INSTRUCTION MANUAL

FOR

INVERTED
VERTICALLY ISOLATED
METALCLAD SWITCHGEAR

IVI

FOR SERVICE VOLTAGES

UP TO 15kV

Wide variations in operating duty and environment make it impossible to specify a uniform frequency of maintenance for all switchgear installations.

However, all equipment should be inspected prior to commissioning and again during the initial 12 month guarantee period, with particular attention to the tightness of fastenings and fixings. It should then be possible to assess future maintenance requirements. Users are recommended to consult "British Standard Code of Practice for the Maintenance of Electrical Switchgear, CP1008".

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IVI SWITCHGEAR - GENERAL -
FIXED PORTIONS - ERECTION

Contents

IVI Switchgear: Fixed Portions

Yorkshire Switchgear's Inverted Vertical Isolation system for metal-clad switchgear provides an outstanding degree of flexibility and interchangeability.

The "moving portion" which can be any one of a range of switching devices including automatic oil circuit breakers, fault making oil switches and oil switch-fuses, plugs into a standard "fixed portion".

Each metalclad fixed portion unit comprises a busbar chamber (1), a cable box (2), isolating contacts (3), receptacle insulators (4) and automatic safety shutters (5).

Busbars Busbars (6) are of hard drawn high conductivity copper supported by D.M.C. moulded barriers (7), compound insulated for long, trouble-free service, indoors or out. Busbars in adjacent panels are joined by bolted fishplate connectors (8) enclosed in compound-filled band joints (9). On outdoor installations the band joints are protected by rain-sheds (10).

The end fixed portions of a switchboard normally have busbar end covers (11), but a busbar end cable box (12) can be fitted to give direct cable-busbar connection. Both end covers and end boxes are compound-filled.

Cable Box A compound-filled, front access cable box (2), complete with all fittings, is supplied as standard. Angled glands, top-entry rear-mounted cable boxes and other modifications are available to order.

Isolating Contacts & Shutters The stationary isolating contacts (3) are protected by porcelain receptacle insulators (4) which remain non-porous even if the tough glaze is damaged. Fixed portions for 15kV service have cast epoxy resin insulators with integral stress screens. Separate automatic safety shutters (5) cover the busbar and feeder shutter apertures respectively when the moving portion is isolated. Ready use rain covers (13) are supplied to protect the shutter boxes (14) of outdoor installations when the moving portions are isolated. A more substantial, deeper lipped cover is available for fixed portions which are to remain un-equipped for long periods, i.e. "skeleton" units.

Foundation Channels Special foundation channels (15) span the cable trench. They carry both the fixed portion, which is bolted on, and the moving portion when an OCB is used. Guide rails (16) on the channels ensure that the OCB is correctly aligned.

Earth Bar A hard drawn, high conductivity copper earth bar (17) runs the length of each unit's rear, all metalwork other than the busbars being directly or indirectly bonded to it. Direct connection is made from the earth bar to spring contacts (18) in the guide rod aperture (28). These provide an earth connection to any plugged-in moving portion.

Band joints are bonded to the earth bar by braids (19).

Unloading on Site

Unless special handling equipment (e.g. winches, ramps, rollers etc.) is available, a crane should be provided. It should have a safe working load (SWL) of at least 1500kg (30 cwt) at the radius required by the site layout, and the jib should be long enough to lift at a hook height of at least 4500mm (15 ft) during off-loading from the lorry.

Two matched, 4500mm (15 ft) wire rope slings with loop ends and a SWL of 750kg (15 cwt) each, or a special cradle with wire rope slings, should be used to lift circuit breakers. The slings or cradle should be run under the OCB carriage floor from side to side and the loop ends placed on the crane hook. Spread the slings as far apart as possible and initially inch the breaker upwards to ensure that it is correctly balanced.

Other items of equipment should be lifted with a 6000mm (20ft) circumference endless manila rope sling, SWL 1000kg (20 cwt). This should be looped under main structural components, and never under operating handles, interlock levers or other non-structural components.

Do not attempt to operate any item of switchgear until the procedure detailed in the appropriate "Preparation" section of this manual has been observed.

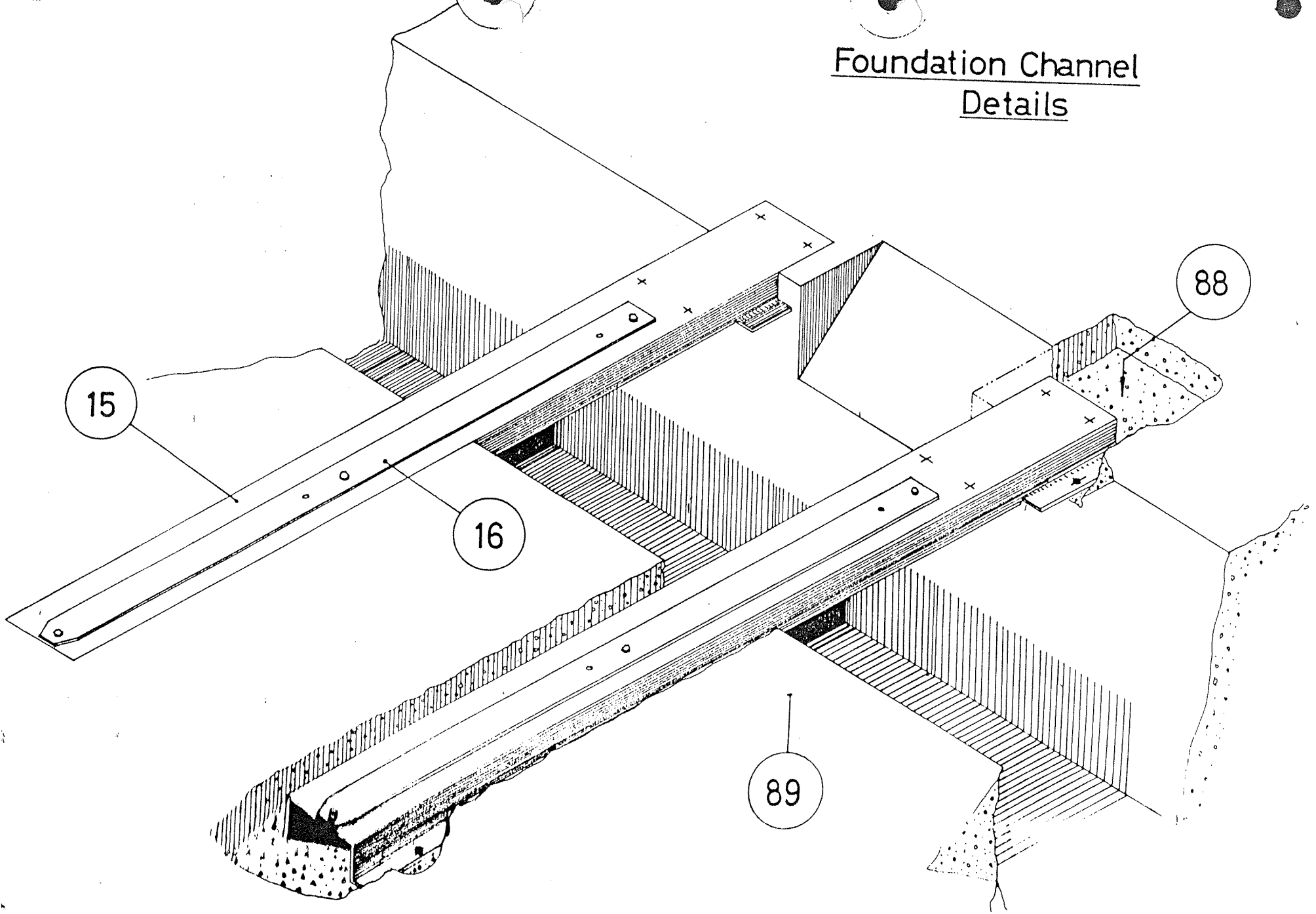
See also "Switchgear Weights and On-Site Oil and Compound Requirements".

Switchgear Weights and On-Site Oil & Compound Requirements

	Despatch Weight		Tank Oil		Cable Box Compound	
	kg	lb	Litres	Galls	kg	lb
IVIO-13 OCB	615	1350	77	17	-	-
IVIF-13 OCB	615	1350	77	17	-	-
Extended Front Panel	various	various	-	-	-	-
IVIF-type VT	82	180	36	8	-	-
IVIO-type VT	79	174	38	12	-	-
FMS-II Isolatable	96	210	39	8.6	-	-
FMS-II Non-Isolatable	176	388	39	8.6	37	80
OFS-10 Isolatable	112	244	55	12	-	-
OFS-10 Non-Isolatable	178	390	55	12	26	56
OFS-14 Non-Isolatable	180	396	77	17	26	56
Standard Fixed Portion	106	233	-	-	26	56
Busbar End Cable Box	31	67	-	-	39	85
Band Joint	1	2	-	-	7	14
Busbar End Cover	8	16	-	-	7	14

NOTE: All quantities and weights quoted are approximate minimum values. Variations in equipment and design can give rise to appreciable

Foundation Channel Details



Storage of Switchgear

If switchgear is to be stored for any length of time before installation, it should be kept in a warm, dry place. Always store compound-filled switchgear upright to prevent disturbance of the compound levels.

When isolatable outdoor switchgear is to be left on site in the "isolated" location the fixed portion rain cover(s) should be fitted.

Equipment which has stood in the "isolated" location for any length of time should have the isolating plugs and contacts cleaned, and the contacts themselves smeared with petroleum jelly ("Vaseline") as described under "Isolating Contact Maintenance" before being plugged into the fixed portion.

Preparation of Substation Floor

Foundation arrangements vary from installation to installation; reference must always be made to the foundation plan supplied for the particular switch-board concerned.

A cable trench will normally be required to accommodate the HV cable connections, which are usually terminated in bottom entry front access cable boxes (2) at the front of the switchgear fixed portion.

Two methods of working are permissible. The first is to cast and float the floor to finished level (89), leaving recesses approximately 216 mm (8.1/2 in) wide for standard channels, or 292 mm (11.1/2 in) wide for bus section or similar extra-width channels, by 70 mm (2.3/4 in) deep, by up to 255 mm (10 in) longer than the channels to be used, cast or chased in the plinth to accommodate the switchgear foundation channels.

Alternatively, the channels (15) can be set up on a rough floor level (88) approximately 70mm (2.3/4 in) below the finished level. The final floor (89) can then be floated after the setting of the foundations.

The finished floor should be as smooth as is conveniently possible, as this makes it easier to wheel moving portions to and from the switch-board.

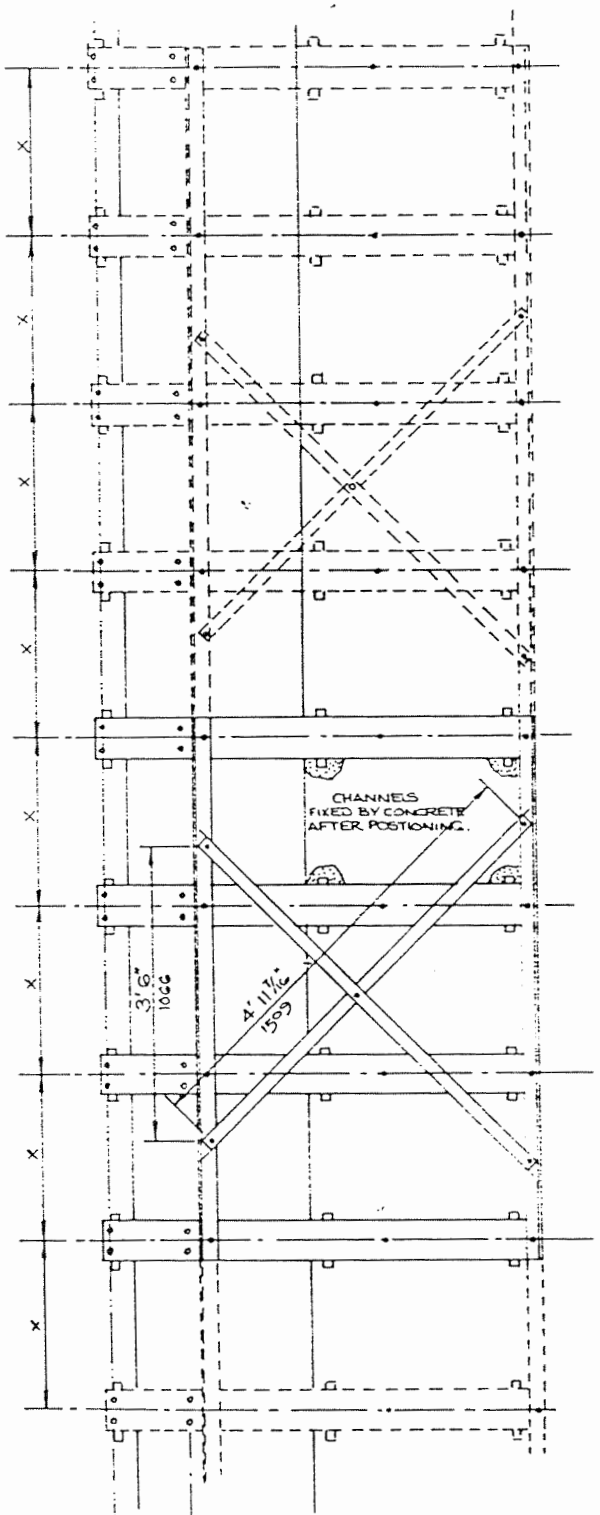
Setting the Foundation Channels

The foundation channels (15) provide a firm base for fixed portions of isolatable switchgear and for non-isolatable switch and fuse switch units. They also carry the guide rails (16) for, and support the weight of, circuit breaker moving portions. If the channels (15) are set level, parallel and at the correct centres, erection of the switchgear is simplified and reliable operation is assured.

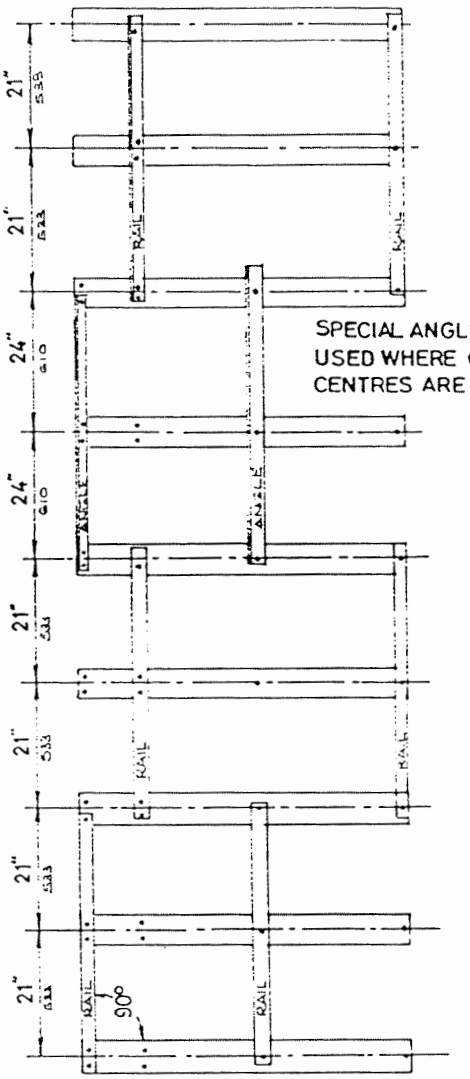
1. Place the channels (15) in their recesses (or in their approximate positions on the rough floor (88)) and remove the guide rails (16). Using the rail fixing holes, bolt the guide rails (16) or a simple jig (90) (see diagram) across adjacent channels (15) to bring them to the correct centres. Where centres other than the standard 533mm (21 in) are specified, jigs of suitably drilled angle iron may be used.

FOUNDATION DETAILS FOR TYPE IVIO/F SWITCHGEAR

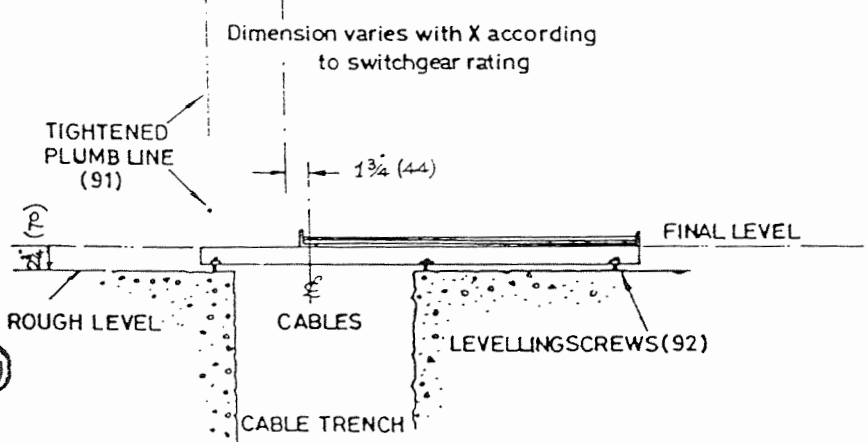
(A) METHOD OF SETTING FOUNDATION CHANNELS USING SETTING JIG.

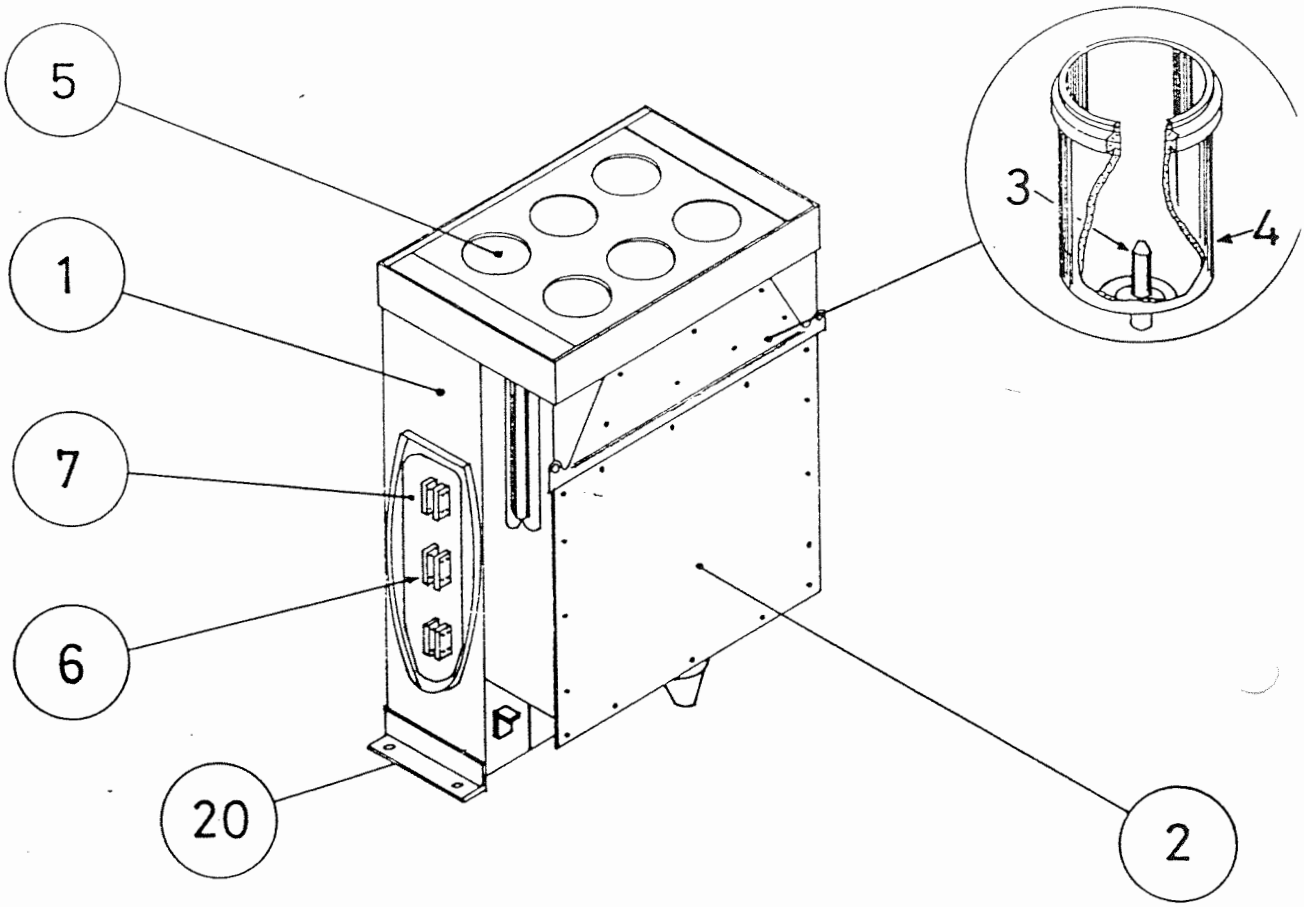


(B) METHOD OF SETTING FOUNDATION CHANNELS USING GUIDE RAIL.

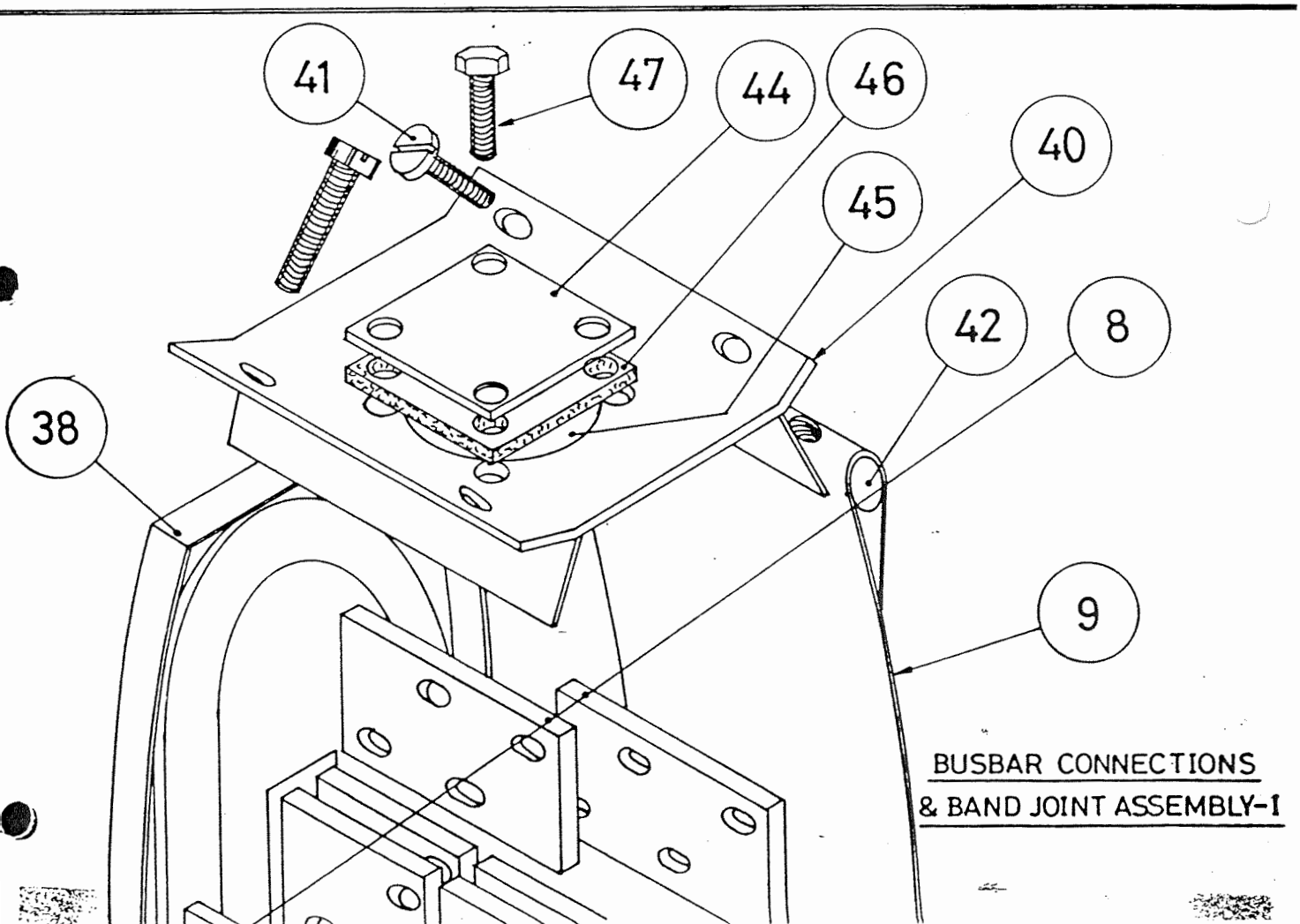


SPECIAL ANGLE IRON JIG USED WHERE CHANNEL CENTRES ARE NOT 21" (90)

