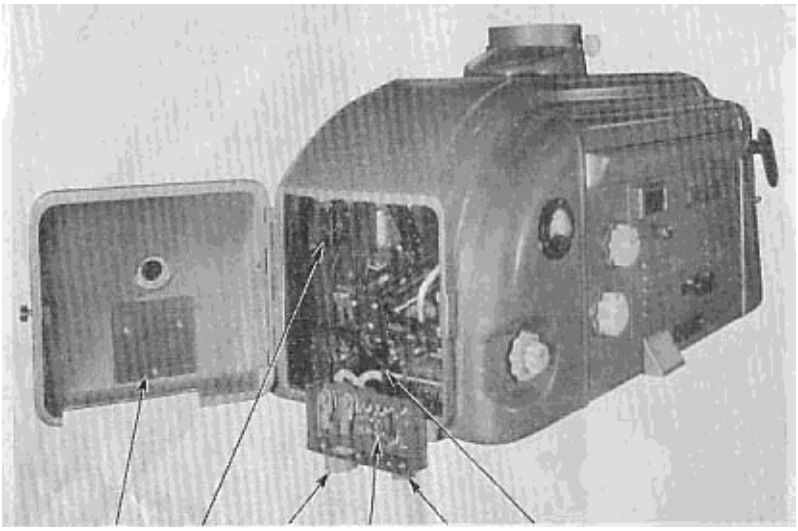


PROJECTOR LANTERN
Type N 6 Form A

THE TYPE N LANTERN is designed to meet the requirements of wide-screen or polarized-light projection systems, or for use in "drive-in" and other cinemas where the highest possible light-intensity is desired. The lantern is of the mirror-arc type, operating at up to 110-amp. arc-current, and it employs a high-speed optical system. It must therefore be used with modern heavy-duty carbons and high-speed lenses if it is to give the full light-output for which it is designed.

To avoid the severe film-heating that would otherwise occur as a result of the high output, a heat-absorbing filter is interposed between the arc and the gate, reducing the heat content of the beam. This filter is arce-cooled by a separately-mounted blower supplied with the lantern.

Normal current and voltage ratings are as follows:—

Arc current	..	90 to 110 amperes.
Arc voltage	..	54 volts nominal (see page 13).

The recommended line voltage is 100 volts, and, unless choke-controlled rectifiers are to be used, should never be less than 80 volts. On the other hand, for reasonable running efficiency and to avoid overloading the striking solenoid, the recommended voltage should not be greatly exceeded. The ballast resistances must be selected to give the correct voltage drop and current tappings. Choke-controlled rectifiers when used for arc supply are usually designed or preset to give the correct operating conditions.

The positive carbon, which is non-rotating, lies along the optical axis. To ensure the burning of a perfect crater under all conditions the negative carbon-tip can be raised, lowered, or slewed by means of external operating knobs; an image of the arc is projected on to a plate attached to the lantern body, enabling the correct relative position of both carbon-tips readily to be checked and maintained. The mirror can be tilted or slewed so that the light-beam is correctly centred on the gate and the screen.

Other noteworthy features are:—

Automatic Arc-striking, ensuring the correct closing and opening speeds for efficient striking.

Automatic Focus-control, holding the position of the crater relative to the mirror to within very close limits, irrespective of variations of carbon burning-rates and feed-motor speed.

Quick Re-setting of Carbons, enabling a fresh "bite" on the carbons to be taken instantaneously. An indicator is fitted showing the length of positive-carbon stroke still available.

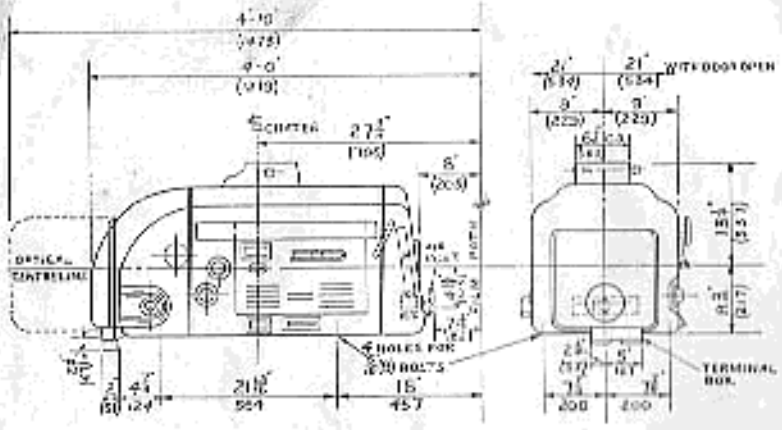


Fig. 1. Outline of Lantern. Principal dimensions in inches and millimetres.

The special features of the equipment are described under the appropriate headings in later pages, and it is recommended that, before attempting to use the lantern, these sections should be studied so that operation and adjustments are thoroughly understood.

UNPACKING

The mirror frame, mirror, heat filter, etc., are dismantled before despatch, but are packed in the same case as the lantern body and chassis. In addition, there may be certain spares or extra fittings, such as a spare mirror or adaptation gear.

Great care must be taken when unpacking to see that no part is bent, broken, or otherwise damaged; examine the packing material to make sure that no loose parts are left in the case.

Do not touch the glass in the heat filter with the fingers, or the special glass may be permanently impaired. All metal parts should be cleaned before assembly; the protective paint or grease used on the bright parts of export equipment can be removed with paraffin or a similar solvent.

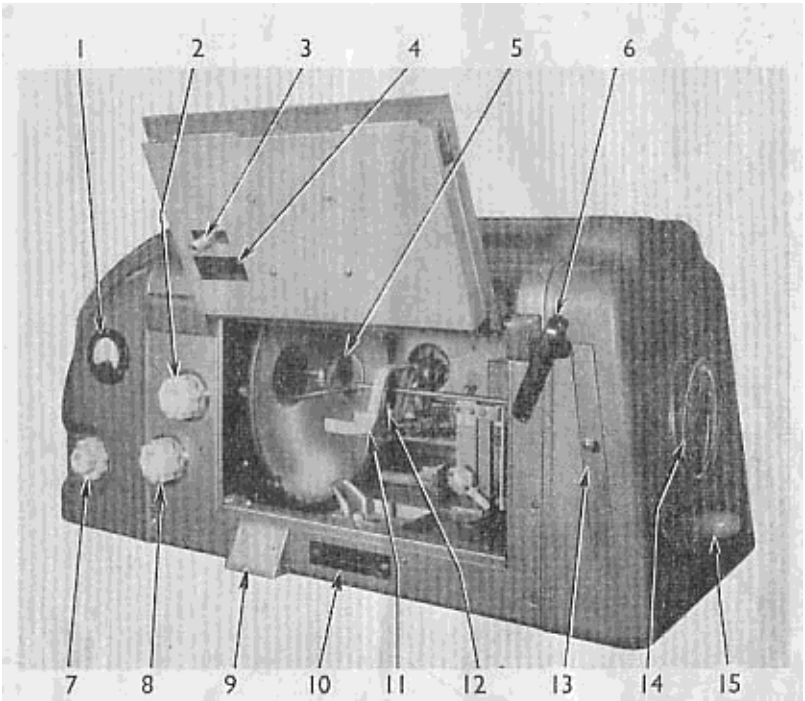
ERECTION

NOTE: The "right-hand" or "left-hand" sides of the lantern are as viewed from behind the lantern and facing the screen. The right-hand side is also referred to as the "operating side".

