting the Image Orthcon Tube (Fig.15)

WARNING: When a camera is being brought into service for the first time, or when there is doubt about the efficiency of its tube protection circuits, it is recommended that an old or second grade tube is used for initial setting up.

Fit the Image Orthicon tube as follows:-

(a) Open the door at the rear of the camera.

(b) Pull the 14-way base connector back on its lead until it just lies outside the camera.

(c) Unplug the 26-way connector at the side of the deflection coil assembly. Turn the two 'D' catch-bolts a quarter turn to release them. It should then be possible to pull the complete deflector coil assembly out through the opening.

(d) The two screws clamping the locating ring at the rear of the focus coil should be slackened at this stage to allow rotational adjustment of the tube.

(e) Fit the Image Orthicon into the deflector coil assembly, taking care that the connector strips at the front end mate correctly with their contacts.

NOTE: The tube has two bushes on its shoulder contact ring which engage with locating pins on the deflection yoke.

(f) Carefully insert the tube and deflector coil assembly into the camera and push them as far forward within the focus coil as they will go.

DO NOT push the tube base at this stage as this may cause the front end to disengage. The assembly should be pushed forward by the deflection coil rear cover.

(g) Turn the two 'D' catch-bolts with the 'D' cuts to the outside and one at a time press them home into their locating holes until they click into position.

(h) Connect the 14-way base socket and the 26-way connector to the deflection coils.

(j) Check that the deflection coil with tube can be twisted about its axis and that there is no fouling of the focusing carriage movement from cables etc. Close the rear door.

The camera is now ready for the initial setting-up procedure detailed in Section 3.

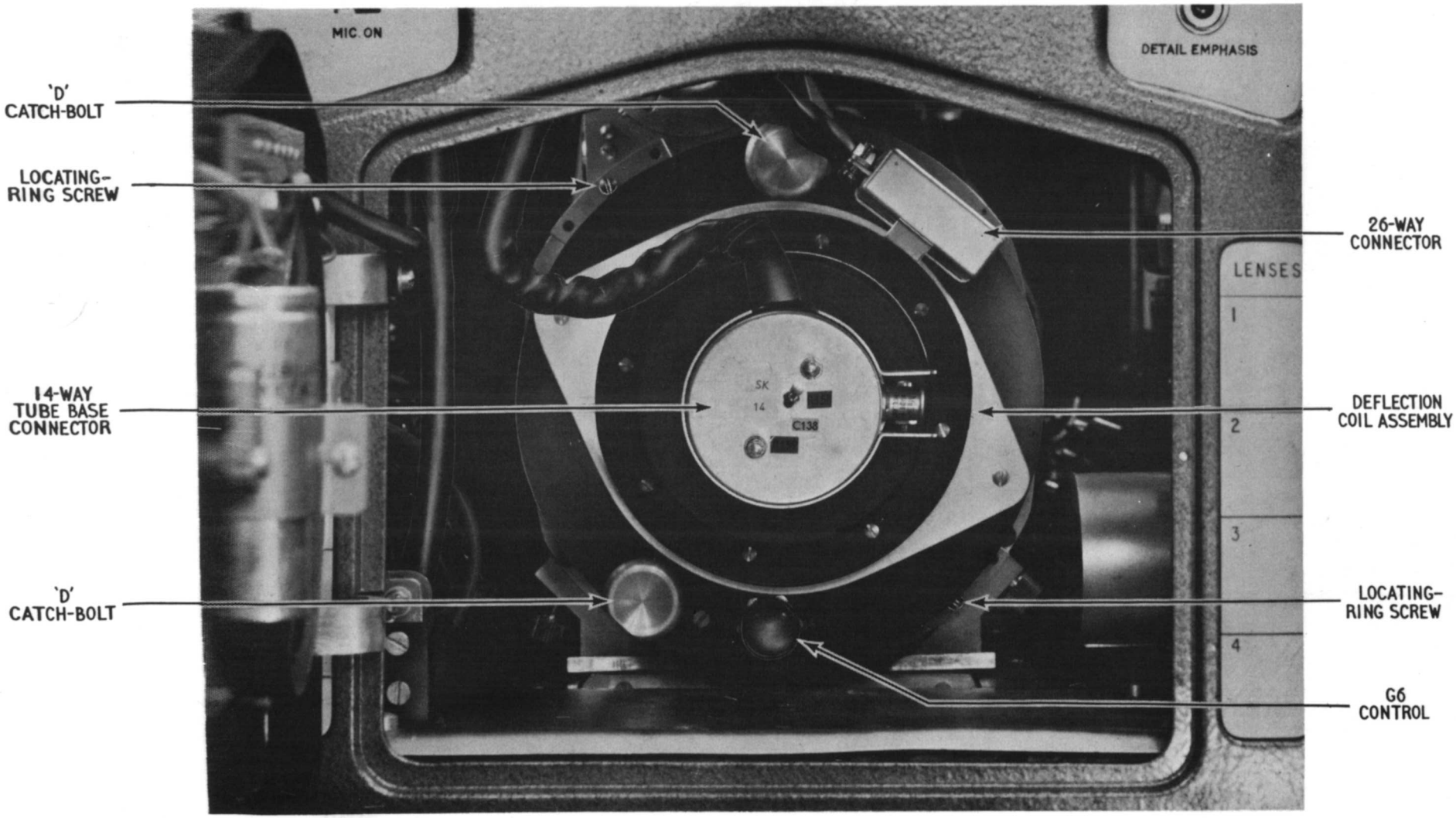


FIG.15 TO FIT IMAGE ORTHICON TUBE (SEE TEXT)

SECTION 3 - SETTING-UP INSTRUCTIONS

3.1 PRELIMINARY SETTING-UP

After the camera chain has been installed in accordance with Section 2, the following procedure should be followed. Subsequently it should only be necessary to re-adjust those controls affected by changes of Image Orthicon, camera cable length, etc., and to re-check settings generally at intervals of approximately one month.