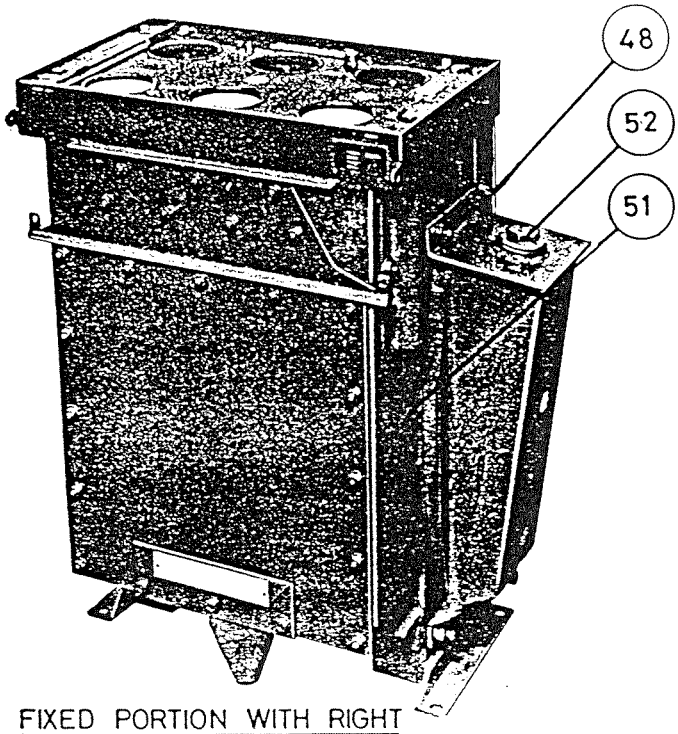




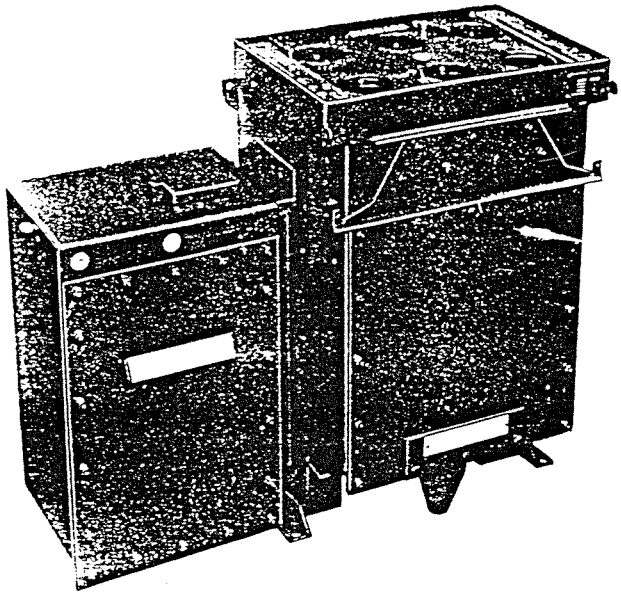
FIXED PORTION MAJOR COMPONENTS



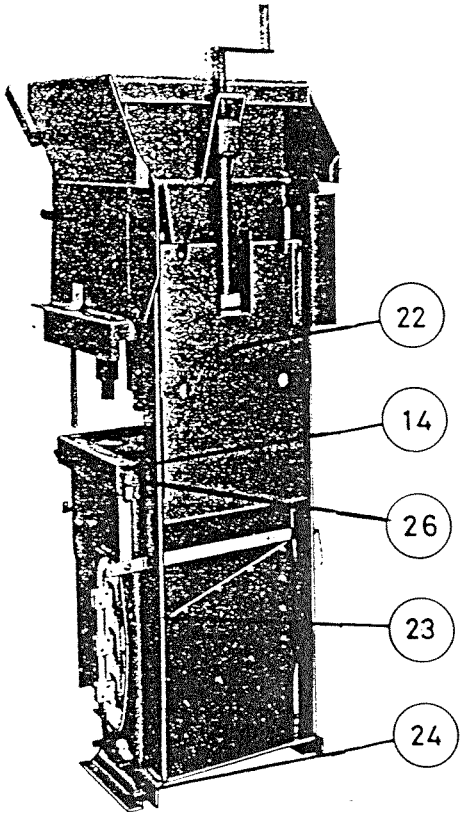
BUSBAR CONNECTIONS & BAND JOINT ASSEMBLY-I



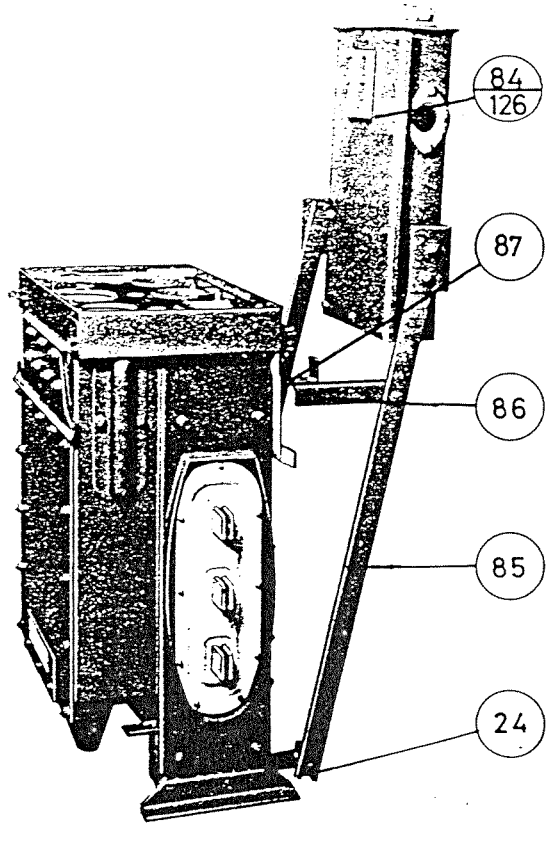
FIXED PORTION WITH RIGHT HAND BUSBAR END COVER(11)



FIXED PORTION WITH LEFT HAND BUSBAR END CABLE BOX(12)



FIXED FRAME FITTING



REAR WIRING BOX FIXING

2. Use a tightened cord (91) stretched above the rearmost pairs of channel bolt holes and check corresponding diagonal measurements to ensure the squareness of an installation where diagonal jigs have not been used.

3. Using packings of scrap metal or other material, plus the channel levelling screws (92) when they are fitted, bring the channel top surfaces level with each other and with the finished floor level (89). Check with spirit level and straight edge. When all are correctly adjusted, fix each levelling screw (92) and its lug in position with a stiff concrete mix.

4. Insert screws into the tapped holes in the channels to protect their threads. Grout in the channels with a wet 4:1 sand and cement mix, taking care to run as much as possible under the sides and ends of the channels. Check that all is still square and level.

5. Float off the channel grouting or the overall floor to finished floor level (89). Make a final overall check and leave the jig in place until the grouting has set stiff.

6. Remove the jig and replace the guide rails (16).

7. Repeat until all channels (15) are in place. Leave until the concrete is cured before erecting switchgear on the channels (15).

Erection of Fixed Portions

The fixed portions of isolatable switchgear are located at the rear of the cable trench, with the front cable boxes (2) overhanging the trench. Four set screws secure each fixed portion to its foundation channels (15).

1. Clean surface of channels (15) and underside of fixed portion feet (20).

2. Place all fixed portions in position on the channels (15), but do not screw them down.

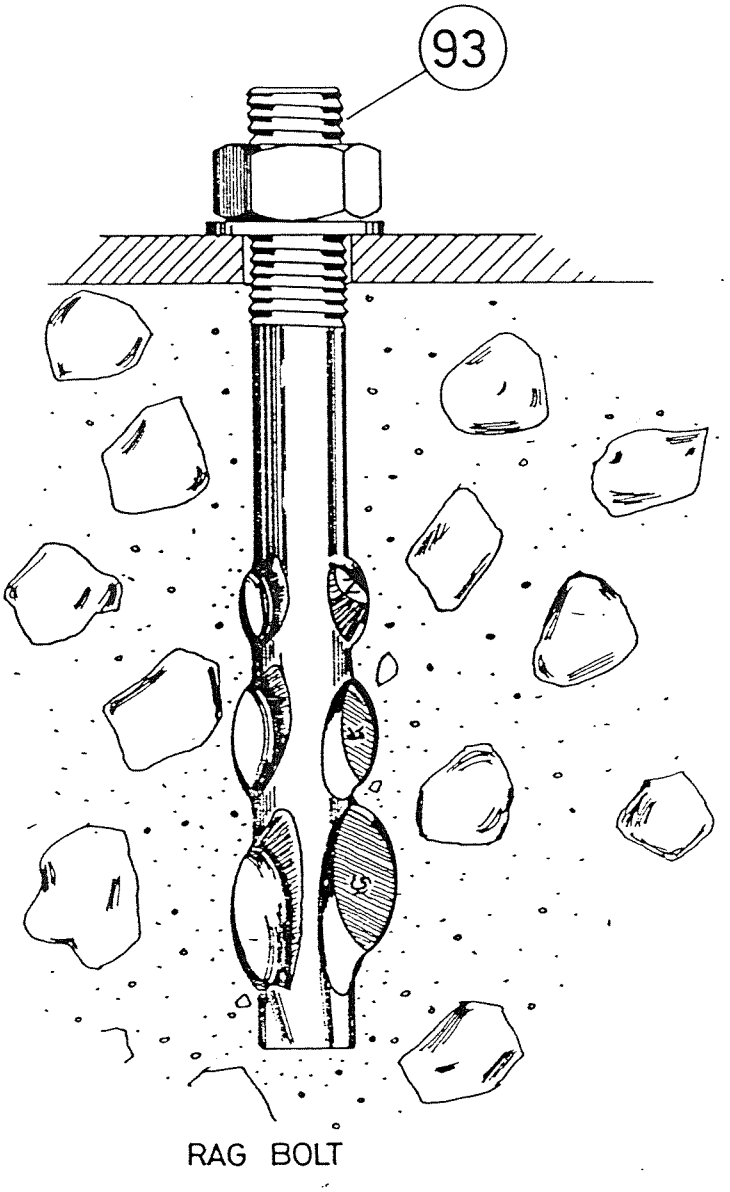
3. Sight along the front and rear of the switchboard and test with a tightened string to check for correct alignment.

4. Test each shutter box top (21) in turn with a spirit level: any slight deviation from the horizontal can be remedied by the insertion of shim washers under the fixed portion feet (20). The height of each shutter box top (21) from the channel (15) (not rail) top surface should be 751 mm (29.9/16 in) $\pm$ 1.5 mm ($\pm$ 1/16 in).

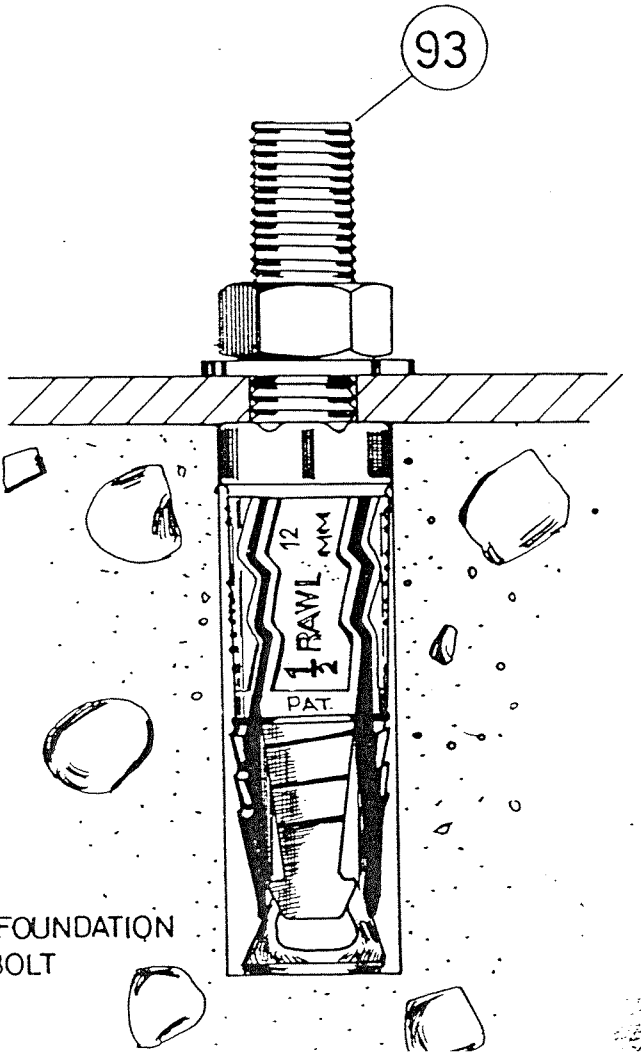
5. Note that the busbars (6) of adjacent fixed portions are in line before finally fastening down.

6. Connect the switchboard earth bar (17) to the substation earth. Fasten the inter-panel earth connections.

7. Fit fixed frames (22) to the rear of those fixed portions which are to carry isolatable oil switches or oil fuse switches (unless the frames were fitted before delivery). Place the legs (23) over the support feet (24) on the rear of the fixed portion; secure the brackets (26) which screw onto the rear of the shutter box (14).



RAG BOLT



RAWL FOUNDATION BOLT

FOUNDATION BOLTS

Erection of Non-Isolatable Extensible Switchgear

The erection of non-isolatable oil switch and fuse switch units is basically the same as the erection of fixed portions for isolatable units. However, in Item 4 of "Erection of Fixed Portions" reference is made to the levelling of the shutter box tops. In the case of non-isolatable switchgear, the tank side plates should be tested for vertical.

Erection of Non-Extensible Switchgear

Certain special non-extensible designs require that the unit footings be rag-bolted direct to the floor.

1. Four foundation bolts (93) are provided for each unit. They must be grouted in at the centres shown on the foundation plans provided. Measure diagonally between centres to check the setting. The threaded portion of each bolt should protrude approximately 25 mm (1 in) above the finished floor level. Leave to set.

2. Lower the switchgear unit over the protruding rag bolt shanks. Screw the nuts down loosely and check the unit with a spirit level to ensure that it is horizontal. Check that the bolts are central in their holes in the unit footings and that there is no distortion of the frame. If necessary, lift the unit clear and pack up the feet with washers.

3. When the unit is satisfactorily located and levelled, fasten it down with nuts on the rag bolts. Make a suitable earth connection from the frame to the substation earth.

Paintwork

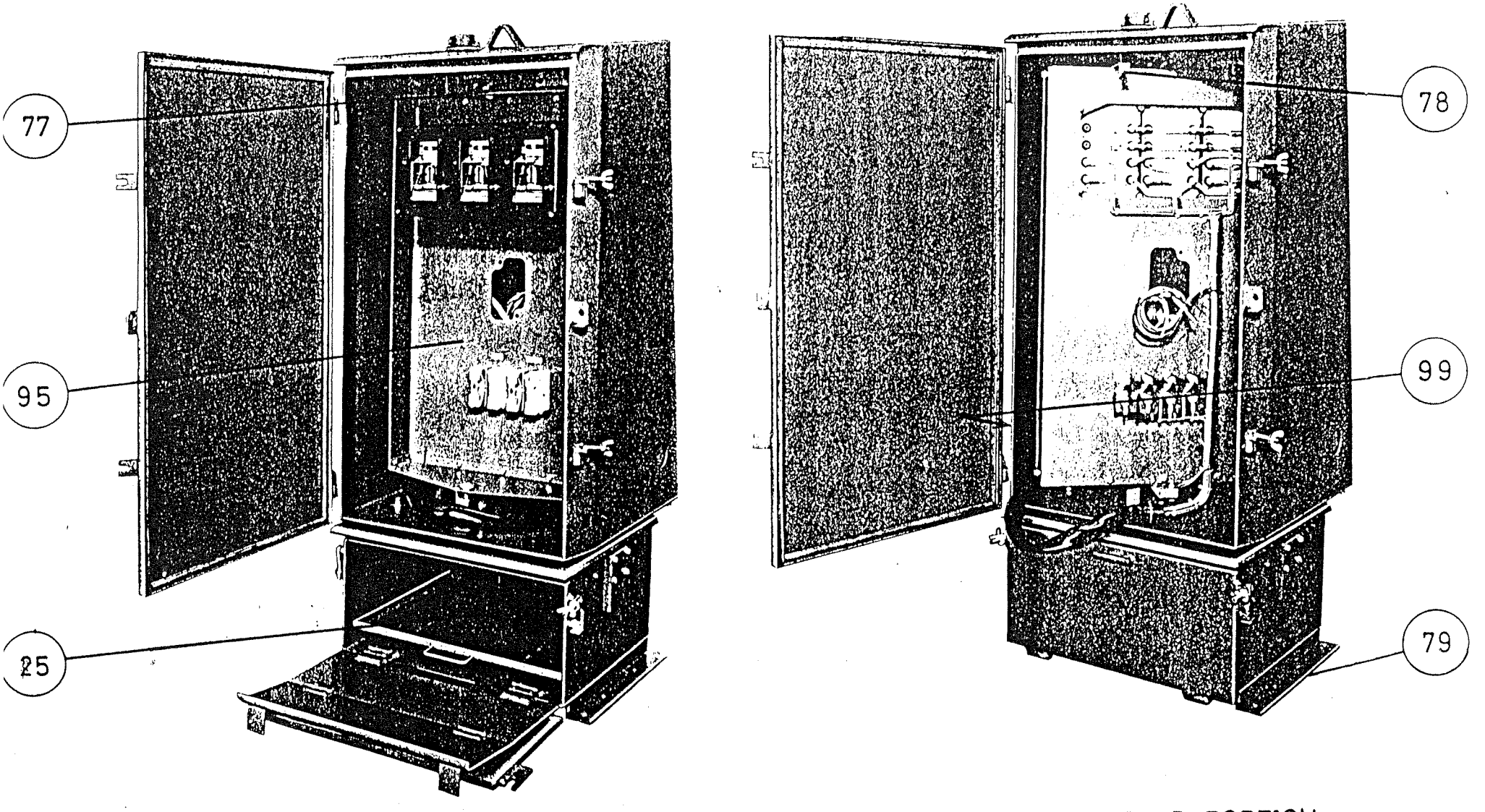
All components are given a high quality protective finish before leaving the works, but the paintwork may be damaged during transport, erection or service. Any scratches or chipped portions of the paintwork should be touched up immediately they are noticed, otherwise the metalwork may rust.

Suitable touch up paint is available from Yorkshire Switchgear, or it may be obtained from any reputable manufacturer. The specification is:

"Glossy Synthetic Air Drying Enamel for Outdoor Use".

Quote the appropriate colour reference from the following:

Colour	Colour No. (BS.381C: 1948)
Brilliant Green	221
Dark Battleship Grey	632
Signal Red	537
Lemon Yellow	355
Light Grey	631



RELAY CABINET (94, 127) FOR USE BEHIND OR REMOTE FROM THE FIXED PORTION

Relay Cabinets and Rear Wiring Boxes

Where relay cabinets (94) are supplied, four foundation bolts (93) are provided for each. They should be grouted in at the centres shown on the foundation plan provided. Measure diagonally between centres to check the setting. The threaded portion of each bolt should protrude approximately 25 mm (1 in) above plinth final floor level.

Lift each cabinet in turn and lower over the protruding stems of the rag bolts. Screw the nuts down loosely. Open the door of the cabinet and check that the instrument plate (95) is still free.

If distortion occurs due to the irregularity of the plinth, washers should be inserted below the feet to level up. Cabinets supplied for mounting behind the switchboard fixed portions are equipped with a triple copper earth bond which should be secured to the switchboard earth bar connection adjacent to it. In the case of a remotely situated cabinet, a suitable connection should be made from the cabinet earthing stud to the substation earth.

The inter-panel wiring is carried through steel tube conduits which are located by clamp rings fitted inside adjacent cubicles. To fit a conduit, remove both clamp rings and place the conduit between the units. Roll the rubber ring gasket on to each end of the conduit and re-fit the clamp rings using pressure plastic under the screw heads. It is an advantage if an assistant can hold the fixing screws whilst the clamp rings are tightened.

Rotation of the instrument plate through 90^{o} will allow adequate access to the wiring plate (99) of a relay cabinet. The instrument plate may, however, be removed by loosening the locknut on the top pivot (77) and screwing the pivot down until it is clear of its locating tube. The instrument plate may then be lifted upwards and forward and hung on the cubicle door by the hooks (78) fixed at the top of the plate. Reverse the sequence to replace the plate, taking care that the plate is offered to the cubicle with an anti-clockwise motion to lay the flexible conduit correctly.

Pass the loose interpanel wiring through the tubular conduit and make off in the adjacent cubicle in accordance with the wiring diagram.

Feed the pilot cables into the cabinet and mark off the lengths of the various tails. Remove gland and cable to make off the core terminations then replace and bolt on the gland and gasket.

Rear wiring boxes (84) are supplied where secondary interconnection is to be made with remote equipment (i.e. equipment not in cabinets behind the fixed portion). Normally rear wiring boxes are delivered already mounted on their respective fixed portions, but where they are fitted later the job is quick and simple: place the box legs (85) over the support feet (24) on the rear of the fixed portion, secure the tie angles (86) to the brackets (87) which screw onto the rear of the shutter box (14).

Compound Filling of Switchgear

Compounds of either the bitumen or rosin oil type are extensively used in metalclad switchgear for filling cable boxes, busbar joints etc., and provided that a certain amount of care is exercised during the filling process the equipment will function for long periods without further attention.

Dust, damp or any foreign matter is deleterious to the compound, and a very small percentage of any impurity greatly reduces its dielectric properties. Care should therefore be taken to ensure that all tools, buckets etc., which are used are perfectly clean.

The correct method of taking solid bitumen compound out of the tins is to cut off the ends with a cold chisel, and then split the cylindrical portion from end to end. The compound can then be removed and broken into small pieces before going into the bucket for heating.

Until the compound is fluid, side heating only should be applied, and at all times direct contact between the flames and the outside of the bucket should be avoided.

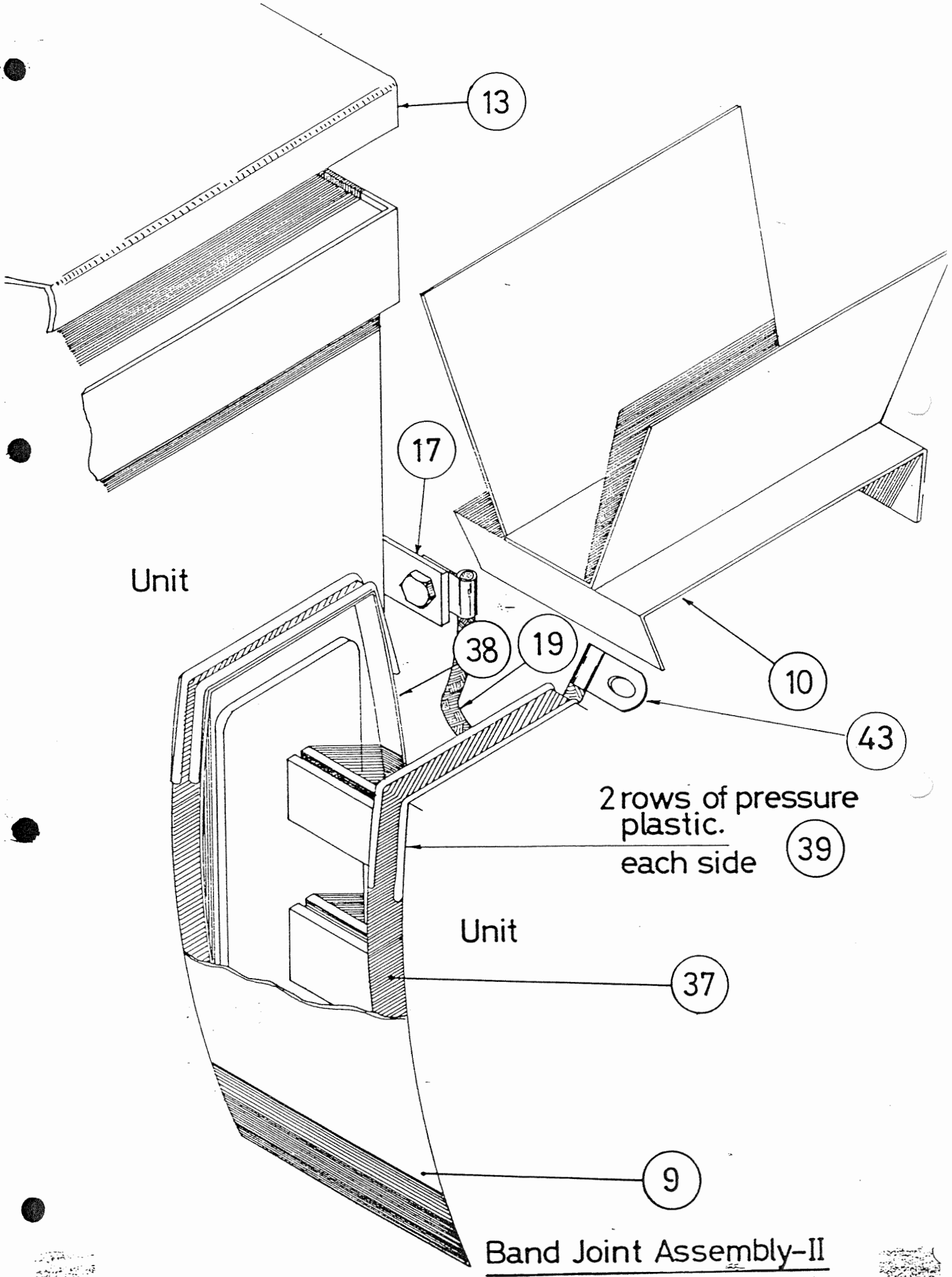
The compound should be stirred at regular intervals, preferably with a stirring rod having a built-in thermometer, until the pouring temperature as stated by the manufacturers is reached. The lid should be fitted to the bucket except during stirring.

Before any chamber or cable box is filled, the walls of the enclosure should be heated, preferably by radiant heaters but otherwise by blowlamp, to remove any surface moisture, and to prevent chilling of the compound and the consequent possibility of void formation.

The compound should be poured slowly, and the chamber filled in one continuous operation and then, since the compound contracts when cooling, it should be allowed to cool before the filling orifice is tightly sealed.

The filling orifice should be protected against the ingress of dust and rain during the cooling period. Certain compounds may require topping up to the original level before they become cold.

Finally all utensils and buckets should be thoroughly cleaned after use; in particular, buckets should never be allowed to cool whilst partially filled with compound.



Band Joint Assembly-II

Specification of "Dussek" A58 Compound

For comparison purposes, the specification of Dussek A58 bituminous jointing compound is given below.

CHARACTERISTIC	A58
* Softening Point (^{o}C)	40-46
* Pouring Point (^{o}C)	115
Temperature Range for Pouring (^{o}C)	105-115
* Flash Point (^{o}C)	260
Resistance to Moisture	Water Clear
* Adhesiveness (%)	100
* Penetration (mm)	15.0-16.0
Contraction (%)	6.5
* Coefficient of Expansion (Per ^{o}C)	0.0006
Dielectric strength (kV) (1 min at 15^{o}C two spherical Electrodes 0.05 in dia., 0.15 in apart)	90
S.I.R. at 15^{o}C (MΩ)	500 x 10^{6}
Permittivity at 15^{o}C	2.68
Power Factor at 15^{o}C	0.02

Tests marked * to B.S.1858: 1957.

NOTE Tabulated values provided by Messrs. Dussek Bitumen & Taroleum, Ltd., 13th March, 1966.

Fitting & Compounding the Busbar Band Joints

The busbar connections between adjacent panels on compound insulated equipment comprise bolted fish plates enclosed in a compound filled band joint. The following account assumes the use of "Dussek" A58 compound. Should any other compound be used the pouring temperature, cooling time and contraction rates will probably differ from those allowed for in this text. Different techniques involving longer cooling periods and "topping up" may therefore be required.

1. Wipe clean the busbar end barriers (7) and join the busbars (6) on adjacent units with the fishplates (8) supplied. 800 A busbars require three, 6.3 mm (1/4 in) thick fishplates per phase; 1200 A busbars require six, 4.8 mm (3/16 in) thick fish plates per phase; and 1600 A busbars require eight, 4.8 mm (3/16 in) thick fish plates per phase. Fit a shakeproof washer under each nut and tighten the fixing bolts fully.

2. 25 mm (1 in) wide impregnated hessian tape (37) is supplied for the band joint gaskets. Fold this along its centre to form a double thickness strip 12.5 mm (1/2 in) wide and apply this in a single layer around the full circumference of each band joint flange (38).

