INSTRUCTION BOOK No. 1645

S/U/P/A

35 mm. CINEMA PROJECTOR

INSTRUCTIONS FOR
INSTALLATION, OPERATION, AND MAINTENANCE

THE BRITISH THOMSON-HOUSTON CO., LTD.
RUGBY, ENGLAND

EDITION A. 0250

IMPORTANT.

The apparatus described in this Instruction Book was designed, manufactured, and tested with care and, with proper attention, should give the purchaser the service which he may reasonably expect.

The purpose of this Instruction Book is to explain the function of the apparatus, and the manner in which it should be adjusted and maintained.

If these instructions are not clear, or appear incomplete in any particular, and you desire further information, this will be promptly supplied upon request.

Please address such enquiries to the Company's nearest District Office, or Local Representative, mentioning the particulars stamped upon the apparatus nameplate.

NOTICE.

BEFORE RETURNING APPARATUS FOR REPAIRS OR OTHER REASON, PLEASE COMMUNICATE WITH HEAD OFFICE, NEAREST DISTRICT OFFICE, OR LOCAL REPRESENTATIVE—QUOTING SERIAL NUMBER—WHEN THE NECESSARY INSTRUCTIONS WILL BE SENT.

COMPLIANCE WITH THIS REQUEST WILL AVOID DELAY AND INCONVENIENCE.

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(Single Unit Projection Assembly)

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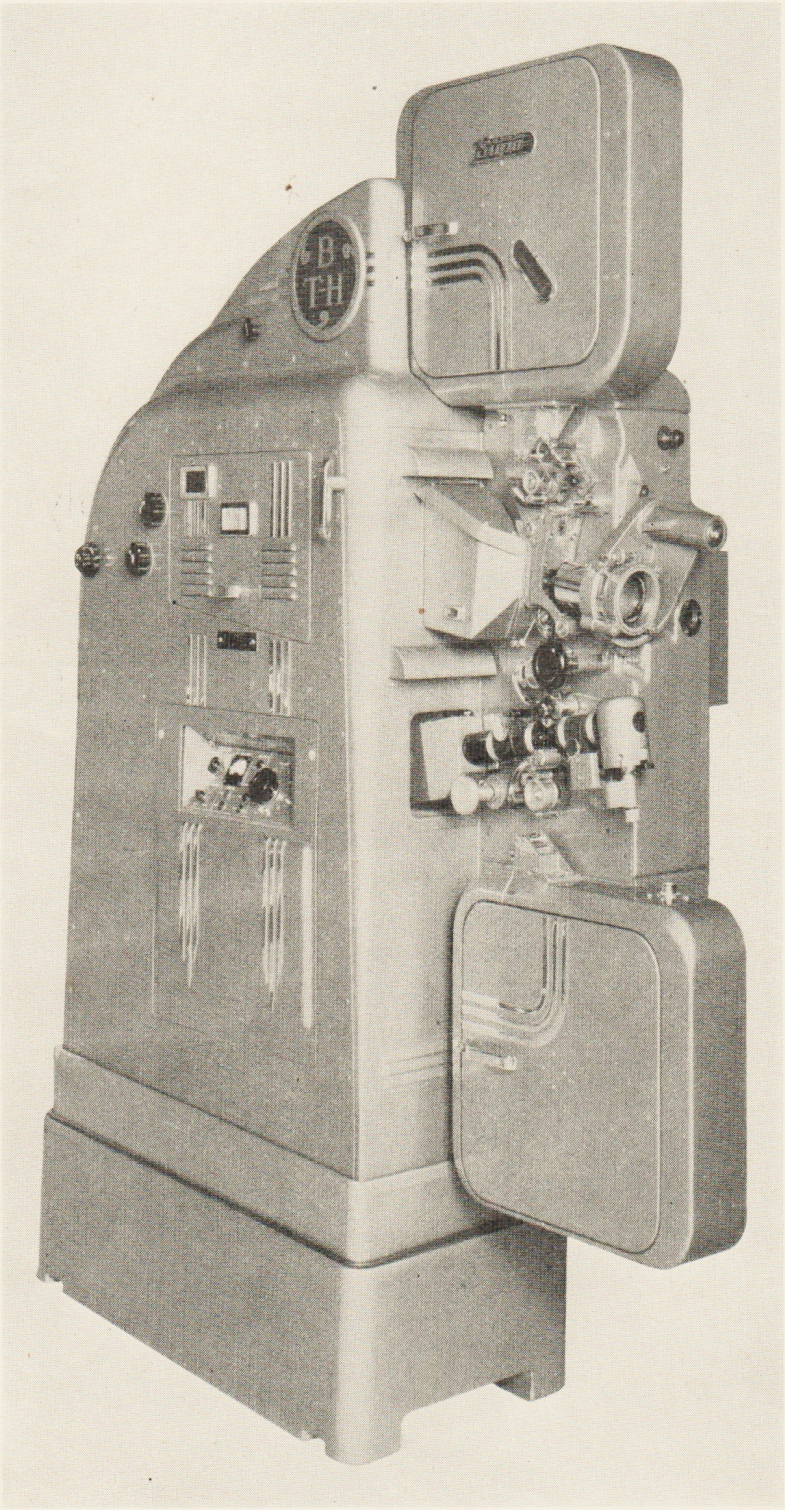

S/U/P/A Cinema Projector.

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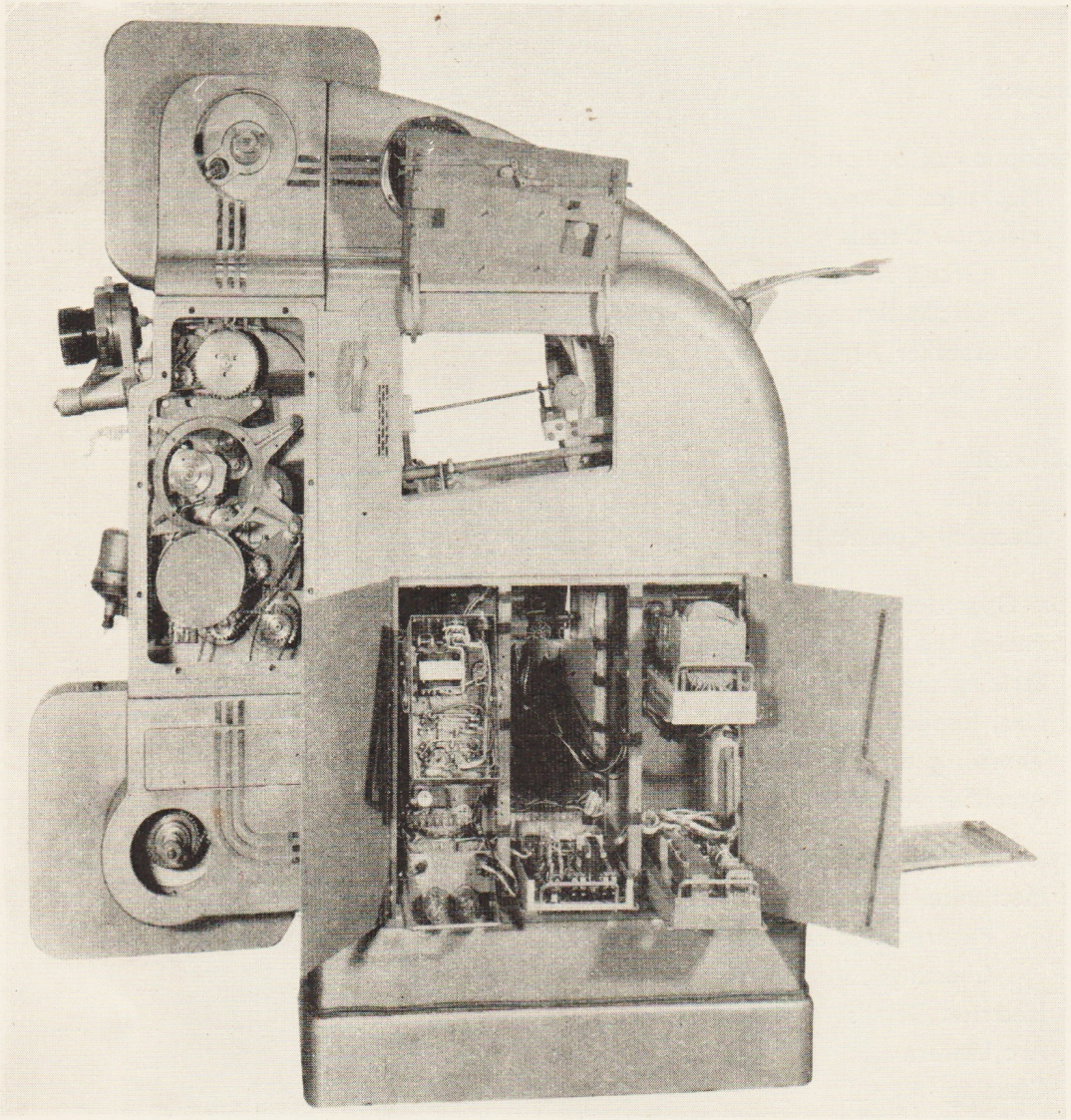

Fig. 1. Non-operating side, with doors open and covers removed. The Power Amplifier Tray is shown inverted for servicing.

INSTRUCTIONS FOR

INSTALLATION, OPERATION, AND MAINTENANCE

OF

S/U/P/A

(Single Unit Projection Assembly)

35 mm. CINEMA PROJECTOR

"S/U/P/A" is a registered trade name formed from the initial letters of the words "Single Unit Projection Assembly." A S/U/P/A Installation consists of two, or in some instances, three composite Projection Units, containing all the equipment necessary for the efficient projection of 35 mm. sound-films, with the exceptions of the arc resistances and loudspeaker system.

The following are among the outstanding features of the S/U/P/A Equipment :—

An adequate audio output (45 or 90 watts according to the capacity of the cinema) enables signal input "peaks" to be handled without overloading, whilst frequency and harmonic distortion are reduced to negligible proportions by the use of "negative feed-back." The signal-to-noise ratio is improved as a result of the specially designed sound optical system and high efficiency input circuit.

The greater light efficiency is due to a combination of improvements in design; (a), the arc lantern, which is fitted with a 14½" mirror, gives a larger aperture (f 1·9) than heretofore ; (b), the new range of Taylor, Taylor & Hobson "Aperful" lenses was designed to take advantage of this fact ; and (c), a high ratio is obtained between the diameter of the flicker shutter and the diameter of the light beam at the point of "cut off."

All the necessary operating controls (except the changeover switch, which is mounted on the bottom spoolbox), are grouped together on illuminated panels fitted to the control cubicles of each machine. The arc is struck automatically by operation of the appropriate push-button, and the governor delay device ensures correct arc striking. The crater is held at the correct mirror focus, irrespective of burning rate or motor speed, by the thermo-optical relay system. The mirror is protected, by an improved form of mirror shield. The carbon travel is sufficient for approximately one hour's burning, without retrimming, so that three projector runs can be completed. "Carboning up" is facilitated by the ease with which both carbon heads can be disengaged from their drive and run back to the ends of their traverse. A carbon indicator shows the length, in inches, of the positive travel available.

For the servicing of any one of the amplifier (except the fader amplifier) or rectifier units, replacement may be effected speedily by merely sliding the tray out of the control cubicle, removing the plug carrying all the external leads, and substituting a service tray. Fig. 1 shows the amplifier supply rectifier unit (top right), L.S. field supply unit (bottom right), control gear unit (centre), deaf aid amplifier (bottom left), and power amplifier (top left). The ability to invert the units, without disconnection of the leads, when they are withdrawn on their runners, greatly facilitates inspection and service. The power amplifier is shown in an inverted position in Fig. 1.

Varying degrees of H.F. and/or L.F. boost can be applied in the fader amplifier circuit to suit individual acoustic conditions, thus obviating all possibility of misuse of a manually-operated tone control.

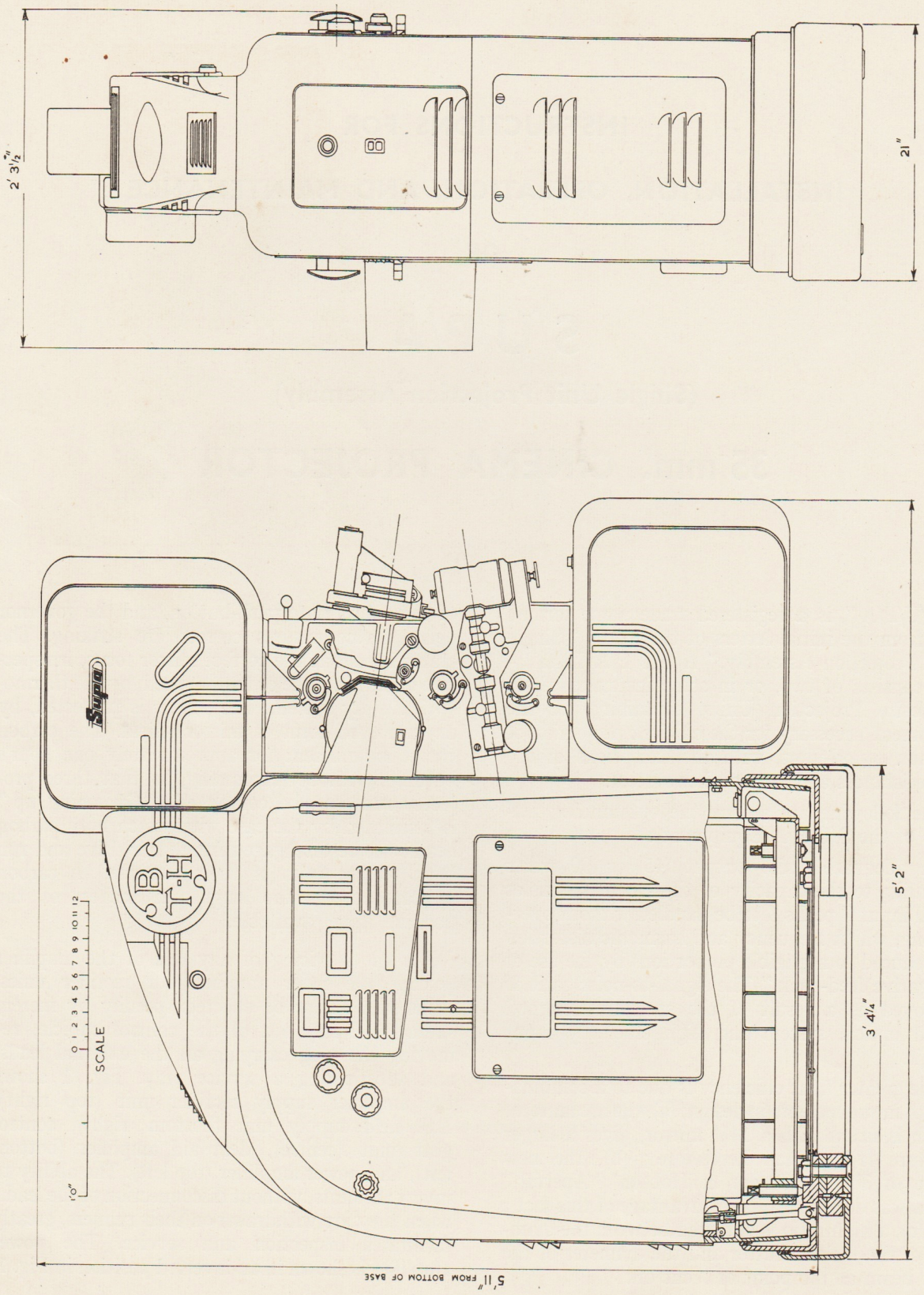

Fig. 2. Outline Diagram, with principal overall dimensions.

DESCRIPTION OF EQUIPMENT

The construction and mechanical functions of each Projection Unit in both 45 and 90 watt systems are basically similar.

The principal overall dimensions of each Projector are indicated in Fig. 2. It must be noted that the Projector is shown in the *normal* position, i.e. as set for $7\frac{1}{2}^{\circ}$ downward rake. For any other angle of rake, the overall height and length will differ slightly from the dimensions given.

The height shown is from the top of the top spoolbox to the underside of the *base*. To this must be added the height of the plinth blocks required for each installation.

MECHANICAL DETAILS

The 45 watt and 90 watt equipments have similar mechanism assemblies and in this respect the following description is applicable to both.

Mechanism Box. The conventional mute and sound heads have been replaced by one mechanism, a feature of which is the use of ball-bearings throughout. The mechanism box is primarily a casing containing various sub-assemblies, each of which is removable as a unit.

Fig. 3 shows the interior of the Mechanism Box, without sound drum and drive motor.

The Gear Drive Assembly, 6, Fig. 3, is spigoted to the main casting and contains all the gears necessary for the drive transmission, including a differential gear for compensating framing displacement and the flicker-shutter bevel-drive gears and shaft.

The Drive Motor Assembly comprises :—

(a) A motor support assembly, made up of two circular brackets, resiliently coupled, the inner bracket being fixed to the motor support plate.

(b) A 240 volt, 1440 r.p.m. capacitor motor, Type BC 2406, fitted to the outer resilient-mounting bracket.

(c) A flexible drive coupling.

The Sound Drum Assembly consists of a special type of motor incorporating an induction disc about which three driving units are symmetrically disposed. The shaft is fitted with a flywheel. Electrical connection is by plug and three-core cable from a socket mounted at the bottom of the mechanism box.

Drum speed control is by the injection of a variable direct current, the resultant magnetic flux through the disc providing damping and braking. The D.C. potential is obtained from a rectifier and pre-set potentiometer. The optimum setting for this potentiometer is such that the film loops above and below the sound drum are equal throughout the run.

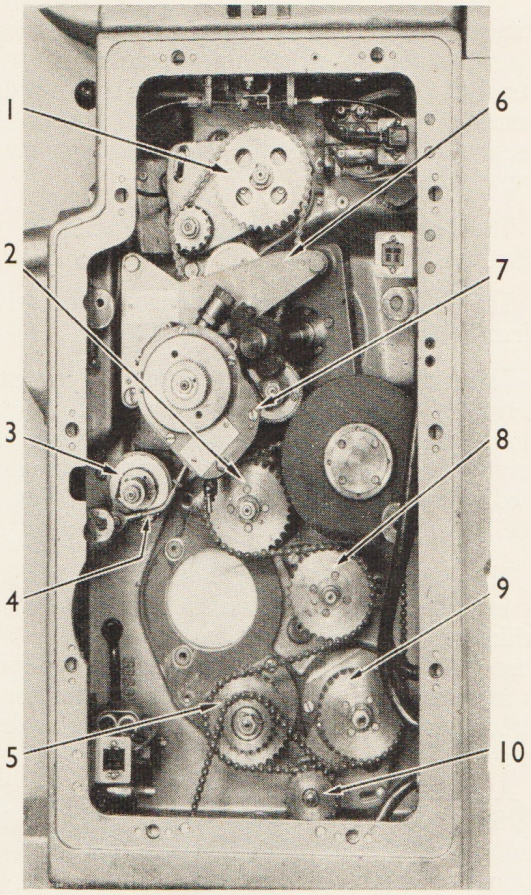

Fig. 3. Interior of Mechanism Box.

1. Top Feed Drive.
2. Sound Feed Drive.
3. Framing Assembly.
4. Framing Link.
5. Bottom Feed Drive.
6. Gear Drive Assembly.
7. Intermittent Mechanism.
8. Idler Assembly.
9. Inching Assembly.
10. Bottom Jockey Assembly.

The Intermittent Mechanism, Fig. 3, 7, consists of a chamber containing the Maltese cross and Geneva cam, with shaft extensions for the driving gear and the film sprocket. It is coupled by a link to the phasing differential to maintain correct relationship between the shutter and the intermittent sprocket.

The Framing Assembly, Fig. 3, 3. The control shaft is carried between two thrust bearings in a flanged support casting. To the end of this shaft is fitted a clutch boss assembly, inner clutch and compression spring. A projection on the clutch boss assembly forms the actuating arm to which the framing link, 4, is resiliently coupled.

DESCRIPTION OF EQUIPMENT (cont'd)

The Inching Assembly, Fig. 3, 9, performs a dual function. Its main use is to inch the mechanism to make sure that film threading is correct. Its shaft is eccentrically carried in a two-bearing housing, and, with a chain sprocket, also provides tension adjustment for the sound feed and bottom sprocket drive chain.

The Bottom Jockey Assembly, Fig. 3, 10, tensions the bottom spoolbox drive chain, and

The Top Jockey Assembly tensions the driving chain to the top sprocket.

The Film Sprocket Drive Assembly consists of a two-ball-race housing and drive shaft, to which chain sprockets are fitted. Three chains are used, driving the top sprocket drive assembly, the sound feed bottom sprocket and inching assemblies, and the bottom spoolbox spindle.

The Hand Trip Emergency Switch Assembly is mounted in the Mechanism Box. The switch, which is coupled by Bowden cables to the " film fuse " holder and the lower spoolbox guillotine, is in series with the arc and drive motor control circuit, and is closed as long as the " film fuse " is set.

A rod projects through the front casting. Striking this rod trips the switch, and the drive motor and the arc shut down and the film guillotines operate.

The Film Fuse consists of a small piece of ordinary film. As indicated above, the burning of this fuse operates the guillotines, severing the film above and below the mechanism, and shutting down the arc and the drive motor.

The Picture Gate Assembly is in two sections and is curved to ensure more even distribution of light over the entire picture area. The resultant film path reduces buckling in the gate.

Two pairs of gate springs are used, each pair located in angled slots in the spring carrier plates. Tension on these springs is adjusted by thumbscrews at the top and bottom of the gate. Three heat reflectors of conventional type are fitted behind the gate.

The framing aperture is at the top of the gate. The framing lamp is of the standard miniature screw type.

The Lens Holder Assembly has been designed to fit large diameter lenses, but adaptors can be supplied for any other size. It will accept without any adaptor the " Aperful " series of lenses developed by Taylor, Taylor & Hobson, Ltd. The steel lens carrier is mounted in a casting which can be hinged upwards and retained in the raised position by a spring catch. Focusing is by axial movement of the lens, coarse and fine adjustment being provided.

The Flicker Shutter consists of a sheet metal dish which projects through the mechanism box at an angle. Apertures are cut in the conical side of this dish, so as to leave two diametrically opposed shutter blades.

Adjustable extension pieces are fitted at the edge of each blade, and a vane is formed at the outer edge of each extension piece to render the transition of " light " to " dark " less abrupt, and so to reduce flicker.

The Fire Shutter is mounted on the boss of the flicker shutter. An eddy-current disc, fixed to the flicker shutter, rotates in the gap of a permanent magnet on the fire shutter assembly, and so opens the fire shutter ; it closes by gravity.

The Changeover Shutter is fitted to the front main frame ; it is solenoid-operated and electrically interlocked with the sound changeover. In the event of failure of the automatic device, it can be manually operated by a lever that projects through the light tunnel.

The Light Tunnel is simply a metal shield enclosing the flicker and changeover shutters.

The Sound Optical Assembly comprises the sound optical system, a twin exciter lamp turret, and the P.E. Cell mounting, with top and bottom sound drum rollers and guide rollers.

The sound optical system is in two sections. Light from the exciter lamp is projected, in the form of a rectangular [illegible]

[illegible] arranged that the door must be closed before the arc or drive motor can run.

Ejector levers are fitted to the spool-driving spindles. In the normal position, these lock the spool in place, but when pinched together they eject the spool so that it can easily be removed.

The changeover push-button switch, actuating the light shutter and the sound changeover relays, is situated on top of the bottom spoolbox.

DESCRIPTION OF EQUIPMENT (*cont'd*)

The Inching Assembly, Fig. 3, 9, performs a dual function. Its main use is to inch the mechanism to make sure that film threading is correct. Its shaft is eccentrically carried in a two-bearing housing, and, with a chain sprocket, also provides tension adjustment for the sound feed and bottom sprocket drive chain.

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Unless otherwise stated, the following instructions apply to projectors delivered after January 1st, 1950.

The Picture Gate Assembly is in two sections, and is curved to ensure more even distribution of light over the entire picture area. The resultant film path prevents buckling in the gate.

Flexible spring skids are used in the fixed part of the gate. Tension of these springs is adjusted by thumb-screw at the top of the gate. Three heat reflectors of conventional type are fitted behind the gate.

The framing aperture is situated at the top of the gate, and is illuminated by a standard 6v. lamp of the miniature-screw type, connected in parallel with the intermittent-mechanism inspection lamp.

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to fit large diameter lenses, but adaptors can be supplied for any other size. It will accept without any adaptor the " Aperful " series of lenses developed by Taylor, Taylor & Hobson, Ltd. The steel lens carrier is mounted in a casting which can be hinged upwards and retained in the raised position by a spring catch. Focusing is by axial movement of the lens, coarse and fine adjustment being provided.

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The Light Tunnel is simply a metal shield enclosing the flicker and changeover shutters.

The Sound Optical Assembly comprises the sound optical system, a twin exciter lamp turret, and the P.E. Cell mounting, with top and bottom sound drum rollers and guide rollers.

The sound optical system is in two sections. Light from the exciter lamp is projected, in the form of a rectangular spot, on to the sound track. An image of the sound track is then magnified, focused on a mechanical slit, and thence transferred via a beam-distorting lens to the P.E. Cell cathode.

The Film Sprockets and Stripper Plates are of conventional design and function. The top sprocket is of the six-picture type, and the sound feed and bottom sprocket of the eight-picture type.

The Pad Roller Assemblies have provision for tension adjustment ; the Top Pad Roller Assembly contains a single roller, while the Sound Feed and Bottom Assembly each contain two rollers. At the Intermittent Sprocket, static-pad film-guides are used.

Fireproof Spoolboxes are fitted, incorporating cable-operated film guillotines. An interlock switch on the top door is so arranged that the door must be closed before the arc or drive motor can run.

Ejector levers are fitted to the spool-driving spindles. In the normal position, these lock the spool in place, but when pinched together they eject the spool so that it can easily be removed.

The changeover push-button switch, actuating the light shutter and the sound changeover relays, is situated on top of the bottom spoolbox.