3.1.1 Systems Switching

(a) In the camera on the pulse unit in the left-hand side panel will be found a three-position switch, 405, 525, 625. This selects certain constants in the scanning circuits together with individual linearity presets and peaking frequencies in the viewfinder detail emphasis curve. It is essential that this is switched according to the system in use.

(b) At the rear of the C.C.U. is a two-position lever switch SYSTEM CHANGE. This selects the appropriate low pass filter and the aperture correction characteristic for the system in use, 405 or 525/625, and should be set accordingly.

When switching between systems the horizontal scan amplitudes may have to be re-adjusted and also the Image Orthicon horizontal centring.

3.1.2 Camera Cable Length

There are three switches in the camera chain which must be set in accordance with the length of camera cable in use. These switches are adjustable in steps of 200 feet (60m) from 0 to 2000 feet (0-600m) and the step chosen should be that nearest to the actual length in use. The first switch marked CABLE x 100 FT is in the camera on the pulse unit and is accessible by hinging down the left-hand side cover. This sets the compensation for frequency attenuation by the cable in the viewfinder and floor monitor video circuit and also the timing of the viewfinder horizontal scan.

A second switch CABLE x 100 FT., is situated inside the camera control unit on the main chassis and is accessible by pulling out the drawer. This sets the cable compensation for the video waveform transmitted from the camera head amplifier. The third switch CABLE COMP., is on the horizontal drive processing board at the back of the C.C.U. chassis and sets the timing of the horizontal drive pulse to the camera. It is essential that this timing switch is always set to the cable length in use as this also governs the timing of clamp pulses in the C.C.U. If an external test waveform is fed

to the C.C.U. input (not via the camera cable) the C.C.U. compensation switch should be set to zero feet irrespective of the cable length and the setting of the timing switch.

3.1.3 H.T. Switches

Leave h.t. switched off by pulling out either the C.C.U. or the power unit drawer and pulling out the push-pull switch B+ just inside at the top of the front panel (subsequently the chain will normally be switched on with these h.t. switches closed). Leave A.C. and PREHEAT switches on the control panel off.

3.1.4 Switching on a.c. supply at the power unit

Switch on the A.C. switch at the power unit. Check that the A.C. volts position of the meter reads within the red datum mark. If not re-set the power unit voltage taps (see Section 2.1.2). The AUX. A.C. and MAIN A.C. indicator lamps should also be on. Check the following meter readings:-

CENT	100% ±10%
+23V	100% ± 5%
-23V	100% ± 5%

3.1.5 Headsets

Connect headsets into the control panel and the camera jack sockets and check that the engineering talkback telephone service is available and that the CALL C.C.U. circuit is working.

3.1.6 Preheat Control

Switch on the PREHEAT at the control panel and check that UTILITY A.C. and OVEN PREHEAT lamps on the power unit are lit, and that PREHEAT indicator lamp on the control panel is lit. Check the -16V meter reading to be 100% ±5%. Check also that the following are operative at the camera:

(a) Main and yoke blowers are on (note that the main blower will switch off at temperatures below 5°C).

(b) Turret indicators and orbit indicator are functioning (orbit indicator comes on when the switch at the right-hand side of the camera is in the suppress position). The green and red heating and beam indicators at the rear of the camera should also be on.

(c) "On Air" indicators flash when the CALL CAMERA key is operated from the control panel. (Note the external camera

indicators may be suppressed by a switch on the right-hand side of the camera).

3.1.7 Switching on a.c. supply at the control panel

Switch on A.C. at the control panel and check that its indicator lights. Open up the C.C.U. drawer and the camera and check that all valve heaters (except V17 in the camera) are lit. Check that the CAM. A.C. and C.C.U. A.C. lamps on the power unit, and the A.C. lamp on the C.C.U. are lit.

3.1.8 Setting of control panel

Set the operational controls on the control panel:

GAIN to NORMAL
CONTRAST CORRECTION to LIN.
A.G.C. to MANUAL
OVERSCAN to NORMAL
VIDEO POLARITY to NORMAL
Function switch to CUT BEAM
BLACK LEVEL mid-way (black/white)
disc visible through slot to the vertical).

Set the controls under the control panel flap as follows:-

HOR. SCAN and VERT SCAN switches NORMAL
HOR. SCAN AMP and VERT SCAN AMP fully clockwise.
TARGET BIAS SET VOLTS to 3
TARGET BIAS SET CUT-OFF mid-way
SHADING switch OFF
LIFT fully anti-clockwise
APERTURE CORRECTION fully anti-clockwise
WHITE CLIP full clockwise

3.1.9 Switching on the h.t.

Switch on h.t. by pushing B+ switches on C.C.U. and power unit. Check that H.T. lamps on the power unit and control panel are lit. Check the meter readings as follows:-

Meter Switch Position	Reading		Meter Switch Position	Reading
A.C.	100%	± 5%	I +200V	800-980mA
+200V	"	"	I -100V	350-450mA
-100V	"	"	I +23V	1.0-1.2A
CENT	"	±10%	I -16V	1.4-1.6A
+50V	"	"	I -23V (A)	400-500mA
+23V	"	± 5%	I -23V (B)	"
-16V	"	"	V REG (+200V)	75-110%
-23V	"	"	V REG (-100V)	"
FOC. CURR.	"	± 1%	V REG (FOCUS)	40-110%
TUBE SUPPLY	"	± 5%	V REG (-16V)	75-110%
			V REG (OVEN)	within blue band when warm.

adjust SYNC AMP for 0.3 volt as measured by a waveform monitor at the video output of the C.C.U. Check that a synchronised raster is obtained on the picture monitor. Turn up LIFT NORMAL and check that a 100% pedestal (0.7V pedestal plus 0.3V sync) is obtainable and turn down LIFT NORMAL to approximately 5% peak white.