3. Fit two parallel "strings" of pressure plastic (39) on the top flat portion of each flange (38), extending 75 mm (3 in) down the front and rear of the flange.

4. Pass the aluminium band joint casing (9) under the flanges (38) and fit the top plate (40) in position so that it joins the flat upper portions of the flanges (38).

5. Insert the band joint securing screws (41) through the holes in the top plate (40) and into the tapped bars (42) at the band joint ends. The rear screw should also pass through the band joint earth connection "flag" (43) which is bonded to the earth bar (17) by a flexible braid (19). Tighten the screws fully home with a screw-driver to pull the joint as tight as possible.

6. Connect up the earth bar (17) between adjacent units.

7. Open the requisite number of compound tins and heat the compound to 110°C (230°F) (see "Compound Filling of Switchgear").

8. Remove each band joint filler orifice cover (44) and, using radiant heaters if possible, pre-heat the joint at front and rear until a thermometer inserted through the filler apertures (45) shows the internal air temperature to be 38°C (100°F).

9. With compound and joint in their respectively correct temperatures, slowly but continuously pour in the compound until it reaches the level of the filler orifice.

10. Re-tighten the band joint securing screws (41) whilst the compound is hot.

11. Cover the orifice loosely with, for example, a clean compound tin lid secured by a weight, to keep out dust and damp. Allow the compound to cool and settle for two hours, then fit the filler orifice gasket (46) and cover (44) and tighten down the orifice cover securing screws (47).

12. On an outdoor installation, fit the clip-on watershed (10) above each band joint.

Fitting & Compounding a Busbar End Cover

Busbar end covers (11) are normally fitted to fixed portions at the Yorkshire Switchgear Works, but they may be fitted on site when changes are made to an existing switchboard.

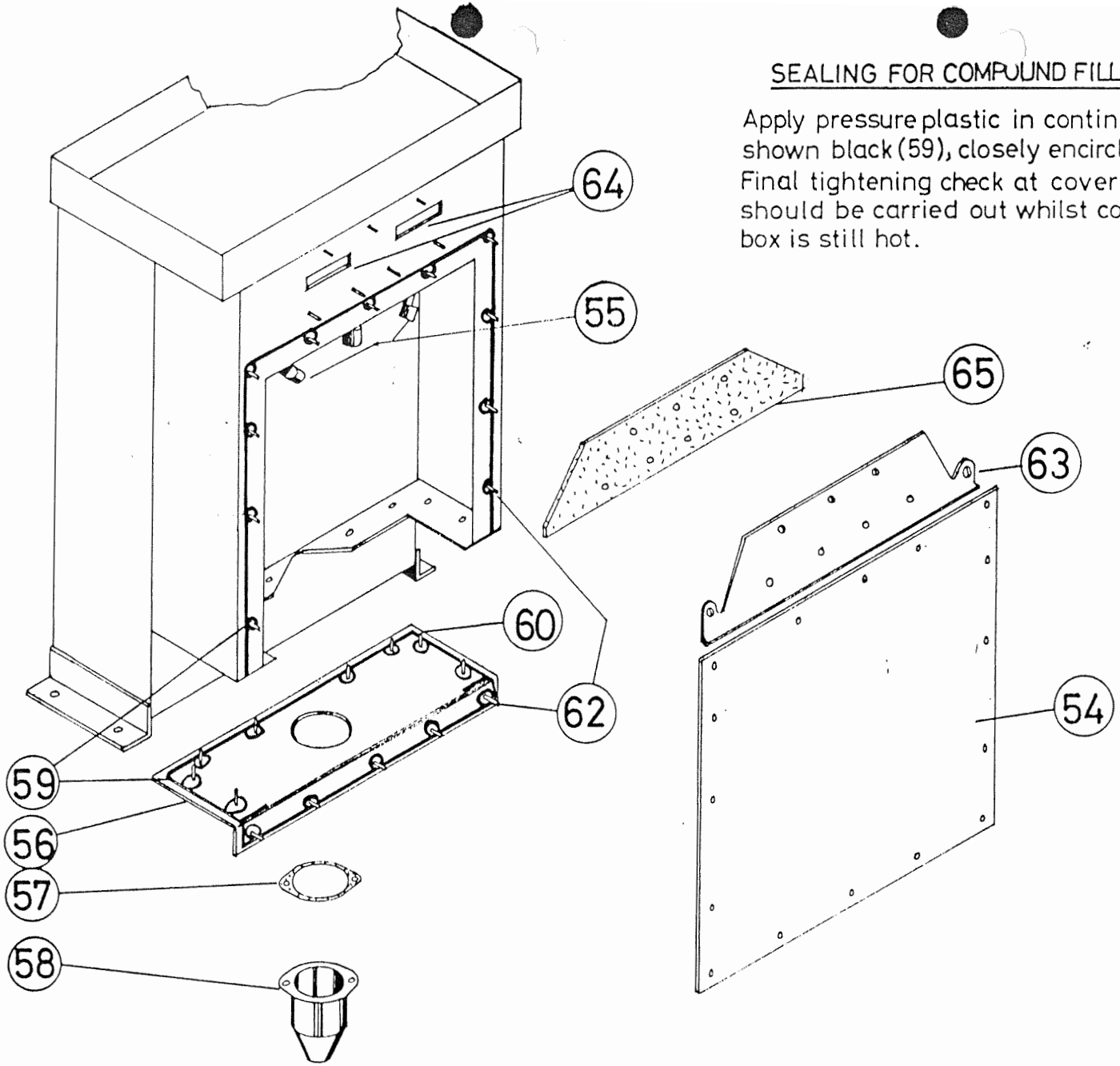
Note: No attempt should be made to work on the busbars of a switchboard which has been previously commissioned until the busbars have been isolated from all sources of supply, proved DEAD and EARTHED & all shutters on the switchboard have been locked "closed" (except where access for busbar earthing is required, where the associated feeder shutter should, however, still be locked closed).

The following account assumes the use of "Dussek" A58 compound. If another compound is used the pouring temperature, cooling time and contraction rates will probably differ from those allowed for in this text. Different techniques involving longer cooling periods and "topping up" may therefore be required.

1. Wipe clean the fixed portion busbars (6) and end barrier (7), having removed any old compound, gaskets etc. left from previously fitted equipment.

SEALING FOR COMPOUND FILLED CABLE BOXES

Apply pressure plastic in continuous run where shown black (59), closely encircling the studs. Final tightening check at cover fixing nuts should be carried out whilst compound in cable box is still hot.



Fixed Portion Front Cable Box (2)

2. Remove the protective shrouds from the end cover securing studs (48) on the fixed portion. Check that the rubber gasket is in place in the groove (51) at the side of the end cover (11).

3. Place the end cover over the busbars, filler cap (52) upwards, and secure the cover in place with nuts on the end cover securing studs (48).

4. Remove the filler cap (52). Open the requisite number of tins of compound and heat the compound to 110°C (230°F) (see "Compound Filling of Switchgear").

5. Heat the end cover (11), using radiant heaters if possible, until a thermometer inserted through the filling aperture shows an internal air temperature of 38°C (100°F).

6. With compound and cover at their respectively correct temperatures, slowly but continuously pour in the compound until it reaches the top of the aperture.

7. Cover the aperture loosely with, for example, a clean compound tin lid secured by a weight, to keep out dust and damp. Allow the compound to settle for two hours, then fit and tighten down the filler cap (52) and gasket.

Jointing & Compounding a Fixed Portion Cable Box

The following method applies to standard fixed portions with front mounted, bottom entry cable box (2). However, only slight modifications are needed for other cable boxes in our range. The use of "Dussek" A58 compound is assumed. If another compound is used the pouring temperature, cooling time and contraction rates may differ from those allowed for, and different techniques involving longer cooling periods and "topping up" may, therefore, be required.

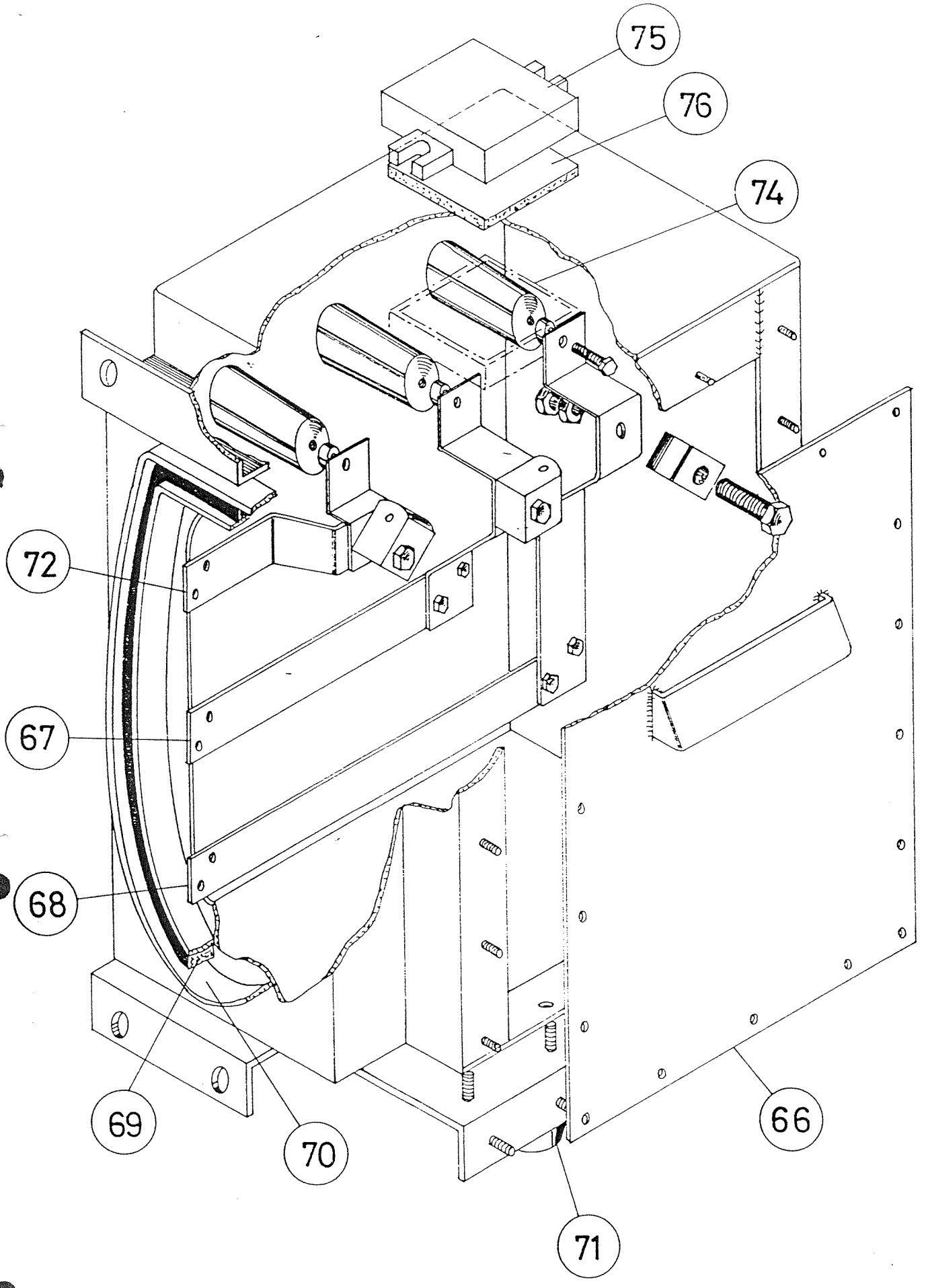
1. Remove the cable box front plate (54) and note the positions of the cable sockets (55) before removing them. Remove the bottom plate (56), gasket (57) and gland (58) and make off the cable through them in the normal way, taking care that the gasket (57) is refitted between plate (56) and gland (58).

2. Put pressure plastic (59) around the bottom plate studs (60) and along the edges of the plate (56), as indicated on the label supplied with the fixed portion. Re-tighten the bottom plate (56) and gland (58).

3. Clean out the interior of the box and wipe the insulators with a clean, dry rag.

4. Put pressure plastic (59) around the front plate securing studs (62) and along the spaces between them, as shown on the fixed portion label. Refit the front plate (54) and tighten down evenly onto the studs (62).

5. Open the requisite number of compound tins and heat the compound to 110°C (230°F), as described under "Compound Filling of Switchgear".



Pusher End Cable Box

6. Remove the filler aperture cover (63) from each cable box and pre-heat the box, using radiant heaters if possible, until an inserted thermometer shows an internal air temperature of 38°C (100°F).

7. With compound and cable box at their respectively correct temperatures, slowly but continuously pour in the compound (using a pre-heated Yorkshire Switchgear compound filler or clean compound tin section) until the compound level reaches the bottom of the apertures (64).

8. Fit the filler aperture cover (63) loosely and leave the compound to cool and settle for two hours. Then check that the contracted level of the compound is sufficient without topping up, fit the filler aperture gasket (65) and cover (63) correctly and fasten them down tight.

Fitting, Jointing & Compounding a Busbar End Cable Box

Busbar end cable boxes (12) are normally fitted to fixed portions at the Yorkshire Switchgear Works, but they may be fitted on site when changes are made to an existing network. In either case the cable jointing will usually be done on site.

Note: No attempt should be made to work on the busbars of a switchboard which has been previously commissioned until the busbars have been isolated from all sources of supply, proved DEAD and EARTHED and all shutters on the switchboard have been locked "closed" (except where access for busbar earthing is required, where the associated feeder shutter should, however, still be locked closed).

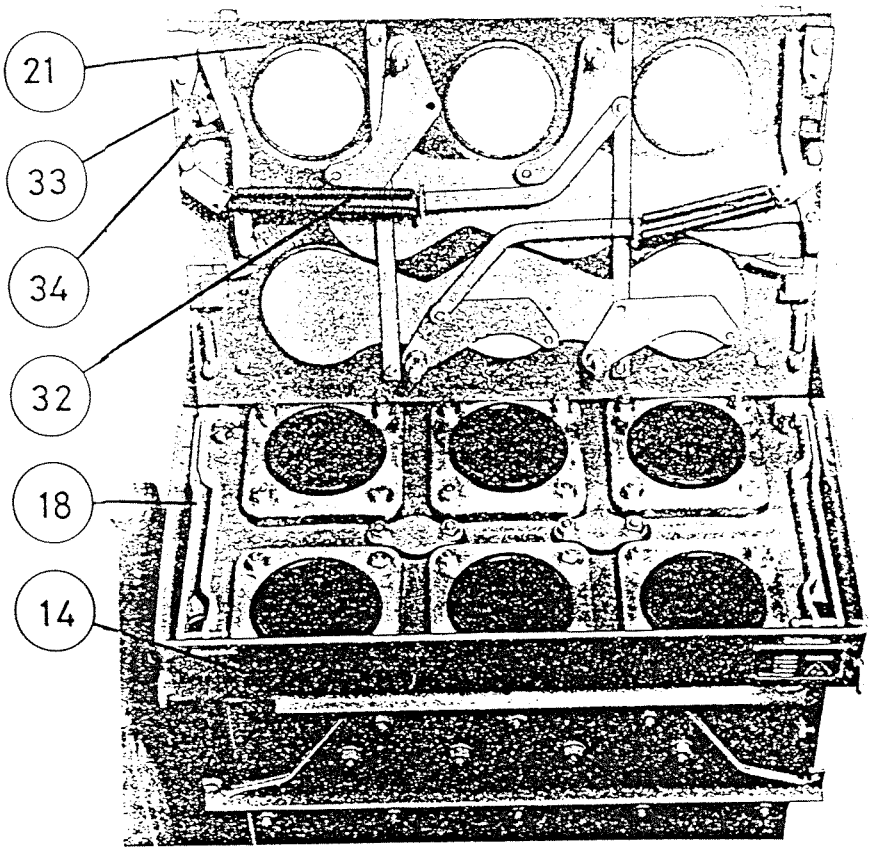
1. Wipe clean the fixed portion busbars (6) and end barrier (7), having removed any old compound, gaskets, etc. left from previously fitted equipment.

2. Remove the front plate (66) from the cable box (12) to be fitted. Remove the middle and lower busbar extensions (67 & 68), noting that the lower one (68) is the longer. Fasten these to the fixed portion busbars (6b & 6c). Check that the rubber gasket (69) is in place in the groove (70) on the side of the cable box (12).

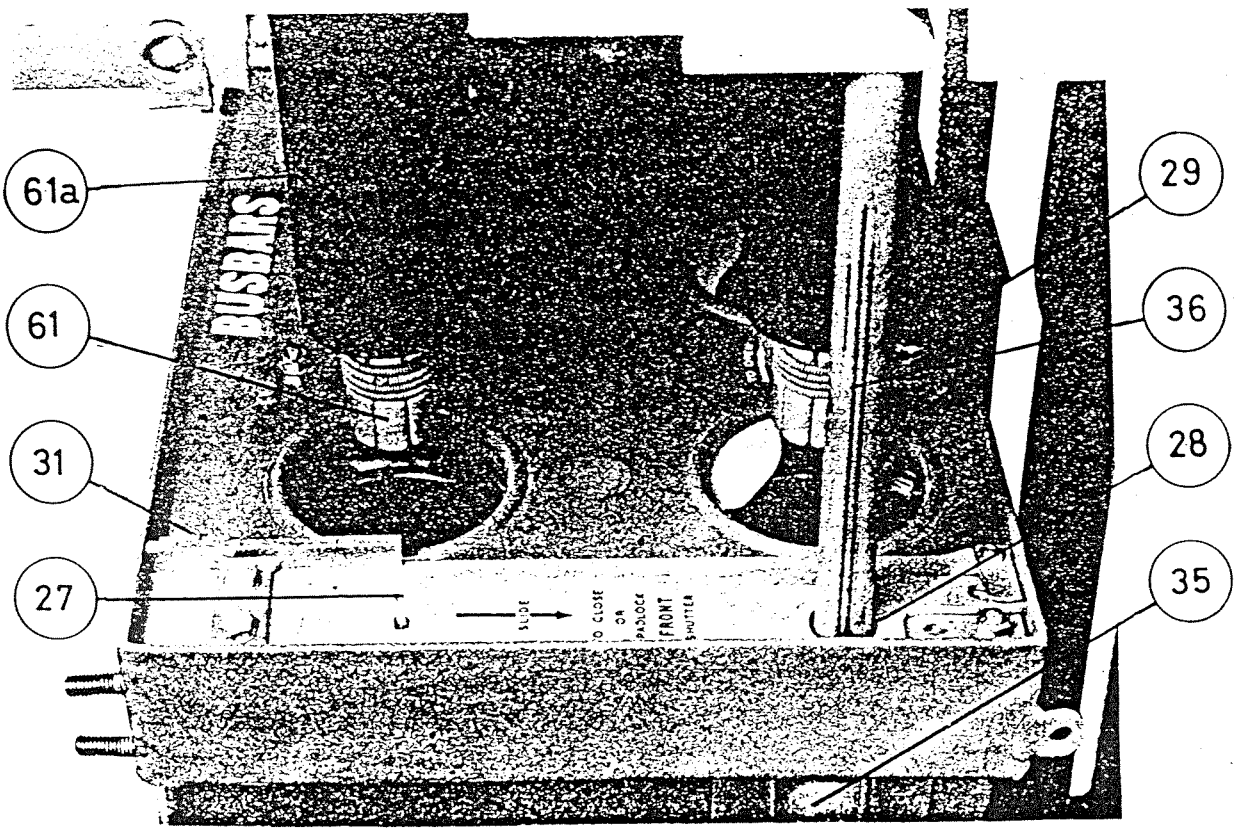
3. Remove the protective shrouds (49) from the end cover securing studs (48) on the fixed portion. Put the cable box (12) over the busbar ends, gland (71) downwards, noting that the short upper busbar extension (72) in the box engages with the upper fixed portion busbar (6a). Secure the cable box (12) in place with nuts on the end cover securing studs (48). Fasten the earth connection (73) to the fixed portion earthing bar (17).

4. Working through the cable box front plate aperture, connect up the busbar extensions (67, 68 & 72) at both ends.

5. Joint in and compound the cable as described under "Jointing & Compounding the Fixed Portion Cable Boxes". The filler aperture (74) is on top of the cable box; it should be filled to over-flowing with A58 compound, the aperture cover (75) should be fitted loosely and the compound should be left to cool and settle for two hours. Then check that the compound level is sufficient without topping up, fit the filler aperture gasket (76) and cover (75) and fasten down tight.



SHUTTER BOX TOP PLATE (21) RAISED TO SHOW OPERATING MECHANISM (30)



GUIDE RODS OPENING SHUTTERS

Preparation of Fixed Portions

SAFETY NOTE

No hand or tool should be inserted into the receptacle insulator orifices of a switchboard or associated feeder unless that switchboard or associated feeder has been made DEAD and EARTHED.

Before attempting to plug an OCB or oil switch into a fixed portion, check that the shutter box (14) does not have a rain cover (13) in place and that the shutter locking slides (27) are not padlocked.

Test for automatic operation of the safety shutters by inserting a 19 mm (3/4 in) diameter rod through the holes (28) in the shutter locking slides (27) at either side of the top plate (21). The front (cable box) shutters (5a) are operated through the left hand hole (28a), the rear (busbar) (5b) shutters through the right hand hole (28b).

Each set of shutters should open fully on insertion of the rod to the appropriate side and close completely when it is removed.

Operate the shutter mechanisms manually by means of the two levers (29) on the shutter box top (21). The shutters (5) should now stay open. Check the cleanliness of the receptacle insulator (4) interiors, and clean the contacts (3) as described under "Isolating Contact Maintenance". Smear a thin layer of petroleum jelly ("Vaseline") on the contacts (3).

Re-close the shutters (5) by sliding forward the locking slides (27), which should move freely. The shutters (5) should close rapidly.

The fixed portion is now ready to receive an OCB or other item of isolatable switchgear.

Operation of Fixed Portions

When a moving portion is plugged into a fixed portion, guide rods (36) on the moving portion enter apertures (28) in the shutter locking slides (27). The rods (36) pass through the earthing spring contacts (18) and operate the shutter mechanism or mechanisms (30) to open one or both shutters, according to the moving portion's location (service location, circuit transfer earthing location).

As the moving portion is lowered further, the moving isolating plugs (61a) enter the stationary isolating receptacles (4) and the contacts (3 & 61) mate.

When the moving portion is isolated, the shutters (5) automatically close again. The busbar (5b) and cable (5a) shutters can be independently opened by hand for inspection, testing or maintenance purposes, when they must be reclosed manually by the sliding forward of their respective padlock slides (27).

Maintenance of Fixed Portions

Note: No work should be attempted on any fixed portion until the feeder cable and busbars associated with that fixed portion have been proved DEAD and EARTHED.

Remove padlocks, if fitted, and remove the two screws which retain the shutter top plate clips (31). Lift the plate (21) off and clean the undersides of the locking slides (27). Check that the return springs (32) are securely anchored. Apply a thin coating of grease to the slides (27) and springs (32) and squirt a little oil between the slides (27) and top plate (21).

Check that the release levers (33) pivot freely and that their securing locknuts (34) are screwed down with at least one thread of the studs protruding.

Lubricate all moving parts of the shutter mechanism (30) with light machine oil and grease the faces of the release levers (33) (these are immediately beneath the guide rod apertures (28) and are deflected by the guide rods (36) when a moving portion is plugged in). Operate the shutters (5) slowly several times by means of the manual operating levers (29) to check that all moving parts operate smoothly without binding. Wipe away any excess oil.

With the aid of a torch check that the guide rod rubes (35) are clear. Clean the receptacle insulators (4) and isolating contacts (3) and smear a thin layer of petroleum jelly ("Vaseline") on the fixed isolating contacts (3) as described under "Isolating Contact Maintenance". Grease the guide rod earthing contact faces (18) immediately above the guide rod tubes (35).

Replace the top plate (21), ensuring that the labels are the right way round for viewing from the front of the switchboard.

Make sure that the shutters (5) are free and that the locking slides (27) cannot be moved into the locking (forward) position until the shutters (5) are fully closed.

Finally, replace the two fixing screws and clips (31) securing the top plate (21) and after checking that no object has been left in the receptacle insulators (4), lower the moving portion gently into the fixed portion, observing that the shutters (5) open correctly and close when the moving portion is removed. Alternatively, test the shutter operation with a hand-held rod.

If, on an outdoor installation, the fixed portion is to be left with no moving portion plugged into it, the rain cover (13) should be fitted over it and locked in position.
Check band joints and cable box for compound leaks.

Lubricating Oil Specification

Specific Gravity	0.893
Pour Point	$-15^{o}F$
Closed Flash Point	$500^{o}F$
Viscosity Redwood	1400 at $70^{o}F$. 172 at $140^{o}F$
Viscosity Index	96
Additives	2% MoS_2 + tackiness agent.

Oil Filling of Switchgear

Switchgear is normally despatched without oil and when the equipment is filled on site it is necessary to observe certain precautions to ensure satisfactory operation.

a) The oil must be of the correct grade (normally B30), should preferably be used from sealed drums, and must have an electrical strength of not less than that specified by B.S.148.

b) All pumps, pipes and other filling utensils must be clean and dry and must have a temperature similar to that of the oil and switchgear.

Rubber tubing or any other material which is soluble in oil should not be used.

c) All components of the switchgear which are to be immersed in the oil must be thoroughly cleaned with lint-free cloth.

d) To avoid condensation, oil and switchgear should be at least as warm as the surrounding air, and in addition the switchgear should be dry.

On indoor equipment, this condition can be obtained by heating the switch-room and allowing the warm air to circulate through the switchgear with the tanks open. All parts inside the chamber or tank will then quickly attain atmospheric temperature.

On outdoor equipment, or if the substation is very dusty, this method cannot be used, but the same result can be achieved by placing bags of dessicant such as silica gel in the chambers for a period of some hours. Care must, however, be taken to ensure that these bags are removed before filling commences.

When the equipment is completely dry, no moisture will appear on a mirror held inside the chamber.

e) The correct oil level is marked on the inside of switch and fuse-switch chambers and on the outside of circuit breaker and voltage transformer tanks.

It should be noted that this is the level with the tank <u>off</u> in the case of OCBs: the level must be carefully checked since several features of the design depend on a correct oil level for successful operation.

f) After filling it is advisable to operate the switchgear several times before applying voltage in order to release any air which may be trapped.

g) No naked l[illegible]
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[illegible]nity of open tanks or
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High Voltage Tests

The application of a high voltage pressure test is often called for, for example, before commissioning or after maintenance, according to the local regulations. BS.116 specifies the following values for such site tests:

1. For service voltages up to 33kV: Twice service voltage plus 2kV (r.m.s.) for one minute.

2. For small wiring and Control Circuits: 2kV (r.m.s.) for one minute.

Test 1 should be applied thus:

a) all phases to earth with OCB or oil switch closed;

b) between phases with OCB or oil switch closed;

c) across the break of the open OCB or oil switch.

