INSTRUCTIONS

for the

INSTALLATION, CARE AND MAINTENANCE

of

Nevelin

Glass Bulb Multi-anode Rectifiers

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Installation, Care and Maintenance of Nevelin Glass Bulb Multi-anode Rectifiers

Types A, B, & C

The purpose of this booklet is to assist users of Nevelin Mercury Arc Rectifiers to get the best possible service from their equipment. It is strongly recommended that these notes be read before attempting to unpack the bulbs or install any of the apparatus.

Nevelin Mercury Arc Rectifiers are engineered and built for long, trouble-free service and, therefore, merit proper installation and adequate maintenance.

In this booklet an attempt has been made to present concise but clear instructions covering the installation of new equipment, with a brief account of the essential features of Mercury Arc Rectifier operation, followed by some notes on maintenance. The Index (on page 23) will, it is hoped, be useful in the event of difficulty, but, if necessary, further advice can be obtained from the nearest local Branch Office or Agent, or from Head Office.

The Current Sign of Nevelin RECTIFIERS *Rectifier Efficiency*

1 CHECKING EQUIPMENT ON DELIVERY

All equipment should be signed for on receipt "received unexamined", and the consignor and the carriers should be notified of any damage to the equipment as quickly as possible, and, in any event, within three days of receipt.

Apparatus and packing cases should be checked against the Advice Note and any shortage reported, together with outward signs of apparent damage which may be readily visible.

2 INSTALLATION

Mercury Arc Rectifier equipment, like all other apparatus, should be located in a dry, cool, well-ventilated site. The ambient temperature should not be less than 5°C., nor more than 30°C., unless the equipment has been specifically ordered for service in ambient temperatures outside these limits.

The rectifier cubicles, transformer and switchgear, if any, should be moved into position before the rectifier bulbs are unpacked, and connections should be made to the a.c. supply and to the outgoing d.c. cables.

The a.c. supply should not be switched on to the rectifier until the rectifier bulbs have been fitted in the cubicles and connected.

On the larger rectifiers the cradles which support the bulbs are removable and should be slid from the cubicles and placed on the floor ready to receive the bulbs when unpacked. (*See Figs. 7 and 8.*)

The a.c. voltage at the supply terminals should be checked and the position of the transformer primary tap changing links or switch should be set to correspond with the supply voltage. A diagram of connections is supplied with every equipment, giving the information necessary to enable this adjustment to be made.

3 UNPACKING RECTIFIER BULBS

All Nevelin multi-anode rectifier bulbs are shipped in special transit cases, which, unless otherwise labelled, are returnable. These cases are designed to minimize the risk of a bulb being turned over, as the rectifier bulbs are intended to be transported with the mercury in the dome of the bulb, thus avoiding possible damage to the glass-to-metal seals of the anode, cathode and other connections.

(a) *See Fig. 1.* To open the case, remove the two fixing screws which secure the cover at each end to the body of the container.

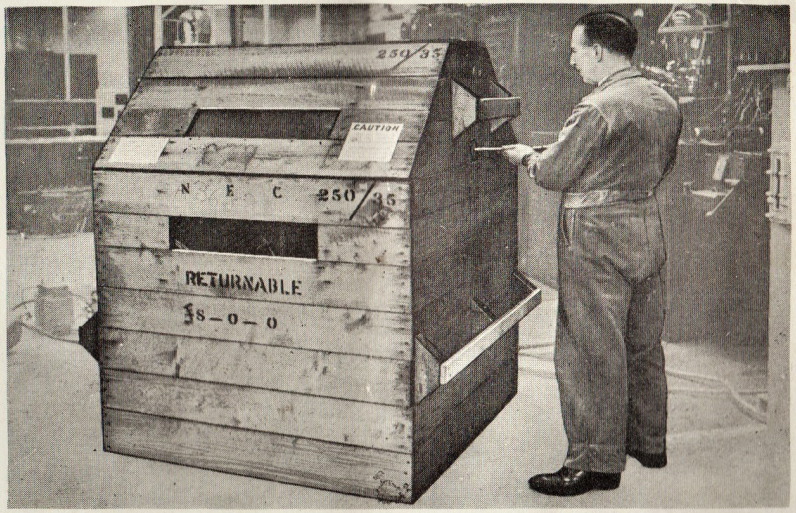


Fig. 1. The fixing screws which secure the lid of the rectifier bulb packing case are located within black circles, one at each end of the case. (*Section 3 (a).*)

(b) *See Fig. 2.* It is unnecessary to dismantle the case, for having withdrawn the two fixing screws, the lid can be easily raised and set aside.

(c) *See Fig. 3.* Carefully unhook the top webbing—taking every precaution to avoid the bulb coming into contact with the sides of its container.

(d) *See Fig. 4* Now, take hold of the bulb by the **main** arms at that part where they immediately protrude from the body, and lift the bulb clear of the case.

(e) *See Fig. 5.* Gently reverse the position of the bulb so that the mercury flows from the dome to the normal cathode pool. Following the procedure shown in Figs. 5 and 6 will enable this operation to be carried out without difficulty.

(f) *See Fig. 6.* Now in its correct and upright position, the bulb is ready for fitting into its supporting cradle.

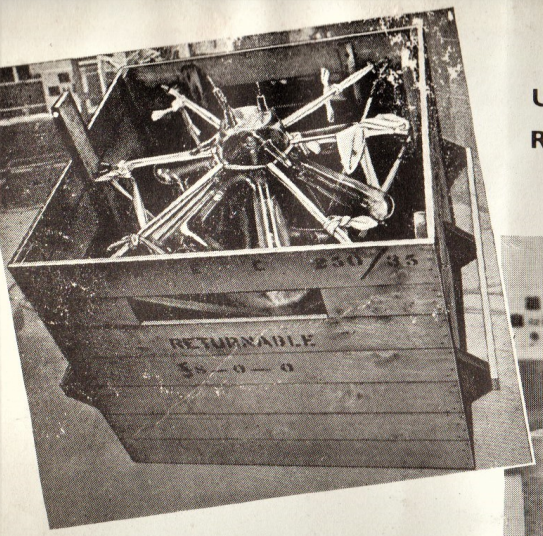


Fig. 2. Typical method of suspension-packing of a Nevelin standard 6-arm bulb. Untying the webbing knots leaves the bulb suspended in its under-seating. (*Section 3 (b).*)