3.1.10 Checking the viewfinder raster

Check that a raster is obtained on the viewfinder (adjust CONTRAST, BRIGHTNESS, and FOCUS as necessary) and set the size and position of the viewfinder raster by means of the V.F. VERT. AMP. control on the scan generator chassis, the V.F. HOR. AMP. control situated on the viewfinder chassis which is accessible througn the right-hand side of the camera (this is a sliding control and is locked by turning clockwise), and the centring magnets. The latter are two knurled rings surrounding the cathode-ray tube neck at the rear of the deflection assembly.

Viewfinder e.h.t. is factory set and should not normally require adjustment. However, it may be measured with an electrostatic voltmeter and should be between 11kV and 13kV. The level may be set by adjusting the preset control marked SET V.F. EHT located on the scan generator chassis.

3.1.11 Checking the beam cut indicator

The red BEAM CUT indicator at the rear of the camera should now be extinguished. If it is lit at low intensity it indicates that the tube gun heater is switched off. The switch marked I. ORTHICON GUN HEATER behind the turret in the left-hand side of the camera should be down. If the lamp is fully lit it may indicate the absence of one or both of the Image Orthicon scans, or, if the scans are correct, then the setting of the beam protection circuits is incorrect. If the BEAM CUT indicator remains on, proceed to obtain a picture using a second grade Image Orthicon tube. Adjust the two cut-out controls on the pulse chassis (left-hand side of camera) until the BEAM CUT lamp goes out when both scans are at 80% or more of normal amplitude, and comes on if either scan is reduced to 50% of normal amplitude or less. These presets are factory adjusted and should not normally require re-setting.

3.1.12 Checking the video amplifier gain

At this stage it is convenient to check the gain and general performance of the video amplifier panel. Firstly the C.C.U. should be set up as follows:-

(a) Set PEDESTAL fully anti-clockwise. Set the timing switch CABLE COMP. on the line pulse board and the CABLE COMP. switch on video chassis to zero feet.

NOTE: Once the C.C.U. has been set up ensure that the timing cable compensation switches (Section 3.1.2) are set for the length of cable in use before commencing the full chain video check.

(b) Video Levels

Feed a sawtooth test signal at standard level (0.7V peak-to-peak) into the C.C.U. EXT. VIDEO input socket; terminate in 75 ohms at the socket. Switch C.C.U. INPUT switch to EXT. VIDEO. Set BLACK LEVEL to its mid-point reference (black/white disc visible through slot to be vertical). Connect an accurately calibrated oscilloscope to the GAMMA test point (high input impedance). Adjust VIDEO GAIN on C.C.U. chassis, LIFT (NORMAL) and WHITE CLIP to set the test signal, here inverted, to 0.7V standard level. Disconnect oscilloscope from GAMMA test point and connect to TRANS VIDEO output; terminate in 75 ohms ±1% at oscilloscope. Adjust GAIN 2 on output amplifier board for 100% standard level. Check the output on MON VIDEO to be within ±4% of TRANS VIDEO output.

Reconnect the oscilloscope to TRANS VIDEO output. Increase the sawtooth signal amplitude by advancing the control panel GAIN control and set WHITE CLIP to clip at the desired level; finally return GAIN to NORMAL.

Adjust SYNC AMP to obtain correct sync. output level.

3.1.13 C.C.U. Preset Adjustments

There are several preset potentiometers in the C.C.U. and the following may have to be re-adjusted during setting up.

(a) GAIN BALANCE Feed a test signal through the C.C.U. as detailed in 3.1.12(b). With a flying lead connect pin 3 of the On Air/Call/Alignment board to the wiper of the gain balance potentiometer R14. Press either of the ALIGNMENT controls and adjust the GAIN BALANCE preset for minimum black level bounce. Release ALIGNMENT control and remove the flying lead.

(b) BLACK LEVEL TRACKING Feed a test signal through the C.C.U. as detailed in 3.1.12(b). With BLACK LEVEL control set to its mid-point reference (black/white disc visible through slot to be vertical) set the apex of the sawtooth to 100%. Turn BLACK LEVEL from minimum to maximum and adjust BLACK LEVEL TRACKING preset on C.C.U. until peak white remains within 2% of initial 100% setting.

NOTE: (i) The BLACK LEVEL mid-position may be checked by measuring the voltage at the wiper of the GAIN BALANCE preset to remain constant when the VIDEO POLARITY switch is thrown.

(ii) As in the final mode of operation the large area white will be set at a level below 100% (typically 80-85%), it is possible to balance the white tracking at this value instead of using the 100% point.

(c) PEDESTAL If pedestal is inserted on TRANS. VIDEO then the level must be adjusted when GAIN 2 is set, to obtain normal output.