If the equipment available is not large enough to produce the correct test voltage, a prolonged test at reduced voltage may be applied (see graph on page 1.31).

D.C. TESTING

The use of D.C. test sets for cable testing is now widespread and the use of this equipment for pressure testing switchgear is often convenient. The case against D.C. testing is that the insulation, particularly of condenser bushings, is not stressed in the same manner as when an A.C. voltage, for which it was designed, is applied, but experience has not indicated that initiation of breakdown is more likely with D.C. than with A.C.

In the event of a D.C. voltage test being applied to the switchgear, the values must be in accordance with table 15, B.S.116/1952, revision 5, the duration of test to be 15 minutes.

Every application of a H.V. pressure test tends to produce a corresponding reduction in the life of the insulation, and the frequency of applying such tests should therefore be carefully considered. For routine tests during the life of the equipment we recommend that test voltages should be in accordance with the table below. If the switchgear includes Voltage Transformers, it is advisable to isolate these and test separately, particular care being necessary if the VT has a primary neutral and possibly graded insulation.

Age of Equipment	% of Original Site Pressure Test
Under 5 years	100.0
5-10 "	87.5
10-15 "	75.0
15-20 "	62.5
Over 20 "	50.0

Testing of Protective Equipment

All protective equipment should be thoroughly tested before commissioning, since the correct operation of circuit breakers on the occurrence of faults is of prime importance, and as relays are called upon to operate only at infrequent intervals it is essential that they should function in the correct manner.

An operational check can be made on current operated relays by either: (1) Primary Injection; (2) Secondary Injection; or (3) Current Transformer Test Winding, and the following notes are intended to serve as a guide to indicate the application of these methods to type IVI Metalclad Switchgear.

Protective systems involving relays embodying both current and voltage elements require more complicated testing equipment, and in these cases reference should be made to the manufacturer's literature.

Prior to any operational check the relays should be examined and any packing pieces removed, and all wiring should be checked to diagram.

1. Primary Injection

This method gives the closest simulation of service conditions, since it checks not only the operation of the protective equipment but also the primary and secondary windings of the CT.

The design of type IVI Metalclad Switchgear provides most convenient facilities for primary current injection, since all the current transformers are accommodated in the OCB moving portion, and after the isolation of the unit from the busbars the heavy test connections can be plugged into the isolating contacts. Test plugs for this purpose are available.

Before carrying out any primary injection testing it is essential to check that none of the CT secondary windings are open circuited, since under this condition all the applied primary ampere turns are employed to magnetise the CT core and dangerously high voltages can be produced.

2. Secondary Injection

This method is a useful test for routine operational checks on relay equipment since the bulky heavy current equipment necessary for primary injection is not required. It is not, however, as complete as Method 1, since it does not check the accuracy of the CT.

If the relays are provided with a bridge type tapping device, or are of the draw-out pattern, secondary injection can readily be carried out by means of split plug type connectors.

Isolating Contact Maintenance

Several designs of isolating contact have been used on the IVI range of switchgear. At the time of writing, all new equipment is being supplied with either the Mark IV or Mark Ia type, and it is envisaged that the Mark Ia will be the future standard.

This manual assumes the use of Marks IV and 1a. Maintenance of the earlier types is basically similar, but where particular problems arise in the maintenance of Marks II and III contact clusters, advice should be sought from our Head Office.

Female (moving) main isolating contacts may be referred to in this manual by Nos. 103, 303, 403 or 503 according to the equipment to which they are attached. Similarly, their protective insulating "plugs" may be Nos. 104, 304, 404 or 504.

Remember, no attempt should be made to service the (male) fixed isolating contacts (3) of a fixed portion, and no hand or tool should be inserted into the receptacle insulator orifices (4) of a fixed portion until the associated busbars (6) and feeder or feeders (2) have been made DEAD and EARTHED.

1. Remove any solidified grease from the male and/or female contacts with the aid of inhibited 1.1.1 trichloroethane and a lint-free, non-synthetic cloth. Do not use any abrasive materials.

2. Apply a thin, uniform film of petroleum jelly ("Vaseline") to the inside and outside surfaces of the female contacts and to the male contacts, but ensure that none is transferred to the porcelain or epoxy insulation. DO NOT apply a contact oil or grease by means of an aerosol or spray, as this can lead to contamination of the deep bushing re-entrant on the Mk.Ia female contact.

3. Clean all accessible insulator surface using inhibited 1.1.1 trichloroethane and a lint-free, non-synthetic cloth. Provided that the insulator is dry and has been cleaned effectively, a surface resistivity of not less than 40,000 M-ohms will be obtained. Inspect the insulators for signs of damage (minor surface scratches are unimportant).

NOTES: 1. Inhibited 1.1.1 trichloroethane may be obtained commercially as:

a)	Genklene	(made by I.C.I. Ltd.)
b)	Inhibisol or Chlorothene NU	(made by the Penetone Co. Ltd., Bassington Industrial Estate, Cramlington, Northumberland).

2. Surface resistivity has dimensions of resistance only. It is the resistance across the opposite sides of a square of insulation surface of any size. For a typical receptacle or bushing insulator, the surface circumference and length are approximately equal. Hence the resistance between the contact and a ring placed near the flange may be expected to be of the order of 40000M-ohms.

3. Should insulator damage be found, remove unit from service and inform Yorkshire Switchgear as insulator replacement is a specialist operation.

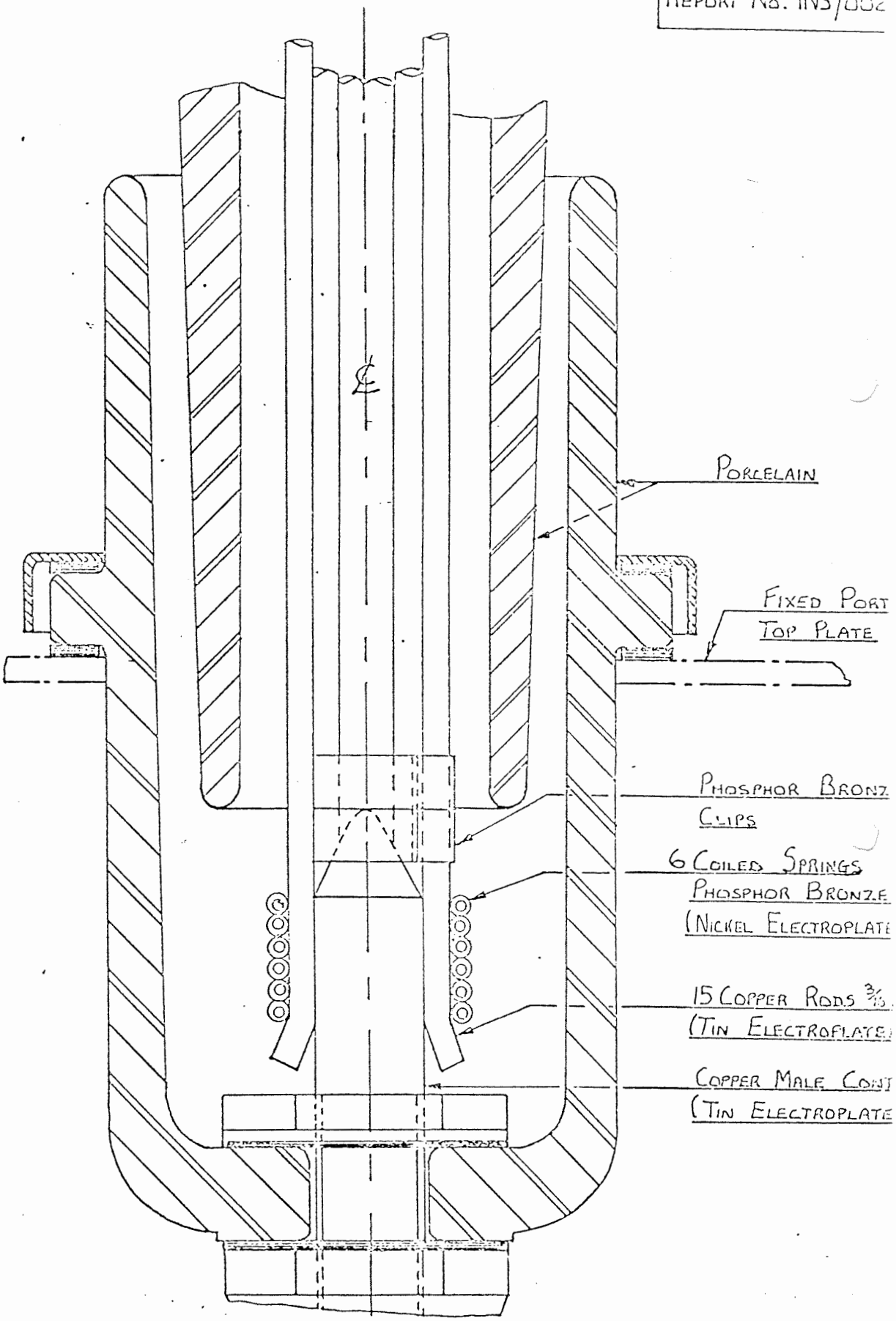


FIG. 1. MK. 1 ISOLATING SYSTEM

RS/

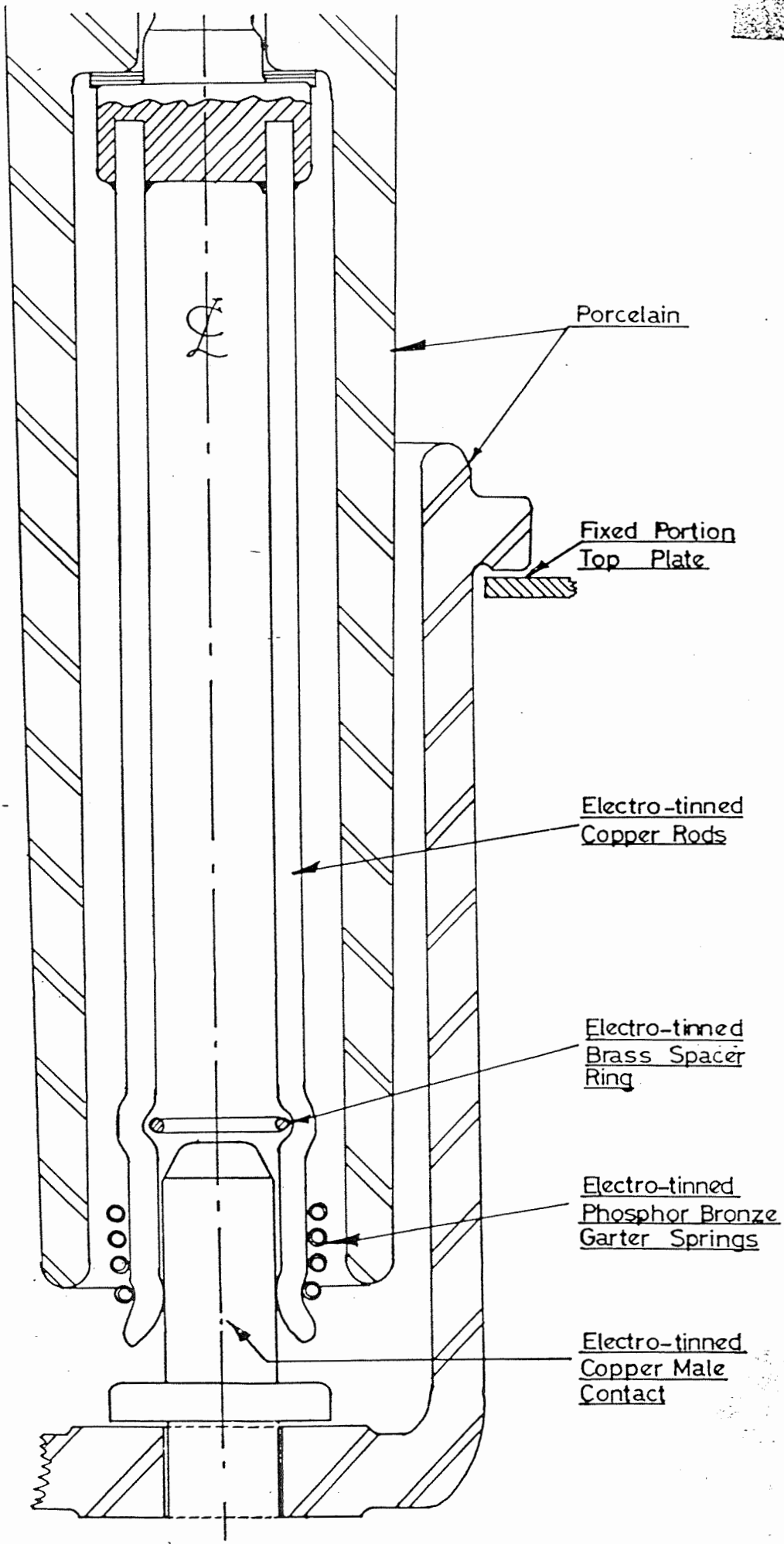
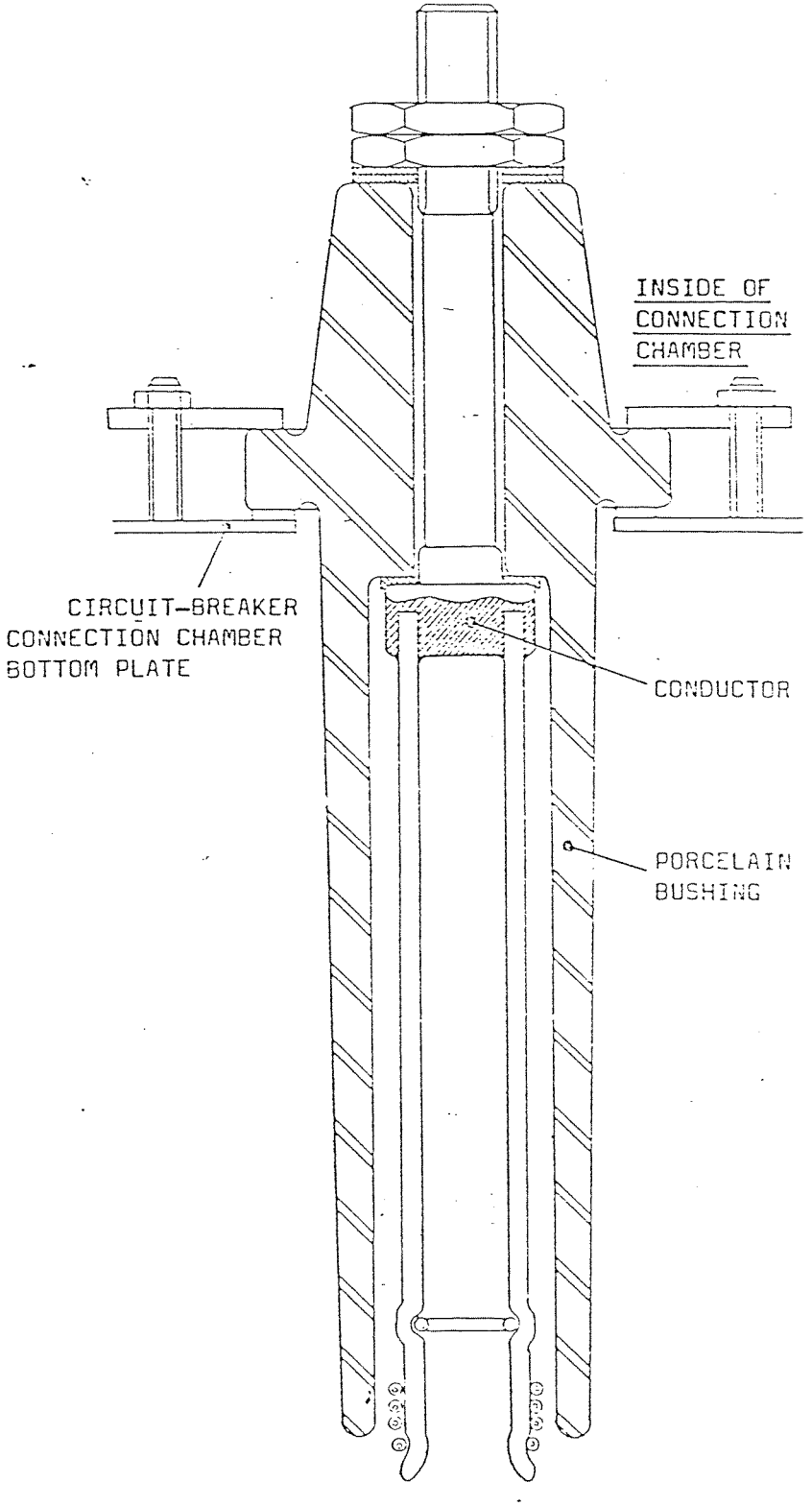