In the following instructions, dimensions are given in inches and millimetres, thus: 8" (203 mm.).

Lantern and Adaptation Gear

The lantern should be lightly clamped in its approximate position on the projector stand, where necessary using the adaptation gear



1. Arc voltmeter.
2. Mirror adjusting knob, "Left-Right".
3. Arc-image periscope.
4. Side inspection window.
5. Mirror shield (in forward position).
6. "Dowser" handle (also operates mirror shield).
7. Controls for negative carbon tip.
8. Mirror adjusting knob, "Up-Down".
9. Arc-image plate.
10. Positive carbon stroke indicator.
11. Arc-control magnet.
12. Positive guide.
13. Cover-plate for heat-filter.
14. Nose lens.
15. Inlet for cooling air for heat-filter.

Fig. 2. Operating side, with side door open.

provided. The front face of the lantern nose should be 8" (203 mm.) from the film gate (Fig. 1); the reflecting surface of the mirror is then 33⅛" (841 mm.) from the film. In deciding the height of the lantern above the projector stand, it should be noted that the optical centre is 8 9/16" (217 mm.) above the base.

The underside of the lantern **must not be sealed in any way** when mounted on the stand. Transverse support straps are recommended, with distance pieces between them and the stand.

To obtain access to the front holding-down bolt-holes, remove the bottom tray, the fixing screws of which are located near the bottom of the right-hand door. Countersunk 5/16" holding-down bolts should be used, noting that special packing-pieces, which are supplied loose, must be placed, countersink upwards, between the chassis runners and the bottom of the body.

When replacing the bottom tray, make sure that the left-hand side is fitted correctly under the locating screw-heads in the chassis runner before inserting the fixing screws and tightening them securely.

Mirror

The mirror fitted may be of anodized aluminium or glass. If it is desired to change over from metal to glass, or vice versa, full instructions will be found in Fig. 11, page 22.

Before attempting to fit the mirror or mirror frame, make sure that the serial number on the latter corresponds with that of the lantern.

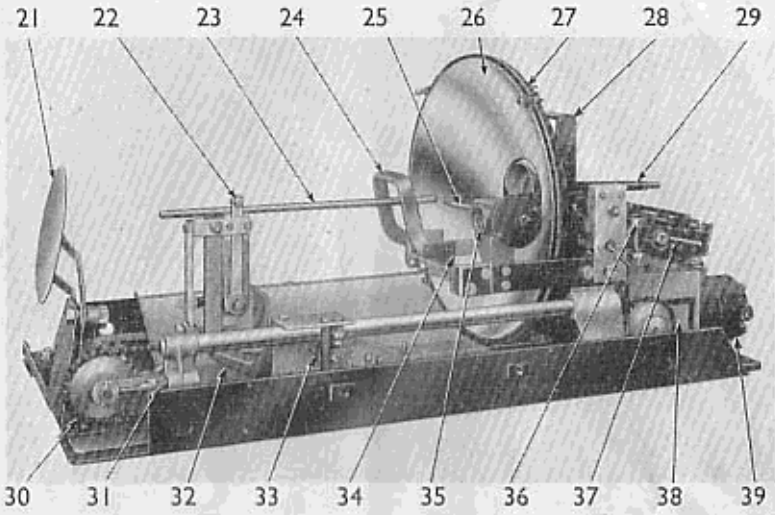
To fit the mirror, the dowser handle 6, Fig. 2, should be operated to open the front shutter 21, Fig. 3, and to retract the mirror-shield 5, Fig. 2. Unclamp the negative carriage by means of quick-release handle 37, Fig. 3, and move it back as far as it will go; tilt the carbon-holder upwards by the external adjusting knob 7, Fig. 2. Now fit the mirror to its frame by loosening the upper mirror clips; the cutaway or diamond cut, if any, **must** be at the top.

Holding the mirror frame with one hand on each side, place it in position in the lantern and lower it on to the bottom pivot screw. There is a recess in the lower lug on the mirror frame for the purpose of temporarily locating the bottom pivot; after the upper pivot is correctly engaged, the mirror frame can be gently moved about until the lower pivot engages.

Lining-up

Correct lining-up is essential, and should wherever possible be carried out by an Installation Engineer of the BTH Company or its Agents. A perfectly straight metal rod will be required, approximately ⅜" (10 mm.) diameter and exactly 33⅛" (841 mm.) long.

Set the positive carriage fairly close to the positive guide and insert a short length of carbon in the holder, resting in the guide vee. If the carbon lies reasonably in line with the axis of the lantern,



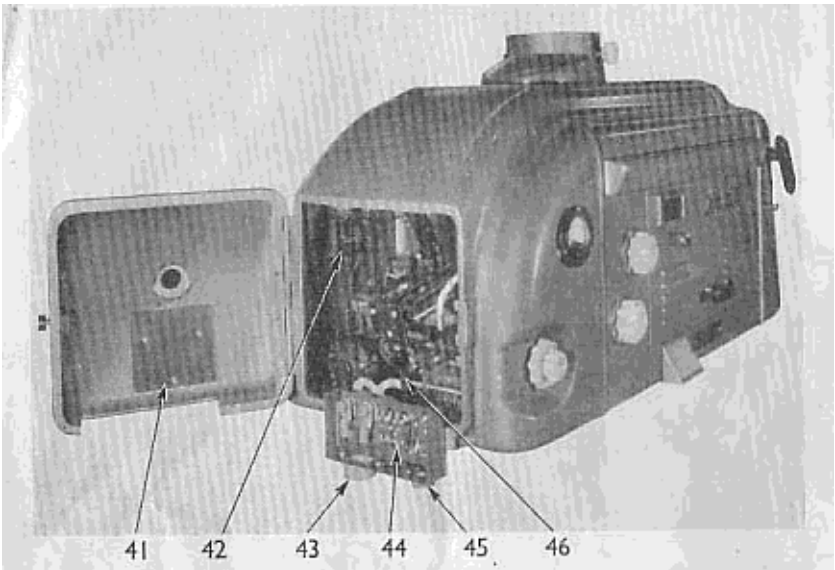
21. Front shutter.
22. Positive carbon clamp.
23. Positive carbon.
24. Arc-control magnet.
25. Negative carbon.
26. Mirror.
27. Mirror frame.
28. Mirror frame support.
29. Mirror-shield guide.
30. Front sprocket and positive driving-chain.
31. Driving-chain tension device.
32. Positive carriage.
33. Positive carriage sprocket.
34. Location of arc-gap gauge (gauge not illustrated).
35. Focus-control periscope.
36. Hand-feed knobs.
37. Negative-carriage locking handle.
38. Gearbox.
39. Motor.