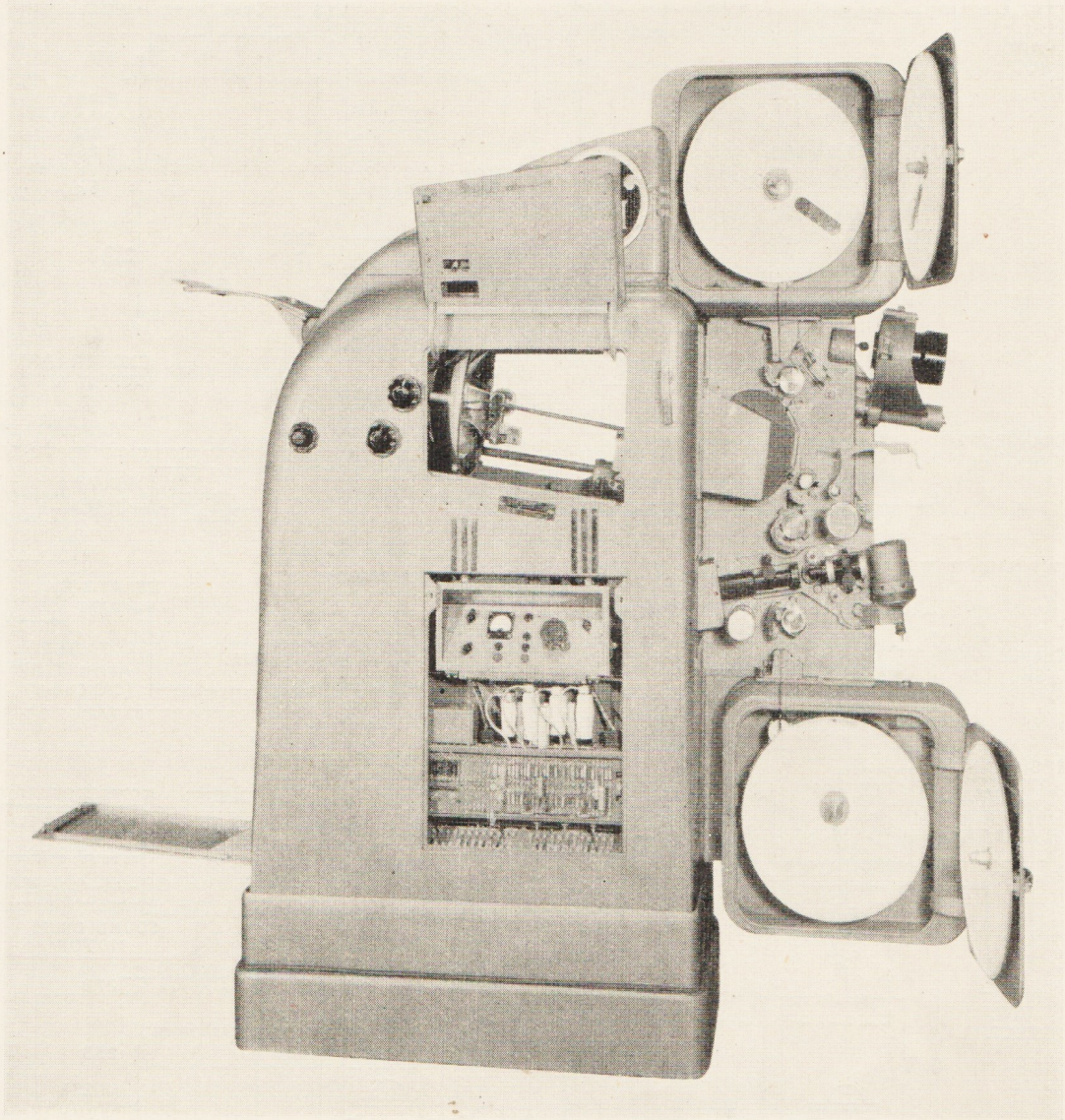

Fig. 4. Operating side of Projector, with all doors open.

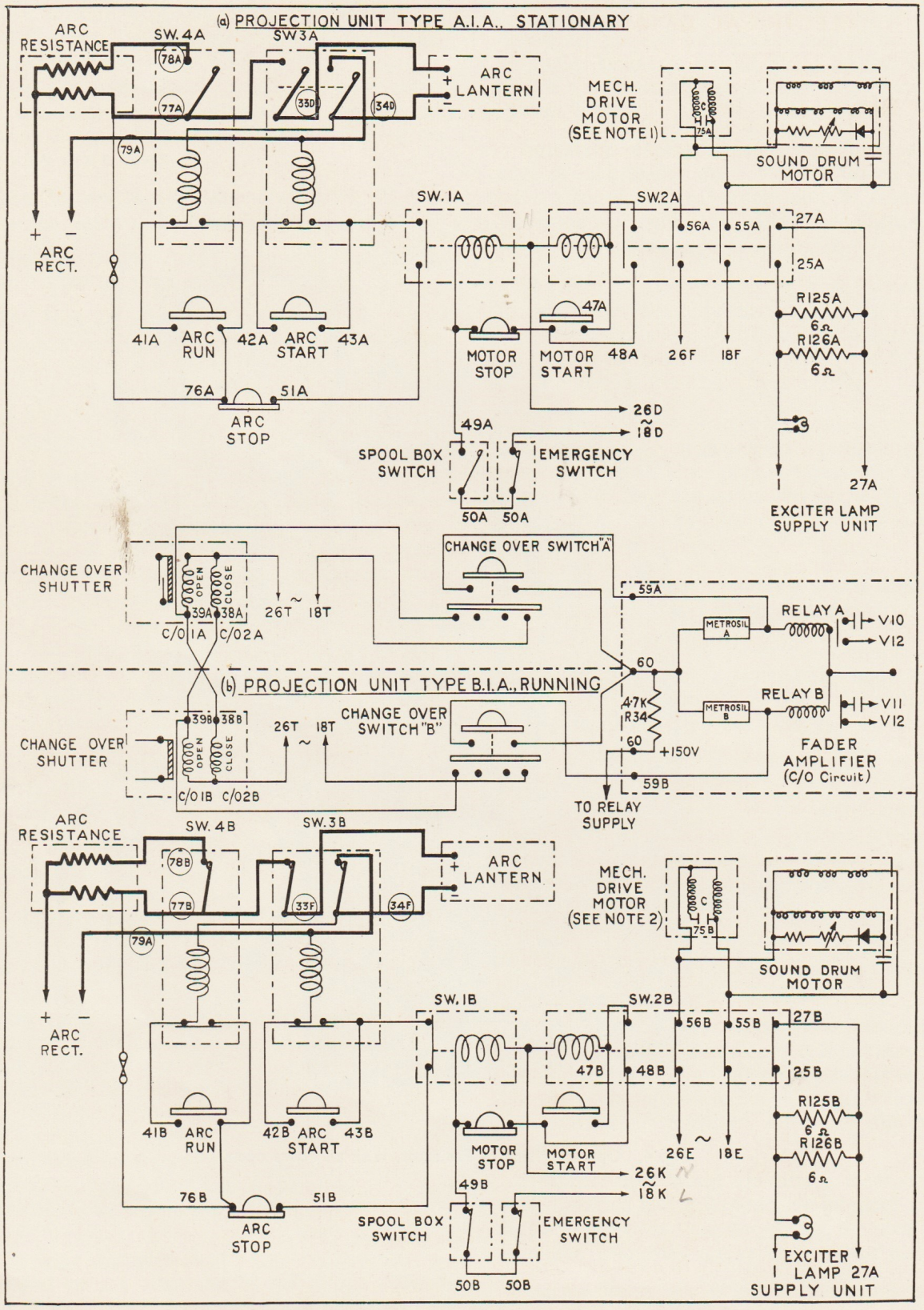

Fig. 5. Control Circuits (45 watt and 90 watt, 2-stand).

NOTE : 1. C 75A is mounted on the Arc Contactor Panel.
2. C 75B is fitted on the Control Gear Unit.
3. Contactor switches 3B and 4B are mounted, with switches 3A and 4A, on the Arc Contactor Panel.
4. Numbers in circles refer to terminals which are located on the Arc Contactor Panel.

DESCRIPTION OF EQUIPMENT (*cont'd*)

ELECTRICAL DETAILS

Supply. The equipment is designed for operation from 240 volt, 50 cycles, A.C. supply ; where the supply voltage is other than 240, an auto-transformer will be provided. The equipment can be operated on D.C. when a special rotary converter is supplied.

Wiring. All wiring external to the Projection Units will be installed by the Electrical Contractors. The internal wiring is carried out at the Factory, in accordance with the following Colour Code :—

Wiring between valve anode & transformer H.T. winding ..	Red
Control Grid wiring	Green
Screen wiring	Green with Red tracer
Suppressor Grid wiring ..	Green with Violet tracer
Cathode wiring	Violet
L.V. Heater, including Exciter Lamp wiring	Blue
Mains wiring	Red with Yellow tracer
Output wiring (A.F.)	Orange
Wiring associated with Arc Control	White
Earth wiring	Black
All other wiring	Brown

NOTE : This Colour Code applies to internal wiring only. The colours of the individual cores of the 7-core P.V.C. interstand wiring cables do *not* conform to the Code.

Control Circuits (45 watt and 90 watt 2 stand).

The mechanism-drive and sound drum motors and the arcs are controlled by contactors actuated by push-button switches on the control panels. The spoolbox door interlock and the hand emergency switches are in the contactor coil circuits, so that the spoolbox doors must be shut and the film fuse set before the motor can be started or the arc struck.

Fig. 5 is a theoretical diagram of the control and changeover circuits for both Reproducer Units, " A " being shown stationary. " B " has been started up as follows :—

If the spoolbox doors are shut and the film fuse set, Switch SW 1B closes when the A.C. supply is switched on. When the " Arc Start " button is pressed, Contactor SW 3B closes, and the arc is struck and operates on 60% of normal current. Pressing the " Arc Run " button closes Contactor SW 4B, and causes the second section of the arc resistance to be shunted across the " striking " section, and the arc runs at full current.

The mechanism drive and sound drum motors are started by means of the " Motor Start " button and at the same time the voltage-dropping resistances R 125B, R 126B are shorted out, applying full voltage to the exciter lamp.

Changeover Arrangements (45 watt and 90 watt 2-stand).

Sound and light changeovers are effected simultaneously by pressing the push-button switch on the bottom spoolbox of the incoming machine.

Separate first stage valves are used to amplify the input signals from each Projection Unit. Miniature relays, mounted in the fader amplifier, switch the output from either one of these valves to the second stage valve as indicated in Fig. 5.

Each of the changeover shutter assemblies contains two solenoids, arranged to open or close the shutter. It will be seen from Fig. 5 that the operation of the changeover switch causes coil C/0 2A to close its shutter, and C/0 1B to open the shutter on the incoming machine.

To minimize burning of the contacts on the changeover switch in the shutter coil circuit, a resistor and two condensers are arranged as an arc-suppression circuit, Fig. 26.

Changeover Arrangement (90 watt, 3-stand).

On the fuse-panel of Reproducer Unit " C," a switch, SW 21, marked " AB," " BC," and " AC," is provided for selecting any pair of machines ; operation between the machines selected is then carried out as with a 2-stand installation.

Stand-by Arrangements

90 watt equipments are provided with two sets of amplifiers and associated supply units ; one set is stand-by. The same facility can be provided on 45 watt equipments when desired.

When stand-by arrangements are provided a selector switch SW 24 is fitted on the " B " machine at the left-hand side of the operating panel, to allow the amplifiers to be changed over in the event of failure during operation. The switch controls P.E. Cell, Bias, and Suppressor Grid supplies, and Relay Control and Remote Control Box (P.A.) circuits.

The switch wiring is shown in Figs 23 (2-stand) and 24 (3-stand).

Control Gear Unit

This Unit, Fig. 18, is accommodated in the control cubicle of Projection Unit " B," and contains the contactor switches SW 1B and SW 2B controlling " B " machine, the mechanism drive motor condenser, and the exciter lamp shunt resistances.

Arc Contactor Panel

In addition to the double and single pole arc contactors 3A, 3B, 4A, 4B, Fig. 17, this panel carries components as mentioned in the preceding paragraph for the control of Projection Unit " A."

Operating Panels

These are fitted to each Projection Unit above the control cubicle, and carry all controls for the operation of the equipment, with the exception of the changeover switch. The panels are illuminated by two 240 volt, 15 watt S.B.C. lamps and are hinged to facilitate access to the rear.

DESCRIPTION OF EQUIPMENT (cont'd)

Fig. 19 is a circuit diagram of the operating panel for " A " machine. It carries :—

Mechanism Drive Motor " Start " and " Stop " push-buttons.

Arc " Start," " Run," and " Stop " push-buttons.

Volume Control for this machine.

Arc Volt/Amp. Meter and Switch.

Input Switch for Film/Disc selection.

" B " machine operating panel, Fig. 20, carries the controls mentioned above, and in addition :—

Output Switch which enables the output from either power amplifier to be switched to the screen or P.A. speakers.

Monitor Volume Control and Switch.

Monitor Output Transformer.

The Input Switch for " B " machine permits microphone selection as well as Film/Disc. Provision is made on 90 watt equipments for either the main or stand-by amplifiers to be monitored, also a "test " position is provided on the output switch so that either amplifier can be monitored while its output is fed into an artificial load resistance mounted behind the operating panel.

Public Address Arrangements

On the 90 watt equipment, the Stand-by Amplifier may be used for Public Address while the Main Amplifier is on Film or Disc. This allows mixing of P.A. and Film signals ; a remote control box, Fig. 27, is used to switch the P.A. channel in or out as required, and also to control the P.A. volume. The volume control works in the same way as the main volume control, by varying the D.C. bias on V 455 suppressor grid.

Deaf Aid and Monitor Switching (90 w. equipments)

A switch is provided on " B " operating panel to switch the monitor speaker and Deaf Aid output from film channel to P.A. channel. The circuit is shown in Fig. 22.

CIRCUIT ARRANGEMENT (45 watt)

Input Circuit

Fig. 16 is a theoretical diagram of the input circuits. Analysis of the P.E. cell circuit shows that the anode is decoupled by R 1 and C 1, and that R 2 is the load resistance. R 3 and C 2 are used to isolate the Film/Disc/Microphone (F/D/M) switch from the D.C. potential developed across R 2. The input line to the fader amplifier is of high impedance ; a considerable increase in the signal input voltage and an improved frequency characteristic result from the omission of coupling transformers from the input circuit.

Low capacity co-axial cable, with insulated braiding, is used for the wiring between the P.E. cell, the F/D/M Switch, and the Fader Amplifier ; similar cable is used for the wiring between terminal 30 on the input switches and the non-sync. matching transformer, and for the lead from terminal 32 on " B " input switch and the microphone matching transformer. The braiding of the cable is earthed at the fader amplifier only, and the entry and exit glands at the F/D/M switches are bonded together and insulated from the switch boxes. The common points R 2, R 3, and C 1 in the P.E. cell circuit are bonded to the cable-braiding, and must not in any circumstances be earthed at the cell-housing.

The capacities of the input lines are equalized by the use of a 100 mfd. condenser in shunt with the shorter line. Disc and microphone line impedances are matched to the input line by transformers T 1 and T 2. These are separately screened and are mounted on the control panel of the Projection Unit containing the amplifiers. The components in the secondary circuit of T 1 are used for correction of disc response, since the L.F. response from the pick-up is lower than the H.F., and as a result of the use of H.F. boost in the fader amplifier. Needle scratch is filtered by a low pass filter having a sharp cut off above 3000 cycles, the series elements of the filter consisting of the pick-up inductance and the leakage inductance of the transformer T 1, while the shunt elements consist of C 111, C 110, and C 105.

Fader Amplifier Type E4A

Separate first stage valves, Type V 455, high gain variable mu H.F. pentodes, are used to amplify the input signals from each Projector.

The output from either of the first stage valves is switched by the sound changeover relays to the second stage valve, Type SP 41. The two V 455 circuits are identical, as illustrated in Fig. 33.

The input from the F/D/M switch is applied to the control grid of V 10 or V 11. Negative bias is applied via the potentiometer circuit decoupled by C 8. Volume is controlled by the 5000-ohm potentiometer located on the operating panel, which varies the bias on the suppressor grid. Possibility of stray " pick-up " is prevented by the use of R 9B and C 6B.

The voltage of the signal applied to V 13, via C 7B and the relay switch, is determined by the setting of the preset potentiometer R 14. The overall gain of the amplifier can thus be determined during installation to suit individual requirements. The output from V 13 feeds a tone-control network housed in the power amplifier tray. The anodes and screens of all valves are conventionally decoupled ; the 1000-ohm resistances in the anode leads are meter shunts.

DESCRIPTION OF EQUIPMENT (cont'd)

A fixed cell excitation of 88 volts to "A" P.E. cell is obtained from the junction of R 32 and R 33. For balancing, "B" P.E. cell excitation may be varied between the limits 79-96 volts, by means of a potentiometer. **It should be noted that the resistances used in these circuits are of the 1% tolerance, high-stability cracked-carbon type, and that exactly similar components must be used if replacements are necessary.**

The P.E. cell balancing potentiometer, together with the meter and meter switch are placed on the front of the amplifier while the preset potentiometer R 14 is located close to the SP 41 valve.

Power Amplifier Type B IA

The output from the fader amplifier is fed to the first valve in the power amplifier through the H.F. and L.F. boost networks located in a shielded box at the input end of the amplifier. Various degrees of H.F. and L.F. boost are available by positioning the trailing leads indicated on the amplifier circuit diagram, Fig. 35. The following is a table of the boosts and connections.

Boost	Connection
Max. Top	Connect C 13 across R 21, R 22, and R 23
Mid. Top	Connect C 13 and C 47 in parallel across R 22 and R 23
Min. Top	Connect C 13, C 47, and C 49 in parallel across R 23
Max. Bass	Connect R 24 to C 14
Mid. Bass	Connect R 24 to C 16 and R 25
Min. Bass	Connect R 24 to C 17 and R 26

The characteristics obtained with these connections are shown in Fig. 40.

The cathodes of the phase-splitting valves V 1 and V 2 (Type SP 41) are connected together and biased via R 54 and gridleaks R 52 and R 53. R 51, which carries A.C. current due to the signal on V 1, will develop a voltage in phase with that on the grid of V 1. Consequently the cathode of V 2 is excited by a voltage in phase with the input signal to V 1. Hence, as the grid of V 2 is earthed (via C 31) the operation of this valve is the same as if its cathode was earthed and a signal of opposite sign was applied to its grid. V 4, therefore, is excited from V 2 by a voltage which is equal in magnitude but opposite in sign to the excitation of V 3 by V 1, and the function of a driver transformer is thereby reproduced.

V 3 and V 4 (Type 11E1) operate under Class A.B. 1 conditions. R 61 and R 65 are gridleaks, R 62 and R 64 are bias potentiometers enabling the valves to be matched, and R 63 is a limiting resistance. Resistances R 66-71 are grid, screen, and anode "stoppers," preventing parasitic oscillation.

The anode current for each valve can be ascertained by a meter mounted on the chassis. Distortion is reduced to negligible proportions by the use of a negative feed-back from the output line via R 55 and R 50 to the cathode circuit of the phase-splitter stage. To prevent H.F. oscillation due to the feedback, an H.F. attenuator, formed by R 82, R 83, R 84, and R 85 and C 41 and C 42, is introduced between the phase-splitter stage and the output stage, and C 49 and R 175 are connected across the output line.

Amplifier Supply Rectifier Unit

The circuit is shown in Fig. 30. A full-wave choke input circuit using two UU 5 rectifier valves supplies 450 volts to the anodes of the 11 E1 output valves. A 250-volt stabilized supply is derived from this 450 volt line by the series control valve V 22, which is direct-coupled to the amplifier valve V 23, the grid of which compares a part of the output with the reference voltage derived from the neon stabilizer tube V 24. Any difference between these voltages caused by variation of the 250v. line is amplified by V 23 and acts on the grid of V 22, nullifying the variation and thus keeping the voltage output constant. The actual value of the stabilized output is determined by the setting of potentiometer R 101, which must be set to give 250 volts. Potentiometer R 99 controls the output resistance of the stabilizer, and the factory setting should not be altered. Condenser C 53 prevents self-oscillation of the stabilizer.

In addition, the Unit supplies five heater circuits and a 35-volt negative bias supply obtained from metal rectifier W 1.

Deaf Aid Amplifier

The input is obtained from the power amplifier. Pentode output is used, and negative feed-back is introduced. The impedance ratio of the output transformers is matched to existing headphone control units. For circuit, see Fig. 37.

Exciter Lamp Supply Rectifier Unit

This unit, Fig. 28, comprises separate supply circuits for each exciter lamp. The normal lamp-operation voltage is 8·3 volts, but, in exceptional circumstances this can be increased to 10 volts by adjustment of the transformer primary tappings.

DESCRIPTION OF EQUIPMENT (cont'd)

L.S. Field Supply

Field excitation for the L.F. speakers is obtained from this unit, output voltage being 220.

A transformer T 8 and rectifier W 2 provide the 150 volt supply for the sound changeover relays in the fader amplifier. A smaller secondary winding supplies the framing and mechanism box inspection lamps. The circuit is shown in Fig. 38.

L.S. Filter Unit

Full frequency range is fed from the power amplifier, via the speaker selector switch on " B " machine operating panel. Dual channel output is provided by acceptor circuits, Fig. 39. These pass the L.F. and H.F. bands to their respective speakers, the " changeover " frequency being 500 c.p.s.

CIRCUIT ARRANGEMENT (90 watt)

The general arrangement is similar to the 45 watt equipments with additional or modified components as required.

Fader Amplifier 3-Stand Type F4A

This is similar to Type E 4A, with an additional pre-stage V 455 valve for " C " Projection Unit.

The " A " P.E. cell excitation voltage is taken from the junction of R 32, R 33 as in Type E 4A, but two potentiometers are provided for individual adjustment of " B " and " C " P.E. cell voltages. Circuit diagram, Fig. 34.

Power Amplifier, Type C2A

The 90-watt power amplifier is essentially the same as the 45-watt amplifier, except that two Type 11 E1 valves are connected in parallel on each side of the " push-pull " arrangement. Thus for the same input signal to the grid of V 1 as for the 45 watt equipment, 90 watts are available for the same overall distortion.

Separate coupling circuits are used for the grid of each 11E1 valve to allow for independent adjustment of bias, and four preset potentiometers, connected between earth (1) and the bias supply line (16) are adjusted to give a standing anode current of 50 mA in each valve in the absence of signal. The circuit is shown in Fig. 36.

Frequency Correction

Frequency correction is by an identical network to that in the 45 watt amplifier and gives the same degree of boost. See Fig. 40.

Operating Panels

Fig. 22 shows the wiring of " B " Reproducer Unit Operating Panel. The controls are :—

(a) Mechanism " Start " and " Stop " push-buttons.
(b) Arc " Start," " Run," and " Stop " push-buttons.
(c) Arc volt/amp. meter and switch.
(d) Volume control for this machine.
(e) Input selector switch (film, disc, or microphone).
(f) Combined output switch, switching :—
  (1) Main amplifier on film with " stand-by " on P.A.
  (2) " Stand-by " on film with main on P.A.
  (3) Monitor only on film.
(g) Monitor volume control.
(h) Deaf Aid and monitor switch.

The wiring for " A " operating panel is shown in Fig. 21. It carries duplicates of controls (a), (b), (c), and (d) on " B " panel, but the input selector switch (e) is modified to switch only " film " or " disc."

Amplifier Supply Rectifier Unit

The increased anode current is supplied by an increased rectifier capacity, and by doubling up of control valves. Three UU 5 valves are used in a full-wave rectifier circuit feeding a choke input filter. The electronic stabilizer employs two 11E1 valves in parallel, Fig. 31.

Exciter Lamp Supply

This circuit, Fig. 29 is similar to that for the 45-watt equipment. Since noise level is affected by ripple in the exciter lamp current, smoothing is essential, and is effected by large electrolytic condensers coupled with a choke to form a " pye " filter circuit.

Sound Changeover Relay Supply Units

There are two units, Fig. 32, Main and Standby, each consisting of a full-wave bridge rectifier feeding a capacity input filter to supply the coils of the changeover relays. Each relay is operated in conjunction with a Metrosil which must be fed from a " constant current " source, and R 34 and R 41 are inserted to make the source impedance large.

A 9-volt A.C. supply feeds the framing lamp and the intermittent mechanism inspection lamp in each machine.

To change from main to standby, a switch is fitted on the fuse panel of " A " machine for 2-stand equipments, or " C " machine for 3-stand layouts. The wiring of this switch is shown in Fig. 25 (3-stand).

LOUDSPEAKER ARRANGEMENT (45 watts)

L.F. Speakers

Two L.F. speaker units, Types D 2A and D 2B are used with these equipments. The speech-coils are connected in parallel and the fields in series. The units are mounted in an improved type of baffle, the horn section of which is approximately exponential.

H.F. Speakers

Two Type C 3B permanent-magnet H.F. units are supplied. They are of the metal-diaphragm type, and are connected in parallel. They are fitted to a twin-throat casting, which is bolted to a 9-cell horn mounted above the L.F. baffle.

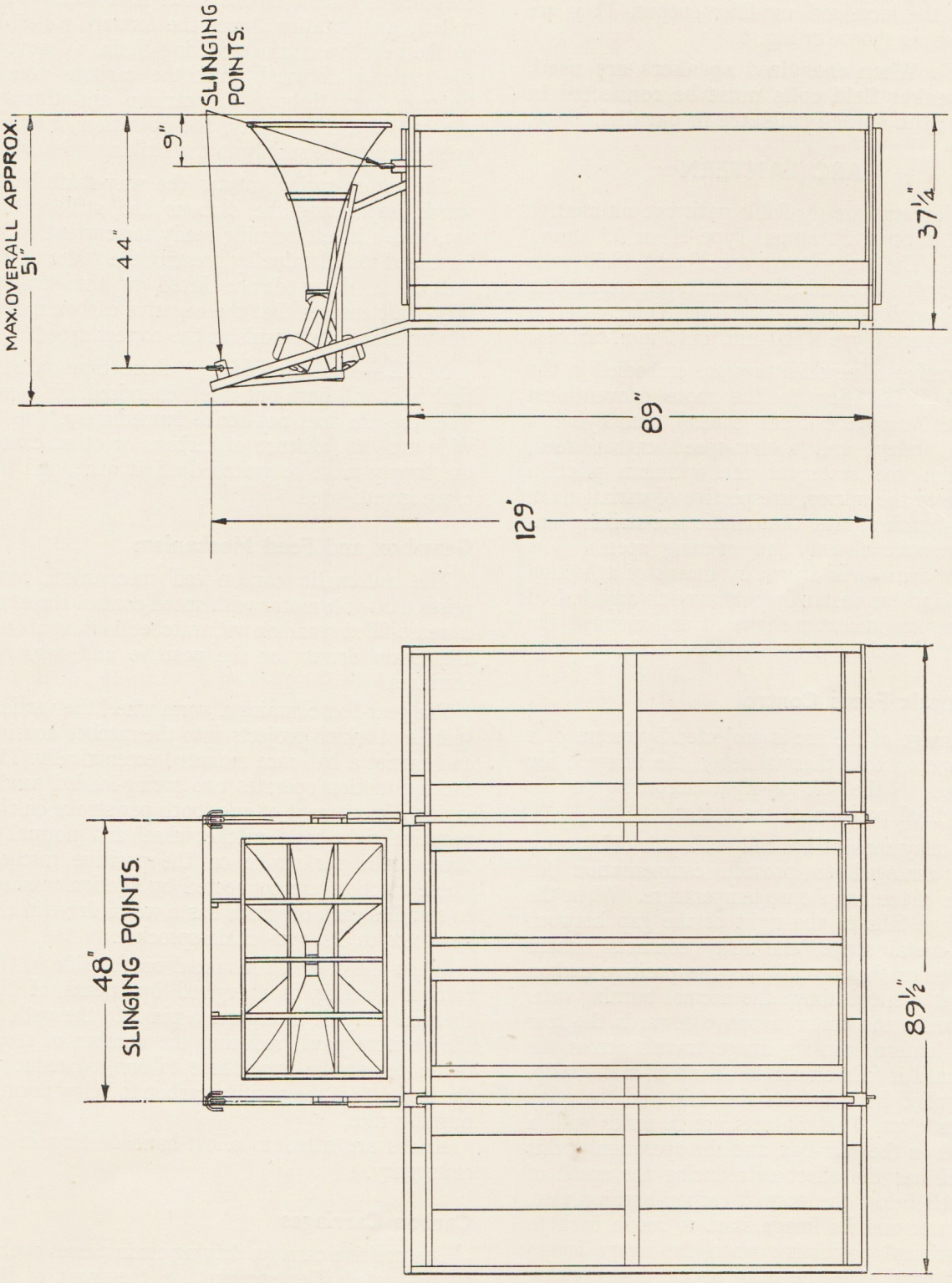

Fig. 6. Arrangement of 90 watt H.F. and L.F. Speaker Units and Baffles.

DESCRIPTION OF EQUIPMENT (cont'd)

LOUDSPEAKER ARRANGEMENT (90 watts)

The Loudspeaker Assembly for 90 watt equipments comprises 4 H.F. Units and 4 L.F. Units, to handle the increased amplifier output. They are mounted as shown in Fig. 6.

NOTE : When energized speakers are used, the speaker field coils must be connected in series ; the speech coils are in parallel.