Fig. 5. Mk. Ia Isolating Contact System



SECTIONAL ARRANGEMENT OF MK V ISOLATING CONTACT SYSTEM EMPLOYED ON TYPE IVI CIRCUIT BREAKERS

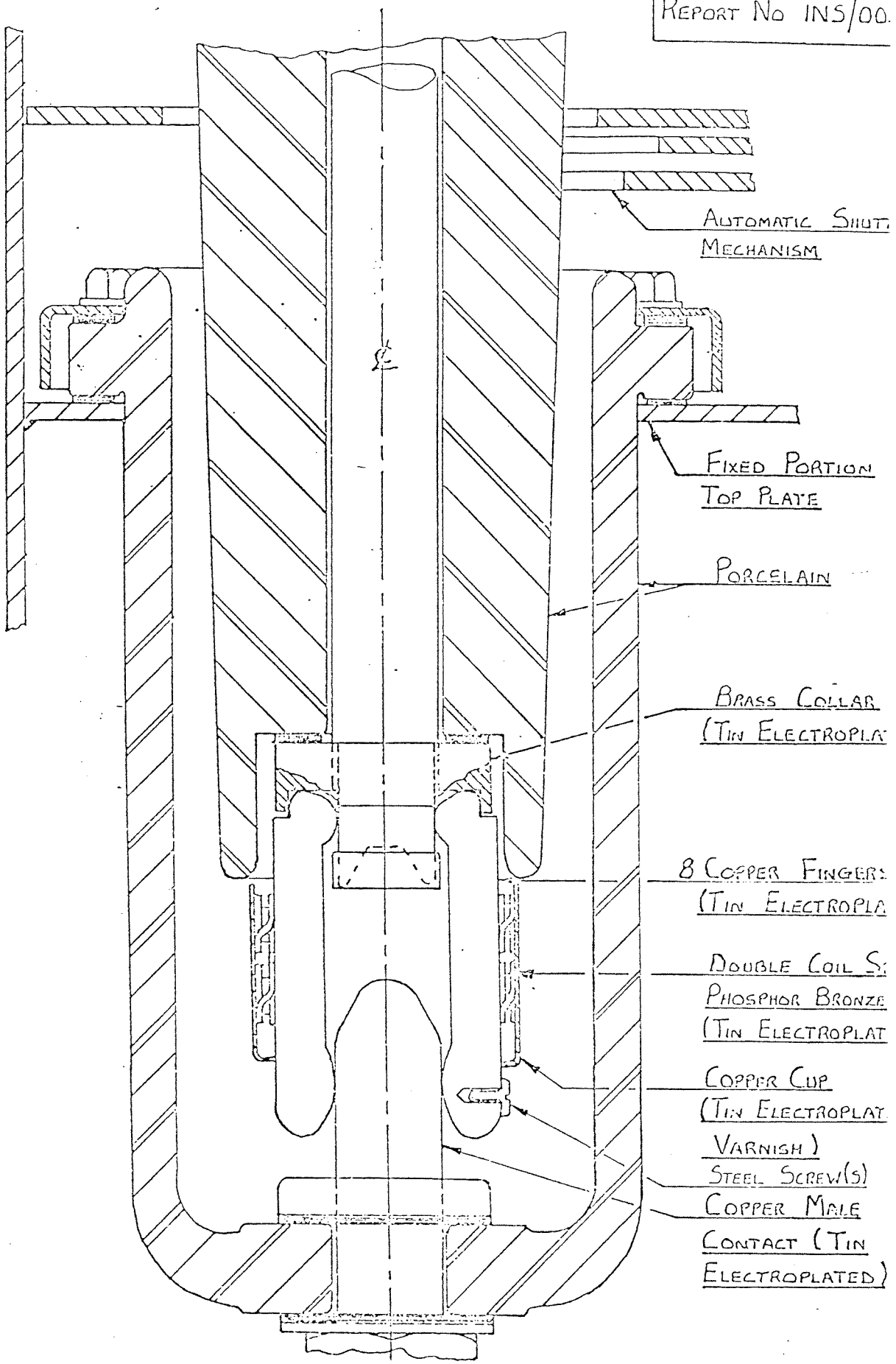


FIG. 2. MK. II ISOLATING SYSTEM

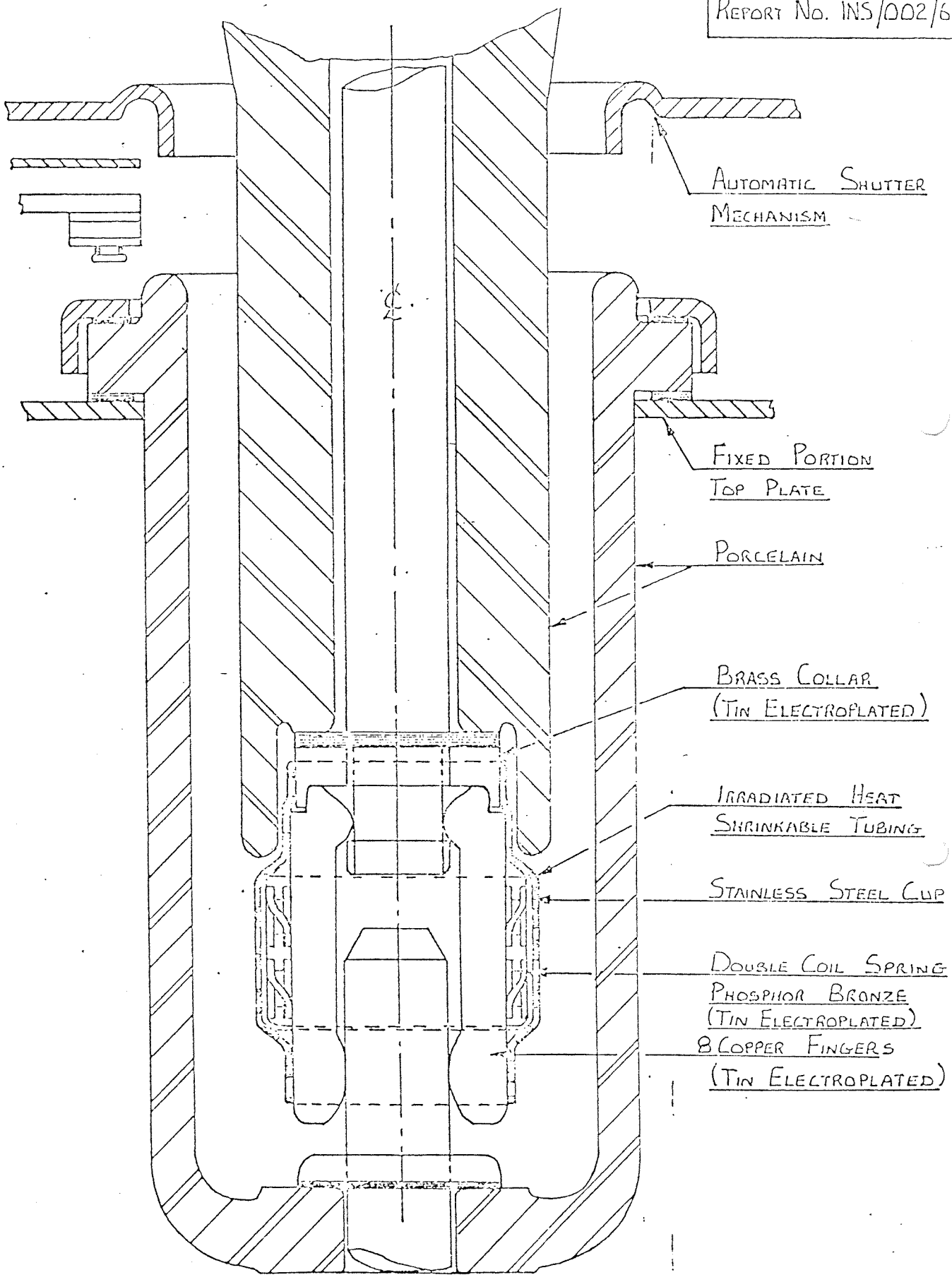


FIG. 3. Mk. III ISOLATING SYSTEM

RS/7

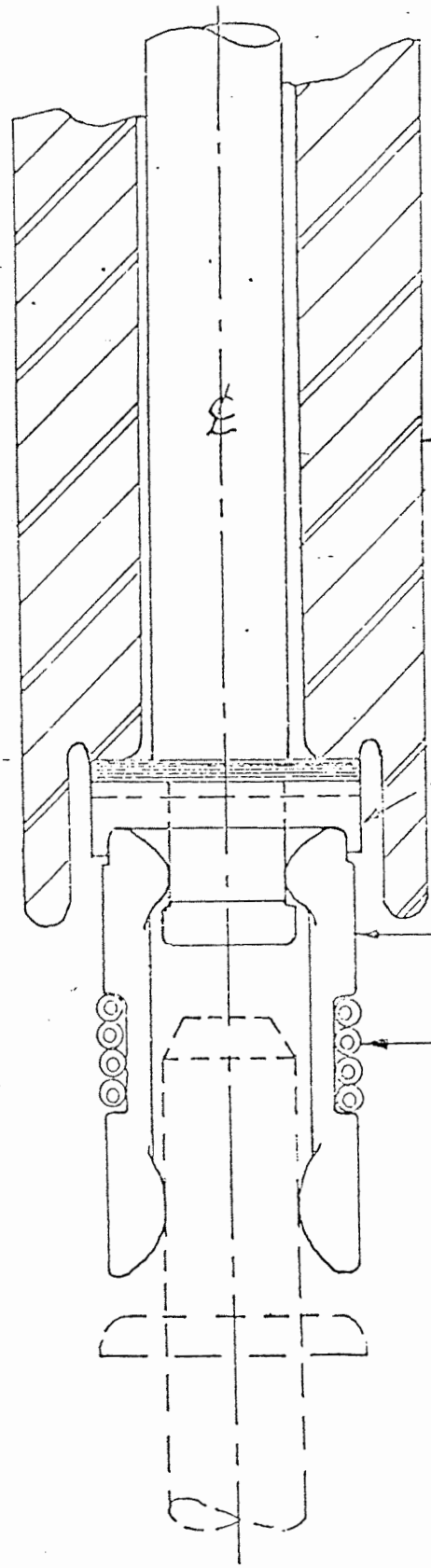


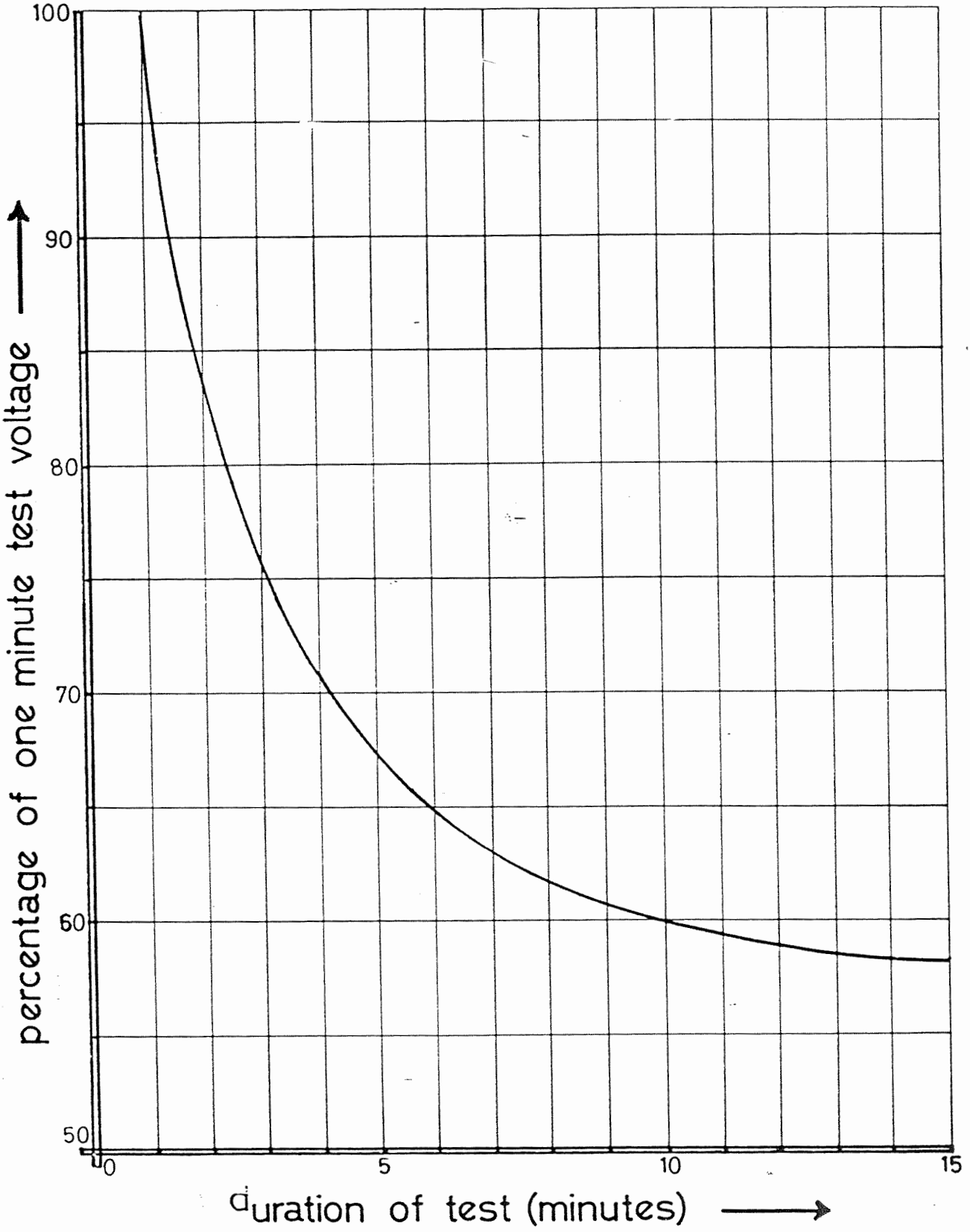
FIG. 4. Mk.IV ISOLATING CONTACT

Key to Illustrations - Fixed Portion

(1) busbar chamber
(2) front cable box
(3) fixed main isolating contacts
(4) fixed main isolating contact receptacle insulators
(5) safety shutters, (5a) front for cable contacts, (5b) rear for busbar contacts
(6) busbars, (6a) upper busbar, (6b) middle busbar, (6c) lower busbar
(7) DMC busbar support barriers
(8) fish plate busbar connectors
(9) band joint casing
(10) band joint rain shed
(11) busbar end cover
(12) busbar end cable box
(13) shutter box rain cover
(14) shutter box
(15) foundation channel
(16) guide rail
(17) earth bar
(18) guide rod sprung earthing contact in shutter box
(19) band joint earth braid
(20) fixed portion foot
(21) shutter box top plate
(22) fixed frame to carry isolatable switch
(23) fixed frame leg
(24) fixed frame support foot on fixed portion
(25) battery compartment
(26) fixed frame bracket
(27) shutter locking slide, (27a) left for cable shutter, (27b) right for busbar shutter
(28) hole in locking slide, (28a) left for cable shutter, (28b) right for busbar shutter
(29) manual shutter opening levers, (29a) for cable shutter, (29b) for busbar shutter
(30) shutter mechanisms
(31) shutter top plate retaining clips and screws
(32) shutter return springs
(33) shutter release levers
(34) shutter release lever securing locknuts
(35) guide rod tubes
(36) guide rods, (36a) for cable shutter, (36b) for busbar shutter
(37) hessian tape
(38) band joint flange on fixed portion
(39) pressure plastic
(40) band joint top plate
(41) band joint securing screws
(42) tapped bars at band joint ends
(43) earth braid "flag"
(44) band joint filler orifice cover
(45) band joint filler orifice
(46) band joint filler orifice gasket
(47) band joint filler orifice cover screws
(48) end cover securing studs
(49)
(50)

(51) groove in busbar end cover for rubber gasket
(52) busbar end cover filler cap
(53)
(54) front cable box front plate
(55) front cable sockets
(56) front cable box bottom plate
(57) front cable gland gasket
(58) front cable gland
(59) pressure plastic
(60) front cable box bottom plate securing studs
(61) moving portion main isolating contacts, (61a) moving portion main isolating plugs
(62) front cable box front plate securing studs
(63) front cable box filler aperture cover
(64) front cable box filler apertures
(65) front cable box filler aperture gasket
(66) busbar end cable box front plate
(67) middle busbar extension
(68) lower busbar extension
(69) busbar and cable box rubber gasket
(70) groove for busbar end cable box rubber gasket
(71) busbar end cable gland
(72) upper busbar extension
(73) busbar end cable box earth connection
(74) busbar end cable box filling aperture
(75) busbar end cable box filling aperture cover
(76) busbar end cable box filling aperture gasket
(77) relay cabinet instrument plate top pivot
(78) relay cabinet instrument plate door hooks
(79) relay cabinet feet
(80)
(81)
(82)
(83)
(84) rear wiring box
(85) rear wiring box legs
(86) rear wiring box tie angles
(87) rear wiring box brackets
(88) rough floor level
(89) finished floor level
(90) rail spacing jigs
(91) tightened cord over holes in channels
(92) channel levelling screws
(93) rag bolt and rawlbolt
(94) relay cabinet
(95) relay cabinet instrument plate
(96)
(97)
(98)
(99) relay cabinet wiring plate.

TEST VOLTAGE ~ TEST DURATION

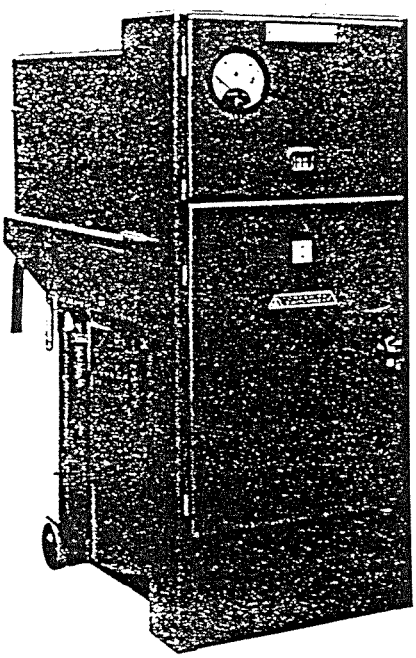


IVI-13 SERIES METALCLAD
OIL CIRCUIT BREAKERS

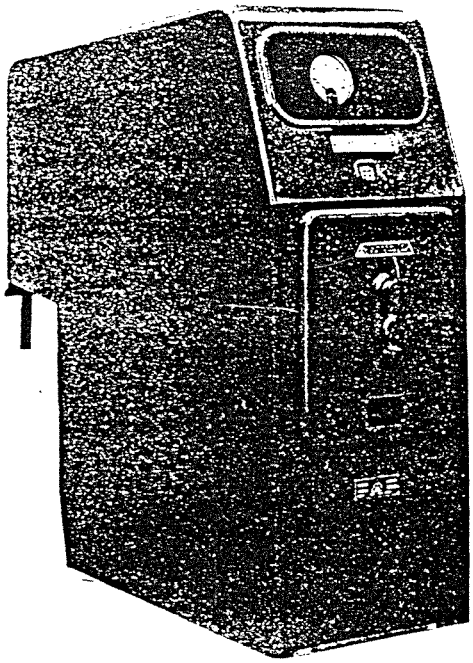
Contents

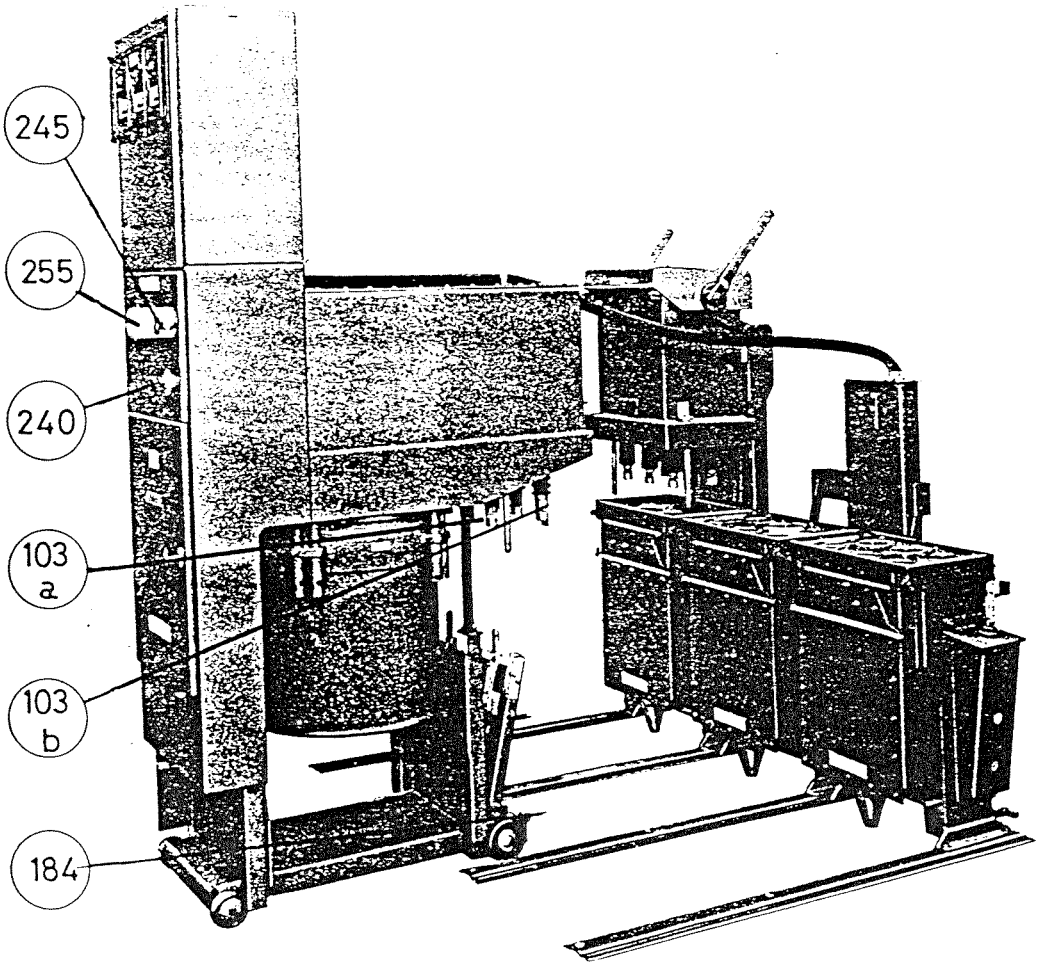
Contents

IVIF-13
INDOOR
OCB



IVIO-13
OUTDOOR
OCB





IVIF-13 OCB ISOLATED FROM SWITCHBOARD

IVI-13 Series Oil Circuit Breakers

The basic unit of the Yorkshire Switchgear range of Inverted Vertically Isolated Switchgear is the 11kV, IVI-13 OCB and its fixed portion.

The IVIO-13 11kV OCB was developed for outdoor use in all climates. Years of successful service in all parts of the world, coupled with a continuing R & D programme, have led to many detail improvements whilst proving the soundness of the basic design. This success led to the development of the indoor, front panel IVIF version.

Both the IVIO and IVIF designs carry the breaker tank (100), Caton Arc Trap arc control device (130), closing mechanism (110), operating mechanism (whichever is fitted), isolating contacts (103), isolating mechanism (200), current and (where fitted) voltage transformers, switch-board-mounted metering and protective equipment and an overall cover (IVIO, 101) or front cover (IVIF, 102) on the breaker carriage (129). Thus auxiliary interconnection between the fixed and moving portions is reduced to the minimum.

Such connections as have to be made, e.g. remote tripping and metering circuits, are made either through single core wiring carried in a flexible conduit (105) which is long enough to allow isolation and withdrawal of the OCB, or by secondary contacts which are mounted at the rear of the current transformer chamber (108).

The overall cover (101) of the IVIO model can be fastened in the partially raised position by a safety catch (101a) on the OCB top plate (213).

Arc Control Device The Caton Arc Trap (130), a double-break design, is mounted on the OCB lift plate assembly (140). Consistently short arcing times reduce contact burning to a minimum. For maintenance, the Arc Trap system (130) can be elevated clear of the tank (100), which then remains on the carriage floor (129) or can be removed altogether.

OCB Bushings (131) These carry the HV connections from the current transformer chamber (108) to the OCB fixed contacts (132, 133, 134). They are of porcelain or synthetic resin-bonded paper, according to the OCB duty rating.

Operating Mechanism A spring assisted manual (SAM) closing mechanism (185) is fitted as standard; speed of operation is independent of the operator's effort.

Other methods of closing: solenoid (170), manually charged spring (150) (with mechanical or electrical release) or motor wound spring (160) (for auto-reclose duty) are also available.

Isolation is normally by hand. Bevel gears (205, 214) and a continuous roller chain (204) carry the drive from the detachable racking handle (109) to the four carriage-frame screwjacks (203, 211). Powered racking equipment can be supplied for installations with an auxiliary power supply.

Isolating Contacts & Shrouds The self-aligning isolating contacts (103) are protected and insulated by glazed porcelain shrouds (104), which remain non-porous even if accidentally chipped. Breakers for 15kV service have cast epoxy resin insulators with integral stress screens. Separate automatic safety shutters (5) cover the busbar and feeder shutter apertures (4) of the fixed portion when the moving portion is isolated.

Voltage Transformers (VTs) Two types of VT are used: horizontal drawout (215) on front panel breakers and vertical plug-in (225) on outdoor OCBs. Both types are oil filled and protected by high voltage HRC fuses (216, 226) within the transformer housing. Secondary fuses (217, 227 are mounted on the breaker front or on the VT itself.

Current Transformers Wound primary and bar primary CTs can be accommodated in the compound-filled chamber (108).

Earthing Transfer earthing of the feeder circuit (192) is available. Earthing of the busbars is via a detachable device (141) which is mounted on the OCB isolating contacts (103). This device can also be used for feeder earthing where the transfer earthing system is not required.

Cladding An aluminium one-piece, weatherproof cover protects the IVIO version of the OCB (101). This cover can be swung clear on a rear-mounted hinge, to give access to the interior for maintenance.

OCB Interlocks & Doorlocks

Interlocks incorporated in the OCB design ensure that:-

1. a circuit breaker cannot be isolated from, or plugged into the "Service" location when it is closed;

2. the closing springs cannot be discharged to close a circuit breaker unless it is correctly located in the "Service", "Isolated", "Earthing" or "Fit Earthing Device" locations (note that "Earthing" and "Fit Earthing Device" locations are only applicable when a portable earthing device (141) is used, and do not refer to transfer earthing (192) of the feeder cable);

3. a circuit breaker cannot be lowered into the "Service" or "Earth" location with its tank (100) off unless the lift screw interlock lever (208) is deliberately held off (as in the case of tank replacement after maintenance);

4. where a voltage transformer is fitted, access to its contacts or interior can only be gained when the voltage transformer is isolated.

Detachable locking devices (145) are supplied to enable OCB tripping mechanisms to be immobilised when breakers are used to earth feeders or busbars.

The operation access door (128b) of the IVIF breaker can be padlocked shut to prevent access to the trip button (235b) or closing mechanism (110). Consumer tripping facilities may be provided by the removal of the label (233) marked "FOR ACCESS TO TRIP BUTTON OPEN DOOR".

A lockable handle (234) on the IVIO breaker's operation access door (128a) covers the trip button and prevents access to the closing mechanism (110). The handle may be modified to give access to the trip button (235a) but not to the closing mechanism (110).

Where a horizontally withdrawable voltage transformer is fitted, the automatic shutters (221) can be padlocked shut.

Preparation of Circuit Breakers

1. Remove all packings, labels, etc., from the OCB interior and exterior and check the overall condition. Touch up any damaged paintwork (see "Paintwork").

2. All secondary wiring will have been completed before despatch. However, some OCBs have secondary interconnection single core cables which pass through a flexible conduit (105) from the OCB to the rear wiring box (126) or relay cabinet (127). In this case the wires and conduit must be made off. The length of the conduit should be sufficient to allow the OCB to be isolated and withdrawn from the switchboard, but not so long as to sag onto the fixed portion shutter box top (14). Check this. A saddle on the current transformer top secures the centre section of the conduit in place on some IVIF circuit breakers.

   If a horizontally withdrawable voltage transformer (215) is to be fitted see the section "Preparation of IVIF OCB Voltage Transformer" for further details before cutting the conduit or wires.

3. OCBs are delivered with oil tanks (100) empty. Since the operation of an OCB mechanism in air can cause damage, no OCB must be closed or tripped until the tank has been filled with oil. It is, therefore, wise to fill switchgear with oil as soon as possible after delivery.

   a) Elevate an IVIO OCB to the "Isolated and Plugs Clear" location (see "OCB Elevation Indicators"). Raise the cover (101) until it can be held by the cover safety catch (101a). Lower the OCB again. With the breaker, either IVIO or IVIF, fully lowered, unscrew the eight tubular tank nuts (149) with a 12.5 mm (1/2 in) diameter tommy bar.

   b) Move the isolation interlock (222) aside, insert the isolating handle (109) and give three clockwise turns to raise the OCB slightly. If the tank does not separate from the top plate, a sharp blow with the hand should break the seal around the tank top edge.

   c) Wind the OCB to maximum elevation and remove the isolating handle (109).

   d) Wipe out and fill the tank as described under "Oil Filling of Switchgear". Make sure that the oil level coincides with that on the tank label (159) with all parts of the arc trap assembly (130) clear of the oil. Over or under oiling can prevent correct operation of the OCB.

   e) Re-insert the isolating handle (109) and wind the OCB down again, ensuring that the tank securing studs (181) pass through the holes in the tank lugs (182). Hold off the tank interlock (183) at the left hand side of the operating mechanism whilst lowering the OCB.

   f) Replace the nuts (149) and tighten them evenly with the tommy bar. In the case of an IVIO breaker, hinge the cover forward to the normal position.

Operate the mechanism several times (see "Operation") and leave for at least an hour before commissioning to allow any trapped air to rise to the surface of the oil.

To Isolate OCB

1. With the OCB "OFF", and the closing springs where fitted discharged, (unless this is operationally undesirable), move the isolating interlock (222) to the left, insert the isolating handle (109) and wind it clockwise to raise the OCB.

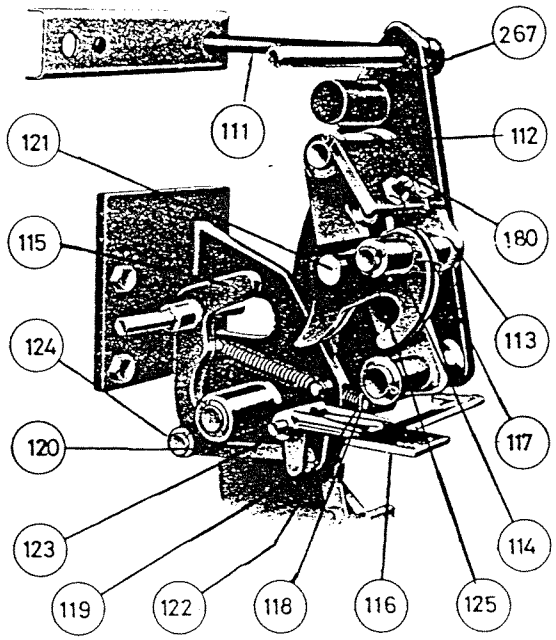
2. When the isolating contacts (103) and guide rods (36) are clear of the shutter box top and sides (21), pull the OCB forward clear of the fixed portion.

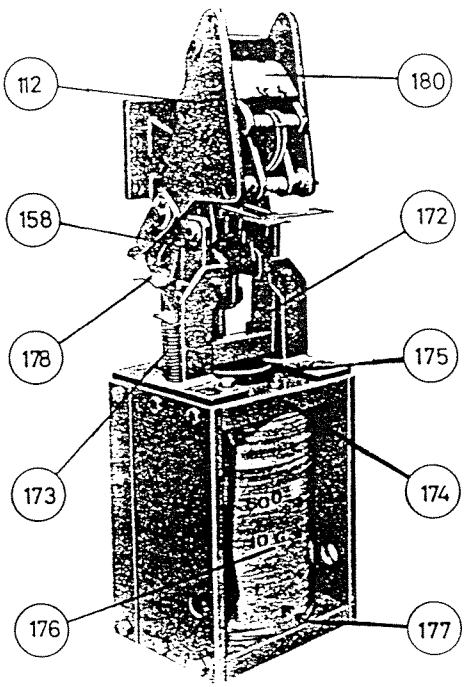
3. Lock off the fixed portion locking slides (27). In the case of an outdoor installation, lock the shutter box rain cover (13) in place.

4. Lower the OCB if necessary, by winding the isolating handle (109) anticlockwise.

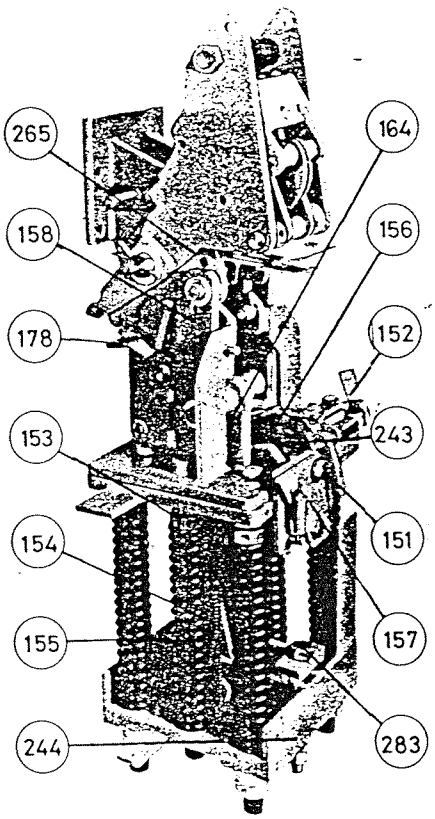
5. Remove the isolating handle (109). Close and lock the operation access door (128) if the OCB is to be left unattended in an insecure location (e.g. outdoor or consumer's substation).

UPPER CLOSING MECHANISM (110)



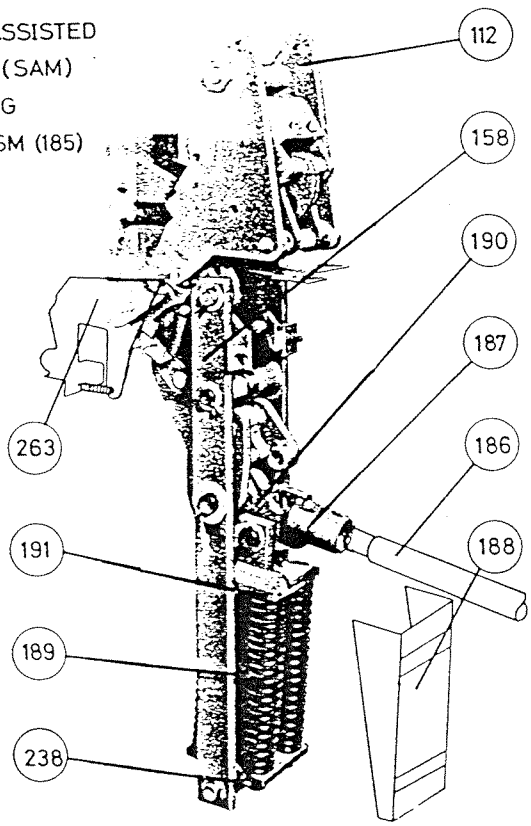


SOLENOID OPERATING MECHANISM (170)



MANUALLY CHARGED SPRING OPERATING MECHANISM (150)

SPRING ASSISTED MANUAL (SAM) OPERATING MECHANISM (185)



The Basic OCB Closing Mechanism

All Yorkshire Switchgear IVI circuit breakers are fitted with a basic closing mechanism which varies in dimensions and details according to the type and size of operating mechanism which is fitted to the OCB.

Closing

On initiation of the closing operation, the vertical motion of the drive levers etc. is converted into a forward and downward motion of the main side levers (112). These, in turn, pull forward the upper sections of the lift rods (111). A roller chain linkage (256), moving in guide tubes which pass through the current transformer chamber (108), transmits the motion through 90° to give a vertical lift to the OCB lift plate (140) and Arc Trap moving component (130).

Hold-in catches (178) latch the mechanism in the OCB closed or ON position and the trip bar roller (119) holds the trip hammer lever in tension.