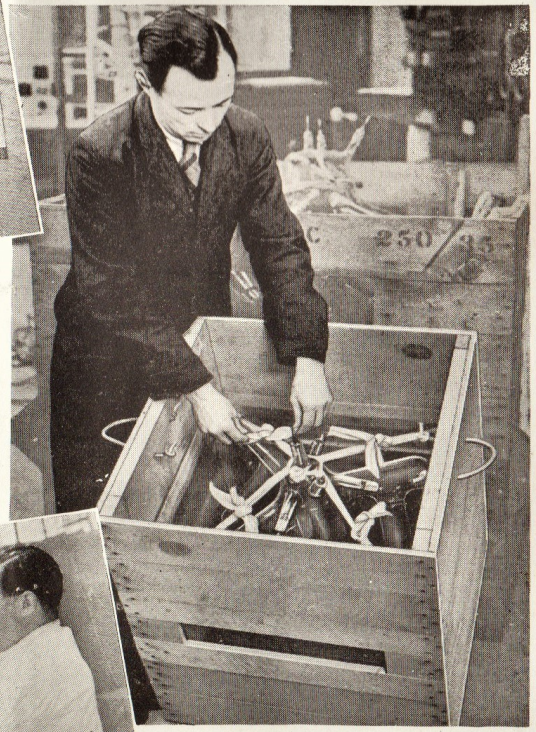


Fig. 3. Untying the webbing in the packing case of a smaller type of bulb prior to gripping the lower arms of the unit and lifting the bulb clear of its container. (*Section 3 (c).*)

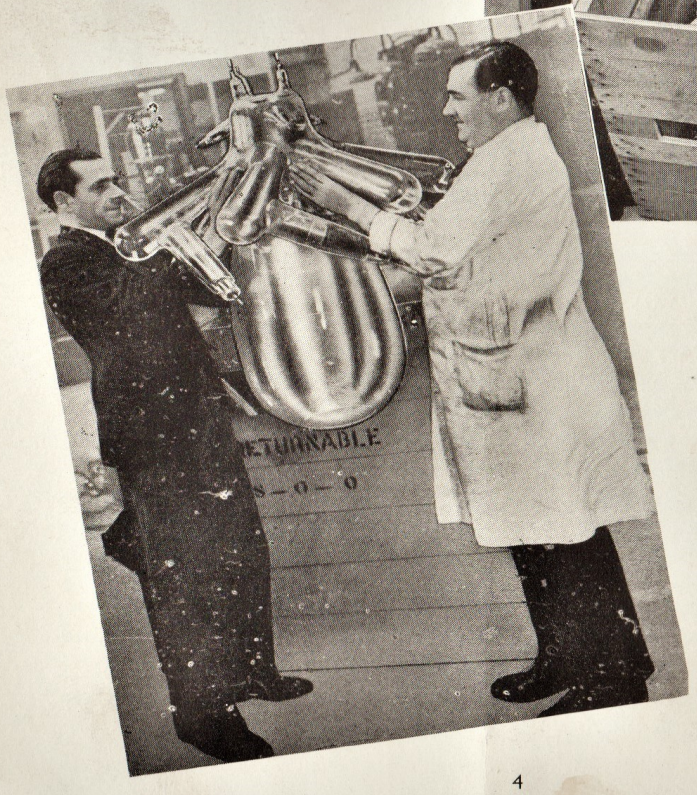


Fig. 4. Lifting the larger type of bulb from its packing case requires dual assistance. This enables the operation to be carried out in a simple manner and without the risk of incurring damage. (*Section 3 (d).*)

Fig. 5. From the position in Fig. 4, the bulb is turned over by the assistant at the "dome end" gently raising his part of the unit and allowing the mercury to flow down very slowly into the cathode pool. (*Section 3 (e).*)

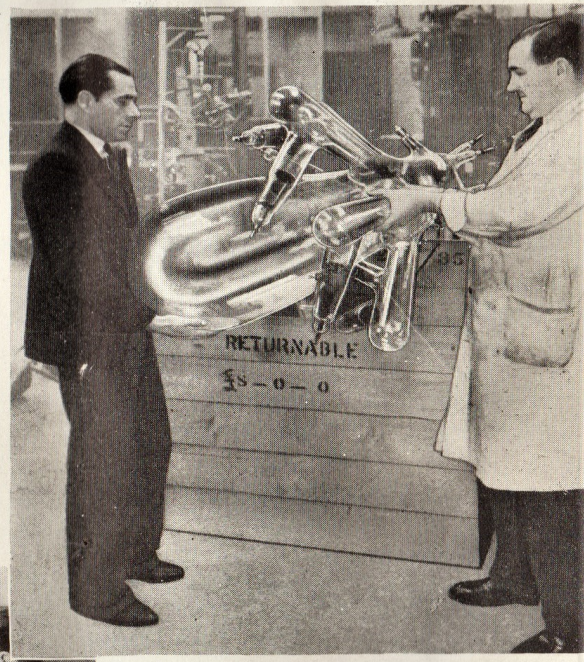


Fig. 6. Completion of the operation in Fig. 5 brings the bulb to its upright position and with the mercury supply now in the cathode pool. (*Section 3 (f).*)

4 FITTING RECTIFIER BULBS IN THE CUBICLES

Nevelin rectifier bulbs are provided with three different types of ignition, and the method of supporting the bulb varies accordingly. Bulbs for type "A" cubicles have pinch bridge ignition, while those for types "B" and "C" cubicles have a dipper electrode to start up the arc.

(a) Bulbs with Pinch Ignition (Type "A")

See Figs. 7 and 8.

Lower the bulb carefully into the cradle and secure in position by means of the top band. (*See Fig. 7.*)

NOTE: For all sizes of bulbs up to and including about 150 amperes, the carrier is secured to the cubicle. Above these sizes, however, the carrier is withdrawable as mentioned in Section 2.

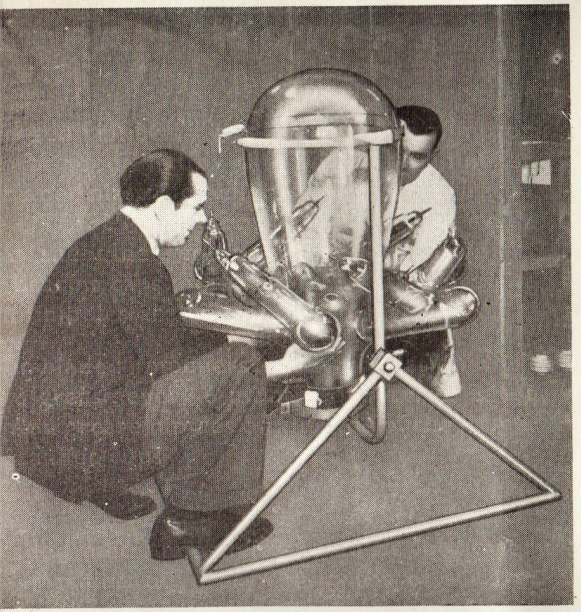


Fig. 7. Fitting a bulb with pinch bridge ignition (Type "A") into its cradle. (*Section 4 (a).*)

Wipe off protective petroleum jelly, then carefully clean all caps and anode and cathode connecting stems, etc. with some fine emery cloth. The cradles with the larger sizes of bulbs can now be placed in the cubicle. (*See Fig. 8.*)

Adjust the position of the bulb by pivoting the carrier to obtain a depth of mercury in the Pinch