ARC LANTERN

Arc lanterns are available with two alternative current ratings, 50 amps. Type H, or 75 amps., Type K. The arc voltages are 39 and 48-50 volts respectively. Mechanically, both types are similar. Type H employs 7 mm. positive and 6 mm. negative carbons ; and Type K, 10 mm. and 7 mm. carbons.

A number of new features are embodied in the lantern in addition to the more conventional fittings. Automatic focus control, employing a thermal relay, and a two-speed carbon feed, maintains the crater at the optimum position relative to the mirror, irrespective of variations in carbon-burning rate. Automatic arc-striking ensures correct closing and opening speeds. The positive carriage is driven by means of a friction clutch, and can instantly be moved to any desired position. An indicator shows at any moment the amount of positive carbon still available.

Automatic Focus Control

An image of the arc is projected by means of a periscope on to a thermal relay, the image being deflected to the left or right according to the longitudinal position of the crater.

The relay consists basically of a pair of bi-metal strips, arranged to provide compensation for changes of the lamphouse temperature. When the arc image falls to the right of the gap between the bi-metal strips, the relay contacts remain open; under these conditions the positive carbon is fed at a speed above the normal burning rate. This causes the crater to move towards the rear of the lantern, and its image travels across the relay until it falls on the left-hand bi-metal strip. The applied heat distorts the strip and the relay contacts close. The contacts are in series with a solenoid on the gear-box, and the operation of this solenoid has the effect of reducing the speed of feed well below the normal carbon-burning rate. The crater and its image start to move back to their original positions ; when the image leaves the left-hand strip the relay opens, de-energizing the solenoid, and increasing the speed of feed to above normal burning rate.

The cycle of operations is repeated indefinitely, and the crater is maintained so close to its optimum position that the small variations of illumination are unnoticeable on the screen.

Automatic Arc-Striking

When the " ARC START " button is pressed, a solenoid is energized that rotates the striking way-shaft. Fitted to this shaft is a sector with rollers, and rotation forces the forward roller on to the negative carriage driving chain, so moving the carriage forward until the carbons touch. Current flows through the carbons and through the coil of a series relay, the operation of which open-circuits the supply to the striking solenoid.

The return-spring rotates the way-shaft backwards, separating the carbons and striking the arc, which is left burning ready for current to be increased to full value by pressing the " ARC RUN " button. A delay device fitted to the striking way-shaft ensures that the negative carbon moves forwards and backwards at the correct speed.

NOTE.—The solenoid is " short time rated," that is, it will burn out if left energized. If, therefore, the arc does not strike immediately, due to wide arc gap, absence of carbons or other cause, the supply must be switched off at once, and the cause investigated.

Gear-box and Feed Mechanism

The automatic carbon-feed mechanism comprises a 50-volt motor with speed-control rheostat, a grease-filled gear-box with ratchet housing above, and chain drives for the positive and negative carriages.

The gear-box contains a worm wheel the vertical spindle of which projects into the ratchet housing and carries a ball race mounted eccentrically. The rocking motion operates two spring-loaded pawls, giving a movement of one tooth per stroke on the negative (right-hand) ratchet wheel, and (normally) three teeth per stroke on the positive ratchet. These ratchets are connected by friction washers to spindles each of which has a worm drive in the gear-box to its own chain-sprocket.

When the solenoid mounted on the side of the ratchet housing, is energized by means of the thermal relay, it interposes a pin into the path of the positive pawl, reducing the number of teeth taken per stroke from three to one, so reducing the feed rate of the positive carbon to below normal burning rate.

Knobs are fitted to allow hand feeding in an emergency.

Carbon Carriages

The positive carriage driving chain passes over a spring-loaded idler sprocket on the front of the lantern chassis. Another sprocket on the carriage engages with the chain, and is normally prevented from turning by a friction clutch operated by the weight of the carriage, aided by a spring. Thus normal feed is communicated to the carriage by the driving chain.

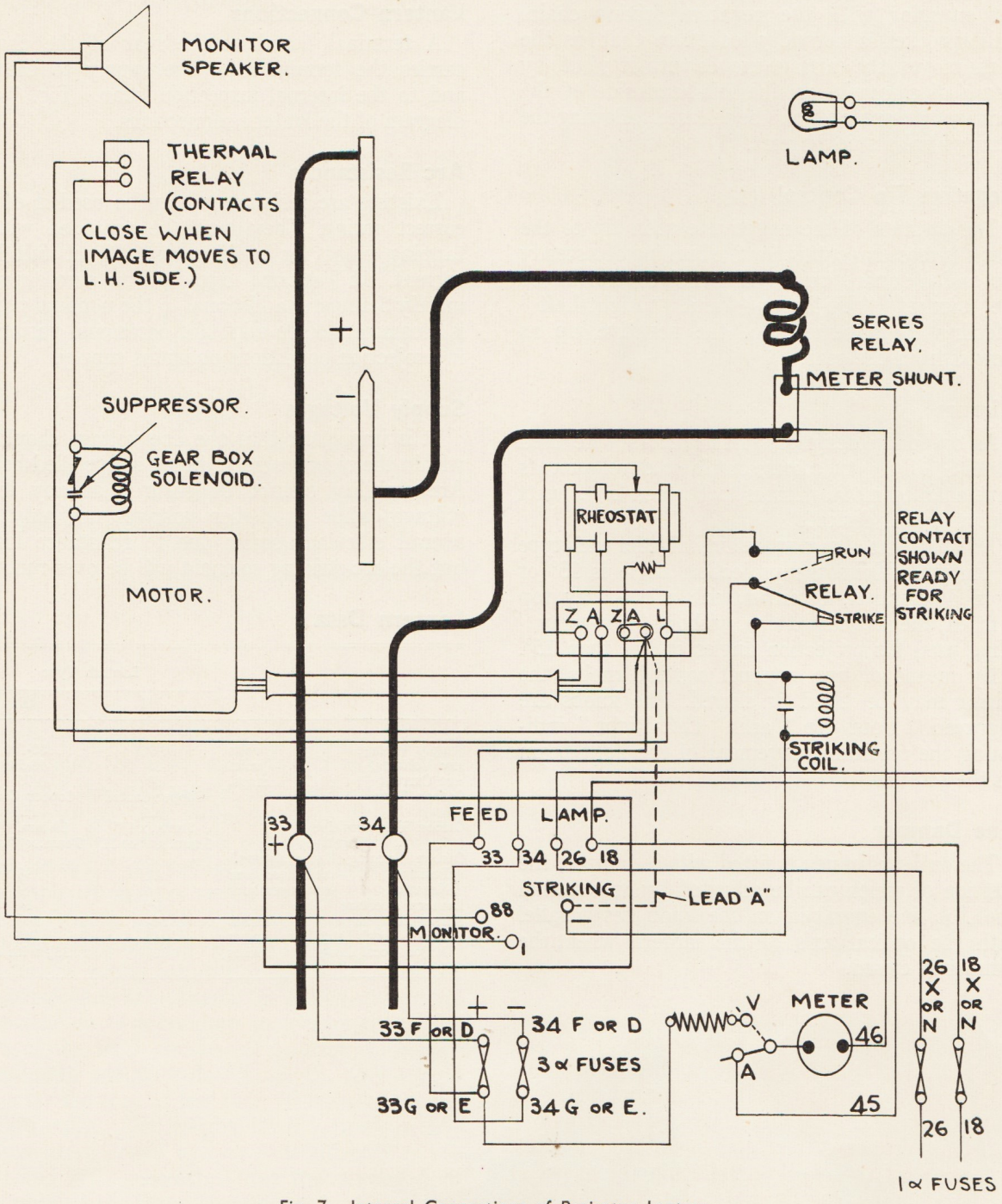

Fig. 7. Internal Connections of Projector Lantern.

NOTE : The extra terminal marked " Striking " is only used when the arc supply does not provide a D.C. supply before striking. In that case, connect auxiliary rectifier positive to the extra terminal and remove lead " A."

DESCRIPTION OF EQUIPMENT (cont'd)

Lifting the carriage, however, relieves the clutch pressure and the sprocket is then able to "free-wheel" while the carriage is moved to the required new position.

The negative carriage is also fitted with a sprocket engaging with the negative driving chain. This sprocket is normally locked so that, as the chain moves, the carriage moves with it ; but, by means of a handle on the left-hand side of the carriage, the sprocket can be released, allowing the carriage to be quickly reset.

Negative Tip Control

The position of the negative carbon tip to the crater is most important for the burning of a steady arc and a square crater. External control knobs are marked "Up-Down" and "Right-Left" referring to movements of the negative tip as viewed from the rear.

Mirrors

As originally designed, glass mirrors were used on all S/U/P/A projectors, but later developments have enabled metal mirrors to be used in 45 watt equipments if desired.

Two patterns of mirror are available for each type of lantern. Where the projection angle is 15° or more downwards, a mirror with a cut-away top is fitted, the second pattern, without "cut-away" being used for projection angles of less than 15°.

By means of two external control knobs, the mirror may be tilted or slewed. The knobs are engraved "Down-Up" and "Left-Right," indicating the resultant movement of the light beam on the screen.

Flue Damper

The outlet chimney is fitted with a damper, the position of which can be adjusted by an external knob. A line engraved on the knob lies parallel with the optical axis of the lantern when the damper is closed.

The damper should be used with discretion. When fully open it will give maximum ventilation and cooling, but will be liable to introduce flicker and increase the carbon burning rate.

Lantern Connections

A terminal board at the rear of the chassis carries the terminals for the supply to the arc and to the internal inspection lamp. Fig. 7 is a diagram of the lantern connections.

Arc Resistances

Existing arc resistances may be used if of the correct rating. They must be provided with a tapping point for striking at 60% of full load current. At least one extra tap, to give approximately 5 amperes additional to the nominal rating, is recommended to allow for occasional variations in projection conditions or mains supply.

Supply Voltages

It is important that the line voltage should be within the recommended limits, as specified below. Arc stability cannot be ensured at any lower voltage, while at higher voltages not only will overall efficiency suffer due to resistance losses, but the arc-striking solenoid will be over-run.

Lantern Data

		Lantern Type	
		H2	K2
Supply Voltage	volts	60-100	80-100
Arc Voltage	volts	39	48-50
Arc Current	amps.	50	75
Carbon Type		Copper Coated H.1	Copper Coated H.1
Carbon Sizes (Positive)		7 mm. × 18"	10 mm. × 18"
" " (Negative)		6 mm. × 8" or 12"	7 mm. × 8" or 12"
Carbon Burning Rate (approx.)			
Positive	inches per hour	11	9½
Negative	inches per hour	4	4
Lantern Aperture Value		1·9	1·8
Mirror Diameter	inches	14½	14½
Minor Focal Length	inches	4⅝	5⅜
Major Focal Length	inches	32⅜	33⅛ with lens

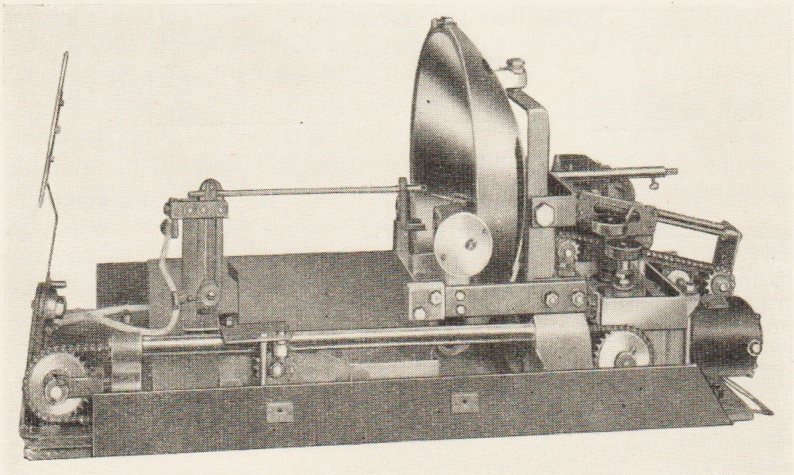

Fig. 8. Side view of lantern chassis.

INSTALLATION

The equipment is dispatched in specially designed cases, numbered and packed in accordance with the following table. Cases numbered 1-12 contain principally components for " B " machine, and cases 13-24, components for " A " machine.

Case Nos.	Contents
1 and 13	Side plates and door assemblies.
2 and 14	Plinth bases.
3 and 15	Top and bottom spool box assemblies.
4 and 16	Mechanism box assemblies.
5	Amplifier cubicle.
6 and 18	Lantern chassis.
7 and 19	Top main body castings and monitor (B machine).
8 and 20	Main body front and rear frames.
9 and 21	Sound optical systems.
10 and 22	Miscellaneous components.
11	Mirrors for both machines.
12 and 23	Bases and fixing details.
17	Contactor cubicle.
24	Film spools for both machines.

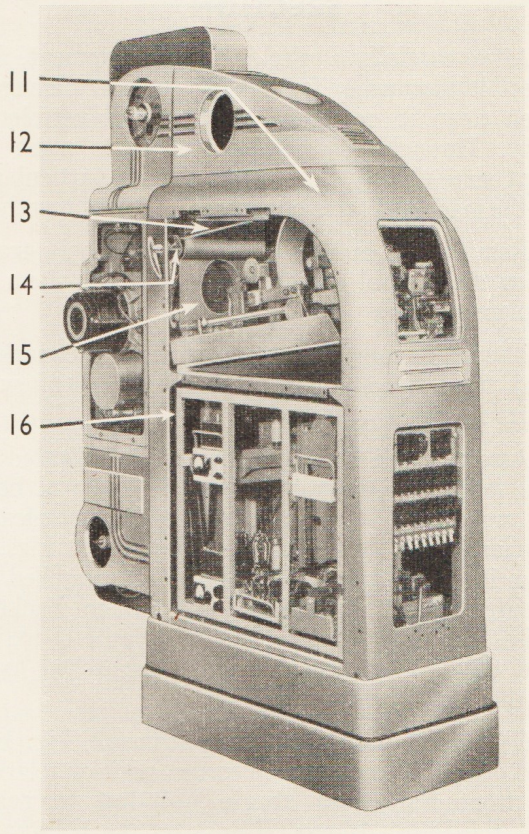

Fig. 9. Constructional Details.

11. Top Main Frame.
12. Monitor Housing
13. Mirror-shield operating rod.
14. Rocker-arm assembly.
15. Lower Heat Shield.
16. Control Cubicle and Fuse Panel.

Wiring

Ducts, conduits, and wiring trays should be recessed into the floor during the constructional work ; but the wiring trays must register with the plinth apertures, and, as the location of the plinth relative to the front wall is critical, measurements **must** be exact. All cutting away of floors should be completed and as much as possible of the external wiring installed before commencing to assemble the equipment. In cases where it is necessary for the wiring to run through the floor of the operating chamber and along the ceiling of the room below, the ducts or conduits may enter the wiring trays in the most convenient position, although, to maintain adequate floor strength, they should not enter the tray at less than 10 inches from the forward edge. The weight of the front of the equipment is carried by two pads adjacent to the tray, and **it is essential that the strength of that part of the floor should not be impaired.**

Existing speaker and non-sync. conduits and wiring external to the projection room may be utilized if they are in a satisfactory condition for further service. No arc-current control resistances are supplied as part of the S/U/P/A equipment, and these must be provided separately, unless existing resistances are available. These must be capable of reducing the arc-current to approximately two-thirds of normal for starting up and must, of course, be able to carry the normal arc full-load current continuously without over-heating.

Similarly, a suitable source of D.C. supply, with the necessary control equipment, must be in existence.

In addition to the mains and arc leads supplied by the electrical contractor, the connections between the Projection Units comprise three 7-core P.V.C. cables, two co-axial cables, and one 3-core or three single-core 40/0·0076 P.V.C. cables ; all of these are supplied with the equipment.

Junction boxes for the input leads, cable lugs for terminating contractors' leads, and a set of synthetic rubber marking sleeves for circuit identification are also supplied by the BTH Company.

INSTALLATION (cont'd)

ERECTION

After carefully unpacking the equipment, inspect it thoroughly for missing parts or damage ; then clean it, removing all traces of petroleum jelly. Throughout assembly, all parts must be kept scrupulously clean ; this applies particularly to the machined faces of parts to be bolted together.

Remove the amplifier and power supply trays from the control cubicle racks, and put them in a place of safety.

The major components of each stand are marked with the serial number of the stand, and all such parts should be matched.

Assemble the stands in the order indicated in the following paragraphs. The assembly of both 45 watt and 90 watt equipments is basically similar. The Part Nos. quoted refer to Figs. 9 and 10. The parts of the frame are dowelled to ensure correct alignment, and where packing shims are required, between the lantern wedge and the body-casting, they are dispatched fixed in their final position.

(1) Insert plinth bolts in plinth (21, Fig. 10), and place Plinth on floor in correct position relative to front wall **with single bolt-lug to rear.** Put the Plinth Blocks, if any, on the bolts, and insert anchor bolt (22, Fig. 10) in rear underside of Base (23, Fig. 10). Put the Base on the Plinth Blocks and, after inserting rubber fillet (24, Fig. 10) between Base and Plinth, tighten up Plinth bolts.

(2) Build up the main frame as a separate assembly. Bolt the Top Main Frame (11, Fig. 9) to the Rear Main Frame (27, Fig. 10) and to the Front Main Frame (26, Fig. 10) ; at each stage, the fixing bolts should be securely tightened.

Now fit the two Distance Pieces (25, Fig. 10). The resilient mountings marked 45 lb. should be to the rear. Take great care not to spring the main frame assembly while fitting the Distance Pieces ; tighten up all fixing screws.

Remove the Top Main Frame (11, Fig. 9) and fit the Lantern Wedge and Tray (28 and 29, Fig. 10), **using shims if provided** at points to which they are fixed for dispatch. **Do not tighten fixing bolts.** Re-fit Top Main Cover and **tighten its fixing bolts,** then tighten lantern-support bolts.

If the angle of projection is less than $7\frac{1}{2}^{\circ}$ downwards, insert the Rake-adjusting Screws (33, Fig. 10) in the Front Main Frame ; if the angle is $7\frac{1}{2}^{\circ}$ or more downwards, fit them in the Rear Main Frame.

Insert Jacking Frame (30, Fig. 10), with the **single jacking-point to the rear,** underneath main frame assembly. Fit the jacking-frame pivot pins (32, Fig.10) in the frame, **at the opposite end to that containing the rake-adjusting screws.**

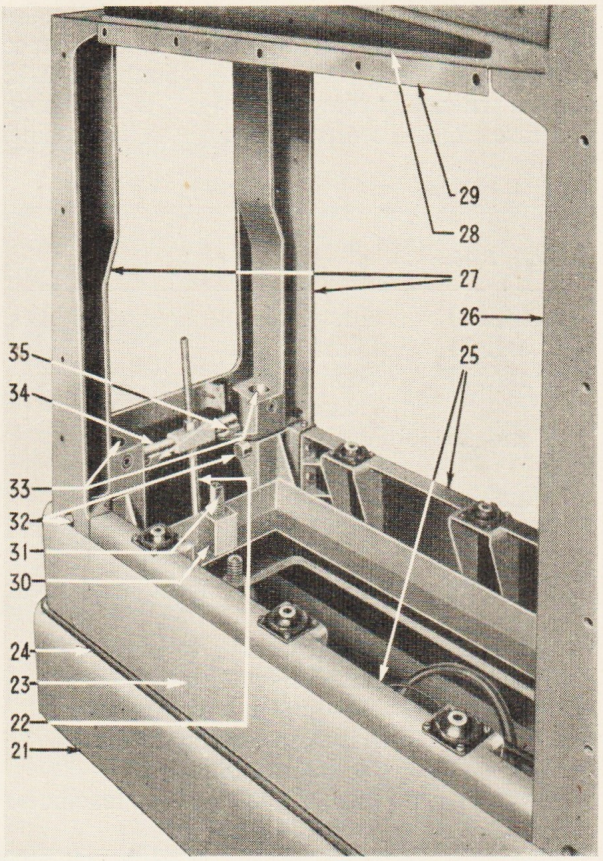

Fig. 10. Frame Assembly Details.

21. Plinth.
22. Anchor Bolt.
23. Base.
24. Rubber Fillet.
25. Frame Distance Pieces.
26. Front Main Frame.
27. Rear Main Frame.
28. Lantern Wedge.
29. Lantern Tray.
30. Jacking Frame.
31. Jacking Screw.
32. Pivot Pins.
33. Rake-adjusting screws.
34. Anchor Bar.
35. Anchor Bar Cradle.

For convenience of handling, tie the free end of the jacking-frame to the rake-adjusting screws, then lift the assembly into the Base, guiding the anchor bolt between the rear frame and the jacking-frame. Place Anchor Bar (34, Fig. 10) on anchor bolt and in cradle (35, Fig. 10) and tighten locknut finger-tight.

(3) Now fit Bottom Spoolbox to main frame. **Check with feeler gauges** that it is resting on the narrow ledge below the locating keyway on the main frame, before tightening the four fixing bolts. Otherwise the spoolbox and mechanism box will be out of line.

Position the rubber gasket on top of the spoolbox, lift on the Mechanism Box, thread the three seven-core cables through the holes in the main frame, and fit and tighten the four fixing bolts ; the two bolts with thin square heads are at the top.

INSTALLATION (*cont'd*)

Remove Top Main Frame and fit Lantern Chassis on its wedge, **using shims as provided.** Check that the mirror frame bears the same Serial No. as the lantern. Thread the arc supply cables through cable entry in top of rear main frame and clamp wiring. Re-fix top main frame.

Fix the Lens Holder on the front of the Mechanism Box by means of the internal expanding collet on the end of the pivot spindle. Make sure that the torsion spring is positioned to compensate for the weight of the lens and holder.

(4) Check lantern alignment using a perfectly straight rod, about 3′ 6″ long, 7 mm. diameter for 50 amp., and 10 mm. diameter for 75 amp. machines. $\frac{5}{16}$″ or $\frac{3}{8}$″ diameter rod may be used if metric sizes are not available. Alignment Gauge A1GBA 45142 is also required.

Close the Picture Gate and set the lens holder in the operating position. Move the positive carbon carriage to the rear end of its travel (it will slide easily if lifted slightly). With the positive carriage close to the fixed positive guide, check that the vees coincide. If adjustment appears necessary, see " Positive Carriage," page 33. Place the gauge in the front end of the lantern chassis (one end of gauge is for use with 75 amp. lanterns, and the other with 50 amp.) locating the pins in the holes provided. Mount the aligning rod in the position normally taken by the positive carbon, supported by vee in the positive carbon guide and by the alignment gauge. The front end of the rod will now project through the lens holder, and, allowing for a slight sag, the rod should be central in the lantern nose lens aperture, the picture gate, and the lens holder. Check with callipers, and if adjustment is necessary it should be carried out by varying the shims between the lantern chassis and lantern wedge.

By removing the rod, and sighting through the optical axis of the lantern, the Projection Unit should now be located as accurately as possible in its final position relative to the port-hole and screen by means of the jacking and rake-adjusting screws. **The jacking screws must be used only for height adjustment, and the jacking frame must remain parallel with the base.** It is advisable to obtain a close approximation of the final position at this stage, since, when the control cubicles, etc. have been built in, the adjusting screws are much less accessible.

(5) In the bottom spoolbox, thread the 7-core cable from the push-button changeover switch through the hole in the main frame, fastening the conduit locknut inside the frame.

Fit bottom spoolbox take-up chain and adjust tension. Thread Bowden cable from bottom spoolbox film guillotine through mechanism box to emergency switch. Fit drive motor assembly to its fixing bracket.

Fit optical system and exciter lamp assembly. This is fixed by three bolts to the bearing boss of the sound drum assembly.

(6) Fit dowser assembly by its two fixing bolts to the front of the lantern. Mount the monitor housing (12, Fig. 9) on the top main frame, and fit the top spoolbox, threading the four-core cable and plug from the door-interlock switch and the inspection lamp through the clearance hole in the top of the mechanism box.

(7) Fit mirror-shield pivot-arm to upper left-hand side of top main frame. Connect mirror-shield operating rod (13, Fig. 9) and front shutter operating rod to the rocker arm (14, Fig. 9). Adjust the length of the shutter rod to give complete shut-off.

Fix the lower heat shield (15, Fig. 9) to the lantern, and fit the upper heat shield which is secured by screws and distance pieces to top main frame, and is screwed at the bottom to the lower heat shield.

(8) Undo the back-of-panel locknuts on the bolts fixing the fuse panel to the control cubicle framework. This will allow the fuse panel to be pushed back out of the way. Remove the fuse-carriers, and lift the cubicle framework on to the resilient mountings on the distance pieces (25, Fig. 10). Do not tighten the fixing bolts at this stage ; the control cubicle may have to be shifted slightly for the control panel to line up with the aperture in the side plate. Fix the fuse panel in its original position.

(9) Connect up the wiring as described in the section " ELECTRICAL CONNECTIONS " (page 22).

(10) The various tray-units are to be fitted to the drawer strips in their respective control cubicles. The Exciter Lamp Supply Unit and the Stand-by Fader Amplifier are fitted in " A " Reproducer Unit Stand ; all other tray-units are housed in " B " stand. The Stand-by Power Amplifier and Amplifier Supply Rectifier Units are fitted immediately below the main units. Each tray is connected by means of a " Painton " plug and socket.

INSTALLATION (*cont'd*)

(11) Retract the mirror shield by opening the dowser. Unclamp the negative carriage, and slide it back to the limit of its travel.

If the projection angle is 15° or more downwards a mirror with a cut-away top will be supplied. Loosen the upper fixing clips on the mirror-frame and insert the mirror. Then put the mirror assembly into position in the lantern and lower it on to the bottom pivot screw ; the lower lug of the mirror frame is recessed to locate the bottom pivot ; when the top pivot is correctly engaged, the mirror frame is gently moved about till the lower pivot engages.

The alignment rod, mentioned in (4) above, should be marked, for 50 ampere lanterns, $32\frac{3}{8}''$ from the end ; and for 75 ampere lanterns, $33\frac{1}{8}''$ from the end. Fix it as before in the positive clamp, with the rear end exactly level with the reflecting surface of the mirror. The mark on the rod should then coincide with the plane of the picture gate.

Remove the alignment rod and fit the nose-lens in the front of the lantern, securing it with the spring clip provided.

(12) Fit the side plates and doors. Set the control cubicle so that the operating panel is in line with the aperture in the side plate, then tighten the bolts fixing the cubicle to its resilient mountings.

Insert the rubber fillet between the top of the base and the side plates.

(13) Check that all pad rollers have a clearance of 0·020″ clearance from their respective sprockets.

Lubricate intermittent mechanisms as described in lubrication instructions on page 35.

By means of the inching handle, make sure that the movement of all the mechanism is free. Check and, if necessary, adjust the operation of the emergency switch and film-trap guillotine, then " set " the film fuse with a piece of film.

ELECTRICAL CONNECTIONS

45-watt Equipments

The internal rack wiring of the control cubicles is carried out in the Factory and is brought out to terminal boards accessible from the operating side of the Projector Units. The interconnecting cables between the Projectors are connected to these terminal boards, Table 1 being a key to the terminal numbering. Full details of the external wiring are provided in the electrical contractor's wiring specification.

The incoming mains supply leads are connected to terminals 18W and 26W on the fuse panel in " A " control cubicle. Outgoing supplies are taken from this point as follows :—

18W, 26W, to "B" control cubicle (7/0·029 cable).

18Y, 26Y, to non-sync. motors (3/0·036 cable).

If the mains supply is of a voltage other than 240 volts, an auto-transformer is required ; this is generally installed near the mains switch in the projection room.

In addition to supply leads 18W, 26W from " A " control cubicle, other connections on the fuse-panel terminal board in " B " cubicle are :—

10 and 1A —Audio output to screen speakers, via loudspeaker filter unit.

5 and 1A —Audio output to P.A. speakers, via matching transformer.

9 and 1A —Audio output to Deaf Aid head-phones.