Tripping

The OCB may be electrically tripped in a number of ways:

1. By the operation of a local or remote TRIP/CLOSE switch (246) or TRIP push button (240).

2. By the operation of protective relays.

3. By the blowing of the shunt time limit fuses (TLFs) (258) on the OCB front plate by current induced in the overcurrent or earth fault current transformer. The TLFs may be of the bolt-on HRC type or the glass cased rewireable type, according to the age of the OCB and the local supply authority's policy.

Whichever of these three cases applies, the result is the same: one or more trip coils (209) is energised, causing the armature(s) (210) to rise and lift the trip bar (116).

Alternatively, the trip bar (116) may be raised by the operation of the mechanical trip button (235) in the OCB operational access door (128).

However the OCB is tripped, either manually or electrically, the trip bar (116) is raised. This moves the trip bar roller (119) away from the trip hammer lever (120), allowing the spring loaded trip hammer (115) to pivot and knock the main catch (114) away from the catch pin (121). The toggle links (113) then collapse and allow the main side levers (112) to return to the OFF or open position under the influence of the kick-off (259) and accelerating springs (260).

To prevent inadvertent slow opening of the OCB should the mechanism fail to latch in on closing, a slotted metal quadrant arm (261) is attached by a nylon friction bush (262) to the right hand main side lever (112). If the mechanism starts to open before latching in at the end of a closing stroke, the quadrant arm (261) will raise the trip bar (116) to trip the OCB at normal speed and prevent slow opening.

Spring Assisted Manual Operating Mechanism (185)

(Fitted to OCBs rated up to 21.9kA rated symmetrical breaking current only).

The spring assisted manual (SAM) operating mechanism provides an economical means of closing a circuit breaker in a highly efficient manner. Energy is stored in a battery of springs (189) during the major part of the operating stroke, then automatically released to close the OCB at a point approaching the end of the stroke.

Breakers fitted with SAM mechanism can be regarded as being independent manually operated, since the speed of contact travel is independent of the operator's effort.

To Close SAM-Equipped OCB

1. Open the OCB operation access door (128) and remove the detachable closing handle (186) from its bracket inside and to the left of the OCB door (IVIO) or on the substation wall (IVIF). Note the OCB indication OFF.

2. Insert the closing handle into the socket (187) at the front of the spring box (188) and raise it through about 90° until it "catches" in the reset position.

3. Push the handle firmly down through 90°. During the early part of the stroke the actuating springs (189) are compressed as the operating cam (190) pushes down the upper spring plate (191). At a point approaching the limit of the handle's travel, a projection on the operating cam (190) releases the lower spring plate (238) to discharge the springs (189) and close the OCB. The indication (239) will change to ON.

4. Remove the closing handle (186) and replace it in its bracket. Close and lock the OCB door (128).

To Open SAM-Equipped OCB

Either 1. Press the mechanical trip button (235) on the OCB.

In the case of an IVIF breaker the trip button (235b) will be inside the operation access door (128b), but it will be accessible through an opening near the top of the door if the removable label (233) has been taken out. In the case of an IVIO OCB the trip button (235a) is on the front of the operation access door (128a), but covered by the padlockable handle (234).

OR 2. Press the local or remote electrical trip button (240).

OR 3. Open the operation access door (128) and raise the trip bar (116) using the end of the closing handle (186). This method of operation requires great care and should only be used if the mechanical trip button (235) is damaged.

The indication in the small window of the OCB front (239) will change from ON to OFF.

Maintenance Slow Closing and Opening of SAM-Equipped OCB

It will be necessary during inspection and maintenance work to slow close and slow open the OCB contacts, but there must be no risk of slow operating when the OCB is in service. The SAM mechanism allows direct manual control of the slow operating sequence to be simply obtained by the inversion of the spring box front cover (188). The need to depress a slow close release catch (263) during the slow-close operation prevents inadvertent slow-closure should the breaker be accidently put into service with the spring box front cover (188) inverted.

To Slow-Close SAM-Equipped OCB During Maintenance

(With OCB isolated, tank (100) removed and OCB elevated).

The slow closing and opening procedures must NEVER be used with the OCB plugged into the fixed portion.

1. Remove the spring box front cover (188) and replace it in the inverted position. The words "WARNING" and "MAINTENANCE" should now be right way up.
2. Insert the closing handle (186) and raise it to the "reset" position.
3. With the left hand, depress the red slow close release catch (263) below the left hand side of the coil plate (264). Keep the catch (263) depressed.
4. Move the closing handle (186) down to the horizontal position.
5. Release the red catch (263).
6. Complete the closing stroke.

To Slow-Open SAM OCB During Maintenance

(Condition as "6" above).

1. Press the closing handle (186) hard down with the right hand.
2. With the left hand, depress the red slow close release catch (263) and hold it down.
3. Raise the operating handle (186) about three inches.
4. Release the red catch (263) and hold down the trip bar (116).
5. Complete the upward stroke of the closing handle (186).

COPY OF Rating Certificate No. 7299

ASTA The Association of Short-Circuit Testing Authorities

(Incorporated in the year 1938) 8 Leicester Street, London WC2

Certificate of Short-Circuit Rating S/NA r 199 V3v

of a spring operated oil circuit breaker.

Short-Circuit Type Tested in accordance with I.E.C. 56 - 1 : 1954

Rated Voltage 24 kV Max. Rated Normal Current 800 amperes

Maker Yorkshire Switchgear & Engineering Company Limited, Leeds.

Tested for Yorkshire Switchgear & Engineering Company Limited, Leeds.

Designation IVI 24/26 Serial No.

The apparatus, constructed in accordance with the description, drawings and photographs sealed and attached hereto, has been subjected by

The Nelson High Power Laboratory of The English Electric Co. Ltd.

to a complete series of proving tests of its short-circuit rating which has been made, subject to any observations in the record, in accordance with the appropriate clauses of the Specification(s).

The results are shown in the RECORD OF PROVING TESTS and by the oscillograms sealed and attached hereto. The values obtained and the general performance are considered to justify the Short-Circuit Rating assigned by the manufacturer, as stated below.

Breaking-capacity at 24 kV.

Symmetrical 24.1 kA.

(Equivalent to 1000 MVA.)

Asymmetrical kA.

Duty 0-3-CO-3-CO

Making-capacity 61.5 kA. peak at 24 kV.

Short-time current capacity 24.1 kA.

for 1 seconds.

This Certificate applies only to the short circuit performance of apparatus made to the same specification and having the same essential details as the apparatus tested.

The documents under seal forming part of this Certificate are:

(1) Record of Proving Tests: Sheets Nos. 2 to 11

(2) Oscillograms Nos. Umzv 1 to 27 Electromagnetic and Umzv 1 to 6 T.R.V.

(3) Drawings Nos. 8302 FZ

(4) Diagrams Nos. S9950/301 and S9950/330

(5) Photographs Nos. R199/1 to R199/8

SEAL

(signed) J. M. Hawkins. Manager
Nelson Engineering Laboratories

(signed) R. Mc C. Howitt. ASTA Observer
The Association of Short-Circuit Testing Authorities

A.W. PAGE Member of Council

G.C. STEBBING Secretary

The conditions under which this Certificate may be reproduced are governed by Clause 16 of ASTA Publication No.

SAM OCB - Contact and Dashpot Setting after Major Overhaul

1. Slow close the OCB as previously described.

2. Check the OCB contact engagement. The vertical dimension from the shoulder of the contact block (132A) to the upper edge of the arc trap side contact plate (137B) should be 40 mm $\pm$ 1.5 mm (1.9/16 in $\pm$ 1/16 in), with the OCB closed.

3. If the setting is incorrect, estimate the adjustment required (noting that one turn of lower lift plate locknuts (272) is equal to approximately 3 mm (1/8 in) travel) and slow open the OCB as previously described. Adjust lower lift plate locknuts (272) and repeat operations '1' and '2'.

4. When the setting is correct, with the OCB slow-closed, press down hard on the closing handle and again check the vertical dimension (132A-137B). It should be 3 mm (1/8 in) less than at '2' above. This corresponds to the amount of free travel between closing dashpot screw (274) and closing dashpot plunger (275).

5. If free travel (274-275) is incorrect, slow open the OCB, remove screw (274), add or remove washers as necessary to obtain the correct clearance and replace screw (274). Slow close the OCB and re-check as at '4' above.

6. With free travel (274-275) correct, slow open the OCB. Adjust and lock the upper lift plate locknuts (276) to give 3 mm (1/8 in) gap between the bottom nuts and their washers. Set opening dashpot plungers (277) to give 1.5 mm (1/16 in) free travel to the opening dashpots (278). This measurement can be achieved by tilting each side of the lift plate assembly (270) and adjusting each plunger (277) until its dashpot moves 1.5 mm (1/16 in) downwards. Raise the assembly slightly and tighten the plunger (277) grub screws to lock off. Lock off the lower lift plate locknuts (272).

Manually Charged Spring Operating Mechanism

The long-established manually charged spring method of power closing is fitted to OCBs rated above 21.9kA symmetrical breaking current, or OCBs requiring a single shot reclosure facility. Charging of the closing springs (155) is by hand, the springs then being released to close the breaker by the operation of an electrical release circuit (168) or lanyard operated lever (152).

During the charging operation the reset springs (154) lift the main link (164) and side links (158). This causes the drive levers (265) to move backwards until the main catch (114) latches with the catch pin (121) on the toggle links (113) and the spring hold-on catch (156) engages with the pin on the charging crank side. The charging operation can be performed in two stages, thanks to the provision of the full charge interlock catch (157). This prevents slow closure due to the charging handle's being released in mid-stroke.

Provisions for discharging the springs without closing the OCB and for maintenance slow closing and opening are also included in the design.

To Close a Manually Charged Spring OCB

1. Open the OCB operation access door (128) and take the charging handle from wherever in the substation it is stored.

2. Insert the charging handle into the socket (243) at the front of the spring box assembly (244) and depress the handle with a strong, steady pressure, past the full charge interlock catch (157) (which will snap back into position above the handle) and on to the bottom of its travel.

3. Remove the Charging Handle.

4. Where lanyard release is to be used, secure the lanyard to the lanyard release arm (152).

5. Either (a) Close the OCB by pulling on the lanyard.

   OR (b) Where electrical release is incorporated, close the OCB by pressing the CLOSE OCB button (245), or turning the TRIP/CLOSE switch to CLOSE.

6. Remove the lanyard if used.

7. Repeat operations "1" to "3" if single shot reclosure is required and the OCB is suitably equipped for this.

8. Close and lock the OCB operation door access (128).

To Open a Manually Charged Spring OCB

Either 1. Press the mechanical trip button (235) on the OCB.

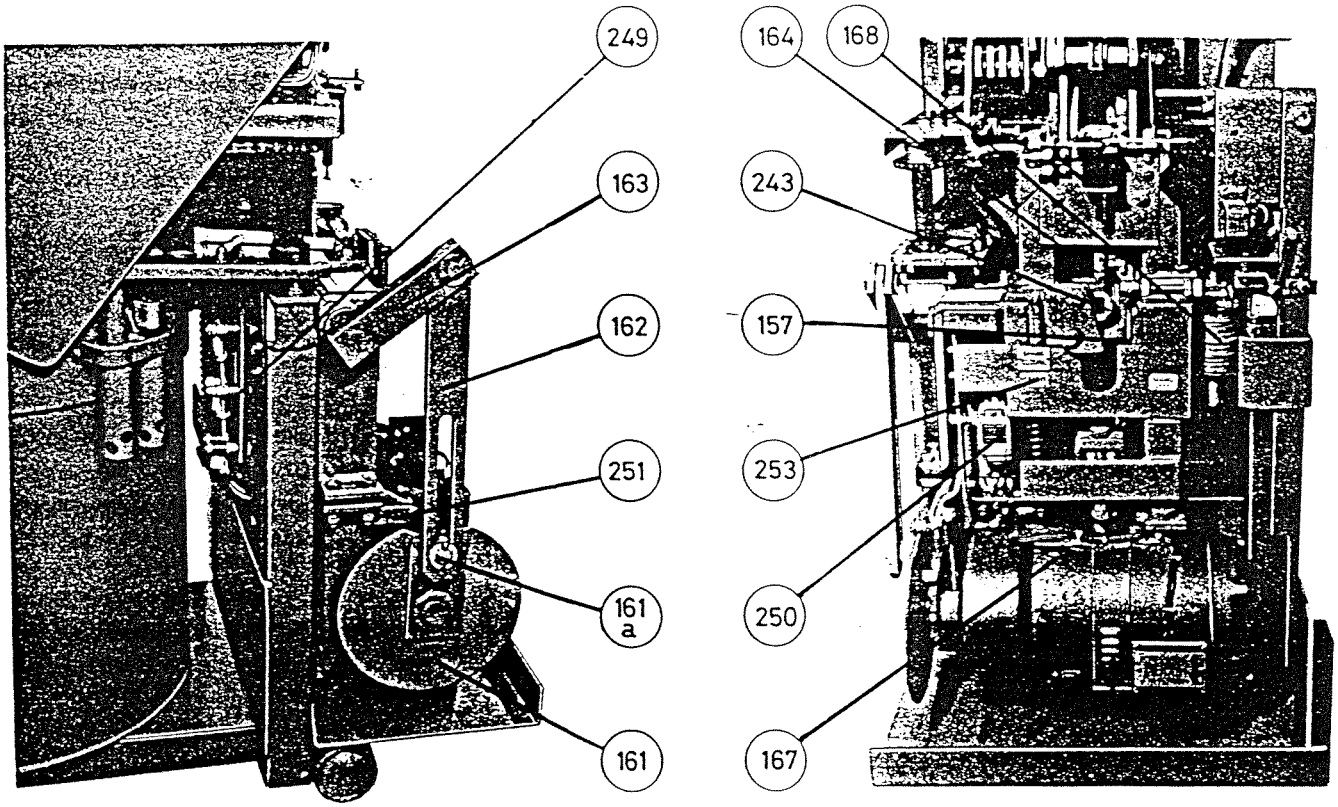
In the case of an IVIF breaker the trip button (235b) will be inside the operation access door (128b), but it may be accessible through an opening near the top of the door if the removable label (233) has been taken out. In the case of an IVIO breaker, the trip button (235a) is on the front of the operation access door (128a), protected by the padlockable handle (234).

OR 2. Press the local or remote electrical trip button (240).

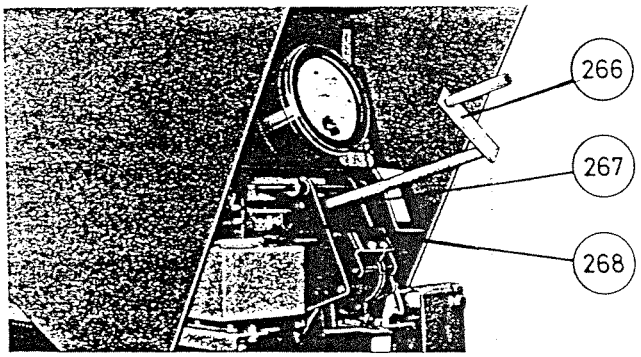
OR 3. Turn the TRIP/CLOSE switch (246) to TRIP.

OR 4. Open the operation access door (128) and raise the trip bar (116) using the end of the charging handle. This method requires great care and should only be adopted if the other tripping system(s) fail(s).

Repeat if the OCB recloses.



MOTOR CHARGED SPRING OPERATING MECHANISM (160)



SLOW CLOSURE BY SCREW JACK

4. Wind the OCB up to the "Isolated and Plugs Clear" location (see "OCB Elevation Indicators") and push it back over the fixed portion until it comes to a positive stop. Check that the guide rods (36) which protrude from the bottom of the current transformer chamber (108) on either side of the isolating plugs (104) are both exactly in line with the holes (28) in the unlocked shutter locking slides (27) of the fixed portion.

   If the rods are not in line with the holes, check that the left hand rod (36a) is not in the "transfer earthing" position, but in line with its twin. Pull the OCB clear and adjust the 12.5 mm (1/2 in) diameter setting screws adjacent (184) to the OCB carriage (129) rear wheels (223). Repeat until the guide rods (36) and main isolating contacts (3, 103) are correctly aligned.

5. Where transfer earthing equipment (192) is fitted, the earthing stops (196) should also be set so that when the left hand guide rod (36a) is reversed and the earthing stops (196) dropped, the OCB can be pushed back until it stops with the left hand guide rod only in line with its hole (28a) in the locking slide (27a).

   To reverse the left hand guide rod (36a), open the hinged portion of the left hand guard skirt (194) (along the bottom edge of the CT chamber) in the case of an IVIF OCB, or lift back the overall cover (101) of an IVIO OCB (see "OCB Transfer Earthing of Cables").

6. Clean the isolating plugs (104) and contacts (103) and smear a thin layer of petroleum jelly ("Vaseline") on the contacts as described under "Isolating Contact Maintenance".

7. Where secondary isolating contacts are fitted at the rear of the current transformer chamber (108), they will have been made off at the Works. The first time the OCB is plugged into the fixed portion, an observer should be stationed at the back of the switchboard to see that both main and secondary isolating contacts mate successfully. The male secondary isolating contacts have a "floating" mounting system to allow the locating dowels to align them correctly. The dowels should not be unduly strained unless they have been damaged in transit.

   When the OCB is completely "home" in the "service" location, there should be a 3 mm (1/8 in) gap between the faces of the male and female secondary isolating contact blocks. If this is not the case, isolate the OCB again and add or remove washers between the end locating brackets (which limit the movement of the male contact blocks) and the OCB mounting plate.

OCB Elevation Indicators

The IVIF breaker has a red pointer (236) fastened to the inside of the operation access door bottom sill at the left hand side. This indicates the vertical location of the breaker against a series of marker labels fastened to the adjacent carriage leg. The locations marked are:-

Fit Earthing Device.

Isolated and Plugs Clear.

Earthing Location
with
Device Fitted.

Service.

Note that the "Fit Earthing Device" and "Earthing" locations only apply when a portable earthing device (141) is used. They are not applicable to transfer earthing (192) of the feeder cable.

In the case of an IVIO breaker the indicator takes the form of a short vertical angle (237) bolted to the lower part of the front left hand carriage leg. As elevation of the OCB from the "Service" location is commenced, a red-painted section of the indicator becomes visible from the OCB front, below the cover (101). This means that the OCB is between the "Service" and "Isolated" location; as the OCB continues to rise, a green section of the indicator is revealed to show when the OCB reaches the "Isolated and Plugs Clear" location. The green section tapers to a point. When the cover is clear of it, the OCB can be safely inserted to or withdrawn from the fixed portion (unless a portable earthing device (141) is fitted). Other locations of the OCB must be checked by observation of the isolating contacts (103).

To Plug-in OCB

1. With the OCB "OFF", open the operation access door (128), move the isolating interlock (222) to the left and locate the isolating handle (109) socket on its spigot (207) at the right hand side of the operating mechanism. The isolating interlock (222) should lock the operating mechanism.

2. Wind the handle (109) clockwise to elevate the OCB until the isolating contacts (103) and guide rods (36) are high enough to pass over the fixed portion shutter box (21).

3. Check that the fixed portion rain cover (13) has been removed, that the locking slides (27) are unlocked, and that the automatic safety shutters (5) are free.

4. Push the OCB back over the fixed portion until it comes to a positive stop and remains in this location.

5. Wind the isolating handle (109) anti-clockwise to plug-in the OCB. Note that the guide rods (36) open the shutters (5) before the moving isolating contacts (103) reach them.

6. With the OCB in the "Service" location remove the isolating handle (109). The isolating interlock (222) should fall to the right, covering the isolating drive spigot (207) and freeing the closing mechanism. Close and lock the operation access door (128) if the OCB is to be left in an insecure location (e.g. outdoor or consumer's substation).

Motor Charged Spring Operating Mechanism

The addition of a geared AC or DC charging motor to the standard manually charged mechanism is the basis of this design. It is ideal for use where numerous operations are required at frequent intervals (e.g. in the control of maximum demand levels or arc furnaces) or where multiple single shot reclosures are required (e.g. in the protection of lightning-prone overhead lines).

OCBs fitted with motor charged spring mechanisms may be supplied equipped for a variety of automatic reclosing duties, with local or remote overriding controls, but the basic operating features remain the same. Spring release is always electrical, through the spring release coil (168).

During the charging operation a tie link (162) pulls down the automatic charging lever (163) to compress the springs (155). Reset springs (154) lift the main link (164) and side links (158), causing the drive levers (265) to move backwards until the main catch (114) latches with the catch pin (121) on the toggle links (113) and the hold-on catch (156) engages with the pin on the charging crank side.

The operation of the auxiliary electrical systems is controlled by two auxiliary switch assemblies which are incorporated in the rewind system:-

a) Motor Rewind Switch Assembly (250). This comprises three separate single pole switches.

   The first is normally open at 360° of revolution and closes at approximately 10° to provide a shunt connection across the push button controlling the re-wind motor supply.

   The second pole is normally closed at 360° and opens at approximately 10° to isolate the timed control circuits during spring charging.

   The third pole operates as does the second, and is in series with the spring release coil.

b) Spring Mechanism Switch Assembly (249). This comprises two switches. One, normally open, is closed when the springs are fully charged to complete a series connection with the spring release coil. The other, normally closed, is in series with the control selector switch to disconnect the motor when the springs are fully charged.

b) OCB open, springs (155) charged, lockout on last reclosure (indicated by relay flag).

Isolate the OCB, lock the shutters (5) then reclose and trip the breaker again to discharge the springs (155) before removing the tank (100).

If for any reason the OCB cannot be reclosed to discharge the springs (155), they may be discharged manually as described under "To Discharge the Springs of a Manually Charged or Motor Charged Spring OCB".

Loss of Auxiliary Supply to Motor Charged Spring OCB

Two electrical limit switches - a spring position switch (249) and a motor limit switch (250) - control the operation of the charge circuits on the motor wound spring OCB. The spring switch (249), at the rear left of the spring box assembly (244), closes when the springs (155) discharge to make the charging motor circuits ready for the next charging duty. Another pair of contacts closes on completion of charging to make the closing circuit ready.

The motor switch (250) is operated through a roller arm (251) which runs on the drive wheel's (161) periphery. It stops the motor (167) at the end of the charging cycle, controls the supply to the motor (167) during starting and acts as an electrical interlock to prevent electrical discharge of the springs (155) until the charging cycle is complete.

If auxiliary supplies fail, it is possible for a motor wound OCB to be left with the springs (155) partially or wholly discharged, and reclosure prevented by the operation of the electrical interlocks. The result is permanent loss of the H.V. supply. If this occurs the springs (155) must be recharged manually.

1. Open the operation access door (128).

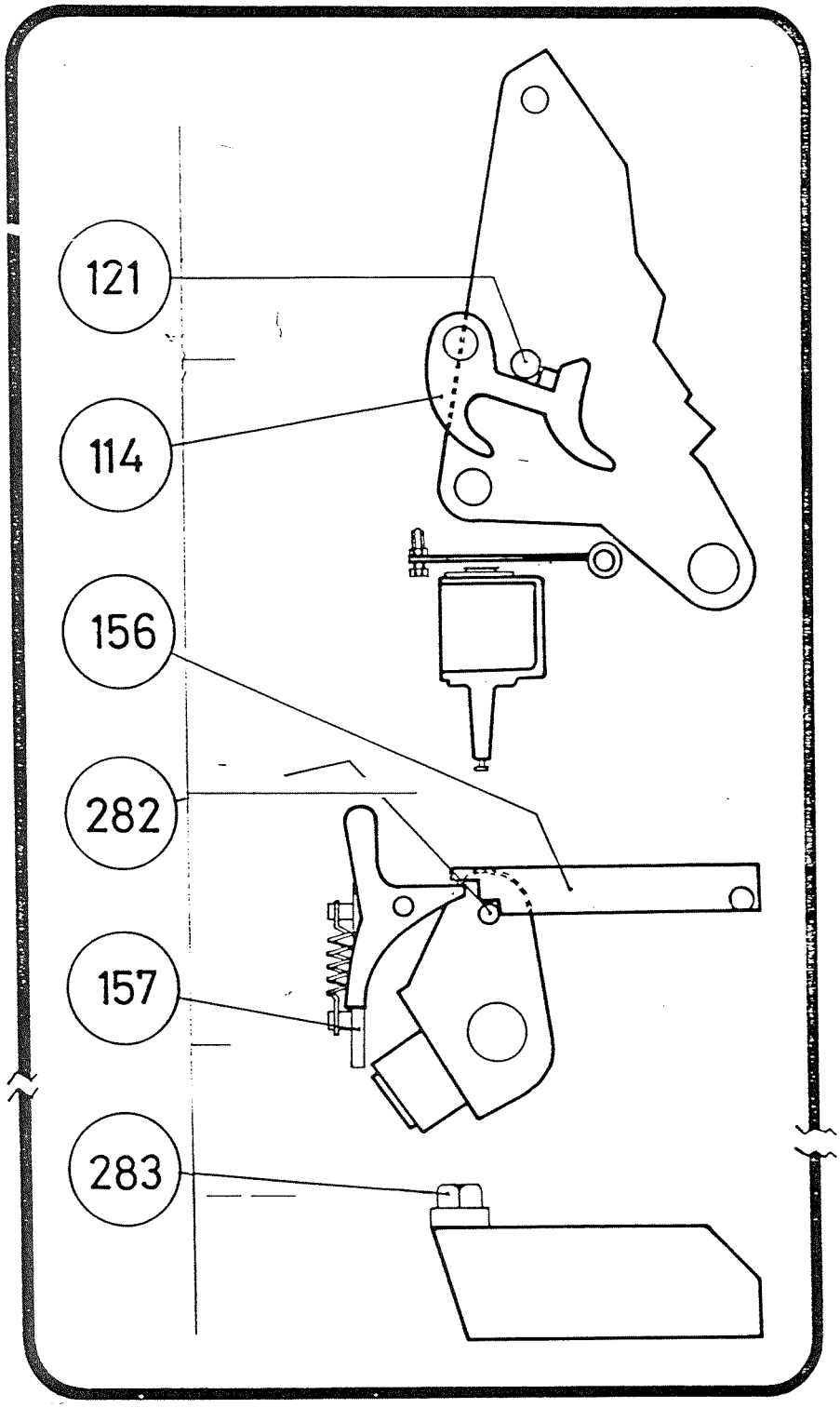
2. In the case of an IVIO breaker, remove the cover plate (252) at the left front of the motor "bulge" in the OCB cover (101).

3. If spring closing "OPERATIVE" is not shown on the mechanism indicator (253), complete the spring charge, if necessary by using the manual charging handle (if access to the charging socket (243) is obscured, pivot the full charge interlock catch (157) aside).