Fig. 3. Chassis, showing focus-control periscope, positive-carbon drive details, mirror support, etc.

it denotes that the alignment of the carriage has not been disturbed in transit. If, on the other hand, the carbon is out of line, refer to Fig. 10 and loosen lockscrew 87. According to whether the moving head is low or high, turn nut 86 **very slightly** clockwise or anti-clockwise till the head is at the correct height, then tighten lockscrew 87.

Place the lining-up rod with the rear end in the fixed positive guide, the centre supported by the moving positive head, and the front end just flush with the gate; the rear end should now be level with the back surface of the mirror, and the longitudinal position of the lantern relative to the gate can be established.

Move the rod forward till the rear end just overhangs the rear of the positive guide. The front end should now pass through the gate and into the lens tunnel, and the position of the lantern on its adaptation gear must be adjusted till the rod passes exactly centrally through these apertures; then, with the longitudinal position determined as described in the previous paragraph, the lantern should be finally tightened down, and the nose lens inserted.



41. Wiring diagram fixed to door.
42. Fuses for blower motor.
43. 1¼" flexible conduit gland (arc supply).
44. Fuses—control and internal lamp.
45. ⅜" flexible conduit gland (internal lamp).
46. Rheostat, feed-motor speed control.

Fig. 4. Rear door open, and terminal-box cover removed.

Heat-filter Blower

The motor and blower should be mounted in a convenient position near the front of the lantern, at the non-operating side. ¾" B.S.P. pipe-fittings are provided on the blower and on the lantern, and suitable piping must be used; pipe runs should be as short as possible, and bends should be used in preference to elbows. No strain must be applied to the inlet fitting on the front of the lantern or the internal air-duct assembly may be damaged.

Cables and External Connections

It is assumed that the external accessories for the control of the arc supply have already been installed and connected up. They include a protective circuit-breaker or fuses, resistances whereby the arc-striking current can be reduced to two-thirds of the normal running current, and control switches, which should be mounted within convenient reach of the projectionist.

The terminals for the supply cables are in a terminal box at the rear of the lantern. A gland, 43, Fig. 4, for flexible metallic conduit of 1½" (38 mm.) outside diameter is provided for the main arc cables. **The positive supply must be connected to the left-hand terminal.** Certain types of arc rectifiers do not give a D.C.

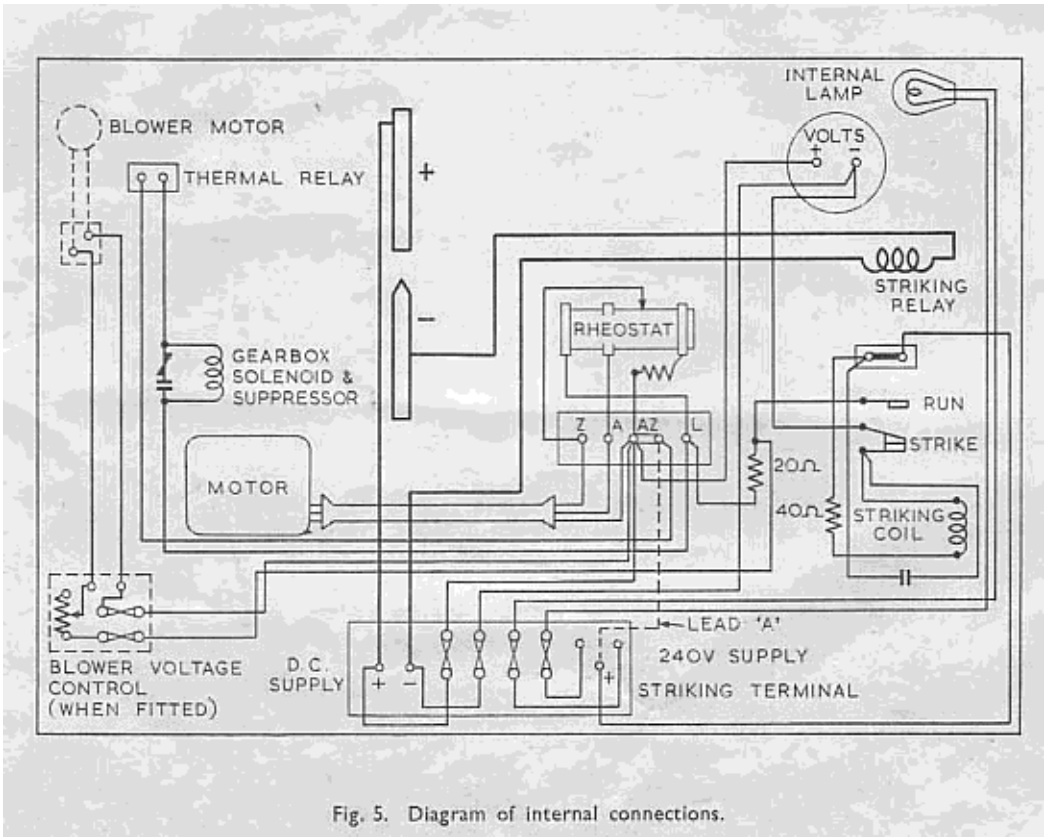
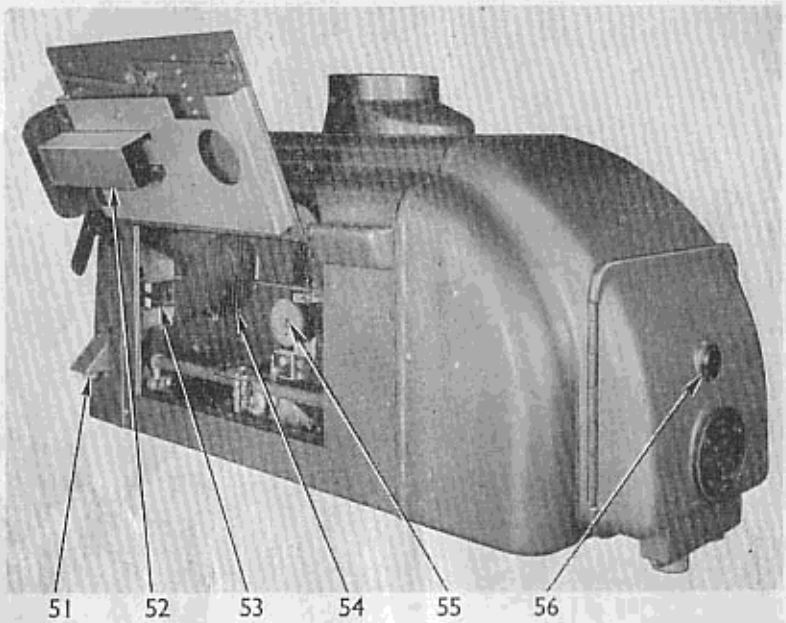