22 and 23 —D.C. supply to L.S. fields. It is sometimes desired to feed a separate loudspeaker field supply rectifier from " B " cubicle ; in this case, terminals 22 and 23 are connected to the **A.C.** supply busbars, and are marked " A.C."

On S/U/P/A equipments, terminal 18 is connected to the live line, and 26 to the neutral.

Incoming cables from the arc rectifier, normally installed outside the projection room, terminate on the contactor panel in " A " cubicle, the terminals being accessible from the non-operating side. The positive and negative cables for each arc must be kept as close together as possible, or stray magnetic fields may produce " arc-hum " on the sound circuits. The negative cable or cables are connected to terminals 79 ; if a separate negative cable is used for each arc, the copper link between terminals 79A, 79B must be removed.

The contactor panel is designed for use with a constant-voltage rectifier with external arc resistances, but, when choke-controlled or other constant-current rectifiers are to be used, the panel and its associated circuits can be modified by the Factory. These rectifiers normally necessitate full-load " striking," so that the " RUN " push-button is inoperative, and in that case no cables are connected to terminal 78.

When the equipment is to be used with an arc rectifier that incorporates an auxiliary rectifier for striking-coil and contactor operation, the link (lead " A " on lantern diagram, Fig. 7), between the " STRIKING " terminal and the positive arc feed terminal must be removed.

INSTALLATION (cont'd)

45-watt equipments normally employ a 50-ampere lantern, and are fitted with Type 2156/A or C contactor panels. Type 2156/B contactor panels are used with 75-ampere lanterns, if the latter are installed.

The stand interconnections supplied with 45-watt equipments are as follows :—

3—7-core cables.
1—3-core cable.
3—Low-capacity co-axial cables (2 where no stand-by amplifier is fitted).

In addition, the following internal connections are supplied :—

2—19/0·044 cables (" A " arc to contactor panel).
4— 1/0·083 cables (Arcs to arc feed fuses).
4—40/0·0076 cables (Arc feed fuses to arc controls).
4—40/0·0076 cables (Fuses to lantern inspection lamps).
4—40/0·0076 cables (Shunt leads 45A or B, and 46A or B).
2—40/0·0076 cables (Monitor Speaker, " B " projector only).

The P.E.C. co-axial cables are connected at the input switch end by the Factory, and are plugged into the photocell housing, as is also the P.E.C. excitation connection from the control terminal board.

The three low-capacity co-axial cables from " A " input switch terminate in "B" cubicle as follows :—

(1) " A " socket on main fader amplifier.
(2) " A " socket on stand-by fader amplifier.
(3) Three-way non-sync. terminal box mounted at the fader-amplifier end of the control cubicle.

At the " A " cubicle end, these co-axials are connected into the input switch. The cables are fitted with metal bends, and the braid is cut to length ; the surplus length of polythene cable must be removed, as this is left to protect the inner conductor during transit.

The 3-core volume control cable may be run in the same conduit as the co-axial cables, but these co-axial cables **must not** be installed in the conduit carrying the 7-core cables.

Flexible metallic conduits are used to bring the

TABLE I—TERMINAL NUMBERS

Terminal No.	Circuit
1	Earth.
2	Power amplifier, V 11E 1 heaters.
3	Power amplifier, V 11E 1 heaters.
4	P.E. Cell H.T. Supply.
5	Output to P.A. speakers.
6	P.E. Cell—Film/Disc Switch (Co-axial).
7	Power amplifier, SP 41 heaters.
8	Power amplifier, SP 41 heaters.
9	Deaf Aid output.
10	Power amplifier output.
11	H.T., 450 volts D.C. (+).
12	Fader amplifier, heaters.
13	H.T., 250 volts D.C., stabilized (+).
14	Fader amplifier output.
15	Fader amplifier, heaters.
16	Grid bias, 35 volts.
17	Negative feed to volume control.
18	A.C. Mains (Live side).
19	Volume control, contact arm.
20	Framing and mechanism box lamps.
22	L.F. speaker field supply (when used)
23	L.F. speaker field supply (when used)
25	Exciter lamp lead.
26	A.C. Mains (Neutral).
27	Exciter lamp supply unit.
28	Film/Disc switch—Fader amplifier (Co-axial).
29	Non-sync. output.
30	Non-sync. transformer to input switch.
31	Microphone output.
32	Microphone transformer to input switch.
33	Arc feed (Positive).
34	Arc feed (Negative).
36A	" A " push-button to 39A/38B.
36B	" B " push-button to 39B/38A.
38	Changeover Shutter coil (" close ").
39	Changeover Shutter coil (" open ").
40	Input to deaf aid amplifier.
41	Arc " RUN " switch.
42	Arc " RUN " and " START " switches (common)
43	Arc " START " switch.
45	Arc volt/amp. switch (+).
46	Arc volt/amp. switch (—).
47	Motor " START " switch.
48	Motor " START " and " STOP " switches (common).
49	Motor " STOP " switch and spoolbox interlock.
50	Spoolbox interlock and emergency switches.
51	Arc " STOP " switch.
54	Drive motor (condenser connection).
55	Drive and sound-drum motors.
56	Drive and sound-drum motors (common).
59	Relay to changeover push-button.
60	Positive feed to changeover relays.
68	Positive 150v. line from c/o relay supply unit.
69	Relay supply (Projector channel).
70	Relay supply (P.A. channel).
76	Arc " STOP " switch (fuse side)
77	Arc resistance " STRIKE " (+).
78	Arc resistance " RUN " (+).
79	Arc rectifier (—).
88	Monitor speaker.

INSTALLATION (*cont'd*)

two pairs of 3/0·036 V.I.R. non-sync. and microphone input leads into " B " stand to the 2-way terminal boxes mounted at the fader-amplifier end of the control cubicle.

In view of the difficulty of running the microphone wiring at a later date, it is recommended that the microphone input line should be connected during installation to a junction box conveniently situated outside the stand, even though the exhibitor does not immediately require P.A. facilities.

90-watt Equipments

The instructions given in the foregoing paragraphs are, with certain exceptions, equally applicable to the 90-watt equipments.

As permanent-magnet loudspeakers are employed, terminals 22 and 23 on the fuse-panel terminal board (" B " cubicle) are not normally in use. If, however, special requirements entail the use of energized speakers, the field supply unit of the remote loudspeakers will be fed from terminals 22 and 23 ; in that case, these terminals will be connected in the Factory to the A.C. supply busbars, and will be marked " A.C."

The inter-stand connecting cables supplied with 90-watt equipments are as follows :—

3—7-core cables.
2—3-core cables (" A " volume control, and " A " monitor speaker).
3—Low-capacity co-axial cables.

In addition, the following internal connections are supplied :—

2—19/0·052 cables (" A " arc to contactor panel).
4—1/0·083 cables (Arcs to arc feed fuses).
4—40/0·0076 cables (Arc feed fuses to arc controls).
4—40/0·0076 cables (Fuses to lantern inspection lamp).
4—40/0·0076 cables (Shunt leads 45A or B, and 46A or B).
2—40/0·0076 cables (Monitor speaker, " B " projector).

When the stand-by amplifier is to be used on P.A., a P.A. control box containing push-buttons and a volume control is supplied (Fig. 27). This control box is mounted in some convenient position in the projection room or non-sync. room, and two 3-core cables are connected to it from " B " projector ; these cables must be run in separate conduits. The volume control cable is connected to terminals 19R, 17VR, and 1VX on " B " cubicle control terminal board ; the second 3-core cable is connected to terminals 60R, 70R, and 59R in " B " cubicle.

INITIAL OPERATION

FITTING THE CARBONS

Slide the positive carriage to the forward end of its travel, lifting it slightly to release the clutch. Pass the crater-end of the positive carbon through the magnet, and with this end projecting about 1" beyond the positive guide, clamp the carbon in the positive head.

Release the negative carriage, and pull it back to the end of its stroke. Undo the carbon collet by means of its clamping handle, then, using another carbon as a push rod, push in a negative carbon point foremost ; set it to give an arc-gap of (for 50 ampere lanterns) $\frac{3}{8}$" ; or (for 75 ampere lanterns) $\frac{1}{2}$" ; clamp collet and carriage.

NOTE : The length of carbon gripped in the negative carbon collet must never be less than $\frac{1}{2}$".

It may be found that a batch of carbons is consistently over or under the nominal size. By slackening a grub screw in front of the negative connection by means of a 2 BA Allen key, the outer collet sleeve may be screwed inwards about one-quarter turn, allowing the collet to accommodate over-size carbons, or outwards, for under-size carbons. The grub screw must then be re-locked.

The tip of the negative carbon must be lined up with the end of the positive by means of the external control knobs on the operating side of the lantern.

STRIKING THE ARC

Open the right-hand door, and remove the two nuts and plate adjacent to the arc image projector. This will allow the removal of the front cover, giving access to the mirror adjustment.

With the carbons set as described in the foregoing section, close the dowser, bringing the mirror-shield forward. Press the " ARC START " button ; the negative carbon will move forward, then retract, striking the arc on two-thirds full-load current. Press the " ARC RUN " button, and current will increase to full load.

INITIAL OPERATION (*cont'd*)

Open the dowser and project onto the screen. By means of the external control knobs adjust the mirror so that the light-beam is concentric on the gate. Hand-feed the positive carbon to the position which gives the best screen illumination, following up with the negative carbon as required. Quickly adjust the periscope-mirror so that the edge of the crater image coincides with the right-hand line of the arc-image screen. Switch off, and, when the internal parts have cooled, set the crater position gauge (on the left-hand side of the lantern chassis, below the automatic focus control periscope) to match the crater. This gauge will be used for future carbon-setting.

Adjustment of Automatic Arc-Striking

The arc-striking has been tested and correctly set before the equipment leaves the Factory. Should any adjustment be found necessary, however, an increase in the length of stroke can be effected by the slack in the negative carriage driving chain ; the rear sprocket bearing-brackets are slotted for this purpose. The adjustment is very critical, and should not be attemped unless it is certain that no other cause such as external friction is responsible for the incorrect arc gap. The setting may be checked as follows.

Operate the solenoid clapper smartly by hand, and measure the resulting stroke of the negative carriage. For 50 amp. lanterns, this should be $\frac{13}{32}$" plus $\frac{3}{32}$" overshoot—a total of $\frac{1}{2}$" ; and for 75 amp. lanterns it should be $\frac{19}{32}$" plus $\frac{3}{32}$"—a total of $\frac{11}{16}$". Slightly longer strokes are permissible.

The return-stroke spring should be so adjusted that it always returns the negative carriage through its full travel, but is not too strong to allow the solenoid to close properly. The spring requires a greater tension for steep projection rakes. The spring-tensioning nuts should be adjusted on site, noting that the mechanical load on the solenoid must be balanced against the satisfactory return of the negative carriage.

Adjustment of Automatic Focus Control

To check the setting of the control periscope and thermal relay again run the arc on full current and check that the crater is in its optimum position as shown on the arc-image plate. Through the hole in the left-hand door inspect the crater image as it appears on the front glass of the thermal relay. It should coincide with the end of the line etched on the glass, and should be located half-way up the glass. If the position requires horizontal correction, adjust the external screw of the control periscope through the non-operating side door. For vertical correction, switch off the arc and loosen the periscope fixing screws. Rotate the periscope body as required and tighten securely.

The response-time of the relay may be varied by an adjustable cam, the setting of which determines the contact-gap. The gap may vary with the projection angle, and the cam must be set so that the contacts are normally just open. The crater image should float in the gap between the bi-metal strips in the relay ; if it tends to move to the left, rotate the cam anti-clockwise.

Adjust the speed-control rheostat so that the negative carbon feeds at the exact burning rate. Clockwise rotation of the rheostat knob (slider moving to the right) increases the negative feed rate.

Feed Mechanism

If the adjustment of the thermal relay is correct, after initial " warming-up," the crater image will " float " about the line on the arc-image glass, with negligible drift. Incorrect adjustment of the gear-box solenoid may cause unsatisfactory operation (See " SERVICE AND MAINTENANCE," page 32).

Check on Optical Alignment

The optical alignment of each projector should now be checked.

Remove the light tunnel from "A" projector, and prop open the fire shutter and the flicker shutter. Open the dowser. Clamp a new carbon in the positive carriage, with its crater end in the arc-striking position, and on this end stick a postage-stamp sized piece of white paper ; this will act as a little screen.

Now light up the screen by means of the other projector or a slide-lantern. If the alignment is reasonably correct, an image of the theatre screen will appear on the paper, and, if the alignment is perfect, this image will be exactly central with the carbon-tip. The image can be brought in or out of focus by means of the positive carbon hand feed.

If the image is only slightly displaced it can be centred by manipulation of the mirror adjusting knobs ; but if it is considerably displaced, serious lantern mal-alignment is indicated, and the procedure outlined in (4), page 21, must be repeated, and the alignment corrected.

Finally, the screws which bear on the cams on the mirror-tilting and slewing spindles must be adjusted so that the screen-image is correctly placed when the knobs are in their central position.

The operation should then be repeated on projector " B," using " A " for screen illumination.

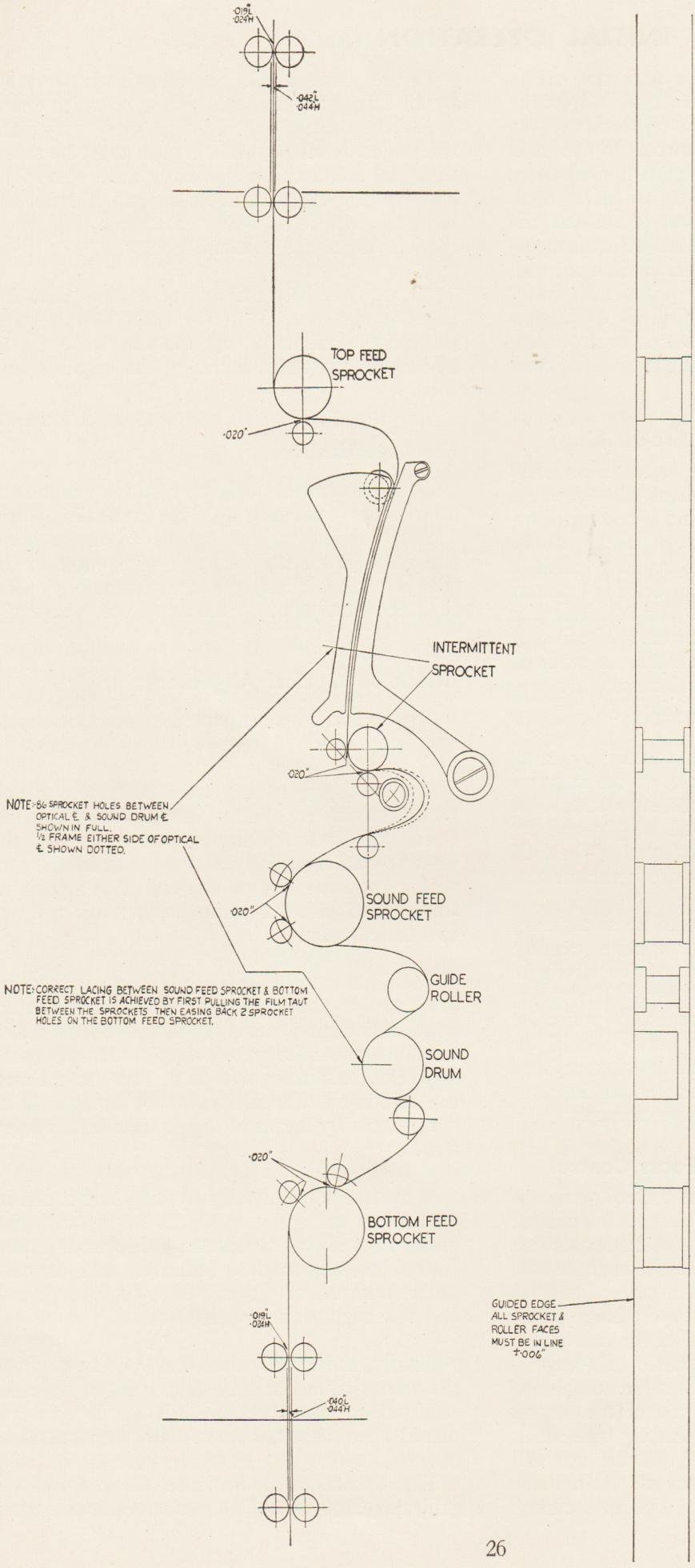

Fig. 11. Film threading Diagram.

NOTE : Later models are fitted with a new type of intermittent guide pin assembly. These should be threaded with 80 sprocket-holes between the optical and sound drum centre lines.

INITIAL OPERATION (*cont'd*)

FINAL INSPECTION

Finally, before putting the projector into commercial operation, attention should be paid to the following details.

(1) Check pad roller clearances. These should all be 0·020".

(2) Check that the intermittent mechanism has been charged with oil.

(3) Turn the mechanism by hand. If the movement is not free and smooth, this must be investigated and corrected before running the motor.

(4) Thread projector and run a film through. Check spoolbox clutch adjustment. Focus projection lens, setting the coarse adjustment to allow equal movement each way on the fine adjustment.

(5) On completion of run, carefully examine the film for traces of scratching or damage.

(6) Check that, when opened, the lens does not foul the fixed portion of the gate.

(7) Using buzz-track film, set the alignment of the sound optical guide roller and focus system.

THREADING THE FILM

Fig. 11 illustrates the film path through the mechanism.

Put the loaded spool on the top spoolbox spindle (it must rotate anti-clockwise), draw off about 6 ft. of film, and thread through fire trap on to top feed sprocket.

Leaving a four-frame loop from the top feed pad roller, thread the film through the gate on to the intermittent sprocket, which must be in the locked position. Close gate and frame film.

Close intermittent pad roller assembly.

Leave a six-frame loop between the intermittent and sound feed sprockets ; lead the film over the guide rollers, insert between drum pressure roller and sound drum, and over the drum take-up roller.

Thread the film over the bottom sprocket and through the bottom fire-traps, then release two sprocket holes from bottom sprocket and distribute the loop above and below sound drum.

Feed the film on to the bottom spool in an anti-clockwise direction.

AMPLIFIER ADJUSTMENT

Before switching on the amplifier turn preset gain-control to zero, and all output valve bias-controls clockwise for maximum bias. Switch on and adjust 250 volt line to give correct voltage. Adjust output valve bias-controls to give 50 milli-amp. anode current in each valve, and check through all other valve anode currents. Next increase preset volume control, focus both optical systems with film loops, and balance outputs of projectors with *main* volume controls set at stop 10. Check frequency characteristics of each projector with calibrated constant-frequency film to make sure that all equipment is functioning correctly.

Run through a feature film with main volume control set at stop 8, and adjust preset gain control to give normal volume level in hall. Leave preset in this position.

Check gramophone and microphone (if this is to be used), and check operation of all controls and switches.

SERVICE AND MAINTENANCE

Regular attention must be paid to the cleaning and lubrication of the complete equipment. Details of the required routine will be found on page 35.

No repairs should be attempted on intermittent mechanism, gear drive assemblies, soundhead, or sprocket drive assemblies. The intermittent mechanism is sealed on dispatch and any interference nullifies the guarantee. With each equipment is provided a list of components and assemblies which the user is recommended to hold as service spares ; as well as the items above, these include Amplifier and Control Gear Units.

Defective units should be returned with full details to :—

The British Thomson-Houston Co., Ltd.,
Sound Reproducer Sales Department,
Rugby,
England.

where they will receive prompt attention.

When ordering spares or replacements, it is essential that the fullest possible information, including **all** the particulars on the apparatus nameplate, should be given.

SERVICE AND MAINTENANCE (cont'd)

MECHANICAL UNITS

Drive Motor Assembly

The assembly is spigoted to the motor support and held by four screws. Electrical connection is by plug and socket. When removing or replacing the assembly, care must be taken to avoid damaging the bonded-fabric pinion (on the end of the coupling shaft) which engages with the steel pinion of the flywheel of the intermittent mechanism.

To remove the motor, first slacken off the two support screws under the outboard end of the support bracket (which extends from the inner mounting bracket), remove springs, cradle, and rubber strip. Remove the four screws fixing the motor flange to the outer member of the resilient mounting, and withdraw the motor from its spigot. The motor half of the flexible driving coupling should slide off the motor shaft extension.

Intermittent Mechanism

Removal of Unit :—

(1) Remove projector mechanism box cover.

(2) Remove intermittent film pad assembly, stripper plate, intermittent sprocket, and nose cap, exposing the locknut.

(3) Slacken screw in locknut, and remove nut with special spanner provided. Remove all four washers (one flat, two dished back-to-back, and one flat) from intermittent shaft.

(4) Remove Drive Motor Assembly.

(5) Rack into horizontal position, and remove the 2BA nut and washer from differential gear—intermittent mechanism connecting-link. Remove 4BA nut fixing connecting-link to framing handle.

(6) Withdraw intermittent mechanism.

If a replacement mechanism is to be fitted, unscrew the pillar holding the phasing link, taking care not to alter position of lock nut. Undo framing link nut, and remove link and stud.

Replacing the Unit :—

(1) Fit phasing and framing links to intermittent mechanism ; make sure that arc in connecting-link to framing handle is downwards. Allow differential to fall to bottom of its travel.

(2) Set shutter in mean position of adjustment, i.e. with the fixing screws in the centre of the slots. Rotate the shutter backwards, setting timing mark to register with lines on edge of heat shields. Hold it in this position.

(3) Well grease the outside of the intermittent mechanism cross-spindle bearing casing with Crimsangere No. 8, and feed intermittent mechanism into framing sleeve until phasing link rests on outer diameter of sleeve, then, holding the mechanism with the timing mark about $1\frac{1}{2}$" clockwise from the mark on the body, slide it in till the gears **just** engage. Release flicker shutter, and guide phasing link on to its stud as the mechanism is pressed right home.

(4) **Check that the timing marks on the flicker shutter and heat reflectors, flywheel and intermittent mechanism line up** as nearly as possible ; if they are more than half-a-tooth out, this must be corrected by re-meshing the gears.
The timing may be half-a-tooth out either way, causing " ghosting " which must be rectified by adjustment of the flicker shutter.

(5) Fix phasing link by replacing and tightening the 2BA nut, with plain and shakeproof washers. Put framing link on its stud, with arc downwards, and fit a washer and a **new** 4BA Simmonds nut.
NOTE : A new nut must be used each time to ensure adequate locking.

(6) Replace the four washers on the sprocket end of the intermittent shaft, fitting first a flat washer, then two dished washers back-to-back, and finally another flat washer. Tighten the locknut carefully, as if it is too tight the mechanism will stick on dead centre, and if too loose, vibration will cause picture unsteadiness.
Tighten screw in locknut.

(7) Replace nosecap, sprocket, stripper plate, and motor.

(8) Test for picture steadiness, and freedom from " ghosting."
Check gate alignment.

Changeover Shutter

The changeover shutter may be removed by taking out four screws, and withdrawing the wiring plug. In replacing it, take care that the stop on the back of the shutter is located between the stop pins on the fire shutter bearing plate, also make sure that the leads to the coil cannot foul the flicker shutter.

Check that the fire shutter and the vanes of the flicker shutter clear the toggle and the operating arm on the c/o shutter. If not, adjust by means of the clearance in the c/o shutter fixing holes.

The insulation of the coil should be checked, and manual operation of the shutter tested, at regular intervals.

Flicker Shutter Assembly

No maintenance should be necessary other

SERVICE AND MAINTENANCE *(cont'd)*

than attention to the fire shutter bearing. This should be examined every four weeks to ensure that it still contains sufficient grease and that the grease has not lost its oil content. For this examination, proceed as follows :—

(1) Remove light tunnel and changeover shutter.
(2) Remove the four screws holding the bearing cap, and the two screws securing the magnet assembly. **Do not disturb the centre screw of the three fixing the magnet ;** this holds the magnet assembly together, and is not used for securing the magnet to the bearing cap. When removing the magnet fixing screws, make sure not to displace the magnet shims.
(3) Withdraw the cap, exposing the bearing.
(4) If the grease has lost its oil content, the bearing must be removed, thoroughly washed in petrol, and repacked with fresh grease.

To remove the bearing for this purpose, first remove the nuts (left-hand thread) fixing the flicker-shutter to the spindle. Then insert four 4 BA × 1½" long screws into the holes, which contained the bearing cap fixing screws. Use these as jack-screws, tightening evenly all round, and the fire-shutter hub, complete with bearing, will be withdrawn.

Gear Drive Assembly

If replacement is required, this assembly can be withdrawn as follows :—

(1) Remove mechanism-box cover, unplug and remove driving motor assembly, and remove motor support bracket.
(2) Remove intermittent mechanism assembly, light tunnel, and changeover shutter assembly.
(3) Remove the three hexagon-headed screws securing the flicker-shutter bearing-housing, from inside of gear drive bracket.
(4) Slacken the two hexagon-headed screws holding the saddle which clamps the end bearing-housing of flicker shutter spindle.
(5) Withdraw the flicker shutter assembly complete with shutter, from the operating side of projector, taking care not to lose the shims fitted between the bearing housing and the gear drive bracket.
(6) Remove top and centre chains.
(7) Remove the three hexagon-headed screws securing the gear-drive mechanism to the mechanism box.
(8) Withdraw the gear drive assembly from the mechanism box.

When reassembling, reverse this procedure, taking particular care to replace the correct shims on the flicker-shutter bearing-housing, so ensuring correct meshing of the bevel gear.

Soundhead Motor

If a new motor is to be fitted remove the old motor as follows :—

(1) Remove drum pressure roller and drum take-up roller, and fit a protective cover over the sound drum. Disconnect and remove the sound optical system, and withdraw the connection plug to the motor.
(2) Remove the three fixing screws, and ease the motor off its spigot. When it is clear, hold it over to the left as far as possible, and lift it out, taking care not to catch the chain sprockets on the main castings. Keep the cover on the motor to protect the windings.

When fitting the new motor use only the shims supplied with it. Make sure that the spigot fits properly and is not burred. Bolt the motor in position, and check that the joint between it and the mechanism box is feeler-tight, ensuring correct alignment. Refit motor plug, and re-connect cables at rear of P.E. cell housing. Refit sound optical system and reconnect exciter lamp leads (the blue and white leads are at the top, and the green and black at the bottom). Re-assemble pressure roller and take-up roller, and test for sound quality.

Film Sprocket Drive Assemblies

The driving shaft and bearings are similar for the top, sound feed, and bottom film sprockets, although the chain sprockets and film sprockets are not similar, and care must be taken not to interchange them ; when fitting new sprockets make sure that they have the correct number of teeth. In each case, the pad roller spindles are fitted to a clamp on the front boss, and must be removed before withdrawing the shaft. The chain sprocket is keyed to the shaft and located by an inner distance piece and an outer screw, but it is not necessary to remove the sprocket to withdraw the driving shaft, as the screws fixing the bearing housing to the mechanism box are accessible through holes in the sprocket. The chains can be removed by easing the tension of the appropriate jockey sprocket.

Inching Assembly

This is composed of a two-bearing housing, a driving shaft, a distance piece between the bearings, a chain sprocket, and the operating handle. The handle is screwed on to the shaft and secured by a taper pin.

The bearings are mounted eccentrically in the housing, and the sprocket acts as a tension-adjuster for the sound feed sprocket drive chain. The bracket for the jockey sprocket of the bottom drive chain is mounted concentrically on the bearing housing.

SERVICE AND MAINTENANCE

Gate Assembly

This assembly has been carefully fitted and adjusted at the Factory, and it is inadvisable that anyone other than a BTH Service Engineer should remove it. If, however, its removal is considered essential, proceed as follows :—

(1) Remove framing lamp, take out the three 2BA fixing screws, and lift the gate off its dowels. Disconnect the framing lamp lead. Take care of the shims, as they must be replaced when re-assembling.