4. Depress and maintain pressure on the charging handle. Rotate the red drive wheel (161) on the motor (167) shaft clockwise (looking from the left of the OCB) until springs "OPERATIVE" is indicated (253). This will complete the interlock circuits.

5. The OCB can now be closed electrically if the closing supply is available, or by the raising of the spring release coil (168) operating bar with a screwdriver.

6. The breaker can be tripped, if necessary, by the lifting of the trip bar (116) with a screwdriver or other tool. Take care not to trap your fingers in the moving mechanism.



SPRING MECHANISM ADJUSTMENT

Mal-Operation of Manually Charged & Motor Charged Spring Breakers

Occasionally, after being in service for some time, the operating mechanism of a manually charged or motor-charged spring OCB may not close the breaker when the springs are released. In this event, check the mechanism setting as described below BEFORE attempting further closures. Failure to do so may cause permanent damage to the mechanism, requiring the replacement of some components.

Whether the breaker is of the manually charged or motor charged type, charge the springs by hand as described under "To Close a Manually Charged Spring OCB". During the charging operation, note the following sequence of events.

1. Charging handle passes full charge interlock catch (157).
2. Main catch (114) engages on catch pin (121).
3. Spring hold-on catch (156) engages on charging crank pin (282) IMMEDIATELY AFTER "2".

If these events do not occur in this order, release the spring charge as described under "To Discharge the Springs of a Manually Charged or Motor Charged Spring OCB" and adjust the main link adjuster screw (283) upwards or downwards until, by trial and error, the correct charging sequence described above is obtained.

The OCB can then be charged and closed in the normal way.

To Discharge the Springs of a Manually Charged or Motor Charged Spring OCB

It may be necessary to discharge the springs of an OCB without closing the breaker, e.g. to avoid reclosure onto a faulty cable or to avoid exceeding the breaker's specified number of operations.

1. Cancel any auto-reclose feature by setting the auto-reclose circuits to OFF, MANUAL or NON-AUTO and withdrawing fuses (255).
2. Insert the manual charging handle into its socket (243) at the front of the spring box assembly (244).
3. Depress the handle fully and hold it down firmly to contain the spring pressure.
4. Disengage the spring release catch (151).
5. Allow the handle to lift slowly under the pressure of the springs (155).
6. Hold off the full charge interlock catch (157).
7. Pull the claw-shaped mechanism main catch (114) forward (it is located behind the ON/OFF indicator (239)) to prevent the contacts' closing as the handle continues to rise.
8. Remove the manual charging handle when the springs (155) are fully discharged.
9. Isolate the OCB and remove it from the switchboard.

NOTE Care should be taken to ensure that the spring energy is kept firmly

Hand Charged and Motor Charged Spring OCBs - Contact and Dashpot Setting after Major Overhaul

1. Insert the screw jack (266) and slow close the OCB fully as described elsewhere.
2. Insert the manual charging handle into its socket (243) at the front of the spring box assembly (244).
3. Depress the charging handle slightly so that the main catch (114) snaps backwards and upwards to engage the catch pin (121).
4. Remove the charging handle.
5. Hold down the trip bar (116) and wind the screw jack (266) back a few turns until it is no longer under compression.
6. Replace the charging handle and again depress it slightly to ensure that the hold in catch (178) engages the bottom of the drive lever (265).
7. Check the OCB contact engagement. The vertical dimension from the shoulder of the contact block (132A) to the upper edge of the arc trap side contact plate (137B) should be 40 mm $\pm$ 1.5 mm (1.9/16 in $\pm$ 1/16 in), with the OCB closed.
8. If the setting is incorrect, estimate the adjustment required (noting that one turn of the lower lift plate locknuts (272) is equal to approximately 3 mm (1/8 in) travel) and wind the screw jack (266) fully tight again.

   Pull the main catch (114) forward (with a screwdriver blade or similar tool) to disengage it from the catch pin (121).

   Hold down the trip bar (116) and unscrew the jack (266) fully to open the OCB. Adjust lower lift plate locknuts (272) and repeat operations '1' to '7'.
9. When the setting is correct, wind the screw jack fully tight and again check the vertical dimension (132A-137B). It should be 3 mm (1/8 in) less than at '7' above. This corresponds to the amount of free travel between closing dashpot screw (274) and closing dashpot plunger (275).
10. If free-travel (274-275) is incorrect, hold down the trip bar and wind the breaker open again, remove closing dashpot screw (274), add or remove washers as necessary to obtain the correct clearance and replace closing dashpot screw (274). Wind the OCB closed again and re-check (274-275) as at '9' above.
11. With free-travel (274-275) correct, hold down the trip bar and wind the breaker fully open again. Adjust and lock the upper lift plate locknuts (276) to give 3 mm (1/8 in) gap between the bottom nuts and their washers. Set opening dashpot plungers (277) to give 1.5 mm (1/16 in) free travel to the opening dashpots (278). This measurement can be achieved by tilting each side of the lift plate assembly (270) and adjusting each plunger (277) until its dashpot moves 1.5 mm (1/16 in) downwards. Raise the assembly slightly and tighten the plunger (277) grub screws to lock off. Lock off lower lift plate locknuts (272).

Solenoid Operating Mechanism

Solenoid operating mechanisms can be supplied for use with all Yorkshire Switchgear OCB units, and can be arranged to operate on DC (250 V max), or rectified AC (500 V max). The actual circuit details vary from installation to installation, and the appropriate wiring diagrams are supplied with each contract.

The upper part of the solenoid mechanism (i.e. the closing mechanism) is as standard, the side links (158) being actuated by the moving core (175) of the electro-magnet.

Hold-in catches (178) at the sides of the mechanism hold the drive levers (265) in the closed position and allow the coil (176) of the electro-magnet to be de-energised at the end of the closing stroke. These hold-in catches (178) are knocked out of engagement by an extension on the left hand main side lever (112) when the OCB is tripped, allowing the drive levers (265) and moving core (175) to reset automatically under the influence of the reset springs (173).

The electro-magnet (176) is wound with heavy gauge wire, taped with cotton tape and varnish impregnated. It is then PVC taped overall. Coil designs vary with unit frame sizes and OCB current ratings. Every coil is stencilled with an identifying reference number which should be quoted whenever information, spares or replacements are required, e.g.

1. Closing coil for 400 A, Serial No. 13/5000,
   Ref. 1250T/14G.

Operation of Solenoid OCB

Variations in control schemes mean that this section can only be couched in general terms. Exact instructions for specific installations will normally be supplied with the General Arrangement and Wiring Diagrams. For further information, consult the British Electricity Boards' ACE Report No.11 (1966), "Report on Standardisation of Auto-Reclosing Facilities on Ground-Mounted Metalclad Distribution Switchgear".

Generally, a single TRIP/CLOSE switch, possibly duplicated at a remote location, will control the OCB's operation.

A LOCAL/REMOTE selector switch will determine which control position has priority. Removal of the tripping fuses (255) (on the OCB front panel or in the relay cabinet) will prevent tripping by any means other than the mechanical operation of the trip bar (116).

Solenoid OCB - Contact and Dashpot Setting after Major Overhaul

1. Insert the screw jack (266) and slow close the OCB fully as previously described.

2. Wind the screw jack (266) back a few turns. The hold in (178) catch will prevent the contacts' opening, but the arc traps will "settle" slightly. The slow close jack (266) will no longer be under compression.

3. Check the OCB contact engagement. The vertical dimension from the shoulder of the contact block (132A) to the upper edge of the arc trap side contact plate (137B) should be 40 mm $\pm$ 1.5 mm (1.9/16 in $\pm$ 1/16 in), with the OCB closed.

4. If the setting is incorrect, estimate the travel adjustment required and wind the screw jack fully tight again. Hold off the hold in (178) catch and unscrew the screw jack (266) for about 12 mm (1/2 in). Release the catch (178) and slow open the OCB the rest of the way. Adjust lower lift plate locknuts (272) noting that three turns approximate to 3 mm (1/8 in) of travel adjustment.

   Repeat operations '1' to '3'.

5. When the setting is correct, wind the screw jack fully tight and again check the vertical dimension (132A-137B). It should be 3 mm (1/8 in) less than at '3' above. This corresponds to the amount of free travel between closing dashpot screw (274) and closing dashpot plunger (275).

6. If free-travel (274-275) is incorrect, hold off the hold in catch (178), unscrew the jack (266) for about 12 mm (1/2 in), release the hold in catch (178) and fully slow open the OCB. Remove closing dashpot screw (274), add or remove washers as necessary to obtain the correct clearance and replace (274). Wind the OCB closed again and re-check (274-275) as at '5' above.

7. With free-travel (274-275) correct, unscrew the jack (266) until it is no longer under compression and the mechanism is held by the hold in catch (178). Scribe a line on the side of the moving core (175), level with the top surface of the solenoid yoke (174).

   Tighten up the screw jack (266), hold off the hold in catch (178) and unscrew the jack (266) for about 12 mm (1/2 in). Release the hold in catch (178) and pull the main catch (114) forward as far as it will go, using a screwdriver blade to prise it loose if necessary. Hold main catch (114) forward and push toggle links (113) down.

   Hold the links (113) down and pull forward the inner head (180) as far as it will go, i.e. until the moving core (175) of the solenoid is resting on the fixed core (177). Scribe another line on the moving core (175), level with the top surface of the yoke (174). Release the inner head (180). The distance between the two scribed lines should be equal to free travel (274-275) or up to 1.5 mm (1/16 in) greater than it.

8. Whether this is the case or not, wind the jack (266) tight again, hold off the hold in catch (178), unscrew the jack (266) for about 12 mm (1/2 in), release the catch (178) and slow open the OCB.

9. If the distance between the scribed lines was less than (274-275) or more than 1.5 mm (1/16 in) in excess of it, remove the trip coil supporting plate (264). This will give access to two socket headed screws (172) on top of the moving core assembly. Slacken off the screws (172) and add or remove 1.5 mm (1/16 in) shims to the top of the moving core (175) to gain the necessary adjustment.

   Repeat operations '7', '8' and '9' as necessary until the setting is correct.

10. With moving core travel adjusted, hold off the hold in catch (178), unscrew the jack (266) for about 12 mm (1/2), release the catch (178) and fully open the OCB. Adjust and lock the upper lift plate locknuts (276) to give 3 mm (1/8 in) gap between the bottom nuts (276) and their washers.

    Set opening dashpot plungers (277) to give 1.5 mm (1/16 in) free travel to the opening dashpots (278). This measurement can be achieved by tilting each side of the lift plate assembly (270) and adjusting each plunger (277) until its dashpot (278) moves 1.5 mm (1/16 in) downwards. Raise the assembly slightly and tighten the plunger (277) grub screws to lock off. Lock off lower lift plate locknuts (272).

Maintenance Slow Closing & Slow Opening of Power-Operated OCBs

(Hand Charged Spring, Motor Charged Spring and Solenoid Operating Mechanisms).

These mechanisms are equipped for slow closing and slow opening by means of a screw jack (266). This acts directly on the tie bar (267) between the main side levers (112). When the jack (266) is in position, the OCB cannot be inadvertently operated - this ensures the safety of those working on the mechanism.

The slow closing and slow opening procedures must NEVER be used when the OCB is plugged into the fixed portion.

For this reason slow closing jacks (266) should not be generally available to operating staff, but should be kept under the control of an Authorised Person and issued only for specific maintenance work.

To Slow-Close and Slow-Open a Power Operated IVIO Circuit Breaker

With closing springs (where fitted) discharged, control circuit fuses removed, OCB elevated with tank off in the maintenance position & main cover set back on intermediate stop:

1. Remove the isolating handle (109) and ensure that the isolation interlock (222) drops back to the service position and frees the operating mechanism.

2. Move the hinged ON/OFF indicator (239) to the side and screw the screw jack (266) through the hole in the tie bar (267) between the mechanism main side levers (112). Locate the end of the jack in the register cavity (268) behind the tie bar (267).

3. Screw the jack (266) clockwise to close the moving contacts (133, 137) to the required position.

4. To slow open the breaker, hold down the trip bar (116) to prevent the operation of the reverse motion trip (261, 262) and screw the jack (266) anti-clockwise until it can be removed. A solenoid OCB which was previously fully slow closed will require to have the hold in catch (178) released before it can be opened again.

To Slow Close and Slow Open a Power Operated IVIF OCB

With closing springs (where fitted) discharged, control circuit fuses removed, OCB elevated with tank (100) off for maintenance and both operation access door (128) and hinged instrument plate (269) open:

1. Remove the isolating handle (109) and ensure that the isolation interlock (222) drops back to the service position and frees the operating mechanism.

2. Insert the screw jack (266) over the top of the ON/OFF indicator (239) and screw the jack (266) through the tie bar (267) hole between the main side levers (112). Locate the jack end in the register cavity (268) behind the tie bar (267).

3. Screw the jack (266) clockwise to close the moving contacts (133, 137) to the required position.

4. To slow open the breaker, hold down the trip bar (116) to prevent the operation of the reverse motion trip (261, 262) and screw the jack (266) anti-clockwise until it can be removed. A solenoid OCB which was previously fully slow closed will require to have the hold in catch (178) released before it can be opened again.

OCB Cable Box and Busbar Earthing by Portable Device (141)

A portable earthing equipment (141) which can be used to earth either cable or busbars through a circuit breaker ensures the safety of the operator, since the OCB is capable of making the full short circuit current without stress if a circuit is accidentally earthed when alive.

The earthing device for use with IVI OCBs is a simple feature embodying the earthing arrangement and the requisite plug extensions (142) as a single component. The only fixing required is by thumb screws (143) on to the OCB guide rods.

The fixed portion safety shutters are independently operated, one set by each of the two guide rods (36) on the OCB. Since the earthing device has only one guide rod extension (144), the position of this determines which shutter is opened. Thus only the contacts to be earthed (3), either cable or busbar, are uncovered. The correct guide rod positions for the respective operations are indicated on the underside of the earthing device (141) and the rod (144) should be fitted accordingly before the device is mounted on the OCB.

1. Isolate the OCB and lock the fixed portion safety shutters (5).

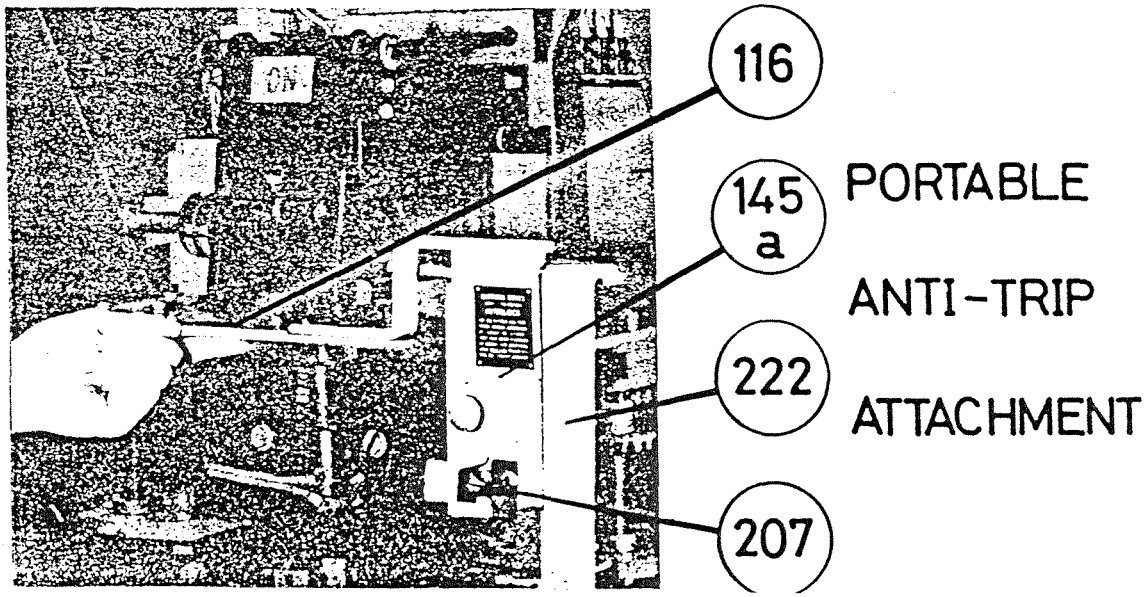
2. Elevate the OCB to maximum height and fix the earthing device onto the OCB isolating contacts (103). Check that the OCB guide rods (36) are visible through the slots in the bottoms of the thumb screw sockets and tighten the thumb screws (143).

3. To prevent the OCB's tripping, secure the anti-trip attachment (145a) to the trip bar (116) and isolation interlock (222).

4. Remove the shutter lock on the side to be earthed and, after a precautionary check to ensure that the feeder or busbar is DEAD, lower the OCB and earthing device (141) into the EARTHING position. The baseplate (146) of the earthing device should seat firmly on the rim of the fixed portion (147).

5. Close the OCB to apply the earth.

6. Close and lock the OCB operation access door (128).



Guide to OCB Portable Earthing Devices

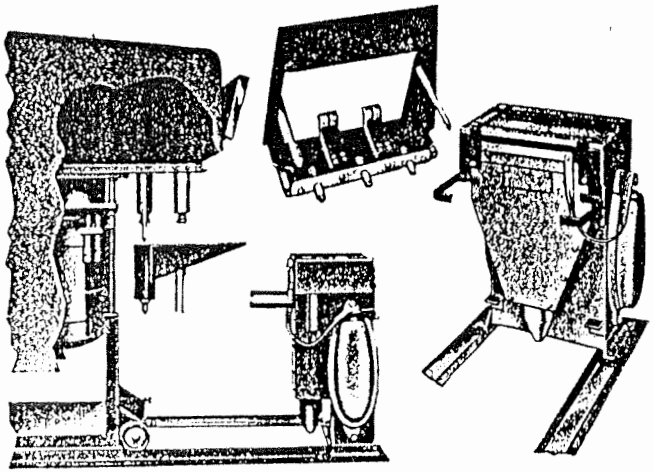
The IVI range of interchangeable switchgear has been continually extended and improved over a period of more than a quarter of a century. Inevitably therefore, it has been impossible to maintain one single design of earthing equipment for all duties. This brief guide will aid the selection of the appropriate device for any particular switchboard within the range up to 15kV rated voltage. For details of devices for higher voltages or for switchboards fitted with frame leakage protection, please contact our Leeds Office.

EARTHING DEVICE Mk.I was designed for application with fixed portion type 1 and OCB carriage types C1 and C2. It is only suitable for feeder earthing and the feeder shutter must be manually operated.

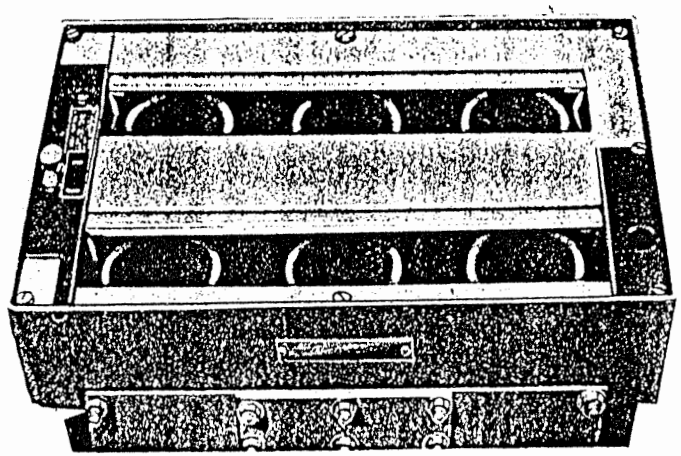
In addition to its designed application, it can also be used with any combination of the following fixed portions and OCB carriages:-

FP2 and FP3

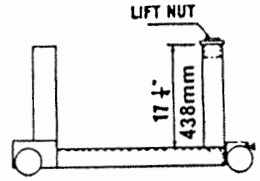
C1, C2, C3, C4, C5.

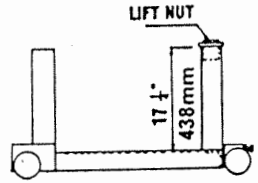


EARTHING DEVICE MK1



INTO FIXED PORTION FP1





ON OCB CARRIAGE C1 OR C2

EARTHING DEVICE Mk.II was designed for application with fixed portion type 2 and OCB carriage types C3 and C4. It is suitable for feeder or busbar earthing and the selected shutter must be manually operated.

In addition, it can also be used with any combination of the following fixed portions and OCB carriages:-

FEEDER EARTHING:

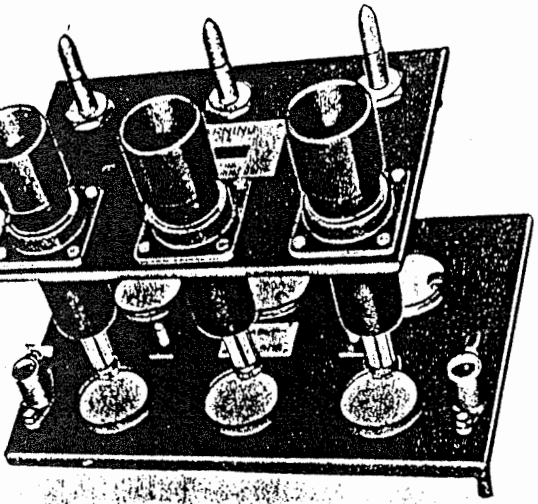
FP1, FP3, FP4.

C3, C4 and C5.

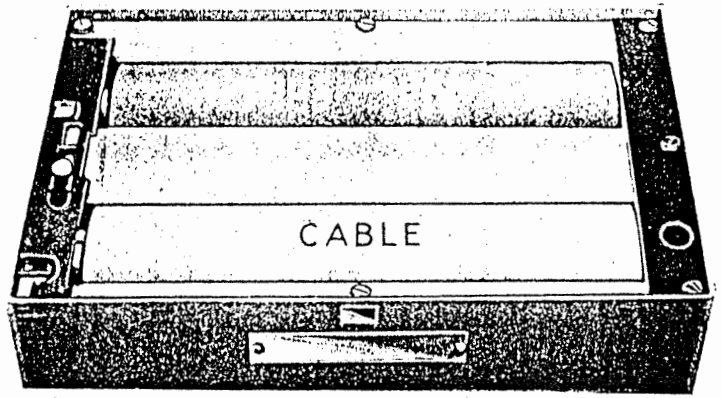
BUSBAR EARTHING:

FP2

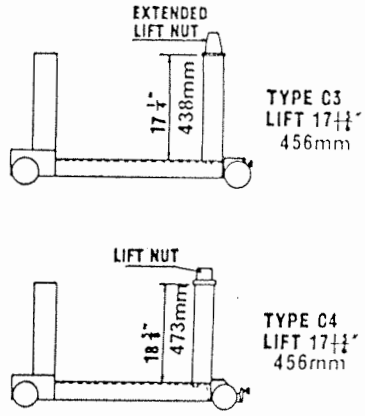
C5



EARTHING DEVICE MK2



INTO FIXED PORTION FP2

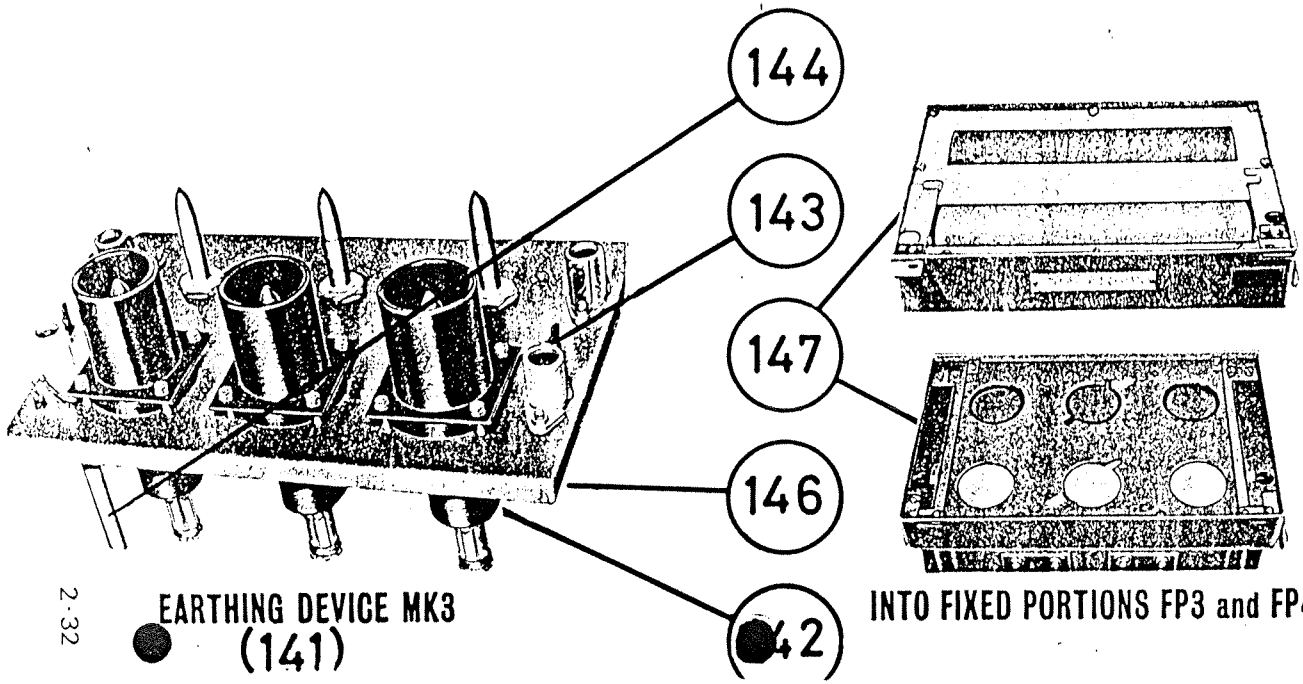


ON OCB CARRIAGE C3 OR C4

EARTHING DEVICE Mk.III was designed for application with fixed portion types 3 and 4, and OCB carriage type C5.

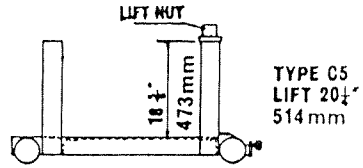
It is suitable for feeder or busbar earthing and the selected shutter is operated automatically.

This earthing device can only be used for its designed application.