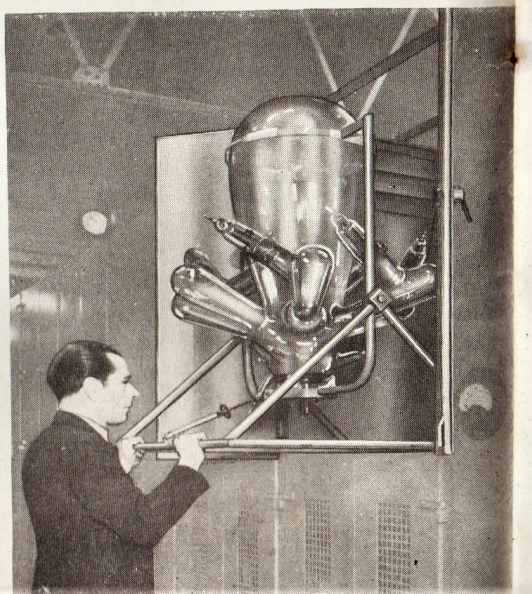
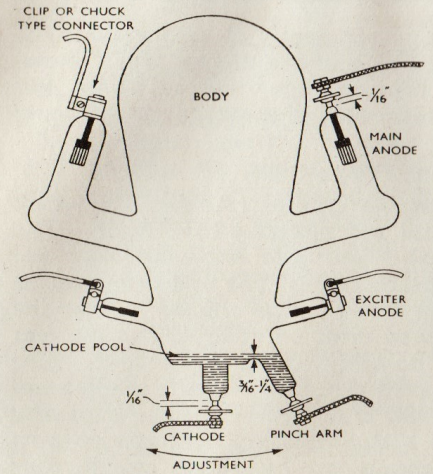


Fig. 8. Fitting a bulb and cradle into a Type "A" rectifier cubicle. (*Section 4 (a).*)



bridge of $\frac{3}{16}$ to $\frac{1}{4}$ inch, as illustrated in the diagram (*Fig. 9*). With the smaller type of carrier this adjustment is carried out by loosening a wing nut engaging on the base quadrant which is situated at the rear of the cubicle. For the larger carriers, an adjustment is provided at the foot of the carrier.

Fig. 9. "A" Type rectifier bulb. (*Section 4 (a).*)

(b) Small Bulbs with Dipper Ignition (Type "B")

Slide the body of the bulb between the sponge rubber pads of the bulb carrier (inserting the base first), slightly depressing it into the cup.

NOTE: An adjustment is provided at the top of the carrier by which the pad and cup assembly can be lowered or raised as required

The removable portion of the girth-band may now be replaced and its securing nuts tightened so that the bulb is firmly yet resiliently gripped.

Adjust the position of the bulb by carefully pivoting the carrier to obtain a gap of approximately $\frac{3}{32}$ inch between the cathode pool and the tip of the Dipper electrode, as illustrated in the diagram (*Fig. 10*). This adjustment is effected by loosening a clamp screw situated at the rear or the base of the carriers.

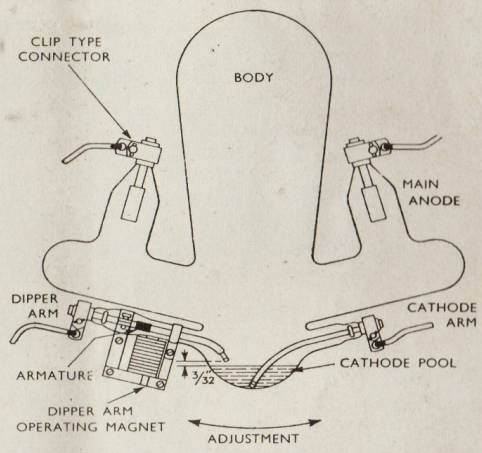


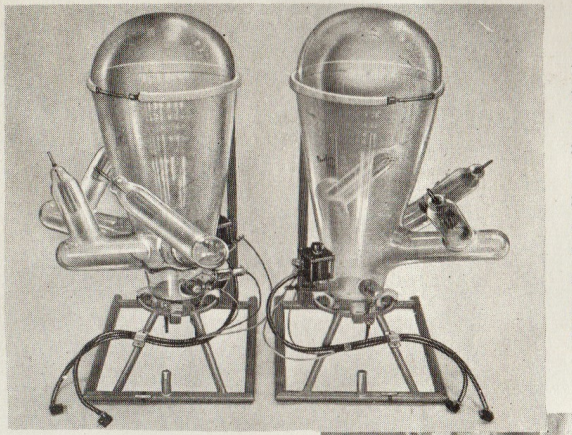
Fig. 10. "B" Type rectifier bulb. (*Section 4 (b).*)

The magnet which operates the dipper should be secured to the arm of the bulb containing the movable Dipper electrode (*See Fig. 10*). The nuts on the circular clip should be loosened and the magnet slid over the arm, the coil being on the inside and the removable clip engaging approximately on the centre line of the bulge in the outer glasswork. The position of the magnet should be adjusted

so that the poles of the magnet are placed nearly centrally about the armature which is contained in the bulge of the dipper arm. Now, screw up the nuts on the circular clips to finger-tightness only, but making them sufficiently secure to prevent the magnet from being easily moved.

(c) **Large Bulbs with Dipper Ignition (Type "C")**

These bulbs are fitted in withdrawable cradles (*see Fig. 11*) which should be removed from the cubicle and placed on the floor. The cradles are in pairs (one right-hand and one left-hand) and are labelled accordingly at the front of each cradle. The bulbs themselves are all interchangeable but must be fitted in the cradles so that the left-hand bulb of the pair has its anode arms pointing to the left rear and the right-hand bulb has them pointing to the right front. (*See Fig. 12.*) The bulbs should be lowered carefully into the cradles and secured by means of the top bands, after which all the caps and connecting stems should be cleaned with fine emery cloth after wiping off any Vaseline or grease. There is no need for any further adjustment of bulb position.



The cradles carrying the bulbs can be then lifted into the cubicles and slid into their correct positions. The connections to the bulb should then be made as indicated in the next section and the dipper operating coil placed gently over the vertical section of the dipper arm until its internal felt pad rests on the glass (*See Fig. 12*).

Fig. 11. Type "C" rectifier bulbs fitted in right and left hand withdrawable cradles. (*Section 4 (c).*)

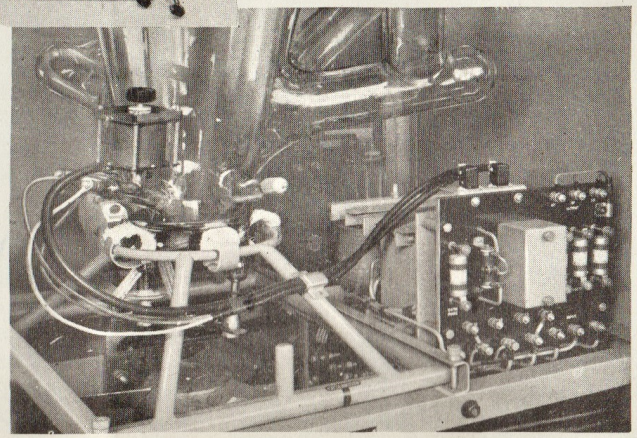


Fig. 12. Dipper operating coil for Type "C" rectifier bulb in operating position. (*Section 4 (c).*) (Note also plug-in connectors to ignition unit on right.)