(2) Remove pressure springs and adjusting screws, etc., first removing the springs from their locating slots. Remove lateral guide rollers, spring, spacer, and spindle. Remove the three heat reflectors and their distance pieces.

(3) Remove the 4BA screws securing the inner and outer casings. The outer gate casting and pressure spring retaining plate are distinguishable by the clearance holes for the framing lampholder.

Re-assembly is a reversal of these operations. Take care when re-fitting the pressure springs to make sure that the loop in each spring is at the bottom of each pair.

The heat reflectors are not dowelled, and will have to be re-aligned with the aperture plate on the moving part of the gate. The film surface of the outer guide roller should be in line with the periphery of the top sprocket.

The moving part of the gate may be taken off its pivot by removing the retaining screw, thrust washer, key washer, and torsion spring. Shims are used to line up the moving part with the fixed gate and these must be replaced correctly. The film guides are registered in position, and the aperture plate is fixed by two screws and nuts.

Spoolbox Clutches

The adjustment of the hold-back clutch in the top spoolbox is correct when (a) the film is not too tight when pulling off, and (b) the spool does not over-run when the motor is switched off. The spring tension is adjusted by a knurled nut accessible when the spoolbox rear cover is removed.

The adjustment of the take-up clutch in the bottom spoolbox should be such that the clutch will operate with minimum pressure, i.e. it should just keep the film taut between the hold-back sprocket and the spool.

If correct clutch friction cannot be obtained by these adjustments, the cause is probably incorrect lubrication. Over-oiling will make the clutch slip, and under-oiling will make it tight. The clutch assembly can be removed as a unit by undoing the three fixing screws.

On the bottom spoolbox only, a screw-down greaser is fitted. This should be given one turn each month.

slots in the eddy current disc. For a bottom "ghost," move the flicker shutter anti-clockwise.

An even top and bottom "ghost" can be cleared by adjustment of the extension pieces on the flicker shutter blades, but care must be taken to avoid loss of light.

ELECTRICAL DETAILS

Contactors

The contactors on the Contactor Panel and Control Gear Unit should be inspected at frequent intervals. Remove any dirt or copper dust from the arc chutes ; check the condition of all connections and fixing nuts ; and examine all working parts, replacing badly worn components.

The main contacts may assume a matt appearance ; this is not detrimental, and these contacts, being silver plated, should **not** be cleaned with emery-cloth, although dirt or oxide should be removed occasionally with carbon-tetrachloride.

SERVICE AND MAINTENANCE (cont'd)

Unless otherwise stated, the following instructions apply to projectors delivered after January 1st, 1950.

Gate Assembly

This assembly has been carefully fitted and adjusted at the Factory, and it is inadvisable that anyone other than a BTH Service Engineer should remove it. If, however, its removal is considered essential, proceed as follows :—

(1) Remove framing lamp, take out the three 2BA fixing screws, and lift the gate off its dowels. Disconnect the framing lamp lead. Take care of the shims, as they must be replaced when re-assembling.

(2) Remove pressure springs and adjusting screws, etc., first removing the springs by releasing the tension and unhooking from the top and then from the bottom. Remove the three heat reflectors and their distance pieces.

(3) Remove the 4BA screws securing the inner and outer casings.

Re-assembly is a reversal of these operations.

The heat reflectors are not dowelled, and will have to be re-aligned with the aperture plate on the moving part of the gate. The film surface of the lower guide pellet should be in line with the outer edge of the top sprocket.

The moving part of the gate may be taken off its pivot by removing the retaining screw, thrust washer, key washer, and compression spring. Shims are used to line up the moving part with the fixed gate, and these must be replaced correctly. The film guides are registered in position, and the aperture plate is fixed by two screws and nuts.

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Spoolbox Clutches

The adjustment of the hold-back clutch in the top spoolbox is correct when (a) the film is not too tight when pulling off, and (b) the spool does not over-run when the motor is switched off. The spring tension is adjusted by a knurled nut accessible when the spoolbox rear cover is removed.

The adjustment of the take-up clutch in the bottom spoolbox should be such that the clutch will operate with minimum pressure, i.e. it should just keep the film taut between the hold-back sprocket and the spool.

If correct clutch friction cannot be obtained by these adjustments, the cause is probably incorrect lubrication. Over-oiling will make the clutch slip, and under-oiling will make it tight. The clutch assembly can be removed as a unit by undoing the three fixing screws.

On the bottom spoolbox only, a screw-down greaser is fitted. This should be given one turn each month.

PICTURE STEADINESS

If picture is unsteady, check that the gate-catch spring is sufficiently strong to hold the moving part of the gate in close contact with the fixed part. Check that the surfaces of the skids on the moving part are in close contact with the spring anchor plates on the fixed part, and feeler-tight within 0·003″ over the whole length of both skids. Check that the surfaces of the guides on the moving gate are in line within 0·0015″. By means of the special gauge, check that the flange of the outer guide roller is 0·010″ clear of the edge of the intermittent sprocket.

With the film in the gate, and the intermittent pad roller open, check by use of the inching handle that the film is being guided on to the intermittent sprocket correctly, i.e., with the teeth in the centre of the sprocket holes. If not, the position of the top guide roller must be altered to suit.

Close intermittent pad roller, and repeat. By opening the pad roller after inching, and examining with a mirror, check that the film is still being guided correctly on to the sprocket. Check that the film surface of the intermittent pad roller is parallel with the sprocket, and that the sprocket, film guides, and pressure springs are clean and free from emulsion.

No alignment of the picture relative to the screen must be attempted by adjustment of the mechanism, but the projector must be moved bodily until the best result is obtained.

GHOSTING

" Ghosting " is corrected by adjustment to the flicker shutter. To clear a top " ghost," which is caused by a " slow " shutter, slacken the screws fixing the flicker shutter dish, rotate the dish clockwise the required amount, and re-tighten the screws. These screws are accessible through slots in the eddy current disc. For a bottom " ghost," move the flicker shutter anti-clockwise.

An even top and bottom " ghost " can be cleared by adjustment of the extension pieces on the flicker shutter blades, but care must be taken to avoid loss of light.

ELECTRICAL DETAILS

Contactors

The contactors on the Contactor Panel and Control Gear Unit should be inspected at frequent intervals. Remove any dirt or copper dust from the arc chutes ; check the condition of all connections and fixing nuts ; and examine all working parts, replacing badly worn components.

The main contacts may assume a matt appearance ; this is not detrimental, and these contacts, being silver plated, should **not** be cleaned with emery-cloth, although dirt or oxide should be removed occasionally with carbon-tetrachloride.

SERVICE AND MAINTENANCE (cont'd)

The contact tips of the contactors should be replaced when worn half-way through. The correct contact pressure is important, and faulty springs should be renewed without delay. Contact heating is generally due to dirty contacts or faulty springs.

Switches

All switches except push-button switches are fitted with self-cleaning contacts, and if properly adjusted should require no attention. Push-button switches, however, should periodically be cleaned with carbon-tetrachloride, or, if the contacts are burnt, with fine emery cloth.

The changeover switch contacts are self-cleaning, but should be frequently examined for possible burning. If the burning appears excessive, the arc suppression circuit is probably at fault.

Where there is any doubt about the condition of a switch, it should be replaced without delay.

Amplifier and Rectifier Units

All plugs and sockets connecting Amplifier and Power Supply trays should periodically be inspected for signs of bad connection, wear, or damage. Make sure that the plug retaining clips are fastened. After withdrawing a tray, check that the valve top-cap connectors are securely in place.

Tables 2 and 3 are valve test figures taken on Amplifier and Rectifier Units picked at random. These figures may be used as a rough guide for use in fault diagnosis, routine inspection, etc., but they **must not** be taken as limits.

Except as stated in the foot-notes to Table 1, all readings were taken with an " AVO " meter Model 7 on the appropriate range.

TABLE 2

Circuit	Valve Type	Volts to Earth					Anode Current Milliamps	Heater Volts	See Footnote
		Anode	Anode	Grid	Cathode	Heater			
Deaf Aid	UG 5	225-0-225	—	—	—	—	—	4·0	—
Amplifier	Pen.45	270	240	—	—	—	—	4·0	—
Fader Amplifier	V 455	115-150	130-150	—	—	—	1·1-1·9	3·5	(1)
	SP 41	112-125	95-105	—	—	—	1·6-2·0	3·5	—
Power Amplifier	11 E1	460	250	—13	—	—	50	6·3	(2)
(45 watts)	SP 41	100-145	200-210	—	—	—	4·7-6·8	3·5	(3)
Power Amplifier	11 E1	495	250	—15	—	—	50	6·3	(2)
(90 watts)	SP 41	100-145	200-210	—	—	—	4·5-6·5	3·5	—
Rectifier Unit	7475	90-110	—	—	—	—	—	—	(4)
(45 watts)	UU 5	550-0-550	—	—	475	—	—	4·0	—
	11 E1	460	460	—	250	250 A.C.	—	6·3	—
	SP 41	240	160	90-100	90-110	80 D.C.	—	3·5	(5)
Rectifier Unit	7475	90-110	—	—	—	—	—	—	(4)
	UU 5	570-0-570	—	—	475	—	—	4·0	—
	11 E1	485	485	—	250	250 A.C.	—	6·3	—
	SP 41	240	160	90-100	90-110	80 D.C.	—	3·5	(5)

NOTES : (1) Anode current measured with volume control at maximum.
(2) Grid voltage measured with " AVO " on 400v. Range.
(3) Screen voltage measured with " AVO " on 1000v. Range.
(4) Voltage measured with Electrostatic voltmeter.
(5) Anode and Screen voltages measured with " AVO " on 1000v. Range. Grid voltage measured with Electrostatic voltmeter.

TABLE 3

	Exciter Lamp Supply Unit	Sound Changeover Relay Supply Unit
A.C. Voltage feeding rectifier bridge	12·3 volts	125 volts
D.C. Output on load (running position)	8·5 volts	—
D.C. Output across C 80	—	150 volts

SERVICE AND MAINTENANCE (cont'd)

Loudspeakers

Periodically check over all connections and fixing bolts.

At frequent intervals, check the operation of all the L.F. Units, the most frequent fault being an open-circuited speech coil ; the correct resistance of the speech coil is 7·5 ohms, ± 7½%.

When a replacement unit is being fitted, make sure that it is of the same type as the original, and that it is correctly connected, i.e., **speech coils in parallel and field coils in series.**

The failure of an H.F. Unit causes a serious loss of H.F. output. Again, the usual cause is an open-circuit. The speech coil resistance is 5·8 ohms ± 7½%, and in the case of wound field units, the field resistance is 340 ohms ±10½%. As in the case of the L.F. Units, it is most important that replacements should be of the correct type and correctly connected. Make sure that neither speech nor field coil is short-circuited to earth.

Check the performance of the Speakers at intervals, with full frequency range audio input at the usual level of volume. The Filter Unit Switch should be operated at frequent intervals to ensure that its contacts are in a satisfactory condition.

When removing or replacing the Monitor Speaker, take care that it is not damaged by the magnet assembly being attracted to the steel-tube housing in the Stand. The Speaker should be supported from the rear while a second person guides the front into position.

Microphone and Gramophone Transformers

On the rare occasions when trouble is experienced on these transformers, it is generally due to an open-circuit between the windings and solder tags or connections. If, however, the fault is internal, the transformer must be replaced.

P.E. Cells

If the output levels of the Reproducer Units are unbalanced they should be corrected by means of the potentiometer in " B " P.E. cell excitation circuit.

The P.E. Cells are fed via a potential divider from the stabilized 250 volt line, and there is little possibility of a voltage variation. However, if it is desired to check this voltage, an electrostatic voltmeter must be used, **not** an " AVO " meter, and the reading should be 88 volts from terminal 4A to earth.

Gramophones

The light-weight pick-up is fitted with a new type of stylus, or " needle," which is capable of about 1000 playings before replacement is necessary. The stylus is easily pulled out by gripping the aluminium collar with the fingers, but, once inserted, it should not be pulled out again until it is finally discarded. Both stylus and pick-up are easily damaged by careless handling.

The gramophone motors must be kept clean and dry. The bearings require little lubrication, but should be given a few drops of best quality lubricating oil at 6-monthly intervals.

ARC LANTERN

Gear Box and Feed Mechanism

The motor only requires lubrication at very long intervals, but periodically the commutator should be inspected and, if necessary, cleaned with fine carborundum cloth. At the same time check that the brushes are not unduly worn.

The correct setting for the armature of the gear-box solenoid is such that, closed, the pin on the link only allows the pawl to pick up one tooth per stroke ; and, open, the pin is **just clear** of the pawl as it picks up three teeth per stroke. If the clearance is too great, the solenoid may not always close on low line volts, resulting in excessive positive carbon feed.

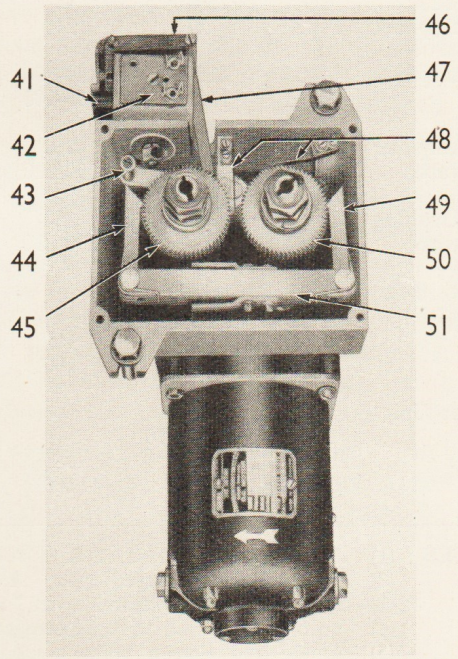


Fig. 12. Top view of Motor and Feed Ratchets.

41. Adjusting screw for three teeth per stroke and solenoid gap.
42. Solenoid.
43. Interference pin operated by solenoid 42.
44. Positive pawl.
45. Positive ratchet.
46. Adjustment for one tooth per stroke.
47. Push-rod.
48. Non-return springs.
49. Negative pawl.
50. Negative ratchet.
51. Rocking lever that actuates pawls.

SERVICE AND MAINTENANCE (cont'd)

Remove the hand-feed knobs and cover-plate. Switch on the arc and note action of the positive pawl (44, Fig. 12), with the thermal relay contacts closed. The ratchet wheel should move only one tooth for each stroke of the pawl. If operation is incorrect, switch off the arc and obtain a thin screwdriver and a 4 BA box spanner through which the screwdriver will pass.

The length of the push-rod 47 probably requires adjustment and to do this, open the left-hand door of the lantern and fit the box spanner over the locknut on the screw indicated at 46, Fig. 12, at the end of the armature. Pass the screwdriver through the box spanner, unlock the nut, and turn the screwdriver (clockwise to lengthen push-rod). Re-lock the nut, and re-check operation.

When the relay contacts are open, the solenoid armature should also be open, and pawl 44 at the end of its stroke should just clear pin 43. If the clearance is excessive, the armature is too far open, and may have difficulty in closing on low arc volts. The armature-travel can be adjusted by means of the stop-screw 41 at the side of the solenoid.

All settings should now be tested with the arc running, checking that the ratchet-pawl correctly engages one or three teeth, while the solenoid opens and closes without hesitation ; when necessary the non-return springs 48, Fig. 12, should be re-set to register each tooth correctly, but they should not apply too great a pressure.

Removal of Motor and Gear-box

The motor is spigot-mounted and can be removed without dismantling the gear-box by first disconnecting the leads from the terminal board at the base of the speed-control rheostat, and then removing the three screws that hold the motor to the gear-box.

To remove the gear-box, ease the tension on the positive driving chain by inserting an 0 BA screw with washer in the tapped holes in the plunger in the bearing of the front sprocket. Tighten the screw until the springs are fully compressed, and lift the chain off the gear-box sprocket. Unbolt the gear-box and unsolder the connections to the ratchet-housing solenoid. The gear-box can then be lifted out.

Positive Carriage

Fig. 13 is a cross-section of the positive carriage. Bracket 61 carries the positive carbon clamp, and is anchored by stud 63. The weight of the bracket, assisted by a tension spring, draws the stud to the right, and, in so doing, forces the clutch-plate 69 fixed to sprocket 68 against friction washer 70. The sprocket is thus locked, and the movement of the driving chain is transmitted normally to the positive carriage.

If the bracket is lifted, however, the clutch is freed, and the carriage may be moved to any desired position with the sprocket " free-wheeling," but becoming locked again when the bracket is released. Rollers 65, 71, and 72 limit the movement of the carriage on the support tubes.

After prolonged service, it may be found that the positive carbon lies below the optical axis of the lantern, indicating that the friction washer 70 is worn. This may be corrected by slackening lock-screw 67 and tightening nut 66, afterwards retightening 67. Worn rollers must be replaced.

Arc-Striking Mechanism

To allow the mechanism to start its movement without load, a small amount of free motion is provided by a slotted link in the time delay mechanism. On high line volts this might cause a tendency to snatch, and this tendency is corrected by the $\frac{3}{4}$" diameter washer on the pin connecting the striking lever to the delay mechanism. Low line voltages may cause the solenoid plunger to fail to complete its travel, due to the delay mechanism coming into play too early ; in that case replace the $\frac{3}{4}$" washer with one of $\frac{1}{2}$" diameter.

Keep the negative carriage guide rods clean of arc bloom, and lightly lubricated with graphite.

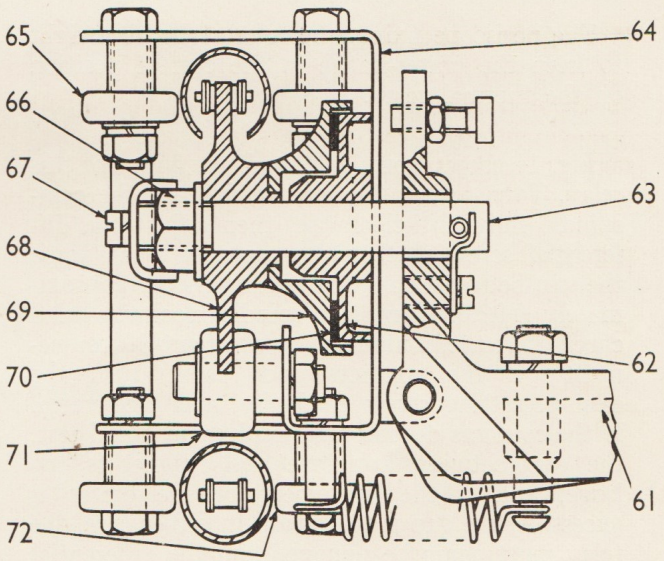


Fig. 13. Cross-sectional view of Positive Carriage.

61. Bracket carrying positive head.
62. Bearing.
63. Retaining stud.
64. Carriage.
65. Rollers.
66. Adjusting nut.
67. Lock-screw.
68. Sprocket.
69. Clutch plate.
70. Friction washer.
71. Roller.
72. Rollers.

SERVICE AND MAINTENANCE *cont'd)*

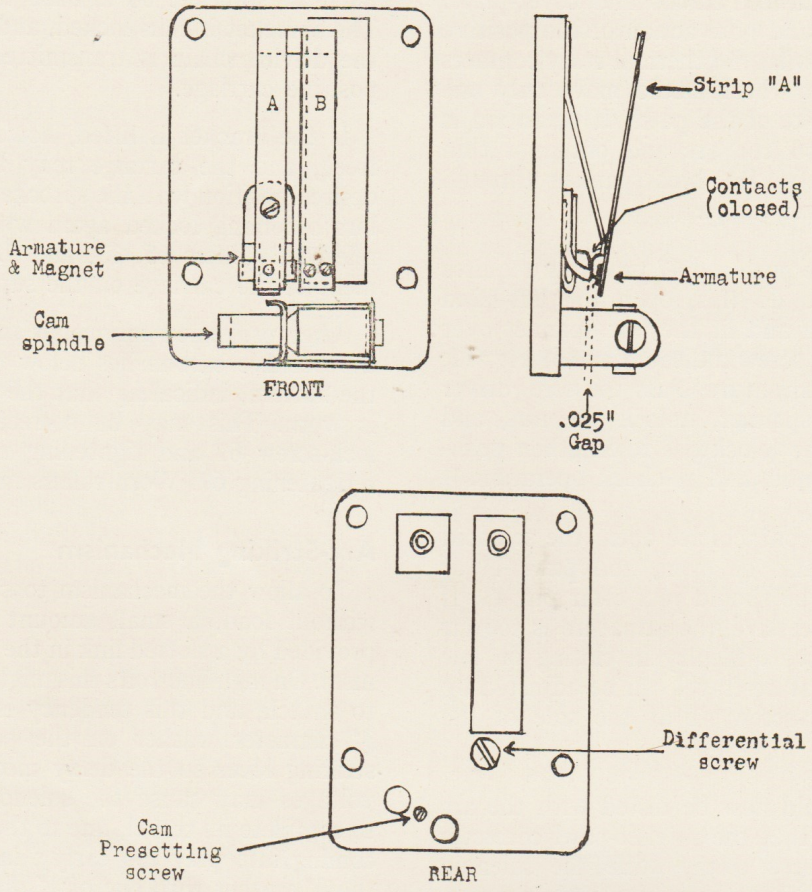


Fig. 14. Thermal Relay Assembly Details.

Automatic Focus Control

The periscope fixing screws must be kept tight to keep the crater-image in the correct position on the thermal relay.

Fig. 14 shows front, side, and rear views of this relay. To re-adjust the setting, first set the cam-spindle fully anti-clockwise, then adjust the differential screw so that the contacts touch when the gap between armature and magnet is approximately 0·025". Turn cam-spindle clockwise, and check that the contacts part at about 90° movement ; if the contacts open early, turn the cam presetting screw clockwise, and vice versa. If the contacts chatter after replacement and test, the gap between armature and magnet is too large, and if the movement of the crater is excessive, the gap is too small. In either case, the relay must again be removed and the differential screw adjusted, 10° anti-clockwise to correct chattering, and 10° clockwise to prevent excessive crater-movement.

The contacts should be cleaned with a pipe-cleaner moistened with carbon tetrachloride passed through the grille at the side of the relay.

Positive Carbon Indicator

Should the Bowden cable break, take care not to kink the new cable when re-threading. On later models, cable renewal can be simplified by the removal of the complete indicator assembly. Having done that, pass the new cable round the pulleys, slightly tension the spring, and temporarily clamp the free end of the cable at the spring end. Refit the indicator, connect up the cable, and release the temporary clamp. Make sure that the indicator reads zero when the positive carriage is at the end of its stroke.

The indicating pin must always be free in its slot.

Mirrors

Mirrors should be removed daily for cleaning. Glass mirrors should first have carbon spots removed and should then be cleaned with BTH C 64188 or other suitable cleaning compound, taking care not to wet the back of the mirror. Metal mirrors should be dusted, with care to avoid scratching the reflecting surface, and a suitable high-grade metal polish, as used for silver, should then be applied.

Glass mirrors can be re-silvered at a reasonable cost, but the front face, if spattered and damaged, cannot be re-polished.

SERVICE AND MAINTENANCE (cont'd)

CLEANING

Scrupulous cleanliness is essential to ensure continued satisfactory operation. The gate runners and other parts of the gate must be kept free from emulsion, and the gate should be inspected, and if necessary cleaned, after every reel. Each day the following items should receive special attention :—

(a) Film-sprockets should be cleaned, and any dirt or emulsion removed from between the teeth.

(b) Spoolbox fire traps and rollers should be cleaned and inspected for any small pieces of broken film or other foreign matter collecting behind the rollers.

(c) Clean pad-rollers and gate guide-rollers and see that they rotate freely.

(d) Clean gate aperture plate, using a piece of wood or brass to remove emulsion.

(e) Open gate fully, clean and inspect moving part.

(f) Remove any traces of surplus oil from the projector and spoolboxes.

(g) Examine lens surfaces, and if necessary clean carefully with a soft cloth which should be reserved for the purpose.

(h) Remove lantern mirror and clean as described in the preceding section, "ARC LANTERN."

(i) Clean the lantern nose-glass, empty the slag-tray, and remove any carbon dust from the main lantern-tray.

The paintwork of the projector body should be cleaned with soap and water (using a minimum of the latter) and finished off with any good brand of car polish.

LUBRICATION

Intermittent Mechanism

On Installation, after setting the projector to its required angle of rake, remove the breather from the top of the intermittent mechanism. With the aid of the oil measure and special funnel provided, pour 25 cc. of "Asteroil AA" in the box. Replace the breather and rack the mechanism round until the oil is just level with the line in the centre of the oil sight. To enable this position to be repeated when checking for loss of oil, mark the top of the framing-handle bearing with a centre punch and make a corresponding mark on the boss of the framing handle.

Each month, check oil level. When the position described above is repeated, oil should still be visible in the oil sight.

Every three months, drain intermittent mechanism, swill out with clean oil, and refill with 25 cc. of clean "Asteroil AA."

Replacing Mechanism. When replacing the intermittent mechanism, the outside diameter of the cross-spindle bearing-casing should be well smeared with "Crimsangere No. 8" grease.

Idler Gear. The idler gear is mounted on the cross-spindle bearing-casing, and runs on needle roller bearings which are lubricated for life in the Factory with "Belmoline RB" (BTH 285).

Soundhead

Each month, add two drops of "Asteroil AA" to the coil-end bearing through lubricator inside mechanism box.

The drum-end bearing is lubricated for life in the Factory, with "Crimsangere No. 8" grease, but, in the event of loss of speed due to this grease losing its oil content, a few drops of "Asteroil AA" should be added through the hole provided. This hole will be found sealed with a cheese-headed screw and visible after removing the sound optical system.

Fire-shutter Bearing

On projectors fitted with **50 amp.** lanterns, the fire shutter bearings are lubricated with 4 cc. (about a large teaspoonful) of "Crimsangere No. 8" grease. On projectors with **75 amp.** lanterns, these bearings are lubricated with "Silicone Grease No. 44" (obtainable from Albright and Wilson Ltd., 49 Park Lane, London, W.1.). When Silicone grease is used in these bearings, extra-heavy balance weights are fitted to overcome the sluggishness in closing due to higher viscosity at low temperatures.

Each month check the grease in the bearing (see page 29).

Every three months wash the bearing out, and re-pack with fresh grease (see page 29).

Ball-bearings

All ball-bearings other than those already mentioned are lubricated for life in the Factory, with "Belmoline RB" (BTH 285) and should require no further attention.

Gears

Every three months, the teeth of all gears should be lightly smeared with "Crimsangere No. 1" grease.

Chains

Each month, all three chains should be lubricated with a few drops of "Asteroil AA."

SERVICE AND MAINTENANCE *(cont'd)*

Bottom Spool Take-up Clutch Bearing

This bearing is lubricated with " Belmoline RB " (BTH 285) grease.

Each month the cap of the grease-cup should be tightened down **one turn.**

Sound Drum Guide Roller

This roller runs on two ball-bearings which have been lubricated in the Factory and should require no further attention.

Sound Optical Take-up Roller

The driven spindle of this roller is mounted on the ball-bearings lubricated in the Factory with " Belmoline RB " (BTH 285) grease and require no further attention. The friction drive between the roller and its spindle is maintained by the " Belmoline RB " grease which is packed into the bore of the roller on assembly.

Every three months, the take-up roller should be dismantled from its spindle and repacked with fresh grease.

Pad and Fire-trap Rollers

With the exception of the rollers mentioned above, all pad and fire-trap rollers run on hardened steel spindles and require no lubrication. To prevent rusting when these rollers are removed for cleaning, their spindles should be wiped with a piece of cloth lightly damped with " Asteroil AA."