Fig. 5. Diagram of internal connections.



51. Conduit-gland for blower motor connections.
52. Light tunnel, automatic focus control system.
53. Thermal relay.
54. Heat filter.
55. Adjusting screw for focus-control periscope.
56. Rear inspection window.

Fig. 6. Left-hand side of lantern.

supply until the carbons touch; in order to use the automatic arc-striking device under these conditions, an auxiliary rectifier, capable of providing 1 ampere at 80 volts D.C., must be fitted, with the negative pole connected to the arc-rectifier negative, and the positive connected to the terminal marked "STRIKING", **after first removing the connection between this terminal and the rheostat terminal board.** See Fig. 5 (lead "A").

A gland, 45, Fig. 4, for flexible metallic conduit of $\frac{3}{4}$" (19 mm.) outside diameter is provided for the supply (200/250 volts A.C. or D.C.) for the internal inspection lamp.

Blower Motor. The gland, 51, Fig. 6, for the flexible conduit for the connections to the blower motor will be found near the front of the lantern, on the left-hand side. Use light leads for the connections from the terminals under this gland, and leave the "motor" end of the cables temporarily disconnected.

Care must be taken to ensure that the terminal tags are neither short-circuited nor earthed. With the motor terminals still disconnected, remove the fuseholder mounted inside the rear of the

lantern, 42, Fig. 4, and connect an Avometer or "megger" to the two terminals of the fuses, and then from the terminals to earth. If infinity readings are obtained, the motor leads can be connected, using the two blank terminals in the motor terminal box.

Early equipments are fitted with 24-volt blower motors, and are connected across the 54-volt arc, with a series resistance mounted at the rear end of the lantern. During installation, this resistance must be adjusted to suit each individual motor; under working conditions, i.e. with 54 volts across the arc, the motor voltage should be approximately 24 volts.

Lantern Flue

In view of the high rating of the Type N 6 Lantern, **cooling by properly-arranged ventilation is of the utmost importance.** A solid connection must be made to the lantern chimney, and the flue must be extended to the open air with tubing or ducting of cross-sectional area not less than that of the lantern outlet.

A vertical rise of at least 8 feet should be arranged in the flue to provide an adequate air-flow through the lantern; where this is impracticable, it will be necessary to employ an exhaust fan.

Thermal Relay

This very sensitive device is adjusted and tested before despatch. Its extremely critical setting must not be disturbed unless it has been upset by damage in transit or mis-handling after delivery; even then, any re-adjustment should if possible be carried out by an Engineer of the BTH Company or its Agents, proceeding as follows:—

(1) Set cam spindle (see Fig. 7) fully anti-clockwise.

(2) Adjust differential screw, so that contacts touch when the gap between armature and magnet is approximately 0·025 in.

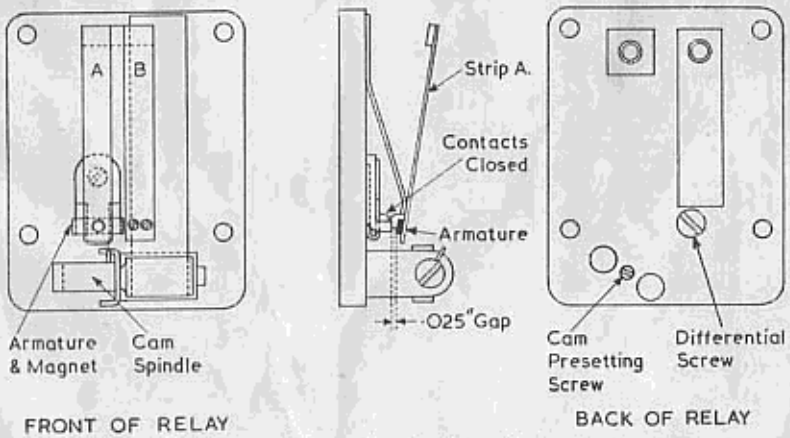


Fig. 7. Diagram of thermal relay. For adjustment, see text.

(3) Rotate cam spindle. Contacts should part at approximately 90° rotation.
(4) If this setting is not obtainable, adjust cam presetting screw. Turn it clockwise if contacts open too early and vice versa. Re-check as in (3).
(5) Turn the cam spindle until the contacts are just closed; the relay is then ready to be fitted into the lantern.

Remove the external grille from the lantern (front end, left-hand side), turn the internal hexagonal clamp to the horizontal, and slide the relay in, with contacts downwards and towards the rear of the lantern. Make sure that the relay is resting on the bottom support strips and that the far edge is in the vertical groove, then turn the hexagon clamp so that the hexagon portion is downwards, locking the relay in position. Do not yet replace the grille on the lantern body.

THE HEAT FILTER

The heat filter and its associated blower motor must always be in use during projection. The heat filter is made up of a number of strips of a special glass; these are very costly and must be treated with particular care. **Never touch the surface of the strips with the fingers.**

To fit the filter, lift and remove the cover-plate immediately below the shutter-operating handle on the right-hand side of the lantern, 13, Fig. 2. Slide the filter in as far as it will go, pressing it home with the attached handle. This handle should then be lifted and the cover-plate replaced.

As the filter removes most of the heat from the light-beam, it will itself become dangerously hot unless continuously force-cooled. The blower-motor circuit is so arranged that it switches on as soon as the carbons touch during arc-striking. If it does not start up immediately, the equipment must be shut down at once, and the fault located and rectified.