5 CONNECTING THE BULBS

Connections to the bulb terminals are made by flexible copper leads with chuck- or clip-type connectors.

Chuck-type connectors should be fitted by sliding them over the terminals until $\frac{1}{16}$ inch of the copper end can be seen projecting beyond the jaw of the connector. It is important to see that the connector is in contact only with the copper, and not over the joint between the tungsten and copper. Do not force the chucks on, as damage may result. Now, tighten the connectors by turning the knurled rings and, at the same time, taking as much strain as possible off the glass itself, by holding the connection lead in the other hand. It is essential that the connections are made well and truly secure. Where small chuck-type connectors are provided for connection to control grids, they are fitted direct to the tungsten rods which do not have any copper extensions.

To fit the clip-type connectors to the bulb, loosen the knurled nut and push the clip **straight** on to the cap. In no circumstances allow it to be twisted. Tighten the knurled nut as much as possible, but only with the fingers.

6 STARTING UP

The rectifier should be disconnected from the d.c. load by opening the circuit breaker switch or withdrawing the d.c. fuses.
It is now necessary to check that the rectifier bulbs have been correctly positioned and are operating satisfactorily. The procedure again depends upon the type of ignition as follows.

(a) **Bulbs with Pinch Ignition (Type "A")**

On equipments with a number of rectifier bulbs, all the ignition relays should be tripped by hand except one (*see Section 10 (a)*. The a.c. supply can now be switched on and the exciter anodes should fire immediately. Should the exciters fail to light and sparks are not visible in the mercury, then the bridge is too thick and the bulb carrier must be tilted to form a thinner bridge, taking care that the flexible leads do not tighten and put strain on the bulb.

> **NOTE:** The absence of sparks across the bridge, even with a very thin mercury bridge, indicates that either the ignition relay has tripped and requires resetting, or the supply from the exciter unit has failed. Should sparks be present across the bridge but the exciter gives no indication of firing, a loss of vacuum in the bulb might be suspected. This can be confirmed if the spark produces a small quantity of white smoke accompanied by a distinct metallic sound. In Nevelin bulbs, as indeed in all good bulbs, neither of these failures should occur.

On multiple bulb equipments as soon as the first bulb is operating satisfactorily on the exciter anodes a second ignition relay can be closed and the procedure repeated with the second bulb.

(b) **Small B[illegible]per Ignition (Type "B")**

Switch on the supply, and consequent upon the dipper dipping into the cathode pool and returning (thereby producing a spark), the exciter anodes should fire immediately. If the ambient temperature is low, the arc may be extinguished and the dipper will then operate several times on starting, but the exciters should fire steadily after approximately 30 seconds. Non-operation of the dipper electrode (assuming it to be undamaged and free to move) indicates a failure of supply to the coil and the a.c. fuses should be checked. If, however the dipper operates, but the excitor anodes do not show any signs of firing, a loss of vacuum in the bulb should be suspected. This is confirmed if the spark produced by the dipper electrode is slightly yellow in colour instead of blue, and is accompanied by a slight wisp of white smoke.

(c) **Large Bulbs with Dipper Ignition (Type "C")**

Type "C" rectifier cubicles are always fitted with more than one rectifier bulb. In order to check the starting of one bulb at a time it is only necessary to remove the single fuse from the left-hand side of the front panels of the exciter units supplying the other bulbs, thus rendering their ignition inoperative.

The dipper electrode should normally rest in the mercury pool, and on switching on the supply it should be lifted clear from the mercury by the solenoid coil and the exciter anodes should fire immediately. If the dipper fails to lift, unlock the knurled ring on the top of the dipper coil and turn the knob two or three turns counter-clockwise to lower the coil. If the electrode lifts but shows a tendency to fall back into the mercury, rotate the knob in clockwise direction to lift the coil. Always re-lock the knurled ring after adjustment. (**Note:** The final adjustment must be such that the dipper rod does not rattle against the top of the dipper arm.) If the dipper lifts but the exciters fail to light, a loss of vacuum in the bulb may be suspected, as in the case of the smaller bulbs, type "B".

7 RUNNING IN

Having checked that the rectifier bulbs are sound, put the rectifier on "half" to "full" load and check that the rotation of each fan is correct and that the airstream is directed upwards on to the bulbs; this is essential for the proper operation of the rectifier. If necessary, two of the fan motor leads must be reversed to obtain correct rotation.

The load should be maintained for an hour and the bulbs watched during this period. It will be observed that the mercury level drops due to the condensation of the mercury vapour which adheres to the sides of the bulb. A continuance of this condition can be expected until the condensed globules commence to flow back into the cathode pool and the walls of the bulb become streaked in appearance, thus

indicating that the bulb is "run in" and the cathode pool has reached its normal working level.

(a) **Bulbs with Pinch Ignition (Type "A")**

By now the pinch bridge will have become quite thin and should be thickened by adjusting the position of the bulb and carrier until the bridge returns to its original thickness.

During the "running in" process, it is important to see that the mercury does not drop so far that the bridge becomes broken and two separate pools of mercury are created. If this does occur, the supply must be switched off immediately and the bulb assembly tilted so that the bridge closes. The supply may be switched on again and the "running in" process continued. Upon completion of the process, the bulb should be approximately vertical, and should not require any further adjustment.

(b) **Small Bulbs with Dipper Ignition (Type "B")**

When the bulb is "run in" as described above, the supply should be switched off and the bulb inspected to see that the gap between the dipper electrode and the cathode pool does not exceed $\frac{5}{16}$ inch, and also that the dipper does enter the pool when the set is switched on. If necessary, a readjustment must be made so that these conditions are met. The bulb when "run in" should be approximately vertical and should not require any further adjustment.

(c) **Large Bulbs with Dipper Ignition (Type "C")**

The ignition system on the bulbs fitted in type "C" cubicles is such that there is no need to adjust the position of the rectifier bulb when the equipment is "run in."

8 PRINCIPLE OF OPERATION

Nevelin rectifiers are designed so that immediately the a.c. supply is switched on to the primary of the rectifier transformer, the rectifier bulb should fire on its excitation anodes, and the cooling fan if fitted will commence to run. (**Note.**—On larger rectifiers, types "A" and "C", the fan may not rotate until an appreciable d.c. load is applied to the set.) The equipment is then ready to supply the d.c. load.

The rectifier transformer not only converts the a.c. supply voltage to the values necessary to give the correct d.c. output at full load but is also provided with an auxiliary winding to supply the exciter and ignition unit, together with grid control and other auxiliary equipment if fitted. The primary windings of the rectifier transformer are provided with tappings to compensate for variations in the supply voltage which are brought out either to terminals and links or to an off-circuit tap-changing switch.

9 IGNITION

In order to establish an arc between the anodes and the mercury cathode pool, the mercury vapour must be ionized, and for the current to be continuous a copious supply of electrons is essential. These electrons are emitted from an incandescent area (the "cathode spot") on the surface of mercury pool, created by an intense bombardment by positive ions.