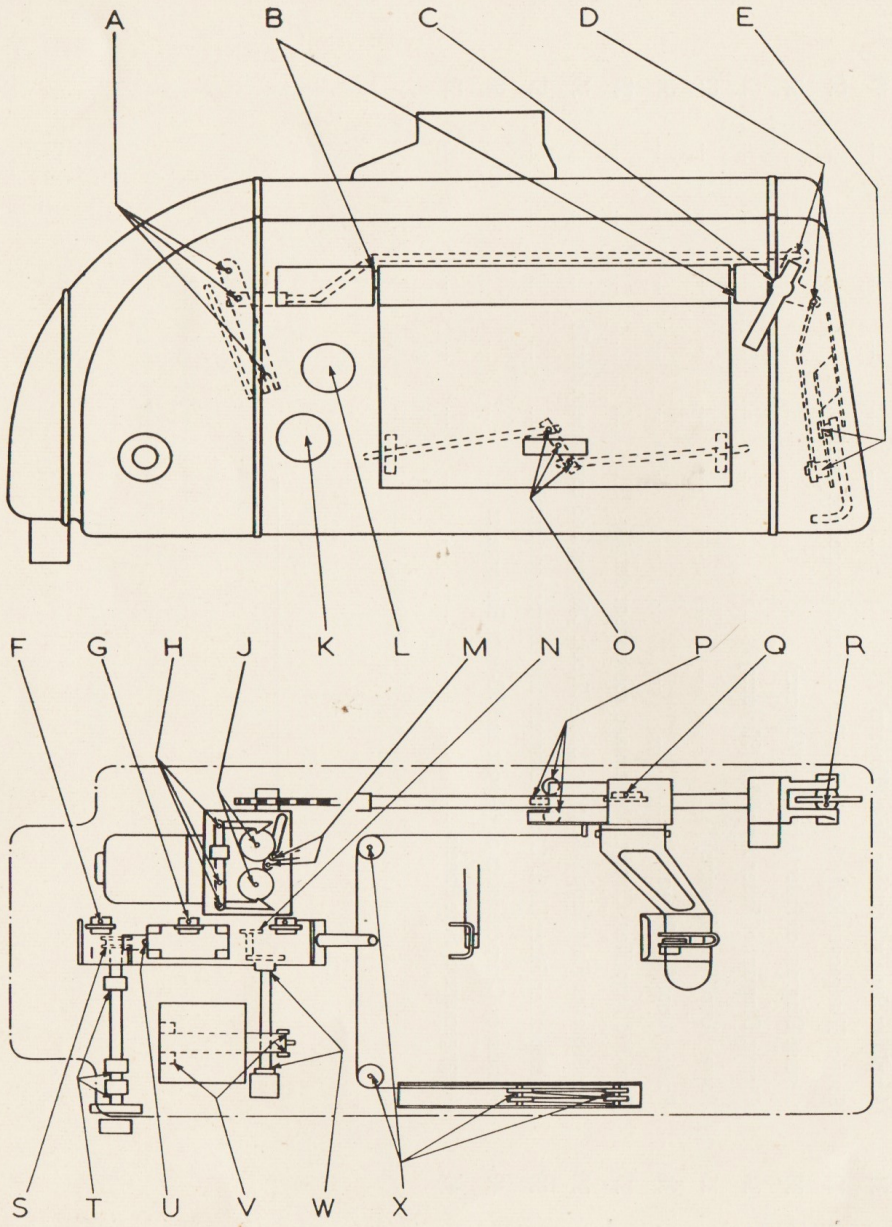
Lantern

Fig. 15 is a lubricating chart of the lantern. Except where otherwise mentioned, the oil used is " Asteroil AA," and the grease a good brand of graphite grease.

NOTICE.

REPLACEMENTS ARE OBTAINABLE FROM ANY SERVICE DEPOT OR FROM THE BRITISH THOMSON-HOUSTON CO., LTD., SOUND REPRODUCER SALES DEPT., RUGBY, WHICH WILL ALSO SUPPLY INSTRUCTIONS SHOULD IT BE NECESSARY TO RETURN APPARATUS TO THE WORKS FOR REPAIR OR OTHER REASON.

COMPLIANCE WITH THIS PROCEDURE WILL AVOID DELAY AND INCONVENIENCE.



Point	Description	Lubricant	Access
Weekly			
P	Positive carriage rollers (not ball races)	BTH 3121	
R	Positive drive front sprocket ..	Oil	Oil-hole
U	Negative collet nut V slot	Grease	Under Negative Carriage.
W	Striking mechanism way-shaft ..	Oil	
Monthly			
A	Mirror-shield mechanism bearing pins	Oil	
F	Negative drive idler sprockets (2) ..	Oil	Oil-holes
G	Negative carriage sprocket	Oil	Oil-hole
H	Driving pawl and lever pins ..	Oil	Remove feed handles and cover and lift out lever.
J	Positive and negative ratchet wheel spindles	Oil (1 drop only per month)	Remove feed handles
K	Mirror adjusting spindles	Oil	Remove mirror frame.
L	Mirror adjusting cams	Grease	Remove mirror frame.
M	Feed control pivots	Oil	Remove feed handles and cover.
N	Arc striking rollers (2 bearings) ..	Oil	Under negative carriage bracket.
Q	Positive clutch sprocket	Oil (1 drop only per month)	
S	Negative tilting cam	Grease	Under negative carriage bracket.
T	Negative tilt and slew spindles ..	Oil	
V	Striking mechanism lever and links	Oil	
X	Carbon length indicator pulleys ..	Oil	Remove bottom tray.
As Required			
B	Side door hinges (L.H. and R.H. doors)	Oil (sparingly)	
C	Shutter handle bearings	Oil	
D	Shutter bell-crank pins	Oil	Remove front heat shield.
E	Shutter hinge	Oil	Remove front heat shield.
O	Side door handle bearings (L.H. and R.H. doors)	Oil	

Fig. 15. Lantern Lubrication Chart.

LIST OF CIRCUIT DIAGRAMS, ETC.

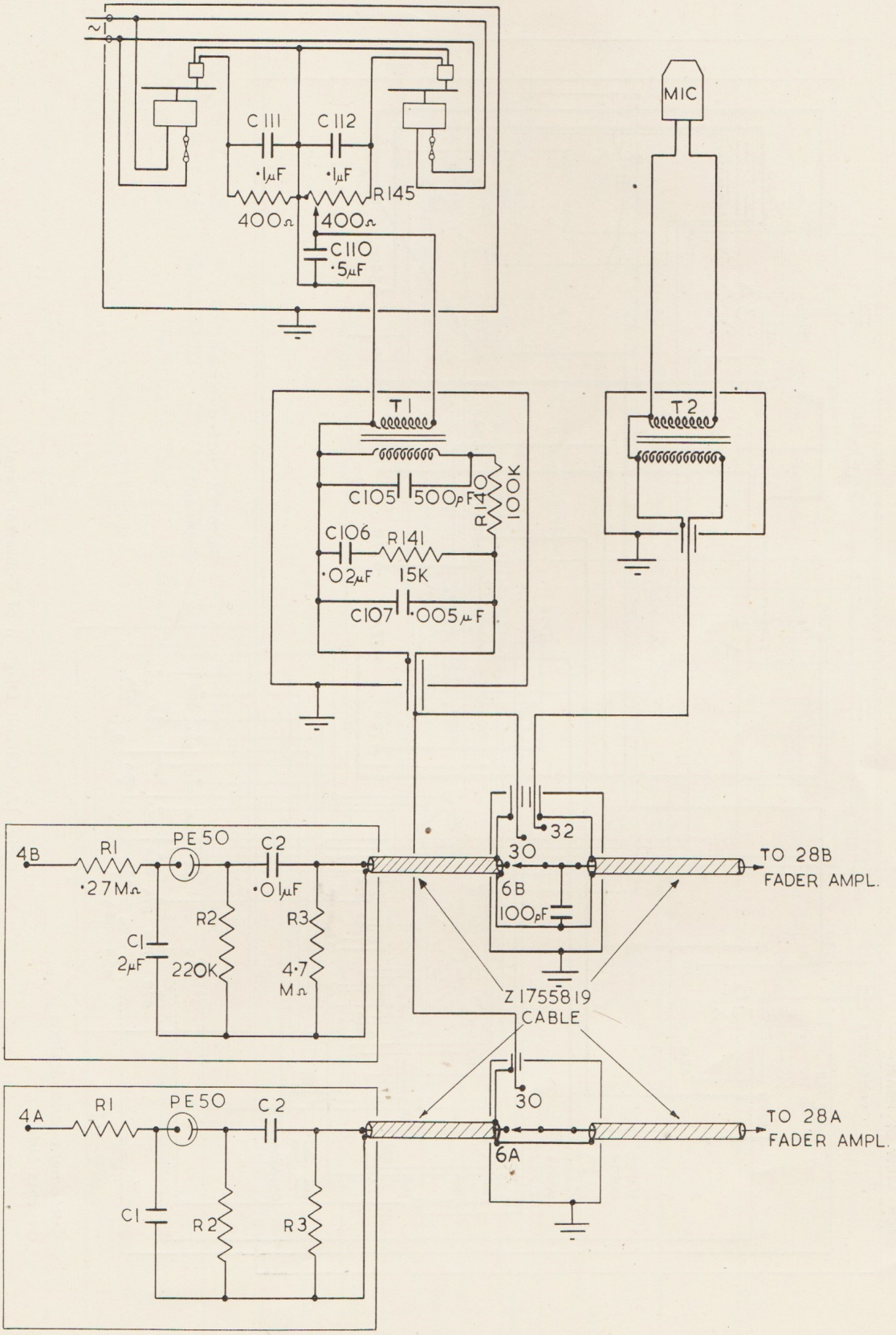


Fig. 16. Input Circuits.

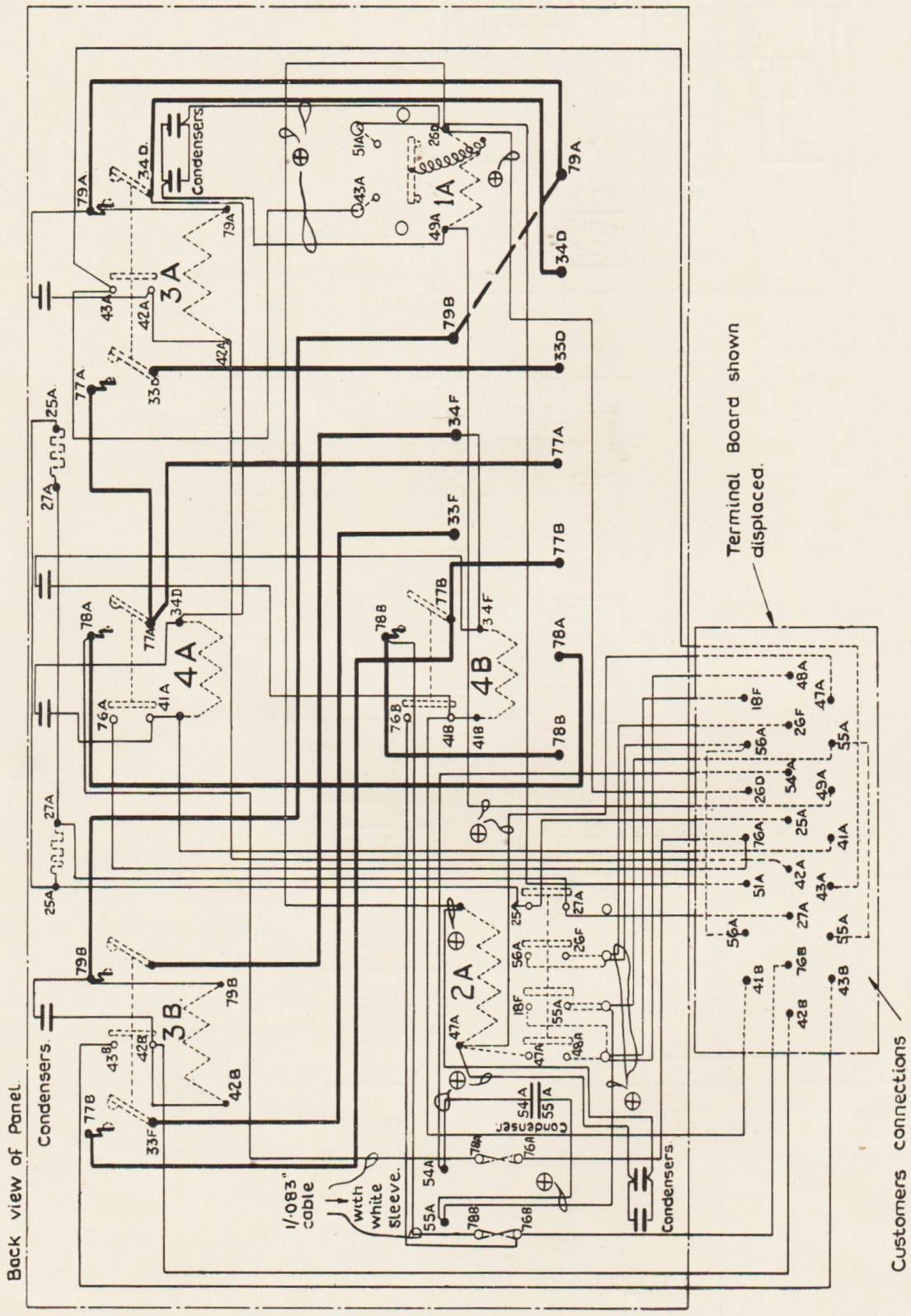


Fig. 17. Circuit Diagram of Contactor Panel.

NOTE : Wiring marked (+) is red, the remainder white.

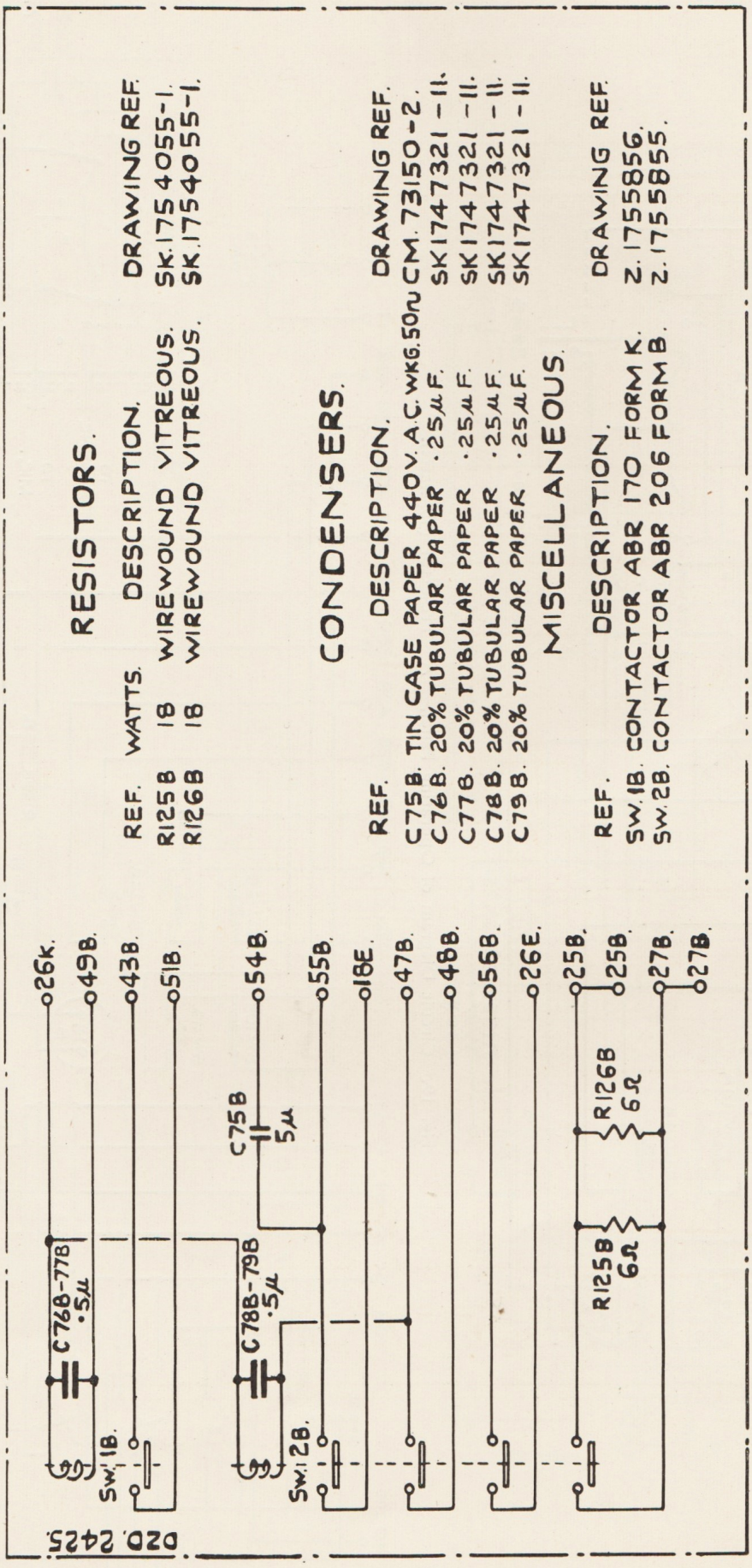


Fig. 18. Circuit Diagram of Control Gear Unit, with details of components.

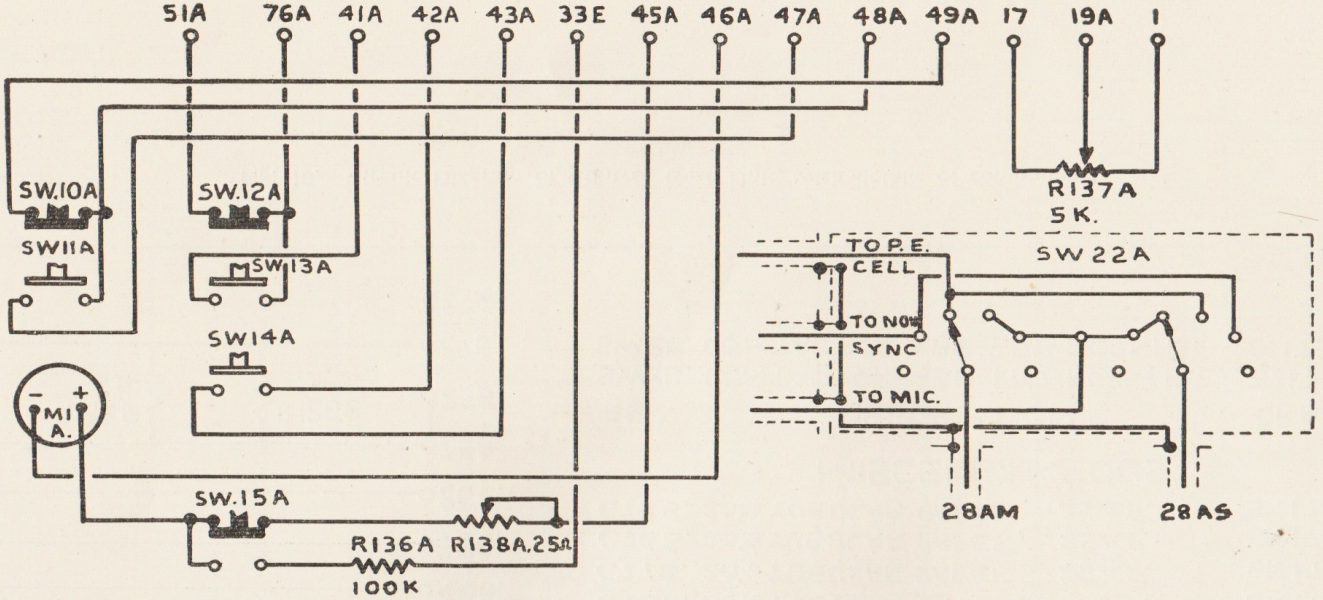


Fig. 19. Circuit Diagram of Operating Panel, "A" Projector (45 watts).

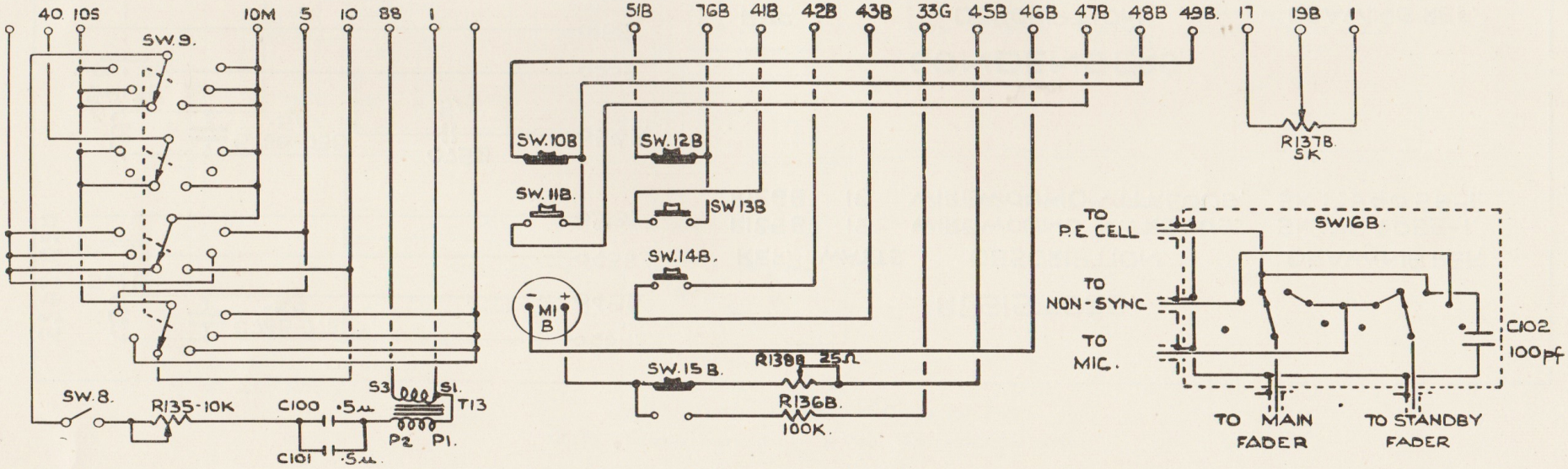


Fig. 20. Circuit Diagram of Operating Panel of "B" Projector (45 watts).

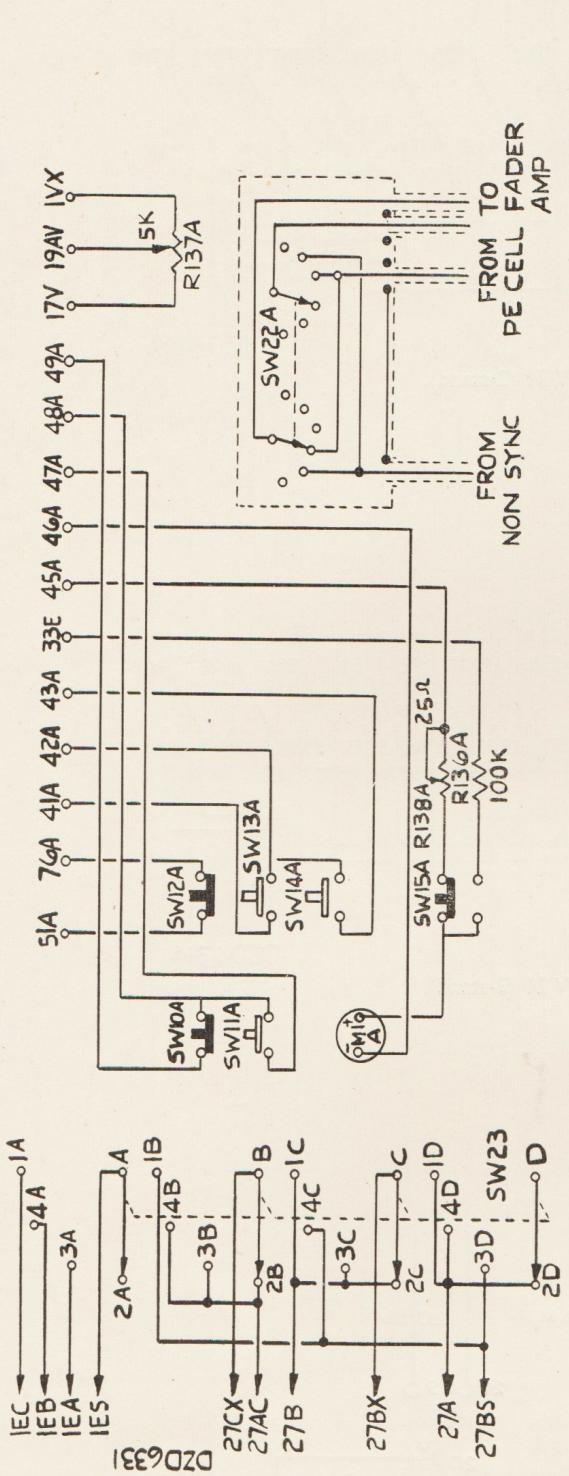


Fig. 21. Circuit Diagram of Operating Panel, "A" Projector (90 watt).

Fig. 22. Circuit Diagram of Operating Panel, "B" Projector (90 watt).

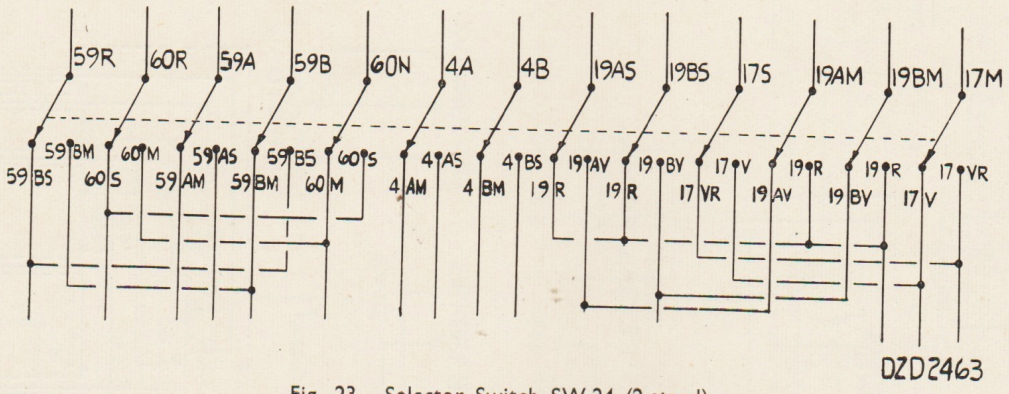


Fig. 23. Selector Switch SW 24 (2-stand).

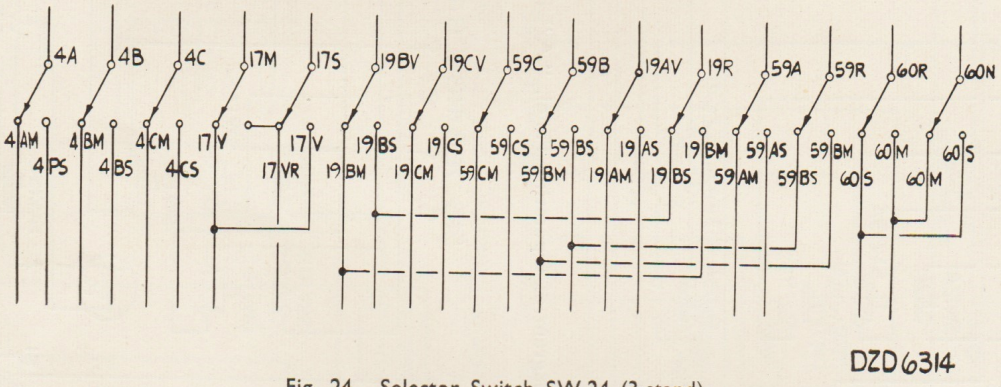


Fig. 24. Selector Switch SW 24 (3-stand).