(d) GAMMA (Contrast correction) In the normally supplied form the C.C.U. is fitted with two black stretch correctors and one black crush corrector in addition to the linear adaptor network. The gain of each of the three regions of the correction curves, and the level of the knees, are all separately adjustable. Irrespective of the system used for setting the correction curves it is important to follow the sequence: slope 1, knee 1, slope 2, knee 2, slope 3. This ensures that controls do not interact on each other. It should also be noted that the groups knee 1, slope 2 and knee 2, slope 3 can appear to be interchanged due to faulty setting-up; this can happen as they overlap by a large extent to give maximum range for setting-up. With regard to the actual system to be used for setting-up, any standard method can be used, but it is preferable to use the differential method when setting gamma powers between 0.7 and 1.4 as a linear display tends to be rather inaccurate in this region.

3.2 SETTING-UP THE COMPLETE CHAIN

3.2.1 Feeding a test signal

First check that the cable compensating and timing switches are set correctly for the cable length in use (Section 3.1.2). Feed a sawtooth test signal at standard level (0.7V) into the input socket EXT. VIDEO at rear of the C.C.U. Turn the function switch on the control panel to TEST. The sawtooth signal is now routed down the viewfinder transmission line to the camera and injected into the first stage of the head amplifier. It should emerge at standard level at the C.C.U. output. If necessary trim the preset VIDEO GAIN control on the C.C.U. chassis for unity gain from test input to C.C.U. output. Any large discrepancy in gain should be investigated as follows:

(a) Set the C.C.U. INPUT switch at the back of the C.C.U. to EXT. VIDEO, this routes the test signal into the C.C.U.

input (cutting out the camera circuit). Check as in Section 3. 1. 12.

(b) Connect the test signal into the TEST VIDEO socket on the head amplifier (camera left-hand side) and pull out the switch next to this socket. This routes the signal via the complete head amplifier and C. C. U. and the gain should still be unity. (Check also the output level of the head amplifier which should also show unity gain). If necessary adjust the preset set gain control R120 in the head amplifier (DO NOT ADJUST R123). The head amplifier gain is factory set and should not normally require adjustment.

3. 2. 2 Checking the peak white limiter

When the C. C. U. output waveform of 0. 7 volt sawtooth has been set up the peak white limiter may be set as follows:-

First increase the sawtooth amplitude by advancing the operational GAIN control, then adjust the WHITE CLIP control to clip at the desired level (105% peak white is suggested but this is a matter for local preference). Finally return the operational GAIN control to NORMAL. Note that black level tracking is upset if this GAIN control is not at NORMAL and only in exceptional circumstances should this control be used operationally e. g. in failing light when it may be necessary to bring an under-exposed picture up to peak white transmission level.

3. 2. 3 Checking black level tracking

Check black level tracking by setting the apex of the sawtooth to 100% white (or whatever value is used as reference) and turning the black level control throughout its range. The white level should remain constant within 2% while the base of the sawtooth moves up and down. If appreciable movement of white level occurs re-check as in Section 3. 1. 13.

3. 2. 4 Checking range of iris control

Check range of iris control as follows:

(a) Ensure that a lens has been fitted correctly with the gears engaged to bring the numbers into line (Section 2. 4. 4).

(b) Iris control over a range of four stops is obtained by moving the joystick control up and down. This range can be re-set towards the open or closed end of the aperture by pressing the joystick control and turning the knob. By this means fully open iris and check that it is within a $\frac{1}{8}$ stop of f. 2.

(c) Now press and turn the joystick control to fully close the iris. The lens should now indicate f.22. If necessary adjust the preset mark SET f.22 located on the regulator chassis in the left-hand side of the camera.

3.2.5 Checking multiplier voltage supply

The multiplier voltage supply to the head amplifier is factory set and should not normally require adjustment. However, it may be measured with a 20k ohm/voltmeter (AVO meter model 8 on the 2500V d.c. range) connected between earth and the high voltage cap connector at the rear of the scan chassis and should be 1600 volts. The level may be set by adjusting the preset control on the scan chassis marked SET MULTI H.T.

3.2.6 Setting the beam controls

On the control panel turn the function switch to CAP and obtain a picture of the target and its frame by adjusting as necessary BEAM CURRENT, TARGET BIAS, ALIGNMENT, BEAM FOCUS, and LIFT.

3.2.7 Setting-up the test chart and adjustment controls

Set up a test chart in front of the camera or direct the camera on to a suitably lit scene. Turn the function switch to NORMAL and obtain a picture. The following controls should be adjusted for their optimum settings:

(a) Gain. Set the gain by means of the three-position switch VIDEO GAIN on the head amplifier and the control marked DYNODE GAIN on the control panel. Set the output level of the channel to normal, 0.7V video. This may have to be re-adjusted from time to time as the other preset controls are altered. The head amplifier switch VIDEO GAIN should be set with the DYNODE GAIN control towards the centre of its range.

(b) Lift. This control should be adjusted from time to time during the setting up process so that the picture blacks are set slightly above the black clipping level as observed on a waveform monitor.

(c) Target Bias. The knob marked SET VOLTS should be set at 3. Press the knob marked SET CUT-OFF and adjust it until the picture is at threshold level and release. The target bias is now set at three volts above cut-off and should be left at this level.

(d) Beam Current. Observe the picture highlights and turn back the BEAM CURRENT control to a position where the highlights are just not being clipped. This adjustment may have

to be repeated from time to time during the rest of the setting up procedure, particularly if a large change in lens aperature is made. Too much beam current will give a noisy picture, too little will give flattened highlights.