The cathode spot may be established in several ways and Nevelin rectifiers employ two methods, "Pinch Ignition" for the larger bulbs in "A" type sets, and "Dipper Ignition" for the remainder in "B" and "C" type equipments.

In Pinch Ignition (Type "A" Rectifiers), a small neck or bridge of mercury is provided between the main cathode pool and an arm on the side of the bulb.

A heavy current is passed through this bridge, which causes it to shrink, due to the electro-magnetic force which neutralizes the hydrostatic pressure of the mercury, thus increasing the current density until the bridge ruptures with an intense spark. This process takes place in the fraction of a second and results in vaporization of the mercury, thus allowing the arc to be established between the excitation anodes and the cathode pool.

In Dipper Ignition (Types "B" and "C" Rectifiers), the mercury is vaporized and an arc is established by a movable electrode drawing a spark from the cathode pool.

10 MODE OF IGNITION

(a) "A" Type Rectifiers *(See Fig. 13.)*

The supply to the exciter ignition unit is connected to two terminals on the back panel which, via one or two ignition fuses depending upon the size of the unit, feed the 115 v. primary winding of a transformer. This is provided with tappings marked A2, A3 and A4 to trim the ignition, but under normal conditions this need not be changed. The secondary windings comprise:—

(i) an exciter winding (centre-tapped 65–0–65 v.) which supplies the exciter anodes via the current limiting choke and the current ignition relay coil.

(ii) two heavy current windings (6·5 volts) feeding the ignition and trip circuits.

The ignition winding passes a current (1,000 amps. approximately) through the pinch bridge to initiate the arc and the trip winding simultaneously energizes the thermal trip, which opens and locks out the ignition relay contacts in 4 to 5 seconds if the exciter anodes do not fire. In this event the relay must be reset *(see Section 6 (a).)* by hand before the rectifier can be restarted.

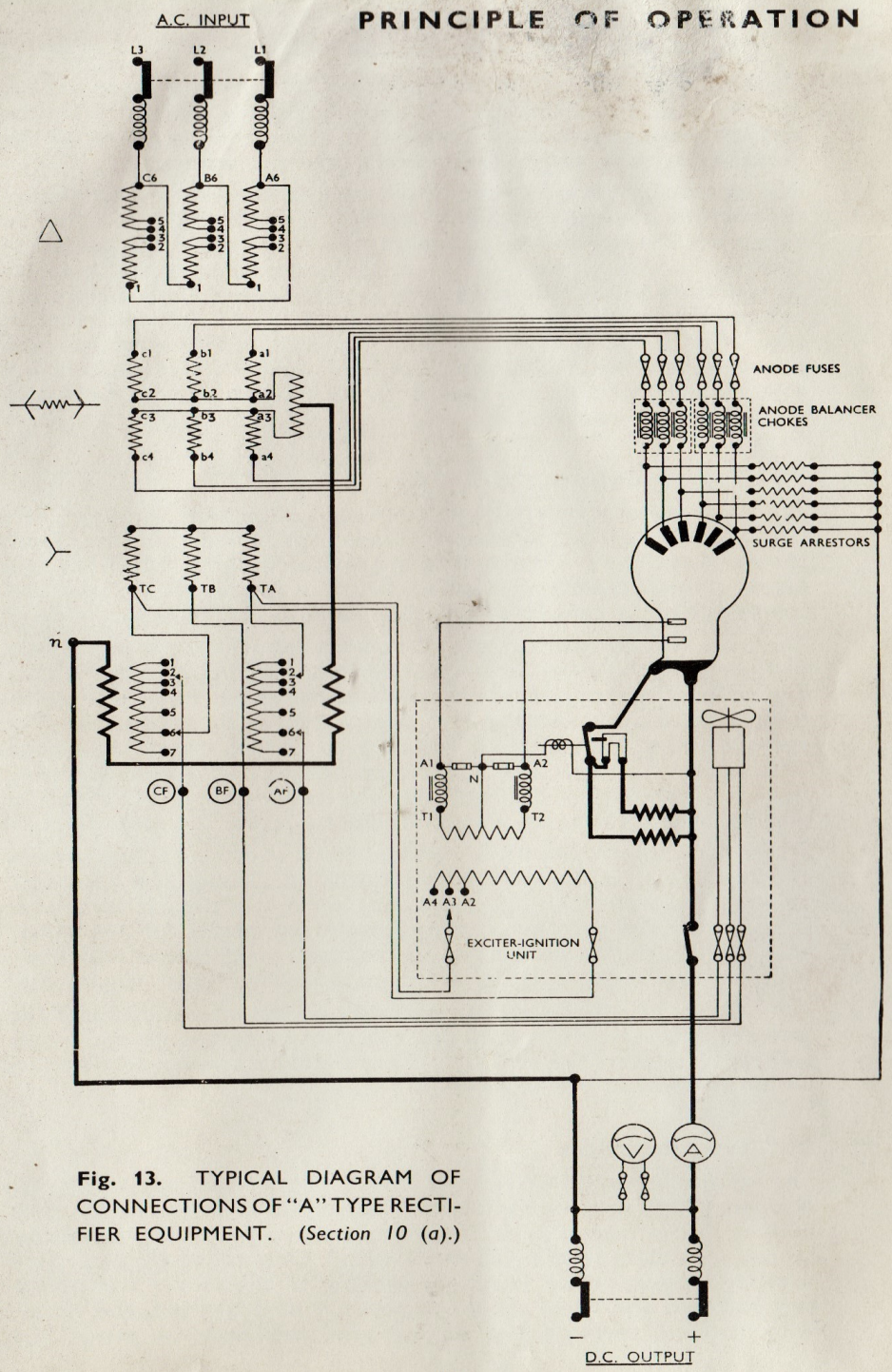


Fig. 13. TYPICAL DIAGRAM OF CONNECTIONS OF "A" TYPE RECTIFIER EQUIPMENT. *(Section 10 (a).)*

Generally the exciter anodes will fire immediately and the exciter current will operate the coil (but not the tripping mechanism) of the ignition relay, thus opening the relay contacts and disconnecting the ignition circuit as long as the exciter current is maintained.

The ignition fuse(s) provide additional protection if the exciter anodes do not fire and the relay fails to trip. The cartridge is timed to rupture in 25 seconds with constant ignition current. The process of ignition should, normally, be instantaneous, but if the ambient temperature is low, the relay may operate several times before the exciter anodes fire steadily, possibly causing the ignition relay to trip. If this occurs, the relay should be reset by means of the knob provided, and the rectifier put "on load" immediately; the bulb will then quickly warm up and the exciters fire steadily, even if the load is subsequently removed.

(b) "B" Type Rectifiers (*see Fig. 14.*)

The main transformer has two single phase tertiary windings, one (65–0–65 v.) supplies the exciter anodes and the other (0–60 v.) feeds the ignition circuit. The ends of the exciter winding (which is single phase, centre tapped) are connected to the anodes via a choke, and the centre tap is connected through the relay coil to the cathode.