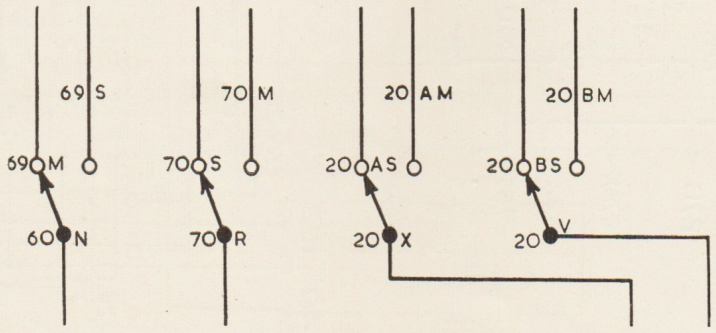


Fig. 25. Selector Switch SW 21 (3-stand).

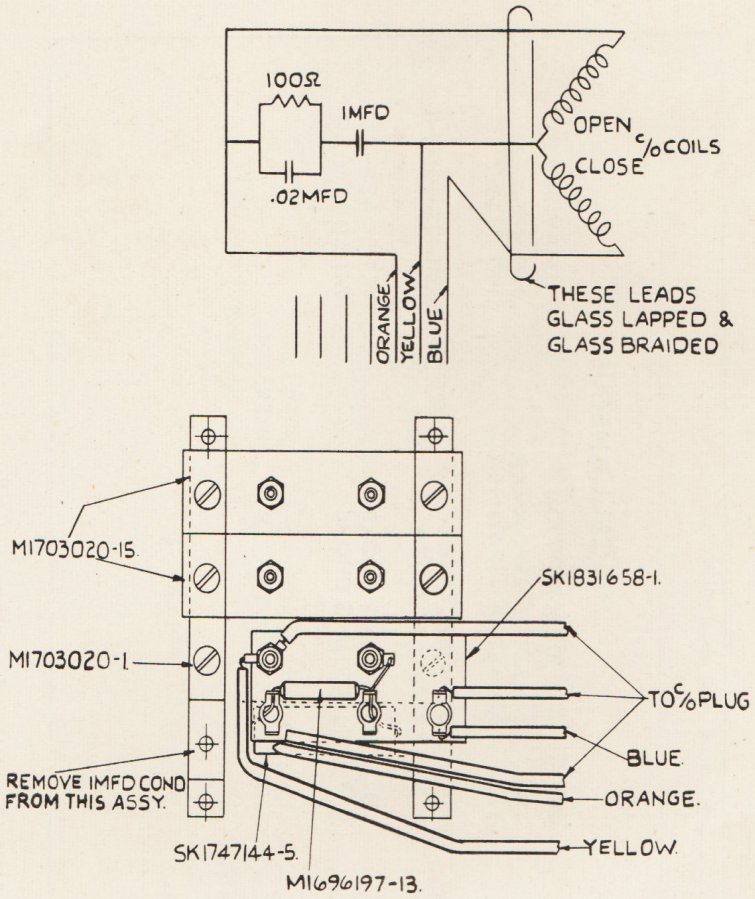


Fig. 26. Arc-suppression Circuit and Arrangement of Components.

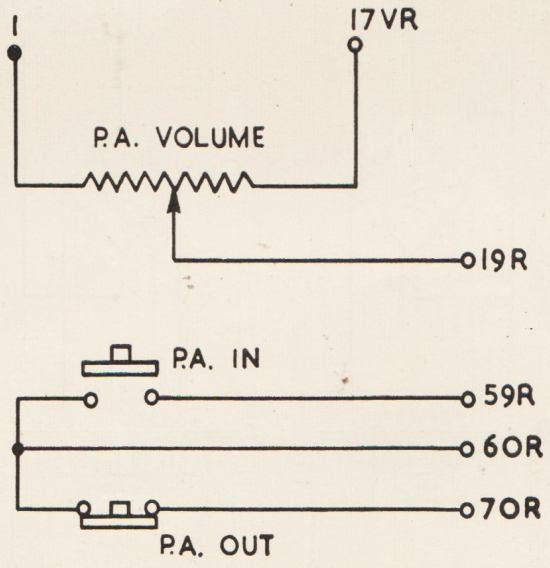


Fig. 27. Circuit Diagram of Remote Control Box.

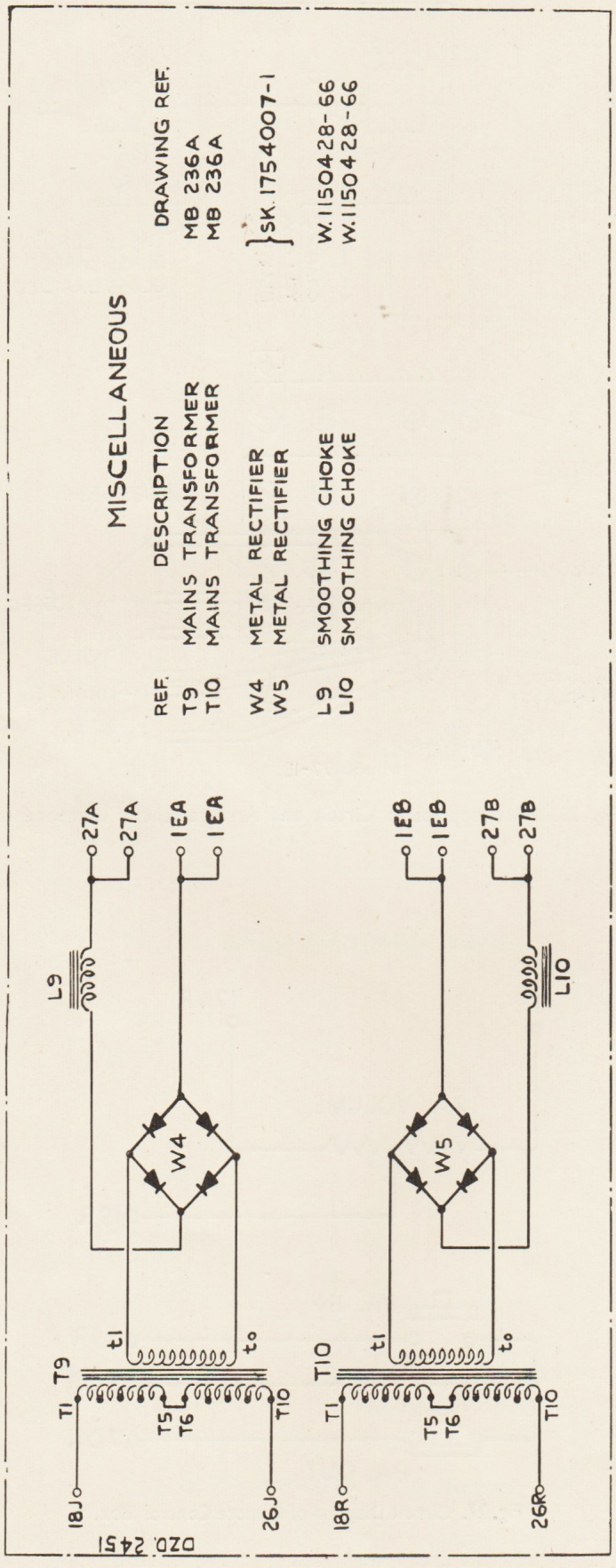
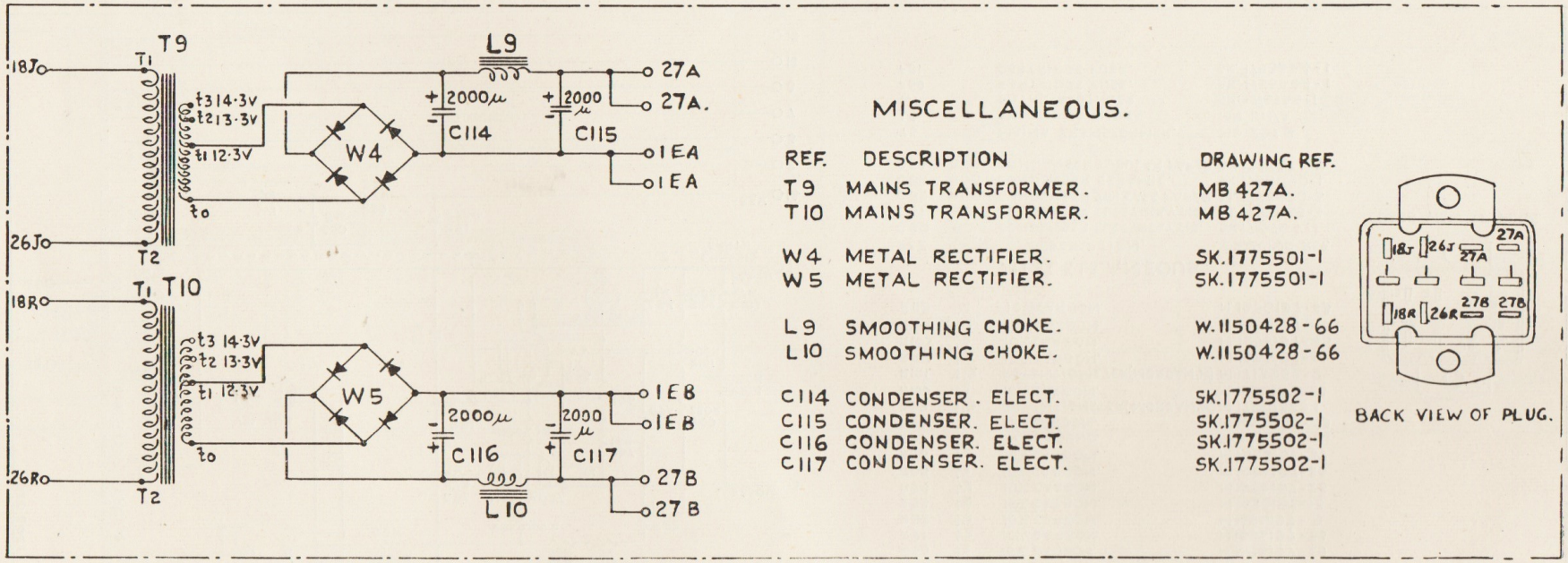


Fig. 28. Exciter Lamp Supply Rectifier Unit (45 watt) and component details.



MISCELLANEOUS.

REF.	DESCRIPTION	DRAWING REF.
T9	MAINS TRANSFORMER.	MB 427A.
T10	MAINS TRANSFORMER.	MB 427A.
W4	METAL RECTIFIER.	SK.1775501-1
W5	METAL RECTIFIER.	SK.1775501-1
L9	SMOOTHING CHOKE.	W.1150428-66
L10	SMOOTHING CHOKE.	W.1150428-66
C114	CONDENSER. ELECT.	SK.1775502-1
C115	CONDENSER. ELECT.	SK.1775502-1
C116	CONDENSER. ELECT.	SK.1775502-1
C117	CONDENSER. ELECT.	SK.1775502-1

BACK VIEW OF PLUG.

Fig. 29. Exciter Lamp Supply Rectifier Unit (90 watts) and component details.

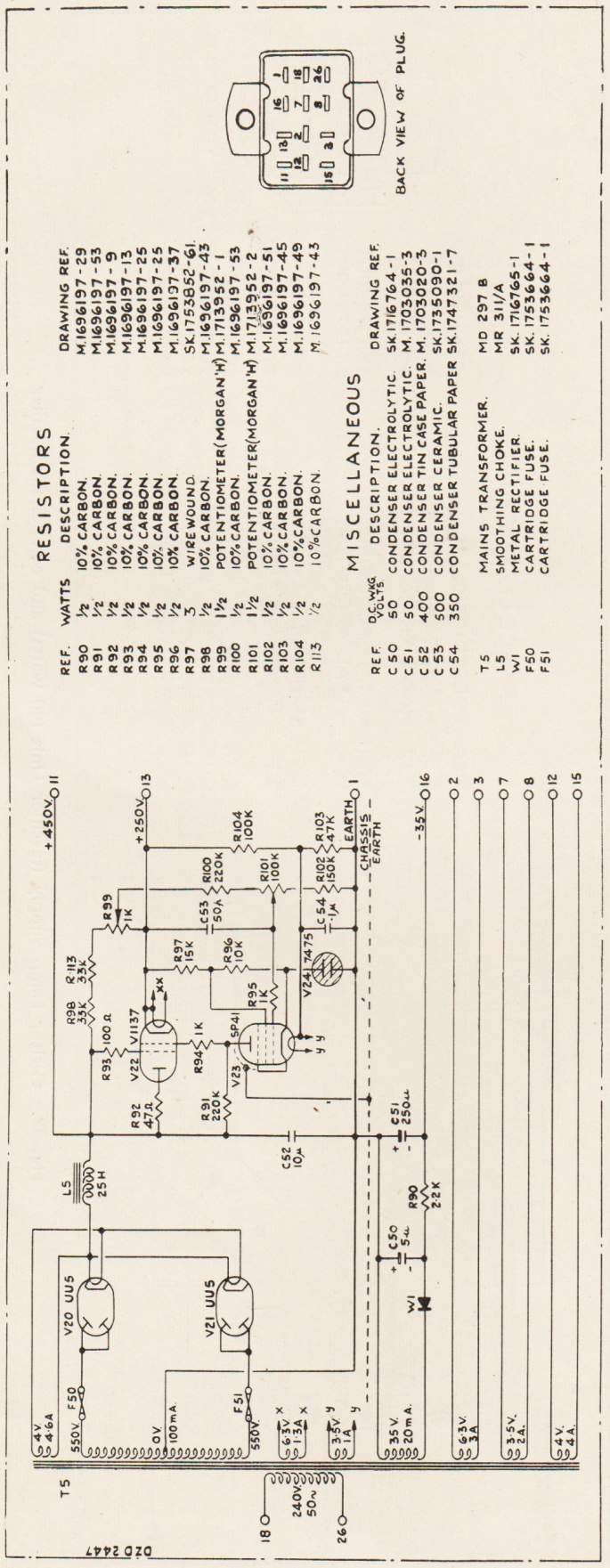


Fig. 30. Amplifier Supply Rectifier Unit (45 watts) and component details.

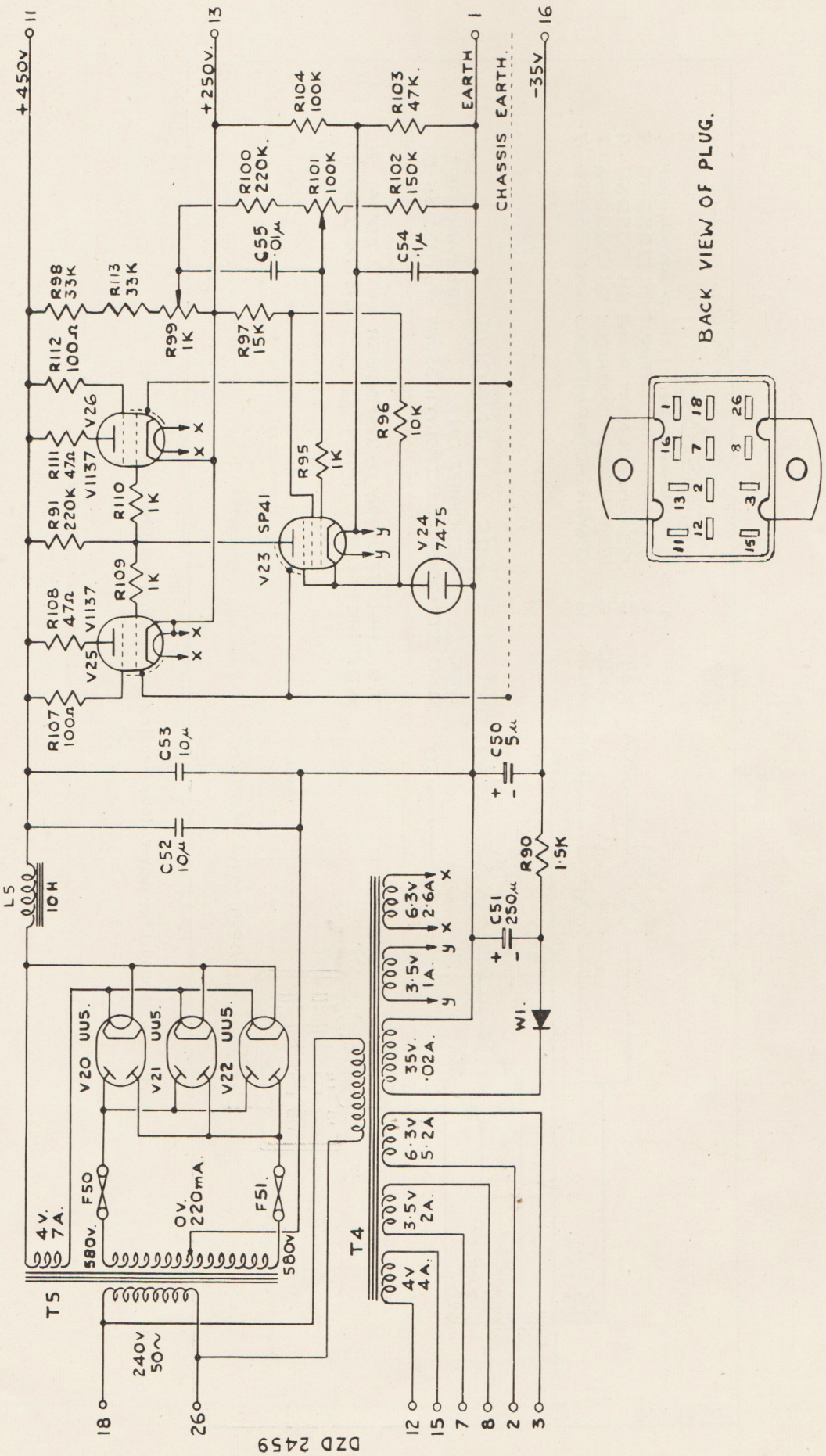


Fig. 31. Amplifier Supply Rectifier Unit (90 watts).

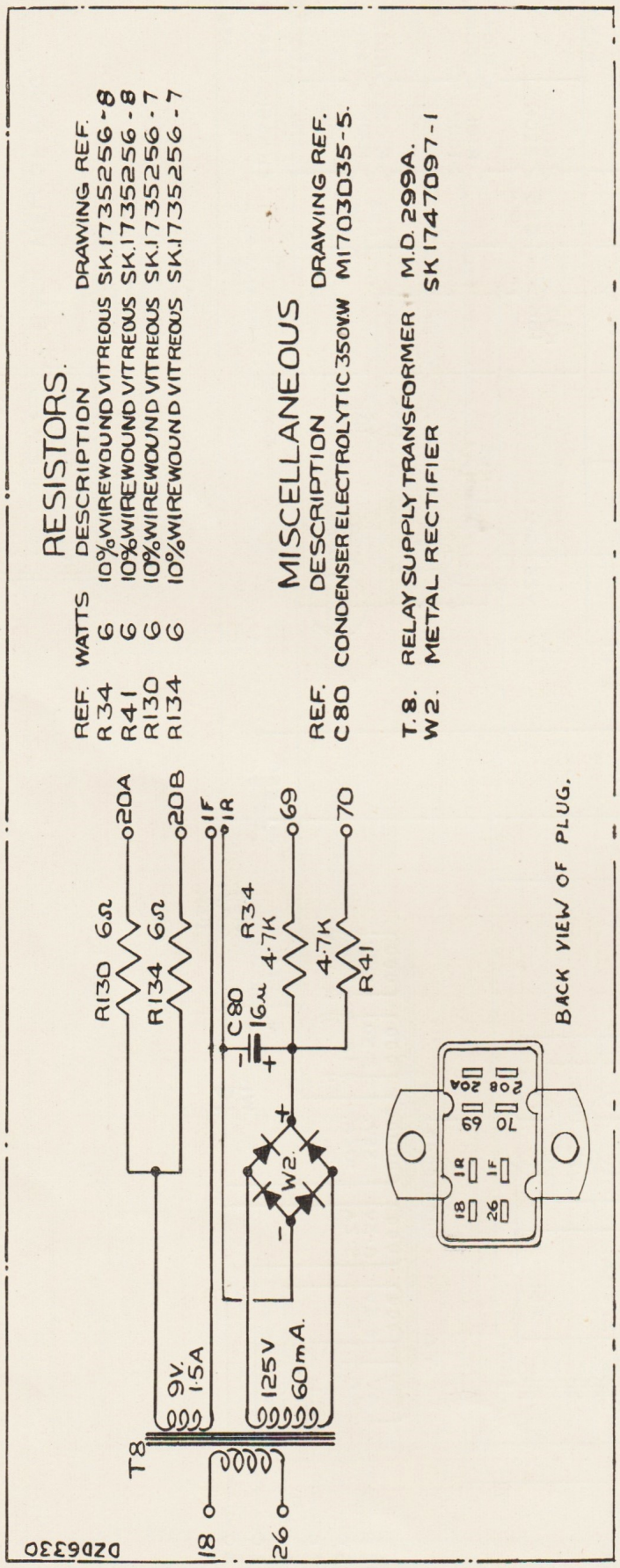


Fig. 32. Sound Changeover Relay Supply Rectifier Unit, and Component details.

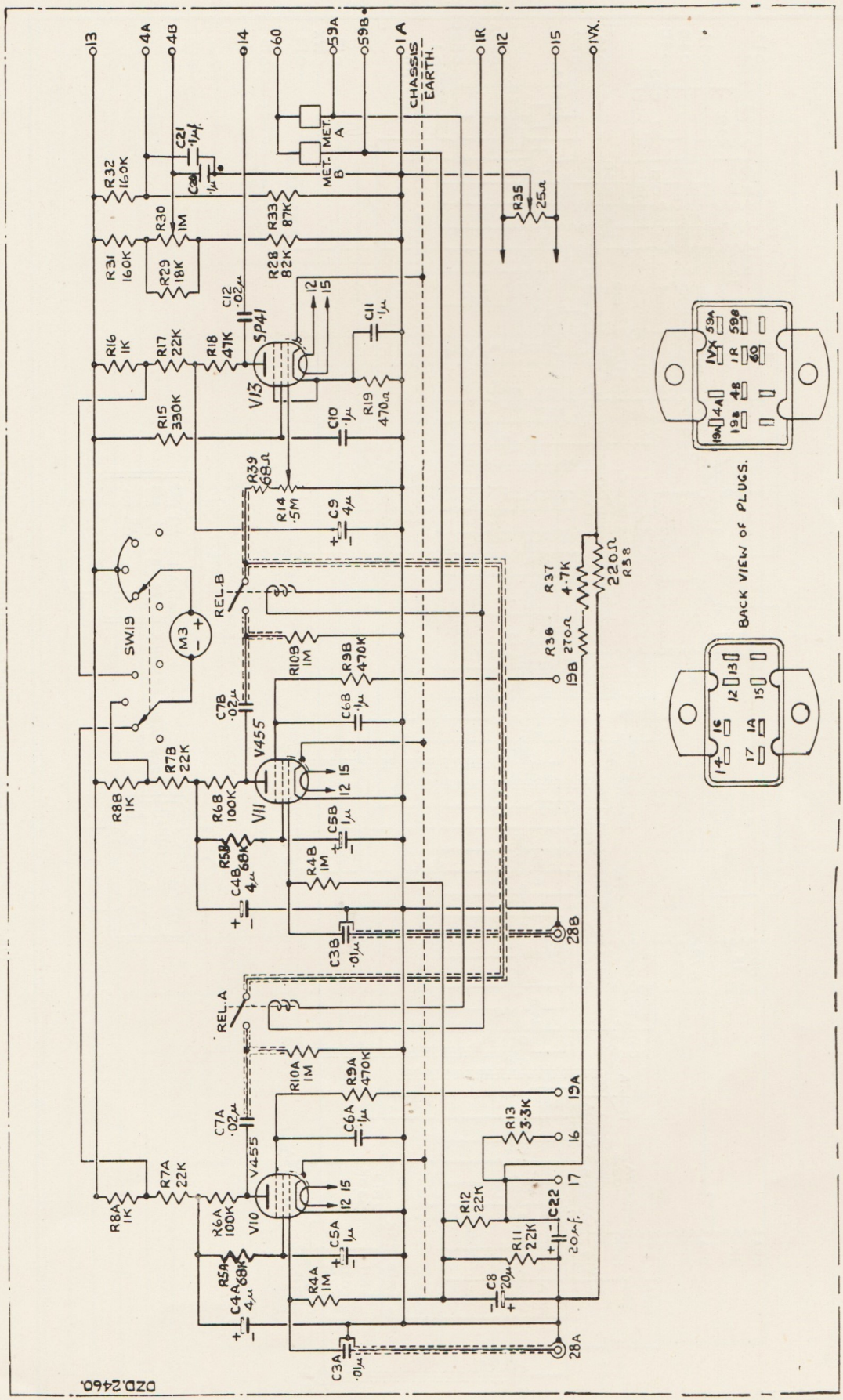


Fig. 33. Circuit Diagram of Fader Amplifier (45 watts).

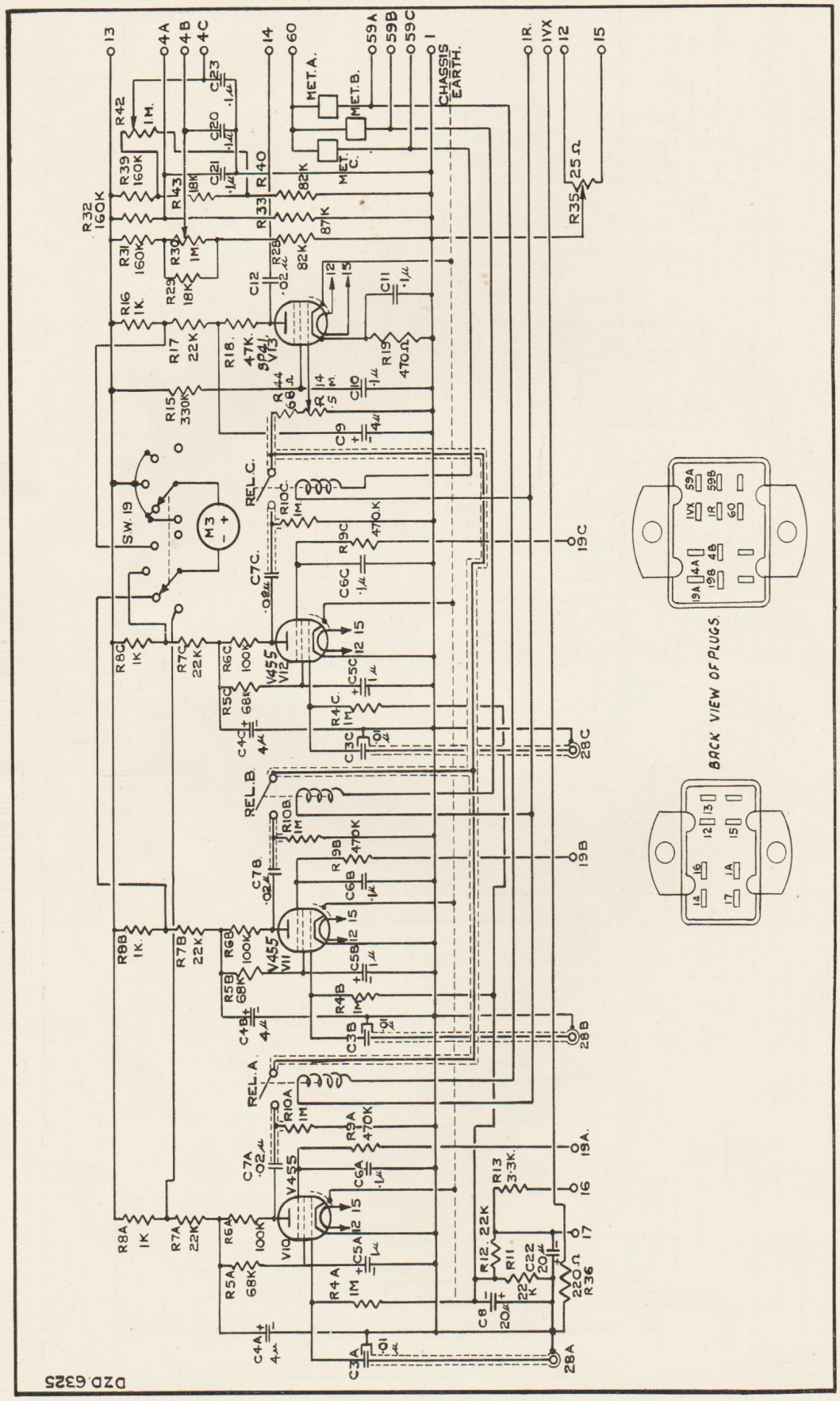


Fig. 34. Circuit Diagram of Fader Amplifier (90 watts).