Adjustments to the Heat Filter

The heat filter is despatched with the maximum number of strips, twelve; but, with efficient gate-cooling, it may be possible to reduce this number without overheating the film, thus providing a useful increase in light-output. For 110-amp. operation it is suggested that not less than 7 strips should be retained, these being located **in the centre.** The unnecessary strips can be removed as follows:—

Lay the filter on a flat surface, with the heads of the countersunk screws upwards. Remove all screws and lift off the top plate and the upper asbestos frame, together with the thin asbestos strips at top and bottom. Lift out the estimated number of glass strips (handling them with a clean dry cloth and wrapping them up carefully for storage). Leave the remainder close-spaced in the centre of the aperture. Replace the thin asbestos strips at the top and bottom ends of the glass strips; finally, re-assemble the asbestos frame and the cover plate.

OPERATION

Carbons

The carbons used with Type N lanterns must be specially designed for the particularly heavy duty involved. The BTH Company or its Agents will be pleased to indicate suitable types on request. The appropriate sizes are as follows:—

Positive	(52-54 volts, 90- 95 amp.)	.. 9 mm. × 14" to 16"
	(52-56 volts, 100-110 amp.)	.. 10 mm. × 14" to 16"
Negative	(either current rating)	.. 8 mm. × 8" to 12"

For reasons of economy, both carbon-holders are so designed that the carbons can be burned down to short ends.

The carbon movements are controlled by the automatic feed mechanism located in the back of the chassis and by the hand-feed knobs 36, Fig. 3. These knobs can be used whether or not the feed mechanism is in operation, as the latter incorporates friction discs which allow the drive to slip during hand-feeding.

NOTE: When fitting the hand-feed knobs, the one with the short stem should be on the right-hand side (the negative feed).

Lanterns are normally despatched with the positive clamp set for 10 mm. carbons. If 9 mm. carbons are to be used, loosen the hexagon screw at the upper tip of the positive head, rotate the eccentric block normally clamped by this screw until its bottom edge is a little lower than before, and retighten the screw. Check that the carbon can still be pushed in from the side and that the clamping lever comes to rest just above the baseplate when the carbon is tightly clamped. During these adjustments avoid undue strain on the carbon-carriage assembly.

Fitting the Carbons

Positive Carbons. Lift the positive carriage slightly, to release the clutch (see "Positive Carriage", page 20), and slide it as far forward as possible. Pass the "crater" end of the carbon through the arc-control magnet on to the positive guide, put the other end in the clamp of the moving head, and tighten the clamp. Normally, the crater end should project about 1" (25 mm.) through the positive guide. Check that the guide is pushed fully down in its holder.

Negative Carbon. Loosen the negative carriage clamping handle, 37, Fig. 3, and withdraw the carriage to the end of its stroke. Loosen the negative collet by rotating its clamping handle, and push the negative carbon in from the rear, point foremost (another negative carbon can be used as a push rod). The carbon should be set in the collet in a position to give an arc gap of about $\frac{9}{16}$" (15 mm.) when using 9 mm. positives, or about $\frac{11}{16}$" (17 mm.) with 10 mm. positives. Finally, reclamp carriage and collet handles.

Control of Negative Carbon Tip

The position of the negative carbon tip relative to the positive crater is very important, as it must be correctly placed in order to

burn a steady arc and a square crater. External control knobs are provided near the rear end of the lantern, engraved "Up-Down" and "Left-Right", 7, Fig. 2. It should be noted that these inscriptions refer to the movement of the negative tip as viewed from the rear. Viewing window 56, Fig. 6, is fitted in the rear door so that carbon alignment can be checked.

Arc-striking

When the lantern is operated for the first time, check that the position of the carbons is as described in previous sections and that the heat filter is in position. Operate the dowser handle, closing the front shutter and bringing the mirror-shield forward; then, by switching on the arc supply, strike the arc. **The filter-cooling motor should start up at once.** The arc-striking current should be two-thirds of full load, and should immediately be increased to its full value by reducing the external ballast resistance. Raise the dowser, retracting the mirror-shield, and project on to the screen. By means of the external knobs 2 and 8, Fig. 2, adjust the mirror so that the light-beam is concentric with the gate, and then 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 arc-image plate 9, Fig. 2, so that the crater-image falls on to the appropriate line on the plate.

The automatic focus control system should now be checked (for a description of its operation and adjustment, see page 17). The arc should then be switched off and the arc-gap gauge (see Fig. 3) should be lined up to match the crater. The negative carbon should be aligned with this gauge, and after making sure that the dowser is closed, the arc can be re-struck. Having re-opened the dowser, the speed control rheostat 46, Fig. 4, can be adjusted so that the **negative** carbon feeds at the exact burning-rate, and maintains the correct gap and arc voltage.

Under maximum-current conditions, it may be found, that, even with the speed-control rheostat set at maximum, the negative feed rate is still insufficient. Extra speed can be obtained by a minor change in the motor connections:—

Refer to Fig. 5. A connection will be seen between the tapping near the left-hand end of the speed-control rheostat and the second terminal from the left ("A") on the terminal board below. Remove the connection from the tapping and transfer it to the left-hand end of the rheostat or the right-hand terminal on the terminal board ("L").

Once the initial settings have been determined, operation will be fully automatic, and the controls should not be disturbed again. Alteration to the setting of the thermal relay should only be necessary when a new mirror is fitted, and then only if the mirror focus differs from that of the old mirror. After fitting a new mirror it is desirable to run the arc for sufficient time to allow the relay to

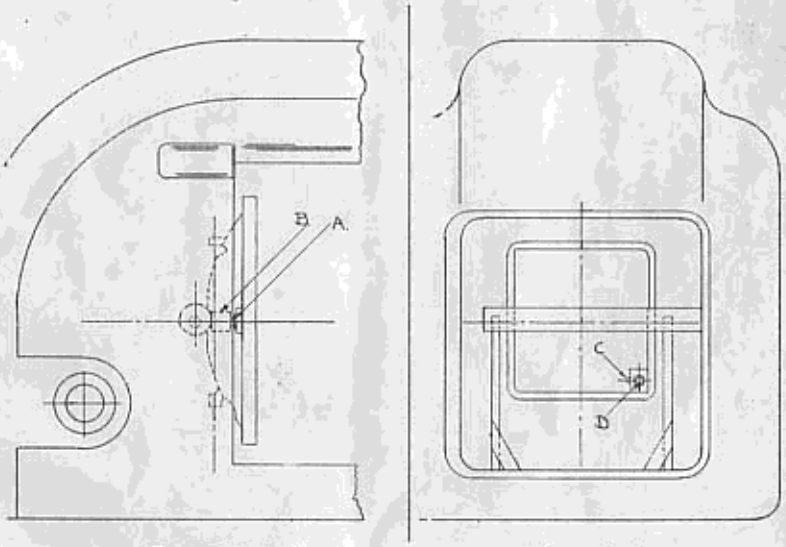
place the crater in its original position, and then to check if any improvement can be obtained by hand adjustment of the crater; but the relay setting should not be disturbed unless it is certain that re-adjustment will give better results.