(e) Focus. Optical focus, BEAM FOCUS and IMAGE FOCUS should be critically adjusted for the sharpest picture in conjunction with G6 (located on the scanning yoke and accessible through the camera rear door). G6 affects overall image focus. FOCUS MOD (in camera on left-hand side) should be adjusted for even all-over beam focus.

(f) Scan Controls. With OVERSCAN switch to NORMAL and orbiting switch on camera OFF critically adjust HOR. SCAN AMP. and VERT. SCAN AMP., and CENTRING for each scan until the image of the photocathode mask lines up with the edges of the active raster. To align vertically open the camera rear door and loosen the two screws on the side of the deflection yoke clamping it to the focus coil (see SECTION 2.4.8). Turn the deflection yoke as necessary to square up the mask with the raster edges then tighten up the screws. Subsequent tube changes will not affect the setting unless G6 control is re-adjusted.

(g) Iris. Observe the picture waveform and carefully adjust iris joystick control until peak white amplitude just starts to flatten off. The tube is now exposed to the knee.

NOTE: A more critical method of setting exposure is to use a light box (Part No. 845434) with the special exposure slide (Part No. 750648) and to set the filter squares to the levels specified.

(h) Alignment. Press in turn each of the two ALIGNMENT knobs. This injects a 4 c/s wobulation on the beam focus voltage. The knobs should be turned until a setting is found where the centre of the picture does not wobble in position.

(j) Mulit-Focus. This control is adjusted for maximum signal amplitude, but in extreme conditions should be adjusted slightly away from this point to obtain best shading.

(k) Shading and Field Mesh. Set the function switch to CAP and switch SHADING to NORMAL. Adjust both SHADING controls for flattest background as observed on the waveform monitor. Note that if gain has to be re-set the shading will also require re-adjustment. Observe the horizontal video waveform and adjust FIELD MESH for minimum parabola shading. Expose the tube to an even all-white background and remove any residual shading by slight adjustment of the ALIGNMENT controls.

(l) G5, This control affects corner geometry and corner shading and should be adjusted for optimum setting.

(m) Aperture Correction

Set up a test chart having resolution bars corresponding to a range of frequencies in the upper region of the bandwidth and also a low frequency pattern with an abrupt transition white to black to white.

First set the compensation for input stage capacity with APERTURE CORRECTION off (control fully anti-clockwise). Observe the low frequency transition edges on a picture monitor and adjust the head amplifier trimmer C105 for minimum smear after a black/white and white/black transition edge in the line direction. When this is correct observe the viewfinder picture and adjust the trimmer C79 in the viewfinder amplifier for minimum smear on this picture also. These adjustments are made easier if the iris is stopped down about one stop below the knee to reduce "throw off" effects and the monitor and viewfinder contrast exaggerated to emphasise the smear. Observe the high frequency series of resolution bars on a strobe oscilloscope and advance the APERTURE CORRECTION control until they are as nearly as possible of equal amplitude. This will also increase the noise background and a compromise between resolution and signal/noise ratio may be preferred. If a suitable test chart is not available these adjustments can be done on a picture, but a test chart is to be preferred.

(n) Negative Video

Switch VIDEO POLARITY to REVERSED and adjust lift as necessary by means of the NEGATIVE LIFT control. Note that any further adjustment of NORMAL LIFT will also affect NEGATIVE LIFT. Return video polarity to NORMAL.

NOTE: In the negative video position the apparent function of the iris is control of blacks, while the black level control affects the whites i.e. the reverse of normal operation.

(o) Reverse Scans

Switch both VERT. SCAN and HOR. SCAN to REVERSE and adjust the reverse centring controls as necessary. Switch the scans back to NORMAL.

(p) A.G.C.

This is an automatic iris control operated by a feedback signal proportional to picture peak white. It is set up as follows:-

(i) Carefully adjust the iris to expose a typical picture with the highlights half to one stop above the knee and note the setting of the iris ring on the lens.

(ii) Using the joystick fully open the iris, leaving the joystick in this position.

(iii) Switch to A.G.C. and adjust SET A.G.C. until the iris ring returns to its original setting (i.e. exposure is returned to the condition of (i) above).

(iv) Pan the camera around and check that the iris is driven automatically to maintain constant exposure of highlights. The joystick may still be used as an over-riding control to stop down the lens below the level of A.G.C. control but it is inoperative if set above this level.

3.2.8 Faults and Protection of Controls

All services and facilities in the camera channel have now been set up and it is ready for operation. Any fault condition, including non-linearity of scans etc. which may have been noted and cannot be corrected by any of the foregoing procedure should be referred to the maintenance section in Volume 2. When once set up most of the adjustments detailed above will hold indefinitely and there is no necessity for frequent re-checking. It is intended tnat the equipment should be operated with the control panel flap closed. This serves the two-fold purpose of preventing accidental knocking of the preset controls and removes the temptation to use the controls wrongly, e.g. to counteract uneven lighting by shading controls.

SECTION 4- OPERATING PROCEDURE

4.1 INTRODUCTION

The following information and recommendations are given as a guide to operation of the camera chain with the object of obtaining optimum performance and results, using all facilities, and preserving the life of the Image Orthicon tube.

Once the chain has been set up in accordance with Section 3 and its Image Orthicon tube left in situ, it should be unnecessary to alter any preset controls when starting up again from cold. All supplies are stabilised to preserve set operating conditions over long periods after the initial warm-up time.