The main transformer current flows from the ignition winding via a resistor and the relay contacts, through the dipper magnet coil. The poles of the magnet are centrally placed about a soft iron armature in the dipper electrode which is attracted to the magnet core and the end of the electrode is pulled down into the cathode pool. This action short circuits the dipper magnet coil; the operating magnet is de-magnetized and the electrode springs back into its original position drawing a spark as the tip leaves the cathode pool.

The exciter anodes should fire immediately, and the exciter current (3·5 to 5 A. d.c.) of the exciter circuit passing through the relay coil, will disconnect the ignition circuit. In the event of the exciter anodes failing to fire and the dipper being allowed to operate for a considerable period, the current limiting resistor, which has a high temperature coefficient, will prevent damage to the dipper magnet coil.

The process of ignition should normally be instantaneous but if the ambient temperature is low the relay may operate several times before the exciters fire steadily. They should, however, settle down within 30 seconds (*see Section 6 (a).*)

(c) "C" Type Rectifiers

The ignition/excitation circuit is shown diagrammatically in Fig. 15. A single phase ignition/excitation transformer is provided for each bulb as in the case of type "A" rectifiers but has only one centre-tapped secondary winding 65–0–65 volts. One half of the secondary winding supplies an a.c. (starting) winding on the dipper arm operating solenoid and when the transformer is de-energized, the circuit is completed through the dipper arm and cathode pool. The

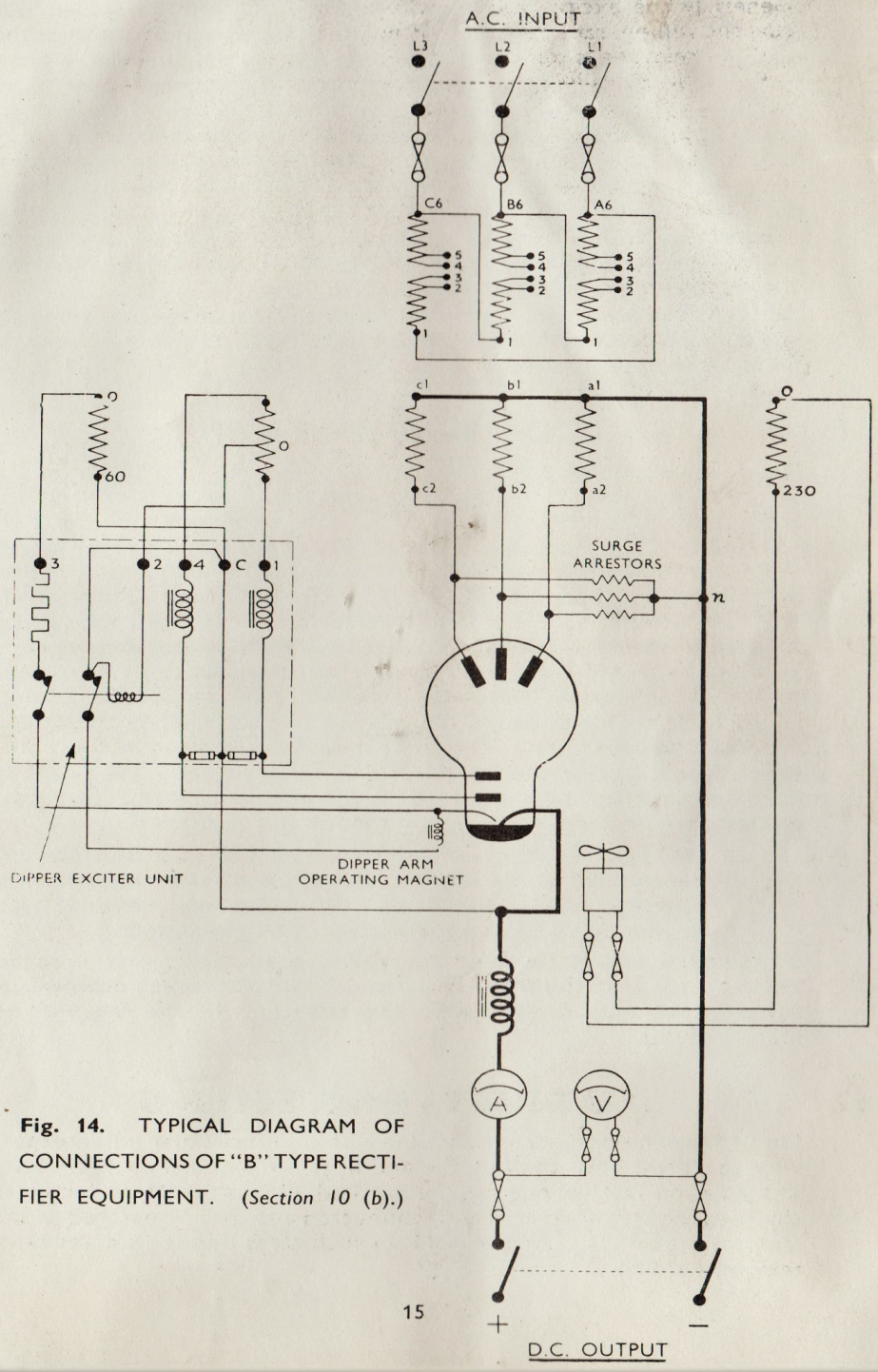


Fig. 14. TYPICAL DIAGRAM OF CONNECTIONS OF "B" TYPE RECTIFIER EQUIPMENT. (*Section 10 (b).*)

secondary winding also supplies two excitation anodes, which are connected across its outers in the usual way; the d.c. excitation current flows through a second (holding) winding of the dipper solenoid and through the operating coil of the ignition relay. On switching on, a small a.c. current flows through a high resistance via the a.c. coil of the solenoid, through the dipper to the mercury and back to the a.c. supply; the current is sufficient to lift the dipper out of the mercury and make a small spark. The exciters pick up the arc and the d.c. excitation current flows through the d.c. coil of the solenoid and pulls the dipper arm clear out of the mercury and holds it there. The ignition relay then disconnects the a.c. supply to the starting winding of the solenoid.

Normally the process of ignition is practically instantaneous, but with low ambient temperatures the dipper and relay may operate several times before the exciters fire steadily.

11 COOLING FAN

Normally, a bulb cooling fan is provided, fed from a tertiary winding on the main transformer through independent fuses. In the smaller equipments, i.e., within the range of those employing a bulb size of up to about 150 amperes, the motor runs at full speed so long as the supply to the main transformer is live. On the larger equipments the speed of the fan is controlled by a Fan Speed Control Choke which is usually placed in the main transformer tank. In this choke a d.c. saturating winding is used in conjunction with an a.c. winding and fluctuations in the d.c. load result in variations in the a.c. voltage applied to the motors. Hence the flow of cooling air varies according to the heat to be dissipated, thereby tending to maintain a constant operating temperature. The control choke is pre-set in the Company's works so that the fan will run at approximately 200 r.p.m. at no load, approaching full speed at 45 per cent. load. Although tappings are provided, this setting should not be altered.