NOTE: When fitting new carbons, the crater end of the positive carbon must be in its correct position relative to the positive guide. If the crater is too far forward, it will be outside the control zone of the relay, and the positive carbon will feed forward too rapidly. Similarly, the tip of the negative carbon must be correctly placed relative to the positive carbon. If it is too close, the carbons will not separate properly after striking; while if the gap is too great, the arc will not be struck at all.

Mirror Adjustment

Two control knobs are provided to enable the mirror to be tilted or slewed to ensure even illumination of the film gate. These two adjustments are completely independent, and the engraving on the control knobs, "Left-Right" and "Up-Down", refers to the resultant movement of the light-beam on the screen. If the mirror-travel provided by the control knobs is insufficient to centralize the beam on the gate, minor adjustments can be made as shown in Fig. 8.

If it is evident that considerable adjustment is necessary, re-check the alignment of the lantern.



(Operating side)

SLEWING

Loosen locknut A; then screw block B in a quarter or half-turn to move light-beam to the left on the screen, and vice versa. Re-lock nut A.

(Rear view)

TILTING

Loosen lock-screw C with 2-BA Allen key. Turn screw D clockwise to raise, anti-clockwise to lower light-beam on the screen. Re-lock screw C.

Fig. 8. Additional adjustment to mirror slewing and tilting controls.

AUTOMATIC ARC-STRIKING DEVICE

When the arc-supply is switched on, it energizes a solenoid connected across the supply terminals, and the operation of the solenoid rotates the striking way-shaft. Fitted to this shaft is a sector with rollers, and rotation forces the forward roller on to the negative driving chain, so taking the negative carriage forward until the carbons touch. Current then flows through the carbons and also through the coil of a relay connected in series with them; this relay closes, and, in so doing, open-circuits the supply to the striking solenoid. This allows the return spring to rotate the way-shaft backwards, separating the carbons and striking the arc, which is then left burning, ready for the current to be increased to its full value. A delay device fitted to the striking way-shaft ensures not only that the negative carbon moves forward slowly enough to avoid carbon breakage, but also that it retracts at the correct striking speed.

It should be noted that the arc-striking solenoid is "short-time rated", that is, while it will safely withstand normal operation, it will overheat if left switched on indefinitely. If therefore the arc does not strike when switched on, due to wide arc gap, absence of carbons, or other cause, the supply must be switched off immediately, and the cause investigated.

If, owing to low line volts or other cause, the striking solenoid mechanism is too sluggish in operation, an increased voltage at this point may be obtained by the following procedure:—

At the rear end of the lantern, just above the striking solenoid are two tubular resistors. The one nearest the back (20 ohms) is in series with the feed motor; the forward one (40 ohms) is in series with the striking solenoid. This latter resistor can be short-circuited to increase the striking-solenoid voltage.

Adjustment of Striking Mechanism

The solenoid stroke and the position and length of the levers on the way-shaft are all set correctly before the lantern is despatched, and should require no further adjustment. Should any alterations be necessary, however, an external adjustment is provided for the length of stroke, which is partly controlled by the length of the negative chain. The rear sprocket bearing has slotted fixings so that the chain tension can be adjusted, but this adjustment is very critical and should only be attempted if it is quite certain that no other cause is responsible for an incorrect arc-gap. To check this, operate the solenoid clapper smartly by hand and measure the resultant stroke of the negative carriage. For Type N 6 Lanterns the stroke should be $\frac{3}{4}$" (19 mm.), plus $\frac{1}{32}$" (2·3 mm.) overshoot; strokes slightly longer than these are permissible when measured in this way.

The return-stroke spring should be so adjusted that it always returns the negative carriage through its full travel, while not being

too strong for the solenoid to close properly. This spring requires a greater tension for steep projection rakes.

AUTOMATIC FOCUS CONTROL

The device comprises a thermal relay, 53, Fig. 6, a periscope, Fig. 3, and a gearbox, Fig. 9, with a two-speed drive to the positive carbon carriage.

The relay, shown diagrammatically in Fig. 7, consists basically of a pair of bi-metal strips, arranged to provide compensation for changes of the ambient temperature inside the lantern. An image of the crater is projected on to the relay by means of the periscope, the image being deflected to the left or right according to the longitudinal position of the crater. When the image falls to the right of the gap between the bi-metal strips, the relay contacts remain open, and the positive carbon is fed at a speed which is 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 reaches the left-hand bi-metal strip. The applied heat causes the strip to distort sufficiently to close the relay contacts. The contacts are in series with the supply to a solenoid, 62, Fig. 9, mounted on the gearbox, and the operation of this solenoid has the effect (explained in a later section) of reducing the speed of feed to well below the normal carbon burning-rate. The crater and its projected image start to fall back to their previous 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 light-intensity are unnoticeable on the screen.

Adjustment of the Thermal Relay and Optical System

These checks and adjustments will normally be carried out when the lantern is operated for the first time (see page 14).

Strike the arc and set the carbon in the position which gives the best illumination on the screen, as described on page 14. An image of the crater will be seen on the thermal relay. Should this image be above or below the window of the housing, slacken the two screws fixing the focus-control periscope and rotate the latter so as to set the image at a height central with the window, then tighten the fixing screws.

Now set the periscope mirror-adjusting screw, 55, Fig. 6, so that, still with the crater in the best position for screen illumination, its image falls in the centre of the gap between the two bi-metal strips to be seen through the relay-housing window. The relay should then automatically hold the crater in the correct position.

Observe the movement of the crater with the relay in control. If the image tends to move excessively on to the left-hand bi-metal strip (carbons feeding too fast), turn the cam-spindle (Fig. 7) slightly anti-clockwise till the relay contacts close. If the image

61. Adjusting screw for three teeth per stroke and solenoid gap.
62. Solenoid.
63. Interference pin, operated by solenoid 62.
64. Positive pawl.
65. Positive ratchet.
66. Adjustment for one tooth per stroke.
67. Push-rod.
68. Non-return springs.
69. Negative pawl.
70. Negative ratchet.
71. Rocking lever that actuates pawls.