4.2 CONTROL PANEL AND SWITCH-ON PROCEDURE

All the controls necessary to maintain picture quality during operation are found on the upper half of the control panel. The setting-up controls are concealed beneath a flap covering the lower half of this unit and should not require adjustment during periods of operation; the adjustment of these controls is explained in Section 3.

4.2.1 Starting up from cold

The following procedure is recommended when starting up from cold:-

(a) Turn the function switch to CAP and switch on both PREHEAT and A.C. switches on the control panel (the A.C. switch on the power unit should already be on).

(b) Within 2 minutes the h.t. should automatically switch on. Check that a viewfinder raster is obtained and that on the camera the red BEAM CUT lamp is extinguished, indicating the presence of camera scans.

(c) Wait until the green YOKE HEATING lamp on the camera is extinguished indicating that the tube has reached its operating temperature. This will usually happen in less than 30 minutes but in very cold weather it may take longer.

(d) When the operating temperature is reached turn the function switch to NORMAL. If the chain has been set up previously and the preset adjustments have not been interfered with a picture should now be obtainable, requiring only adjustment of optical focus and iris controls.

4.2.2 Controls

The centrally placed joystick on the control panel is the main operating control. Moving the control up and down through the full travel of its slot will change the iris aperture over four stops. These four stops can be set in any part of the iris range by pressing and turning the joystick knob.

Black level is adjusted by turning (without pressing) the joystick knob. This should affect only greys and picture black (i.e. contrast range) without altering white level.

Contrast law may be selected to be linear or to be any one of three preset gamma curves by means of the four-position switch, CONTRAST CORRECTION. Normally position A would give black crush and positions B and C different degrees of black stretch.

The operational state of the channel is controlled by the four-position function switch. Camera picture is obtained in the NORMAL position. In the CAP position the photocathode emission is stopped but beam current remains on. In the CUT BEAM position the photocathode is also capped. In the TEST position a relay is operated in the camera and routes any signal fed to the EXT. VIDEO input socket on the C.C.U. rear panel into the head amplifier input and so throughout the complete channel; beam and image section are also cut out in this position, and shading injection is removed.

In the negative position of the video switch i.e. VIDEO POLARITY REVERSED the picture blacks and whites are inverted. Shading is automatically inverted but it will be found that the iris joystick now controls the picture blacks and the black level control will adjust picture whites.

Image Orthicon life will be lengthened if the overscan switch is left at OVERSCAN at all times except when a correctly scanned picture is necessary.

4.2.3 A.G.C.

Automatic iris control is available by switching to A.G.C. In this position the iris will automatically maintain an area of maximum illumination at normal white level. Care should be exercised in the use of this control as it is not suitable for scenes where correct exposure on a chosen subject is to be maintained, regardless of random changes in background illumination, unless the background peak white is never greater than the subject peak white. When A.G.C. is used the joystick control should be in the position of fully open iris. If the joystick is brought down below the level set by the A.G.C. it will override and take control. It will surrender control to A.G.C. again if moved above the A.G.C. controlling level. Thus when

switched to A.G.C. the manual joystick can always be used to override the automatic control in the direction of stopping down the lens but not in the opening direction.

4.2.4 Operational Control

Reduced to its simplest essentials control of picture quality during normal operation consists of maintaining peak white by linear joystick movement (iris) and maintaining picture black level by rotational joystick control. It is seldom that more than this "one hand" control should be required and a rule should be made never to touch any of the control panel controls below the flap during an operational period.

4.3 CAMERA OPERATION

4.3.1 Focus and Turret Controls

The principal operational controls on the camera are focus and turret. Their functions are to achieve changes in picture size (close-up or long shot) and focal plane smoothly and with minimum delay. The turret is turned by a handle at the bottom rear of the camera. This handle may be fitted at any angle to suit the operator's preference and should be removed when the camera is being transported. A protective cap covers the end of the shaft when the handle is removed. One complete turn of the handle moves the turret one lens position and an indent mechanism enables the operator to feel the turret dwell position. Due to the non-linear gear linkage the handle may be moved several degrees away from this position before the turret position is affected. The number of the turret station brought into operation is shown by an indicator lamp visible inside the viewfinder hood.

Focus control is by means of a capstan knob on the right-hand side of the camera. This is on the end of a detachable arm which may be fitted in a variety of positions to suit the operator and should be removed when the camera is being transported. Two turns of the knob will move the carriage from infinity to extreme close-up position. The knob to carriage movement may be set to follow a linear or a part cosine law by re-arranging the linkage mechanism. By screwing up the centre of the focusing knob a variable amount of friction damping may be applied. The carriage may be locked in any position by turning clockwise the knob marked LOCK at the bottom right-hand side of the camera.

4.3.2 Viewfinder

To maintain optical focus at its optimum point at all times, the cameraman must be able to rely on his viewfinder to show the finest

possible detail of the scene. It is important that the setting-up instructions contained in Section 3. 1. 10 should be understood and that focus, contrast and brightness controls should be correctly set before each period of use.

The DETAIL EMPHASIS switch brings in a high frequency boost circuit giving artifical sharpness to fine detail, and introducing ringing at vertical edges. This ensures that any digression from best focus will be immediately observed.

If a camera is to be panned around during non-transmission periods among scenes of varying brightness, it may be advantageous to switch the viewfinder video to the a. c. coupled output. This will ensure that the screen never goes blank due to a fall in general illumination.

4. 3. 3 Superimposition

To frame the camera picture accurately for part-picture keying or superimposition effects, the "basic" picture signal should be fed into the C. C. U. via the EXT. VIDEO socket, and the viewfinder selector marked PICTURE switched to MIXED. The camera picture will then be shown mixed with the "basic" picture on the viewfinder screen. Shortly before transmission the image orbiting device on both cameras should be switched off and the position of the insert or superimposition adjusted exactly.