NOTE: It is essential that the fan rotation should be correct and that the direction of the airstream is upwards on to the bulbs. If necessary, reverse two connections to the terminals of the fan motor.

If it is necessary at any time to replace a fan blade, care must be taken to see that the convex surfaces of the blades face downwards towards the motor, otherwise the efficiency of the fan will be much reduced.

12 OUTPUT-EARTHING

On all Nevelin rectifiers with double wound transformer unless otherwise specified, both the positive and negative d.c. terminals are fully insulated, and either one may be earthed. On certain small rectifiers the rectifier transformer is auto connected and may be earthed at the star point of the a.c. supply main; in such cases neither d.c. terminal may be earthed.

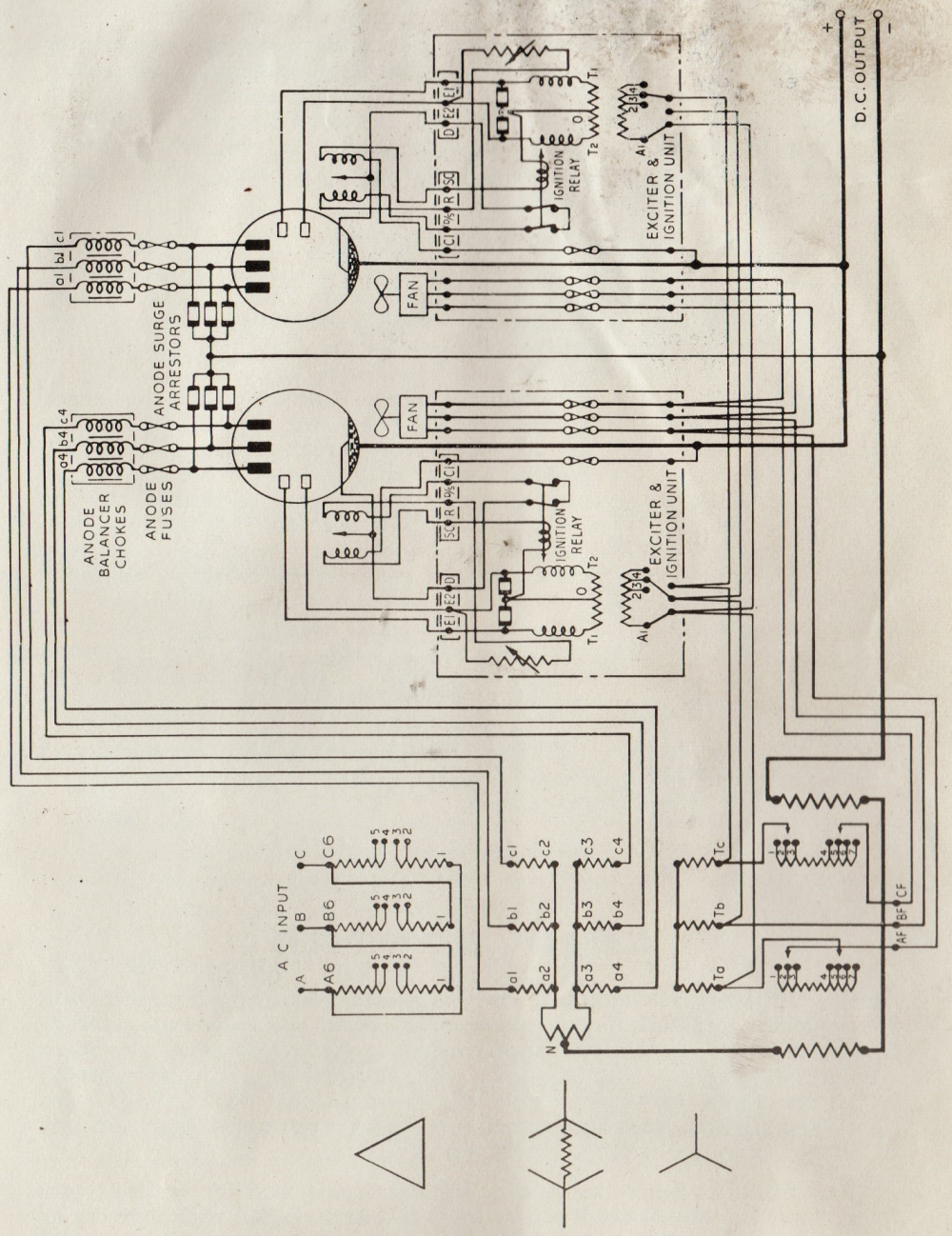


Fig. 15. TYPICAL DIAGRAM OF CONNECTIONS OF "C" TYPE RECTIFIER EQUIPMENT. *(Section 10 (c).)*

13 A[illegible] RCUIT

The neutral of the main transformer secondary winding constitutes the negative pole of the d.c. output, and the phase ends are connected to the main anodes. When the arc has been established in the bulb and a load is applied to the d.c. side, current will flow in turn from each phase via the appropriate anode to the cathode, which constitutes the positive pole. The following components may be connected to the anode circuit:—

(1) MAIN ANODE SURGE ARRESTORS. These are fitted to all equipments. They consist of non-linear resistors—one being connected between each phase and the neutral line. Their duty is to absorb and limit any voltage surges which may be set up in the circuit.

(2) MAIN ANODE FUSES. These are fitted to all the larger equipments as a protection in the event of backfire, i.e., the establishment of an arc between the anodes of the bulb instead of between anode and cathode. Normally this occurs only when the bulb has been overheated, as, for example, by a sustained heavy overload, or unduly high ambient temperature. High-speed fuses with high rupturing capacity are fitted and the same types must be used for replacements.

(3) ANODE BALANCING REACTORS. These are provided with equipments comprising two or more bulbs operating in parallel to ensure that the load is equally shared between the bulbs. When two or more bulbs are in parallel, two 3-phase reactors are used for each six-phase bulb, and can be adjusted on site if necessary by varying the air gap by removing or adding additional packing.

14 GRID CONTROL

On rectifiers provided with control grids, satisfactory operation will only be obtained if the phase relationship between the voltage applied to the anodes and control grids is correct as shown on the diagram supplied with the equipment. Full information is contained in separate Nevelin publications dealing with this subject, which should be read before attempting to start up any grid-controlled rectifier equipment.

It is useful to note that the operation of the rectifier without grid control can be checked quite simply by removing all the connections from the control grid terminals and connecting each control grid terminal to its corresponding anode terminal through a resistance of approximately 2,000 ohms.

15 MA[illegible]T[illegible]CE

Nevelin rectifiers are fully automatic in operation and only need to be switched on or off as the load demands.

NOTE: The positioning of the bulb is of vital importance, and once it has been set in accordance with the instructions given in this book or by the Company's Engineer it should not be moved.

All connections in the rectifier should be examined periodically in order to confirm that they are clean and secure. Any excess of dust or grease should be removed, particularly from the connections on panels, etc., as a tracking surface of conducting particles may be formed, thereby incurring the risk of short circuit.