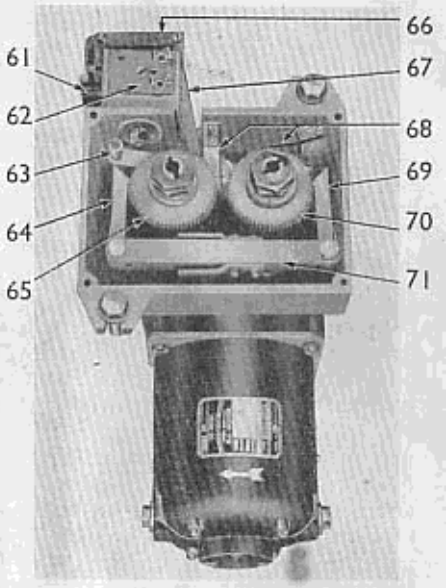


Fig. 9. Top view of Motor and Feed Ratchets.

then drops back too far onto the right-hand strip, turn the cam slowly till the relay contacts open. It may be necessary to repeat these adjustments once or twice to get the crater image to "float" correctly between the two strips.

If the relay contacts "chatter", the gap as set in the section "Thermal Relay", page 11, is too wide. Remove the relay from the lantern and unscrew the differential screw **very slightly** (about 10°) **out.** If the movement of the crater is excessive, the gap is too small. Remove the relay and screw the differential screw **in** about 10°.

Gearbox and Feed-mechanism

The feed-motor drives a wormwheel, on the spindle of which is a ball-race, mounted eccentrically. The eccentric motion rocks a lever 71, Fig. 9, at each end of which is fitted a spring-loaded pawl, 64 and 69. These pawls engage with the positive and negative ratchet wheels, 65 and 70, giving one tooth per stroke on the negative ratchet (right-hand) and, normally, three teeth per stroke on the positive ratchet. The ratchet wheels are connected by friction washers to spindles which pass back into the gearbox, where each has a worm drive to its own chain-sprocket.

When the solenoid 62, mounted on the side of the ratchet housing, is energized via the thermal relay, it interposes a pin 63, into the path of the positive pawl, reducing the number of teeth taken per stroke from three to one, and so reducing the feed-rate of the positive carbon to below normal burning-rate.

Adjustment of Feed-mechanism

A thin screwdriver and a 4 BA box-spanner through which the screwdriver will pass are required for adjustments to the ratchet-feed mechanism.

Remove the hand-feed knobs and the ratchet-box cover. Immediately in front of the ratchet-box will be seen the focus-control solenoid; movement of its armature operates a lever and pin 63, Fig. 9, the pin being in the path of the positive pawl 64. Switch on the arc, and observe the action of the pawl when the thermal relay contacts close. The solenoid armature moves inwards and the pin 63 should deflect the pawl so that the ratchet wheel is moved only one tooth for each stroke of the pawl. If the operation is incorrect, the length of the push-rod 67 probably requires adjustment. To do this, switch off the supply and open the left-hand door of the lantern. Fit the box-spanner over the locknut on the screw indicated at 66, Fig. 9, at the end of the armature, and pass the screwdriver through the box-spanner; unlock the nut and turn the screwdriver (clockwise to lengthen the push-rod). Re-lock the nut and again check operation.

When the relay contacts are open, the solenoid armature should also be open and pawl 64, at the end of its stroke should just clear pin 63. 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 61 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 68, Fig. 9, can be set to index each tooth correctly, but they should not apply too great a pressure.

Removal of Motor and Gearbox

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

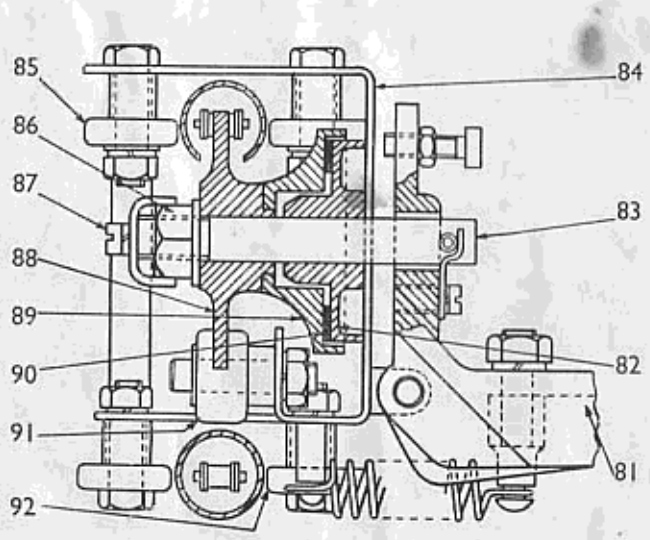
To remove the gearbox, ease the tension on the positive driving-chain by inserting an 0 BA screw and washer in the tapped hole in the plunger in the bearing for the front sprocket, 31, Fig. 3, and tightening the screw until the springs are fully compressed; then lift the chain off the gearbox sprocket. Unbolt the gearbox and unsolder the connections to the ratchet-housing solenoid, after which the gearbox can be lifted out.

POSITIVE CARRIAGE

An endless chain, driven by the positive sprocket on the gearbox, passes at the front end of the lantern over an idler sprocket, the

bearing of which is spring-loaded to keep the chain taut. A third sprocket, fitted to the moving carriage, is engaged with the driving chain and is normally locked and prevented from turning by a spring-loaded friction clutch. The movement of the chain is thus communicated to the positive carriage, giving normal feed. As the friction clutch is operated by the weight of the carriage, assisted by the spring, lifting this carriage will relieve the clutch pressure and release the sprocket. The carriage, while lifted, can be moved to a new position as required, the sprocket "free-wheeling" during the movement and being locked again when the carriage is allowed to drop back into its normal position.

Fig. 10 shows a section through the positive carriage. Bracket 81 is pivoted but restrained by stud 83. The reaction so obtained is transmitted through the stud, causing a clamping action between sprocket 88, clutch plate 89, friction washer 90, and bearing 82. The overhung weight of the bracket is therefore transferred to the moving carriage 84 which runs on rollers 85, 91, and 92, bearing on the main support tubes.



81. Bracket carrying positive head.
82. Bearing.
83. Retaining stud.
84. Carriage.
85. Rollers.
86. Adjusting nut.
87. Lock-screw.
88. Sprocket.
89. Clutch plate.
90. Friction washer.
91. Roller.
92. Rollers.