Alternatively, the image orbiting phase of all cameras may be synchronised if "orbit sync" facility is installed. To do this, first switch on a. c. to all cameras and ensure that the TUBE HEATER switches are all on. Connect pin 4 of all 4-way ON AIR sockets to ground for a period exceeding one minute and then release simultaneously. Orbiting in all cameras will now be in phase and remain in phase as long as the hour-meters continue to run. If a. c. is interrupted or a TUBE HEATER switch is switched off synchronising will be lost. When properly synchronised, superimposition shots may be made with image orbiting on. Synchronising will normally be carried out during the initial warm-up period.

Whenever possible image orbiting should be on.

4. 3. 4 External "On Air" Cue Lamp

A red lamp on the top front of the camera is associated with the "on air" cueing system, together with an indicator below the operational lens. These are lit when the camera is selected for transmission, thus informing participants which camera is live. For certain types of programme this may be undesirable, and a switch is provided on the right-hand side of the camera to take the external cue lamps out of circuit for candid camera shots, etc. In this case, the "on air" indicator still functions in the viewfinder, and also in the

extension unit. The lamp on top of the camera has twin-filaments of high and low power which may be selected by fitting the lamp on to the camera in the appropriate position according to the DIM or BRIGHT wording as seen from the rear of the camera.

4.3.5 Extension Indicator Unit

An extension indicator unit may be plugged into the socket marked INDICATOR EXTENSION. This may be useful to a microphone boom operator or another member of the camera crew. It informs such an operator when the camera is "on air" and indicates the angle of the lens in use (the lens angle may be written on the translucent panels over each indicator). An intercommunication telephone connection is also available at the extension indicator unit.

4.3.6 Zoom Lens

The turret handle should be removed in order to immobilise the turret when a zoom lens is fitted. To lock the camera optical focus, first find the correct focal position of the carriage and turn the LOCK fully on. Then remove the focus arm assembly and replace it with the protection cover. For further details see fitting and operating instructions for the zoom lens in use.

4.4 COMMUNICATION

The successful operation of the camera chain to produce pictures to the exacting standard required in modern television depends upon the close co-operation of the camera teams and the producer. It is therefore essential that all headsets, talkback circuits, signalling devices, etc., are thoroughly checked before each programme, and that any faulty links in the communication chain are repaired or replaced.

4.5 CAMERA CONTROL UNIT

All camera control unit controls should be set up to rigid standards during the setting-up period, in accordance with Section 3. No subsequent adjustment should be required to any of the preset controls inside the camera control unit, except for changes in length of camera cable when the two switches marked CABLE COMP. should be set to the appropriate length. (see Section 3.1.2.).

4.6 PICTURE MONITORS

When a number of camera channels are grouped together as an operational unit, the picture monitors should all be set to the same contrast and brightness conditions in order to ensure that matching of the camera control unit outputs will be simplified.

4.7 CARE OF IMAGE ORTHICON TUBE

4.7.1 Temperature

An Image Orthicon pick-up tube should never be operated uncapped unless the temperature is within the optimum range. Operation when the tube is too cold or too hot may result in permanent or semi-permanent damage to the target.

A warm-up period is standard practice after switching on the Image Orthicon tube and must always be allowed. From cold a minimum of 15 minutes is necessary. Correct temperature is indicated when the green lamp YOKE HEATING on the rear of the camera is extinguished.

During the warm-up time and for standby periods of more than ten minutes the I. ORTHICON GUN HEATER switch at the camera may be switched off. This cuts off the electron-gun heater, and prevents the generation of the scanning beam, thus saving tube working hours and extending the life of the tube. When this is done the hour-meter is stopped and the red BEAM CUT indicator will come on at low intensity (to distinguish between its other function of indicating scan failure).

It is important that the I. ORTHICON GUN HEATER is switched off only if the photocathode is mechanically capped and the function switch set to CUT BEAM. When switching on again the following sequence must be observed:-

(a) Switch on I. ORTHICON GUN HEATER

(b) Wait five minutes

(c) Set function switch to NORMAL and adjust BEAM CURRENT to discharge target.

(d) Uncap lens

(e) Adjust BEAM CURRENT to optimum setting.

Tube hours should be recorded in a suitable book or card system daily, together with any remarks on the performance or deterioration

of the tube, so that a constant check on the age and characteristics of each Image Orthicon tube in use is available.

4.7.2 Image Orbiting

The action of the image orbiting device ensures that, whilst it is on, the image focused upon the target does not remain stationary, thus eliminating one of the chief causes of "sticking". It should always be remembered, however, that image orbiting is dependent upon the movement of the hour-meter, and when the tube GUN HEATER is switched off the device is inoperative. Also, if image orbiting has been switched off for the purpose of keying or superimposition shots it should be restored immediately the shot is finished. The indicator lamp '0', visible above the viewfinder, lights up when orbiting is switched off.

4.7.3 Capping the Photocathode

During standby periods, the photocathode should be capped either by turning the filter control to its "X" position or by switching the function switch to CAP. For long idle periods, or if there is a possibility of the lens coming into the range of a concentrated light source, capping should always be done mechanically by means of the filter control.