16 COOLING FAN MOTORS

(a) **"A" Type Rectifiers**

All motors have grease-charged ball bearings. Three types of motor are in general use and can be identified by the type of fan impeller fitted. Motors with two-bladed plastic impellers should be lubricated with a few drops of grade DTD.825 or "Aeroshell" No. 11 oil every 6 months of service. On the older equipments, which have no external oiling points, the bearing caps must be lifted, but on present equipments push-on oil gun nipples are now standard.

Motors with three or four-bladed impellers need lubrication with 4 c.c. of Shell-Mex Nerita 3 grease every 6 months of service. Most motors have standard push-on grease nipples on the side of the frame, but a few are fitted with Stauffer cups.

(b) **"B" Type Rectifiers**

Motors with small four-bladed metal impellers should be lubricated with a few drops of fine machine oil every 3 months of service. The oil is inserted through holes normally plugged by two plated screws in the sides of the motor endplates.

Motors with two-bladed plastic impellers should be lubricated as described in Section 16 (a).

(c) **"C" Type Rectifiers**

All motors have three-bladed impellers and should be lubricated as described in Section 16 (a).

17 IGNITION RELAYS

The ignition relay is a vital part of the rectifier, and should be inspected periodically to ensure that it is operating correctly. The following instructions should be followed.

(a) Pinch Ignition Relays (Type "A" Rectifiers)

The contacts should be cleaned periodically, and pitting, if apparent, removed by using a very fine file or piece of emery cloth, finally burnishing the faces so that they are made smooth and absolutely flat. (*See Fig. 16.*)

If, at any time, the relay is in need of adjustment, this should be carried out in the following manner:—

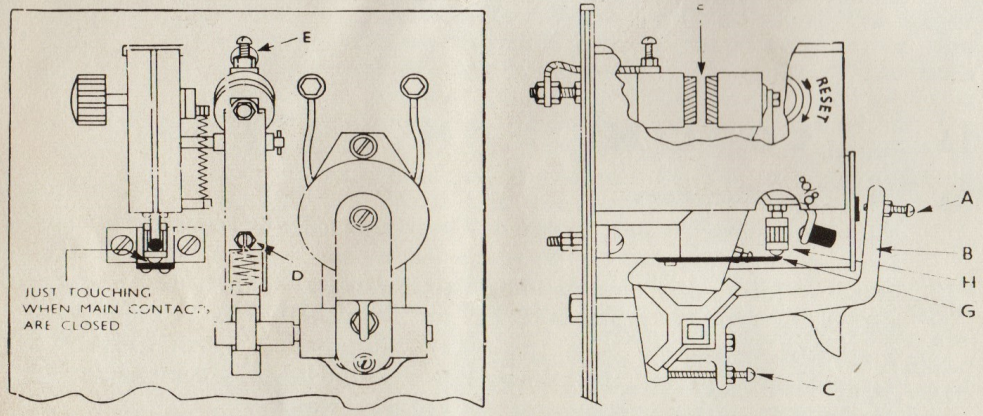


Fig. 16. Ignition relay for "A" Type rectifiers. (*Section 17 (a).*)

(1) The brass de-magnetizing screw (A) in the head of the moving pole piece (B), should be 1/64th to 1/32nd of an inch proud of the inner face.

(2) The screw (C) at the tail of the moving pole piece (B), should be adjusted to give a gap of $\frac{1}{8}$ inch between the fixed core and the de-magnetizing screw, i.e., when the relay is not energized.

(3) The moving and fixed contact adjustment screws (D) and (E) must be set to give the undernoted conditions:

(a) A gap of $\frac{1}{8}$ inch between the contact faces (F) when the relay is energised.

(b) Complete contact over the whole face of both contacts when the relay is not energized.

(c) Approximately $\frac{1}{16}$ inch lateral rubbing movement of the moving contact before the contacts commence to break.

(4) The thermal strip (G) should be examined for signs of overheating and, if necessary, replaced.

(5) With the relay set, but not energized, the trip-button (H) should be so adjusted that it just touches the thermal strip (G). This setting will trip the relay in 4–5 seconds in the event of the exciter anodes failing to fire and with the correct bridge thickness, and in 2 seconds, if the bridge is set too thickly.

NOTE: If the bridge is set much too thickly, the Primary Ignition fuse will blow.

(b) Dipper Ignition Relay (Types "B" and "C" Rectifiers)

The ignition relay is enclosed in a dust-excluding case as shown on the right-hand side of Fig. 13, and is fitted with pure silver contacts which should not normally need any attention or adjustment over a period of several years, but it should be inspected occasionally to ensure that the contacts are opening and closing correctly.

NOTE: Later "C" type relays have a normally open contact brought out to terminals P1 and P2 which can be used to indicate that the bulb is ignited.

18 OIL-IMMERSED TRANSFORMERS

These are normally despatched filled with standard transformer oil, and when cold the oil must not be below the level indicated on the gauge. The transformer should be topped up as necessary to the correct level with transformer oil grade B.30.

On certain transformers fitted with silica-gel breathers, the larger sight glass should be inspected periodically, and at the first signs of the blue colour changing to pink a new dehydrating element must be fitted. The used element can be reactivated by heating in an oven at approximately 300°F. until the element is warmed right through and the blue colour fully restored.

On breathers with oil seals, the oil level in the seal should be checked at the smaller sight glass, and, when necessary, topped up with transformer oil to the correct level through the plug provided immediately above the gauge.

19 SPARES

When ordering spares or replacements it is essential to quote the Serial No. of the equipment which appears on the nameplate. Orders for spares or replacements should also describe as accurately as possible the component required.

NOTE: As modifications are introduced from time to time in the detailed design and construction of Nevelin Mercury Arc Rectifier equipment with the object of still further improving performance and reliability, components may differ in some respects from those described or illustrated in this publication.

20 DELAY IN STARTING UP

After initial cleaning and before attempting to put the rectifier to work, check all insulation resistances. If any value is low dry out the equipment by blowing warm dry air around the affected items. In the case of oil-immersed units, apply to the works or local agent for detailed instructions.

If delay in starting up the rectifier should occur it may be found that a minor adjustment is required, or that a connection or relay needs to be cleaned. Reference should be made to the appropriate section of this Instruction Book as follows:—

Rectifiers Type "A", see Section 6 (a).
Rectifiers Type "B", see Section 6 (b).
Rectifiers Type "C", see Section 6 (c).

The following table shows the normal values of ignition and excitation voltage and current against which the actual values measured should be checked in cases of difficulty.

RECTIFIER TYPE	EXCITATION			IGNITION		
	VOLTAGE		CURRENT	VOLTAGE		CURRENT
	Measured at terminals	Value	Amps.	Measured at terminals	Value	Amps.
A	A1-N-A2	65-0-65	5·5/7·5	Cathode-Ignition electrode (bridge broken)	6·5	1,000 approx.
B	1-2-4	65-0-65	3·5/5·0	3-C	60	8·0
C	E1-SC-E2	65-0-65	5·0/6·0	SC-E2	65	0·7

NOTE: For all readings, except excitation current, a.c. instruments must be used.

The excitation current is the current in the ignition relay coil and must be measured with a moving coil instrument.

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