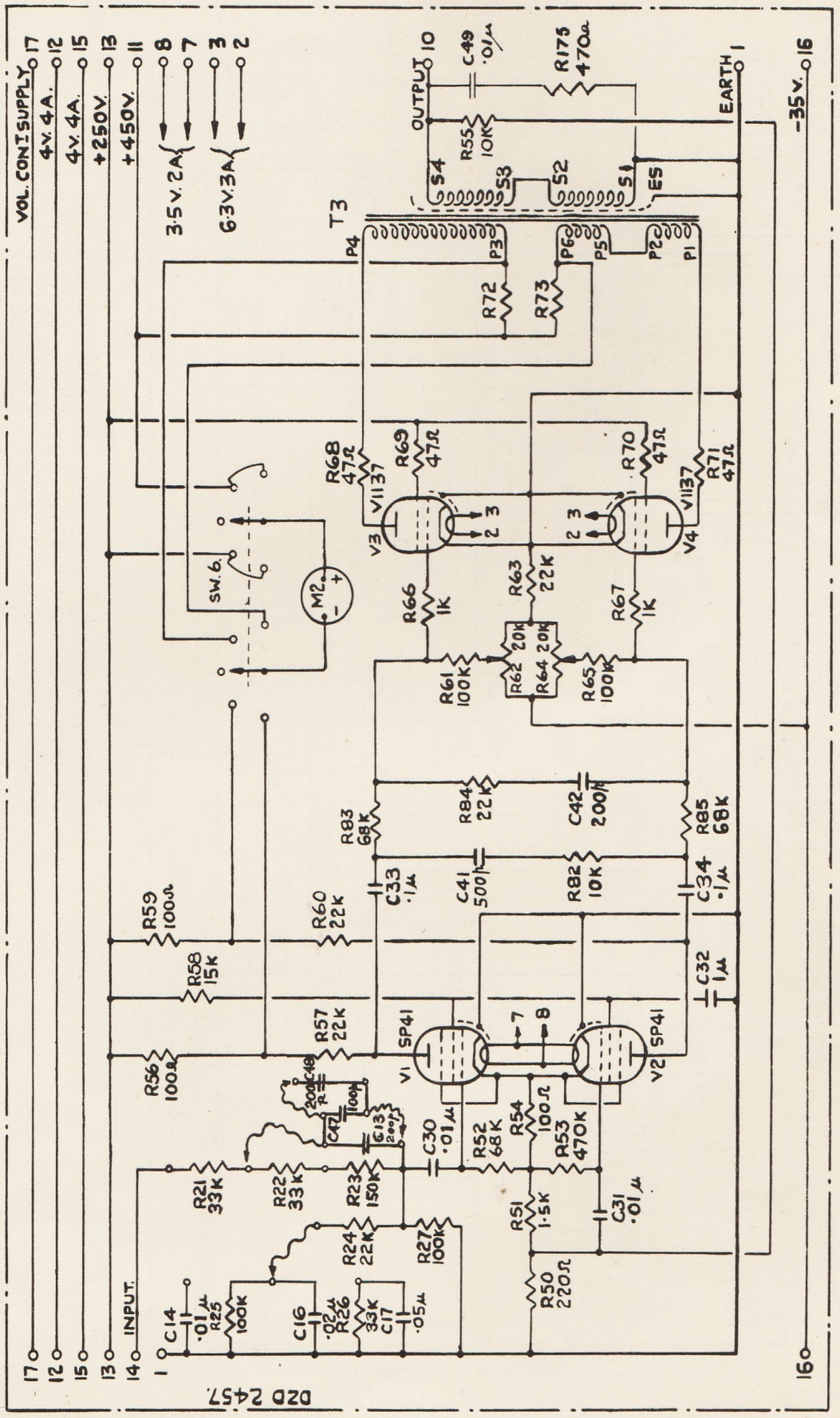


Fig. 35. Power Amplifier (45 watts).

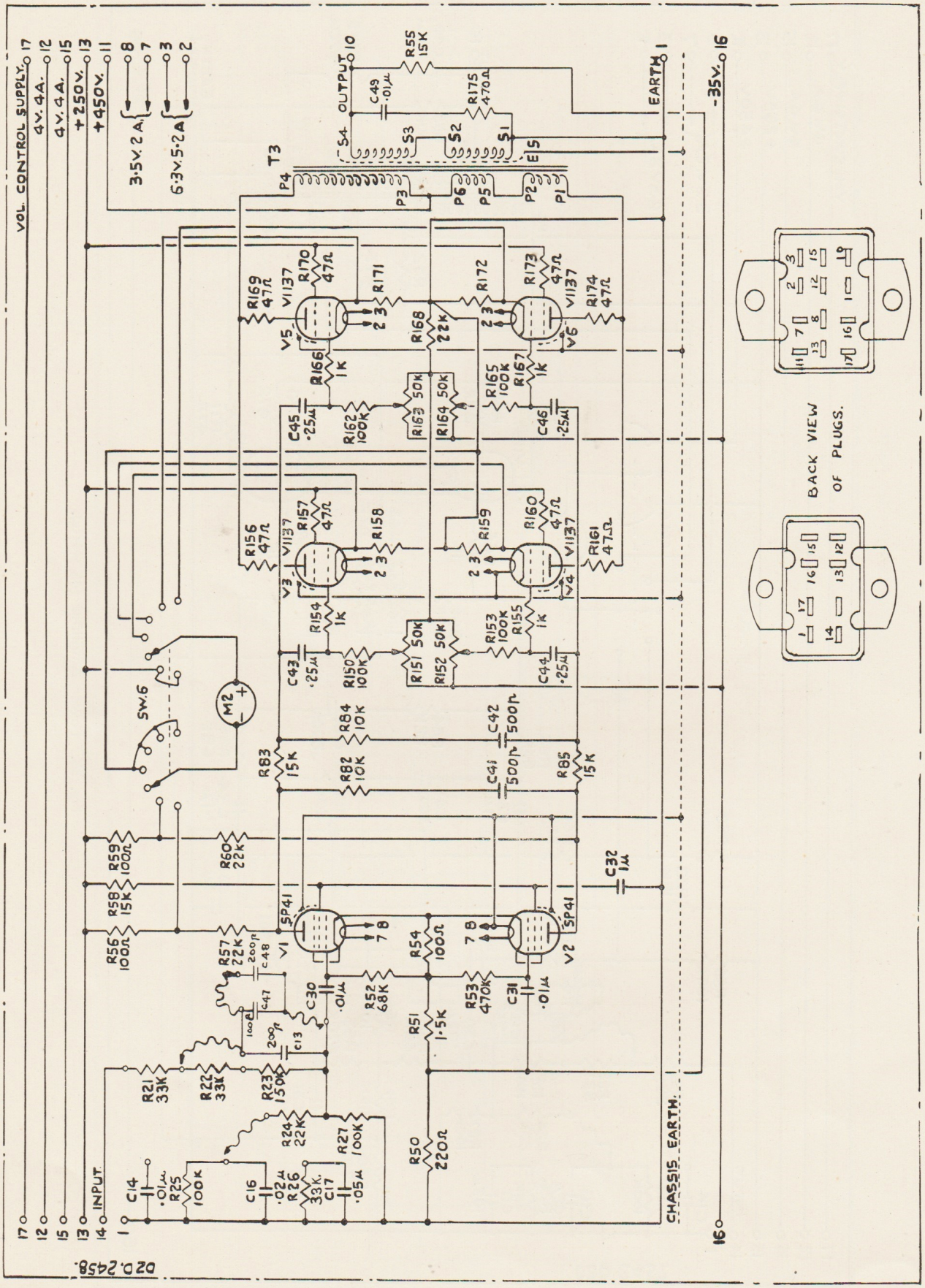
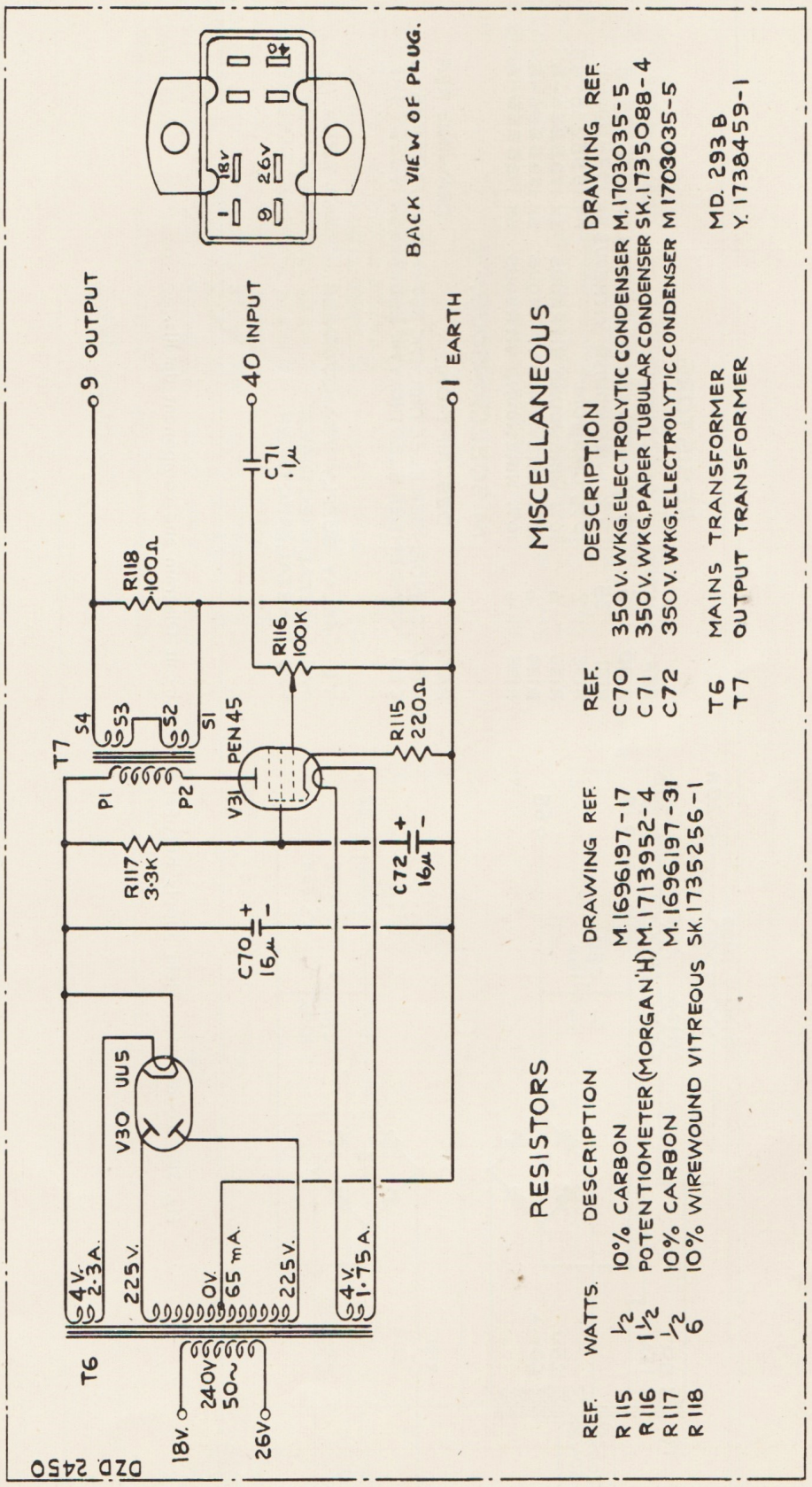


Fig. 36. Power Amplifier (90 watts).



RESISTORS

REF.	WATTS.	DESCRIPTION	DRAWING REF.
R 115	½	10% CARBON	M.1696197-17
R 116	1½	POTENTIOMETER (MORGAN'H)	M.1713952-4
R 117	½	10% CARBON	M.1696197-31
R 118	6	10% WIREWOUND VITREOUS	SK.1735256-1

MISCELLANEOUS

REF.	DESCRIPTION	DRAWING REF.
C 70	350 V. WKG. ELECTROLYTIC CONDENSER	M.1703035-5
C 71	350 V. WKG. PAPER TUBULAR CONDENSER	SK.1735088-4
C 72	350 V. WKG. ELECTROLYTIC CONDENSER	M.1703035-5
T 6	MAINS TRANSFORMER	MD. 293 B
T 7	OUTPUT TRANSFORMER	Y.1738459-1

Fig. 37. Deaf Aid Amplifier, Circuit Diagram and component details.

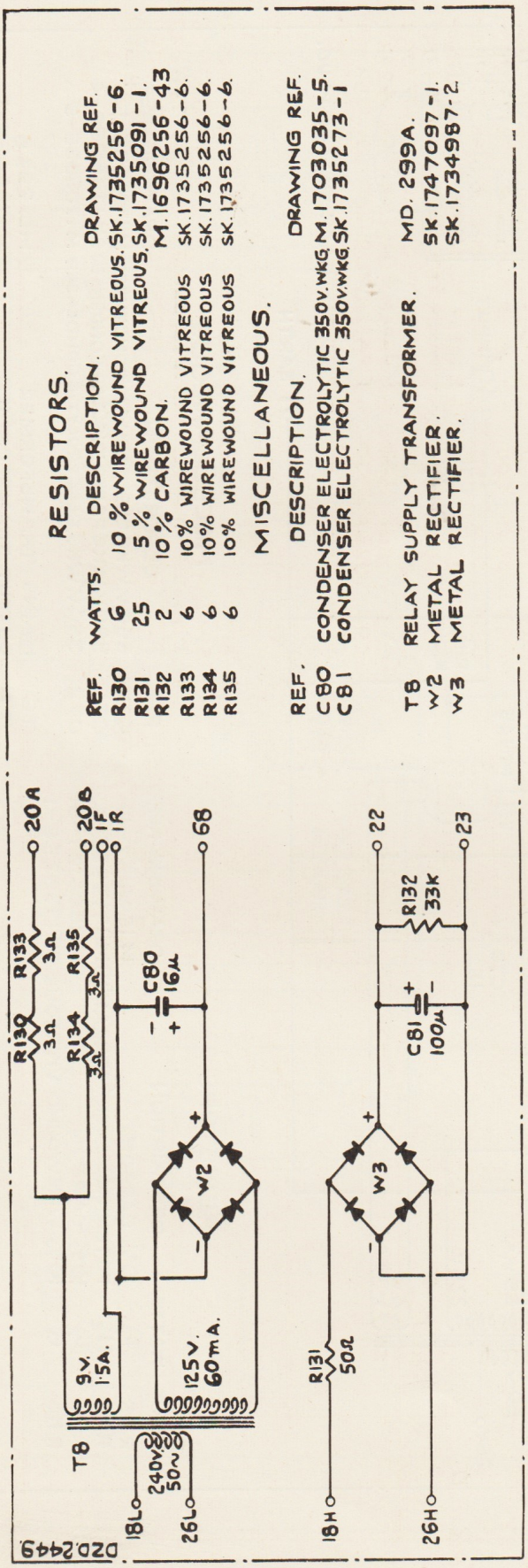


Fig. 38. Loudspeaker Field Supply Rectifier Unit, Circuit Diagram and component details.

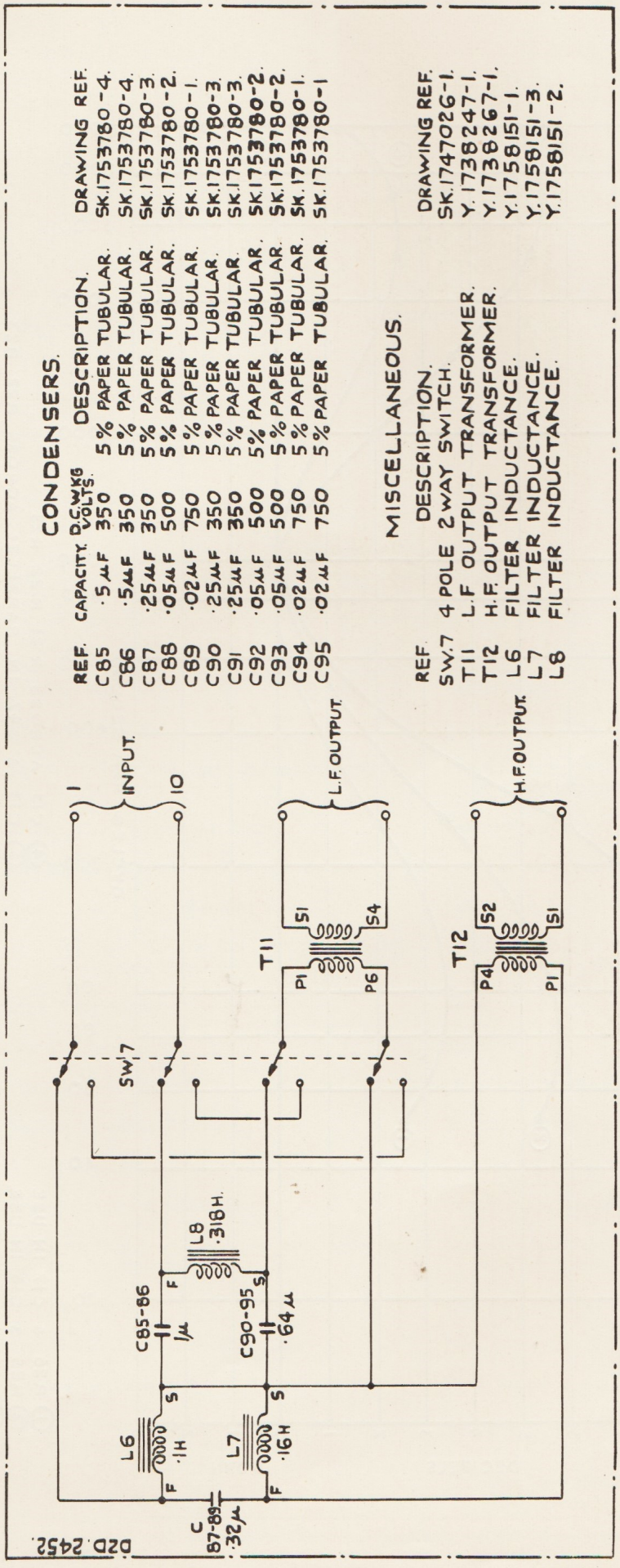


Fig. 39. Loudspeaker Filter Unit, Circuit Diagram and component details.

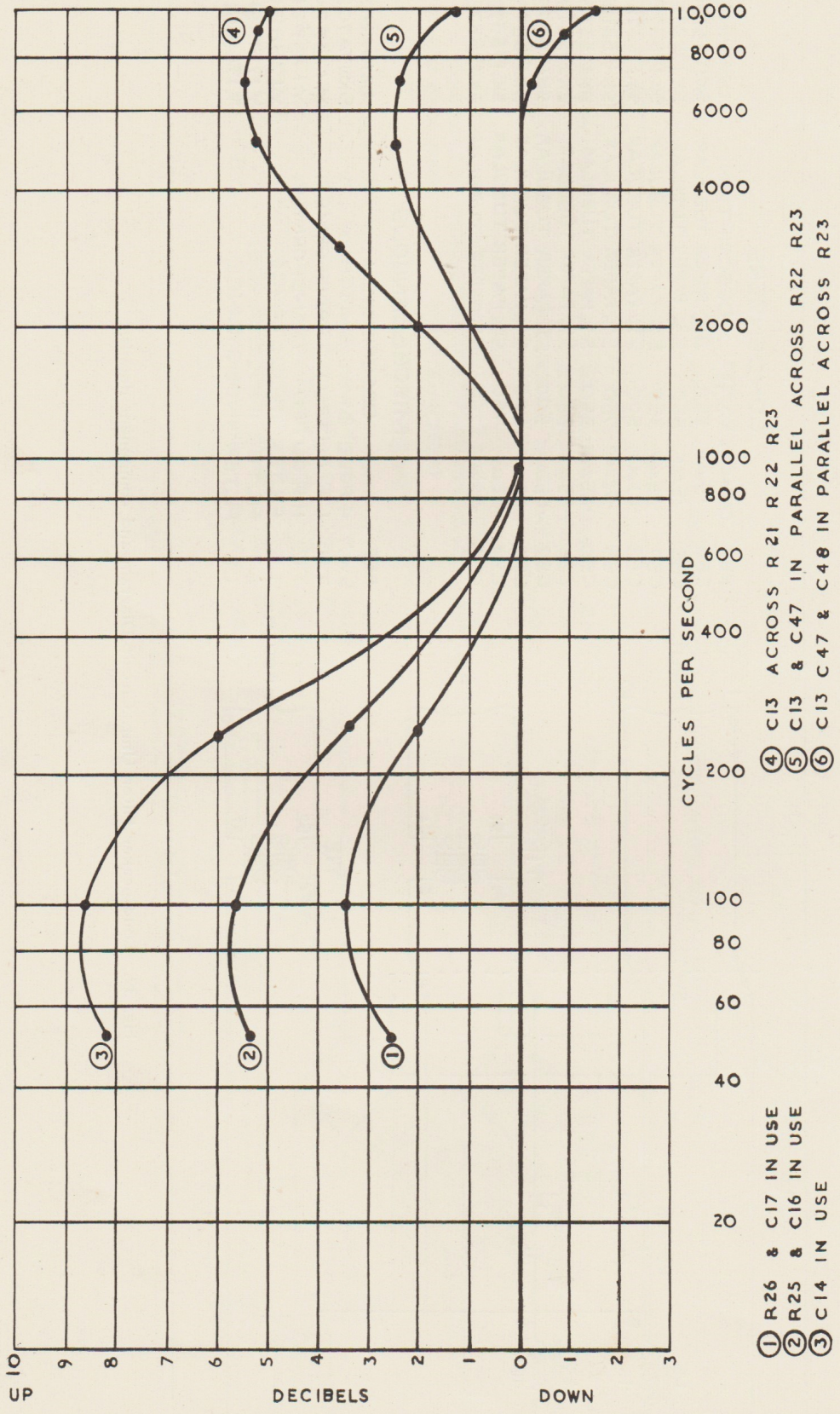


Fig. 40. Frequency Characteristics of 45 watt and 90 watt Equipments.
NOTE : These characteristics are as taken with a signal generator.

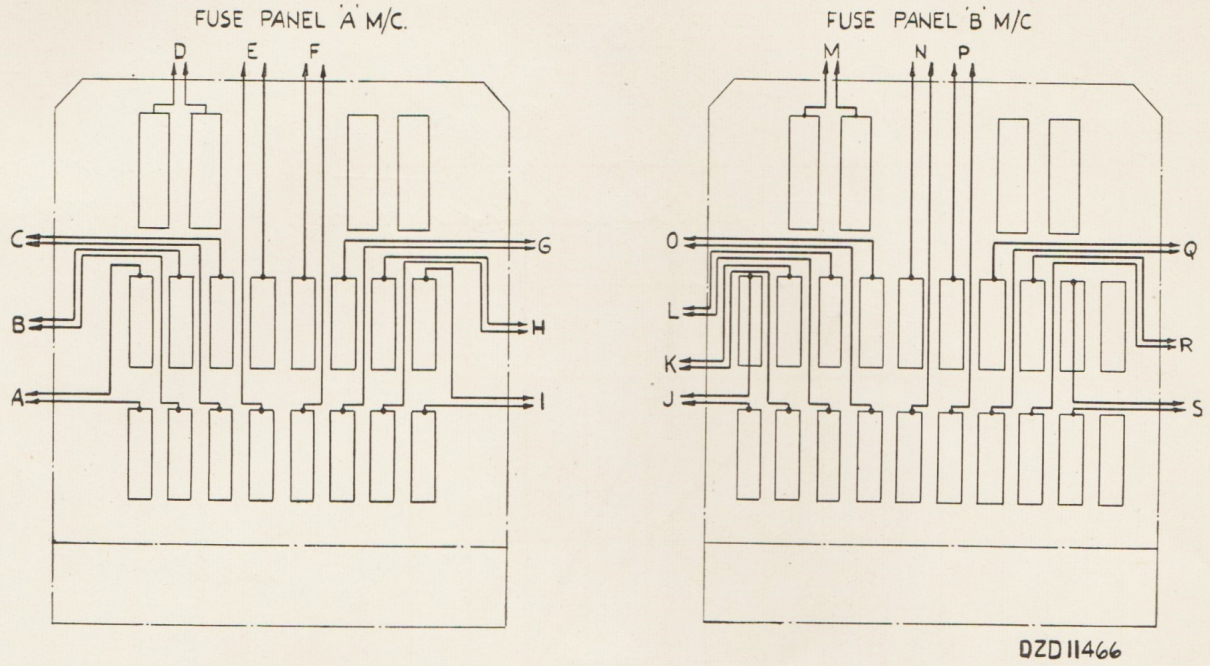


Fig. 41. Arrangement of Fuse Panels.

Fuse Connections	Circuits and Components Protected	
	90 watt Equipments	45 watt Equipments
A	Exciter Lamp "A"	Exciter Lamp "A"
B	Exciter Lamp "B"	Exciter Lamp "B"
C	Lamps for Fuse Panel, Operating Panel, Spoolbox, and Arc Inspection	Lamps for Fuse Panel, Operating Panel, Spoolbox, and Arc Inspection
D	Projector and Soundhead Motors	Projector and Soundhead Motors
E	Gramophone Motors in Non-sync. Unit	Gramophone Motors in Non-sync. Unit
F	Nos. 1 and 2 A.C. Operating Coils	Nos. 1 and 2 A.C. Operating Coils
G	D.C. Arc Feed (Striking Coil, Arc Feed Motor, and Gearbox Solenoid)	D.C. Arc Feed (Striking Coil, Arc Feed Motor, and Gearbox Solenoid)
H	Main Relay Supply	Spare
I	Standby Relay Supply	Spare
I	Main Amplifier Rectifier	Main Amplifier Rectifier
K	Standby Amplifier Rectifier	Standby Amplifier Rectifier
L	L.F. Speaker Field	L.F. Speaker Field
M	Projector and Soundhead Motors	Projector and Soundhead Motors
N	Lamps for Fuse Panel, Operating Panel, Spoolbox, and Arc Inspection	Lamps for Fuse Panel, Operating Panel, Spoolbox, and Arc Inspection
O	Deaf Aid Amplifier	Deaf Aid Amplifier
P	Nos. 1 and 2 A.C. Operating Coils	Nos. 1 and 2 A.C. Operating Coils
Q	Changeover Coils in A and B Machines	Relay Supply
R	D.C. Arc Feed (Striking Coil, Arc Feed Motor, and Gearbox Solenoid)	Changeover Coils in A and B Machines
S	Spare	D.C. Arc Feed (Striking Coil, Arc Feed Motor, and Gearbox Solenoid)

NOTE : Fuses D and M are 7 amp. rating, the remainder 2 amp. Wire 7 amp. fuses with 0·009" tinned-copper wire, and 2 amp. fuse with 0·0164" 63/37% tin/lead alloy wire.

NOTES

750

G/3,3·81/1-8,50-999