4.7.4 Overscan

For periods of operation other than transmission, the overscan switch should be switched to OVERSCAN. This has the effect of causing the beam to scan a larger area of the tube target so that any burns at the edges of the raster will be outside the picture area when normal scanning is resumed. In general, if the effect of the beam is spread over the larger area, the life of the target is extended, and therefore the life of the tube. The switch should be returned to NORMAL for line-up and transmission periods, and should always be switched to OVERSCAN before the apparatus is switched off.

4.7.5 Scan Failure

If the beam remains on without one of the scans working permanent damage can be done to the tube target. The camera incorporates a protection circuit which cuts the beam if either scan fails. The functioning of this circuit should be checked from time to time by fitting a second-grade tube and disconnecting, one at a time, the horizontal and vertical drive connections from the synchronising pulse generator, In each case the beam should be cut and the red lamp, BEAM CUT, at the rear of the camera should light.

TREATMENT FOR ELECTRIC SHOCK

Human beings are rarely killed outright by electric shock and can, in most cases, be saved by immediate commencement of artificial respiration. Electric shock affects the nerves controlling the breathing and the action of the heart and unless prompt aid is given the victim may become unconscious and die. ALWAYS SEND FOR BUT NEVER WAIT FOR A DOCTOR.

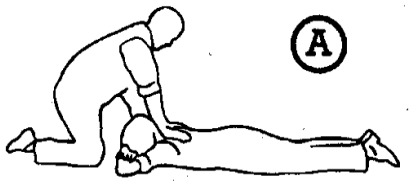
Before touching the injured person, make sure that he is not in contact with a live conductor. If he is, break the circuit by opening the power switch - DO NOT TOUCH THE VICTIM WITH YOUR BARE HANDS. If it is not possible to switch off the current, use a piece of dry insulating material, such as wood, bakelite or rubber, to knock or push aside the conductor. Alternatively, pull the victim free using a leather belt or braces, protecting yourself still further by standing on a folded newspaper or a dry mackintosh.

HOLGER NIELSON METHOD OF ARTIFICIAL RESPIRATION

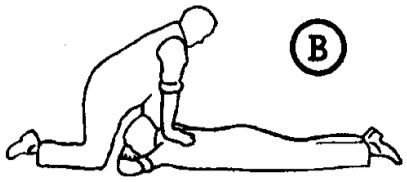
(1) Immediately the patient is released from electrical contact loosen his collar and any tight clothing as quickly as possible.

(2) Remove false teeth and sweets etc. from the patient's mouth and make sure that the tongue is free by giving two or three firm slaps with the flat of the hand between the shoulder blades.

(3) Lay the patient face downwards with the forehead resting on the fore arms so that the mouth and nose are kept clear of the ground (A).

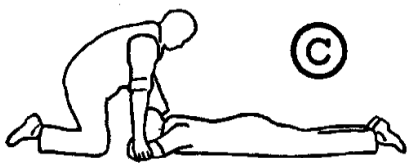


(4) Kneel on one knee a little in front of and to the side of the patient's head so that the left foot is at the side of the patient's elbow. (A). The arms should slope forward so that the hands lie close together on the patient's shoulders with the wrists over the top of the shoulder blades. This is the starting position.



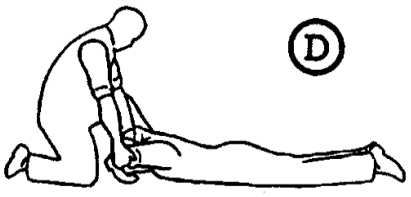
(i) Rock forward on outstretched arms until the arms are vertical above the patient's body (B). The pressure should be light and without force; the movement should take approximately 2 seconds.

(ii) Release the pressure by allowing the hands to slide quickly down the patient's arms to the elbows taking approximately $\frac{1}{2}$ a second (C). Then raise his arms and shoulders slightly, at the same time moving your body backwards (D), taking approximately 2 seconds.



(iii) Lower the patient's arms until they touch the ground (E), and return your hands to the original position on his shoulders and resume the position as before. Take approximately $\frac{1}{2}$ a second for this movement.

(5) Repeat the movements described in (i), (ii) and (iii) so that the complete cycle takes approximately six seconds. That is, about nine complete respirations per minute.



(6) Whilst artificial respiration is continued have someone else:-

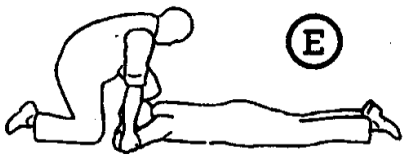
(a) Loosen patient's clothing and keep him warm.

(b) Send for a doctor.

(c) Watch so that they can take over if prolonged treatment is necessary.

(7) Keep going for at least four hours even if there is no sign of recovery.

(8) Do not move the patient until he is breathing normally without assistance. There should be no hurry to move him after he has recovered.



(9) Do not give the patient oxygen or other stimulants unless ordered to by a doctor. When fully recovered the patient may be allowed to drink cold water with, if available, one teaspoonful of Sal Volatile to a glass. He may also be permitted to sniff smelling salts.

TREATMENT FOR BURNS

If as a result of electric shock the patient is suffering from burns, the following treatment should be given without hindrance to artificial respiration:-

(1) Remove the clothing near the affected part to enable the burn/s to be treated, taking care not to break any blisters that may have formed.

(2) Saturate the burn/s using a warm solution made up of one dessertspoonful of bi-carbonate of soda and a pint of warm water. If bi-carbonate of soda is not available, use a teaspoonful of salt.

(3) Cover the burns with lint soaked in the above solution and apply a bandage taking care not to burst any blisters that may have formed.

(4) If a solution as above is not available cover the burns with a sterile dressing to exclude the air.

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