Fig. 10. Cross-sectional view of Positive Carriage.

If the friction washer becomes unduly worn, the bracket and the positive head will fall below normal. This can be corrected by slackening screw 87 and turning nut 86; the correct setting is when the vee in the moving head lines up exactly with the vee in the positive guide.

If the carriage rollers become slack through wear, new rollers should be fitted.

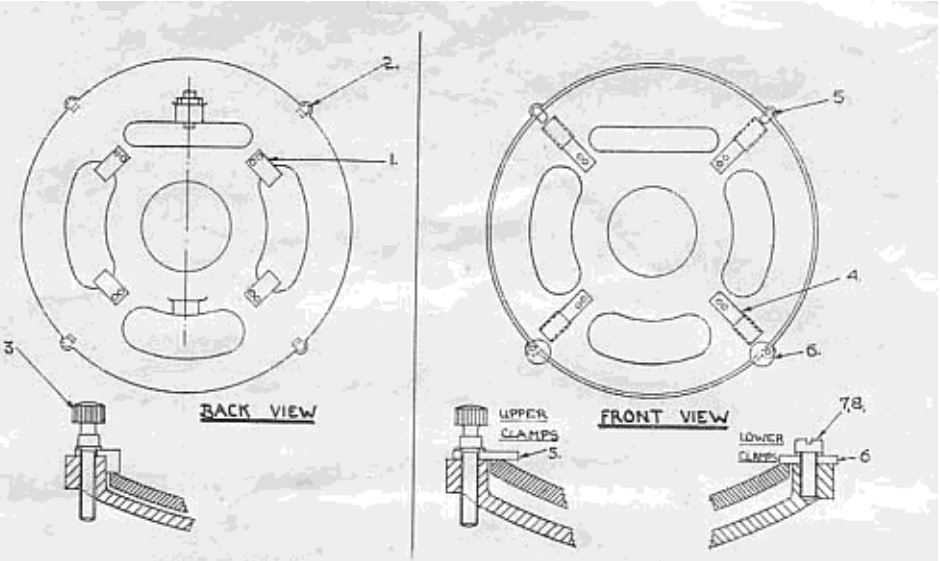
SURGE SUPPRESSORS

Both the striking solenoid and the gearbox solenoid are fitted with suppressors to prevent contact sparking and wear, and to avoid interference with the sound system.

The striking solenoid has a 0·5-mfd. 350-volt condenser connected in parallel with the coil. A Metrosil surge-suppressor and condenser assembly are connected in series across the gearbox solenoid coil, and are located in a metal housing attached to the gearbox.

Should the blower motor cause interference with the sound channel, local suppressors should be fitted to suit individual conditions.

A list of the recommended Spares will be supplied on application.



Glass to Metal

(1) Remove existing mirror springs and mirror clips; retain screws and washers.
(2) Fit new springs (Pt. 1) at **back** of frame as shown.
(3) Fit new clips (Pt. 2) at bottom, with projection inwards, using screws, Pt. 3.
(4) Fit metal mirror and new upper clips. The mirror should now be below the edge of the frame, and should be held against the clips by spring pressure.

Metal to Glass

(1) Remove existing mirror springs and mirror clips; retain screws and washers.
(2) Fit new springs (Pt. 4) to **front** of frame as shown. Remove the initial stiffness by hard finger pressure.
(3) Fit the long clips (Pt. 5) at top, and round clips (Pt. 6) at bottom. Leave screws loose.
(4) Fit glass mirror, with diamond cut at top, rotating the clips to permit entry. Tighten clip screws.

Fig. 11. Glass-to-metal or metal-to glass mirror conversion.

MAINTENANCE

Daily Attention

(1) The mirror can be cleaned in position, or can be removed with the mirror frame.

(a) **Metal mirrors.** Experience has proved that the daily cleaning of metal mirrors is essential, as neglect will cause the appearance of a chemical film, very difficult to remove, on the reflecting surface. Use only a high-grade silver polish or a special mercury-free rouge which can be supplied by the BTH Company.

(b) **Glass mirrors.** Remove any small carbon spots, and then clean with suitable mirror-cleaning compound, taking care not to wet the back of the mirror.

(2) Withdraw the heat filter and clean it very carefully, using a dry camelhair brush. Never allow moisture, grease, or the fingers to come into contact with the filter glass. While the heat filter is out of the way, the nose lens should be cleaned.

(3) Empty the slag tray.

(4) Brush carbon dust from the main tray.

(5) Lubricate (sparingly) any points requiring attention (see page 24).

(6) Replace any inspection windows that may be broken. A cracked window is dangerous to the eyes.

Weekly and Monthly Attention

(1) Carry out lubrication in accordance with the instructions on page 24.

(2) Examine main flex leads, and check all joints, tightening where necessary.

General Attention every 3 to 6 months

(1) Clean contacts of thermal relay, inserting a pipe-cleaner moistened with carbon tetrachloride between the contacts.

(2) Adjust (if necessary) thermal relay differential screw to compensate for contact wear. Only necessary if crater movement has become excessive.

(3) Check positive carriage for alignment with positive guide. Re-adjust height if wear has taken place. If the anti-lift device has become loose and allows the carriage to rock, its fixing screws should be loosened, the slack taken up, and the screws retightened.

(4) Check the motor brushes for wear.

(5) Replace any worn or damaged parts with the correct spares.

(6) Refer to lubrication diagram for points requiring occasional lubrication.

LUBRICATION

Fig. 12 shows the points requiring periodic lubrication, and these should receive attention as indicated in the following table. Except where special instructions are given, all points are freely accessible without the removal of any parts. The recommended lubricants are as follows:—

Oil .. Asteroil AA Grease .. Graphite Grease.

Point	Description	Lubricant	Access
Weekly			
P	Positive carriage rollers (not ball races)	Oil	
R	Positive drive front sprocket	Oil	Oil-hole.
U	Negative collet nut vee 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 (1 drop only per month)	Remove feed knobs and cover and lift out lever.
	Rear spindle—oil recess behind ballrace		
J	Positive and negative ratchet wheel spindles		Remove feed knobs.
K	Mirror adjusting spindles	Oil	Remove mirror frame.
L	Mirror adjusting cams	Grease	Remove mirror frame.
M	Feed control pivots	Oil	Remove feed knobs and cover.
N	Arc striking rollers (2 bearings) ..	Oil	Under negative carriage bracket.
Q	Positive-carriage clutch sprocket ..	Oil (1 drop only per month)	
S	Negative-carbon tilting cam	Grease	Under negative carriage bracket.
T	Negative-carbon 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	