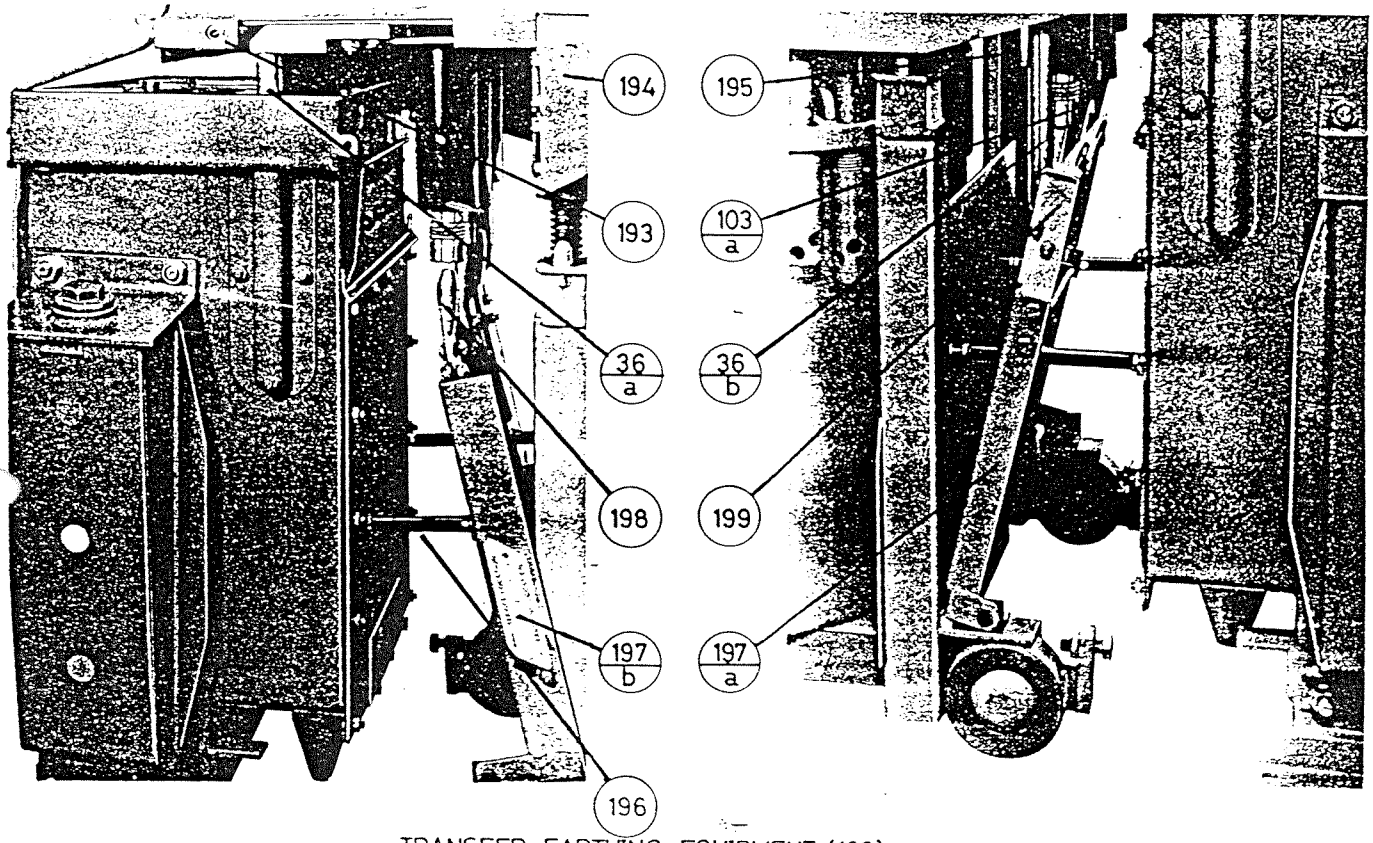


EARTHING DEVICE MK3 (141)

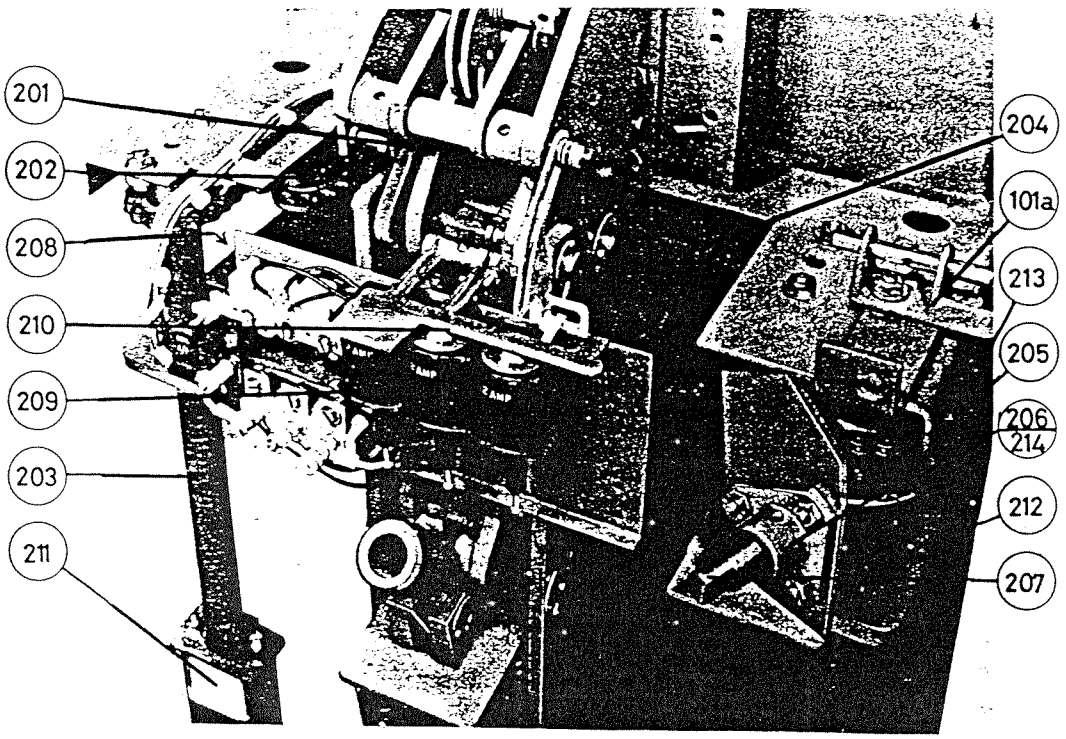
INTO FIXED PORTIONS FP3 and FP4



ON OCB CARRIAGE C5



TRANSFER EARTHING EQUIPMENT (192)
(skirt open for clarity)



OCB ELEVATING MECHANISM (200)

OCB Transfer Earthing of Cables

Circuit breakers can be supplied equipped for transfer earthing of the feeder cable only. The procedure for this operation is as follows:-

1. Elevate the OCB.

2. On an indoor OCB, twist the quick release fastener (193) securing the rear hinged portion of the left hand chain guard skirt (194) and open it. On an outdoor OCB, lift back the overall cover (101).

3. Reverse the left hand guide rod (36a). This turns an interlock bar (195) so that the OCB cannot be fully lowered until the next step has been completed.

4. Lower the earthing stops (196) on the transfer earthing plate (197a) at the rear of the tank. The circuit earthing indicator (197b) on the side of the transfer earthing plate (197a) should now point to EARTHING LOCATION.

5. Close the chain guard skirt (194) or lower the overall cover (101).

6. Check that the cable shutter locking slide (27a) is unlocked and the rain cover (13) removed from the fixed portion.

7. Push the OCB back over the fixed portion until it comes against a positive stop.

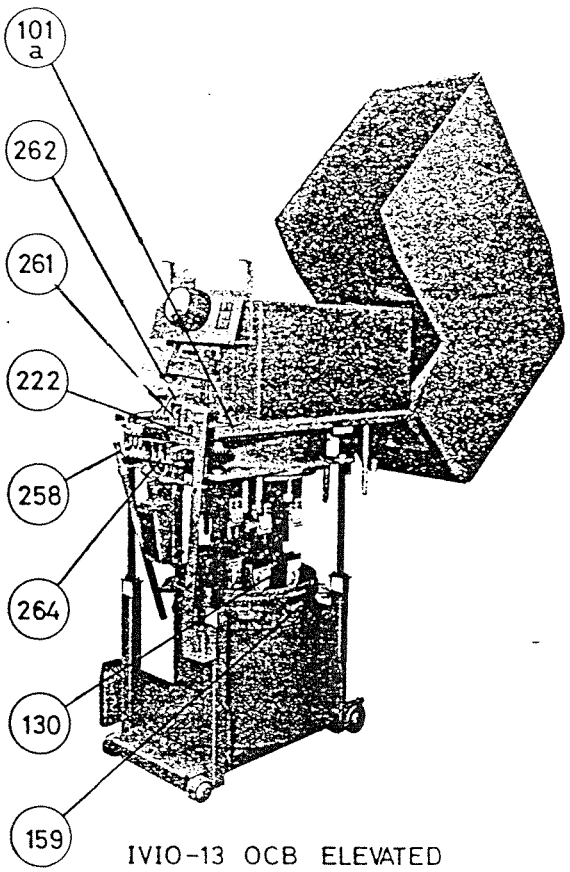
8. Fit the isolating handle (109) over the OCB isolating spigot (207) and wind anti-clockwise to lower the breaker into position. Note that the guide rod (36a) opens the cable box shutter (5a) before the rear isolating contacts (103b) reach it. Note also that the other isolating contacts (103a) mate with the transfer earthing device contacts (198) and that the right hand guide rod (36b) engages in the U-shaped contact (199) to complete the earthing circuit.

9. Lift the hinged anti-trip device (145b) onto the trip bar (116).

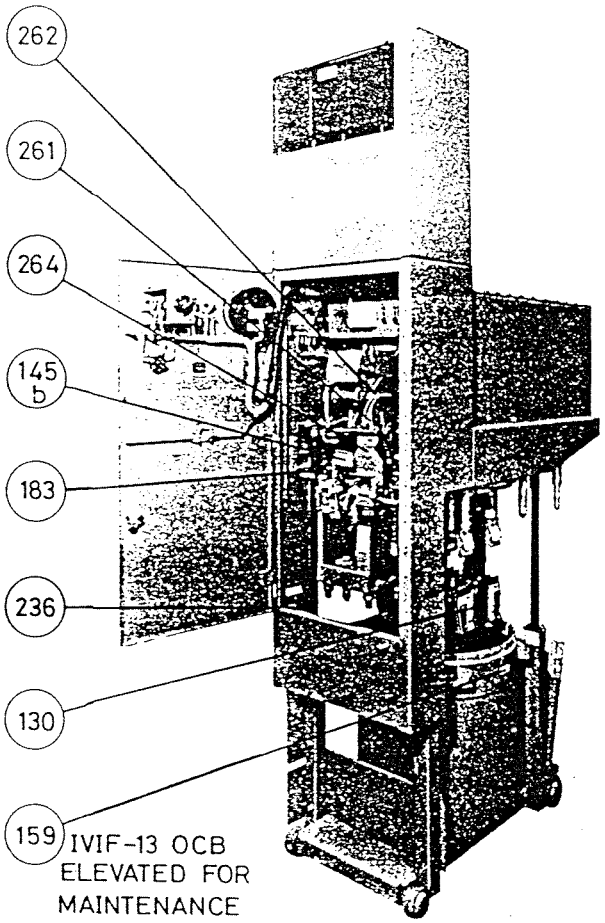
10. Close the OCB to EARTH the feeder.

11. Close and lock the OCB operation access door (128).

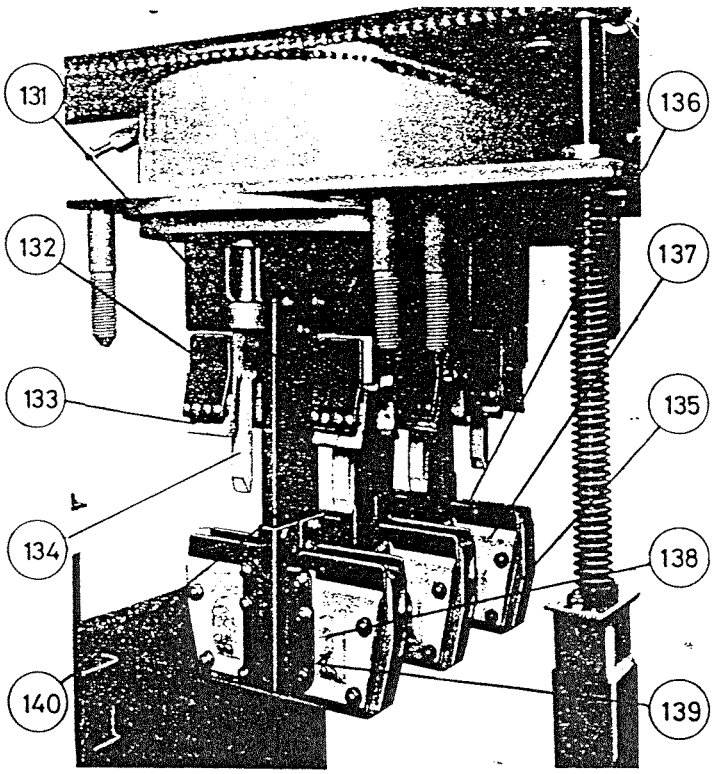
To remove the earth, unlock the door (128), remove the anti-trip device (145b) and trip the OCB. Elevate and isolate the breaker, return the left hand guide rod (36a) to its normal position and the earthing stops (196) to theirs.



IVIO-13 OCB ELEVATED FOR MAINTENANCE



IVIF-13 OCB ELEVATED FOR MAINTENANCE



CATON ARC TRAP SYSTEM (130)

Maintenance of Circuit Breakers

Never trip a circuit breaker or release the charging springs unless the tank is in position and filled to the correct level with oil. Neglect of this precaution can cause damage to the OCB bushings and contacts.

Except during the testing of operation and protective circuits, all control circuit fuses should be removed until maintenance is completed. This is to protect the maintenance team from injury due to accidental operation of the OCB.

Removal of OCB Tank for Maintenance

1. Isolate, withdraw and fully lower the OCB. In the case of an IVIO breaker, hinge back the overall cover (101) to the maintenance position.
2. Unscrew the eight tubular tank nuts (149) using a 12.5 mm (1/2 in) diameter tommy bar.
3. Move the isolation interlock (222) aside and insert the isolating handle (109).
4. Wind the OCB to maximum elevation.
5. Remove the tank (100) from the OCB carriage (129).
6. The OCB may now be slow closed and slow opened for contact inspection and measurement.

Arc Trap Design (130)

Three different concepts are combined in the Caton Arc Trap:

a) a unique design of arcing electrode and arc path;

b) A co-operative effort between two electrodes within a special enclosure;

c) an arc control feature which is isolated from the system after operation.

Mounted at the lower end of the OCB bushings (131) are the fixed contact blocks (132). These support the main contacts (133) which take the form of opposed sets of pivoted, spring loaded fingers.

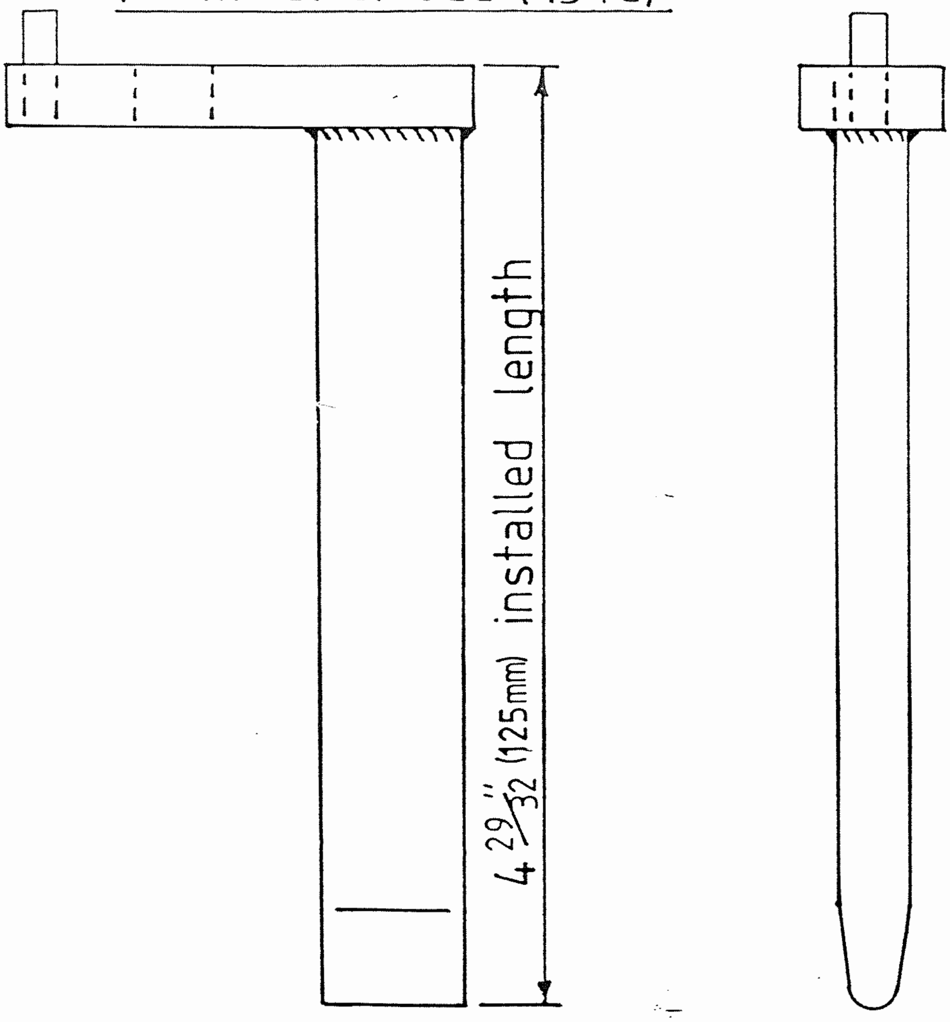
Between the main contacts are the renewable fixed arcing electrodes (134). Because they must engage the moving arcing contacts when the main contacts have separated, the fixed electrodes extend several inches beyond the main contacts.

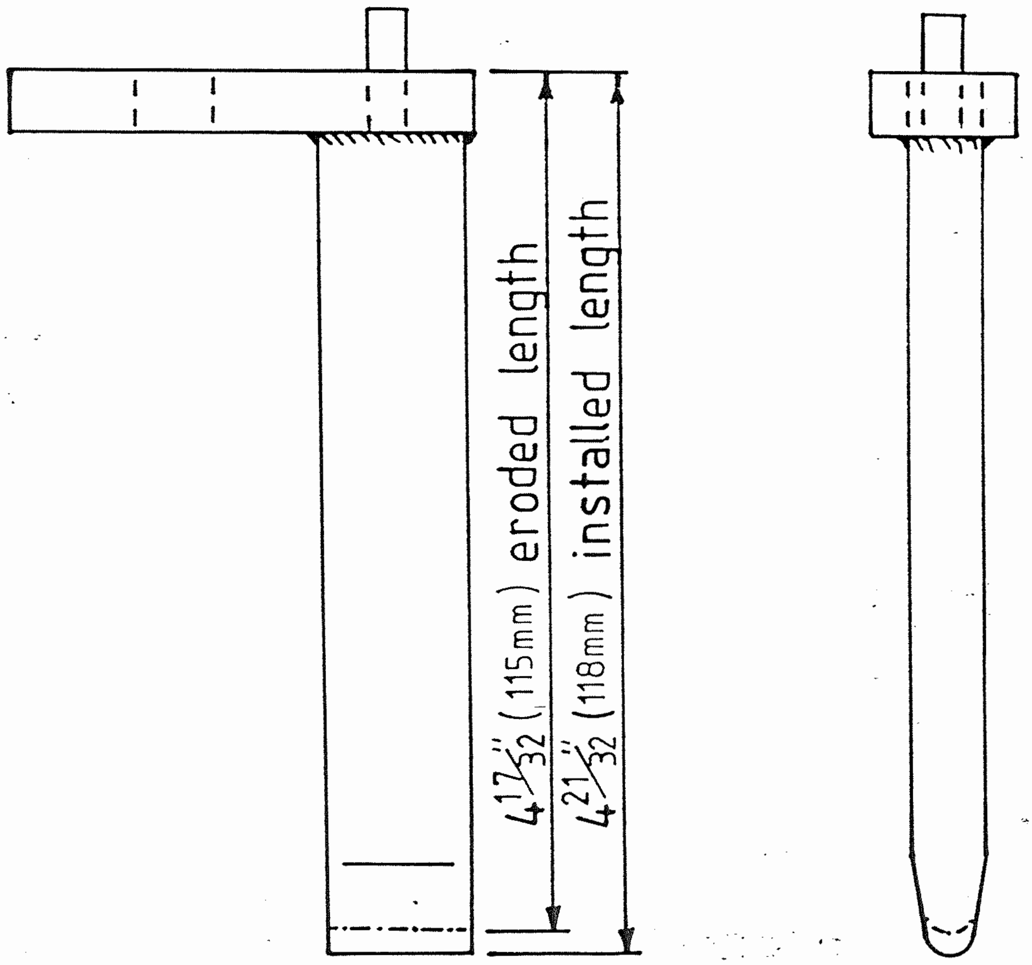
The Arc Trap itself is assembled from laminations of vulcanized fibre sheet (135). Bolt holes, the arcing chamber and the exhaust ports are drilled and routed in the sheets.

On either side of the laminated chamber assembly are outer plates of synthetic resin-bonded paper (136), the whole being clamped between formed copper contact plates (137) which constitute the main moving contacts. Within these plate contacts are housings (138) containing the spring-mounted moving arcing contacts (139).

This strong, elastic and reliable structure is mounted at the bottom of a substantial densified wood lift plate assembly (140).

Front electrode (134a)





Arc Trap Contact Maintenance

The design of the arc trap ensures that most, if not all of the burning caused by duty or short circuit operations will be confined to the fixed arcing electrodes (134). The three rear fixed arcing electrodes (134b) are 6.3 mm (1/4 in) shorter than the front ones (134a), and consequently they initiate the arcing and suffer most burning. Only after many normal load operations or several full value short circuit interruptions will replacement be necessary. We recommend that when the rear electrodes (134b) have been reduced to 115 mm (4.17/32 in) in length, as indicated on the drawing, both front (134a) and rear (134b) electrodes should be replaced, together with the moving arcing contacts (139) within the traps.

In very rare cases it may be necessary to replace fixed electrodes (134) due to excessive side burning.

Usually the fixed electrodes (134) will only require cleaning or trimming with a file during the course of routine maintenance.

The fixed arcing electrodes (134) are held in position by easily accessible set screws. Offset spigots ensure that the front (134a) and rear (134b) electrodes cannot be accidentally interchanged.

In order to maintain or replace the moving arcing contacts (139), it is necessary to remove the complete arc control devices (135 to 139) from the OCB. This operation is quite straightforward and merely involves the removal of the bolts securing the arc traps to the bottom of the lift plate (140). The arc traps (135 to 139) can then be removed individually as follows:

1. Place a piece of scrap wood between each contact block (132) and the arc trap fibre laminations (135).

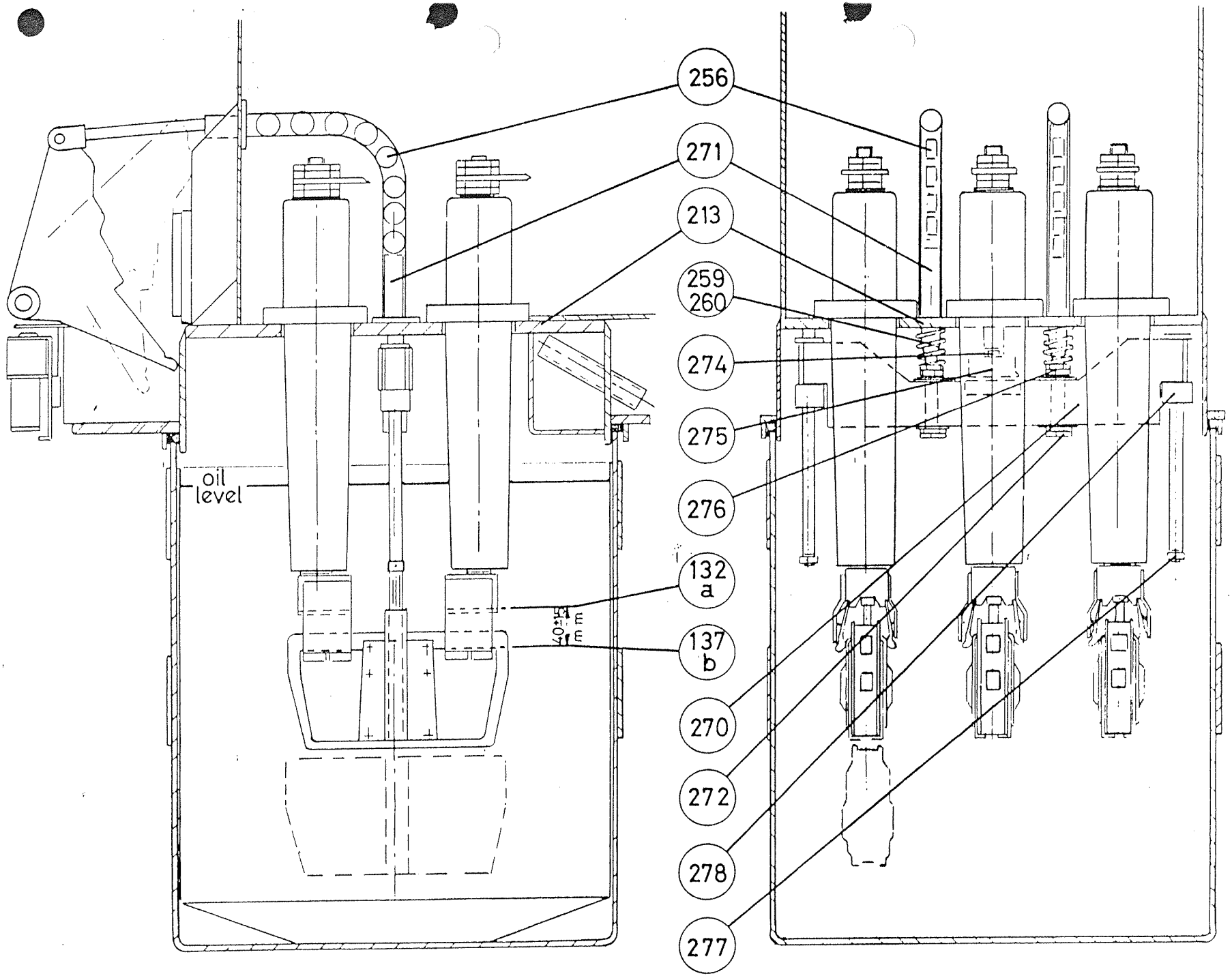
2. Arrange somehow to support the arc trap (135 to 139) to prevent its falling to the carriage floor.

3. Slow close the OCB as previously described to force off the arc trap (135 to 139).

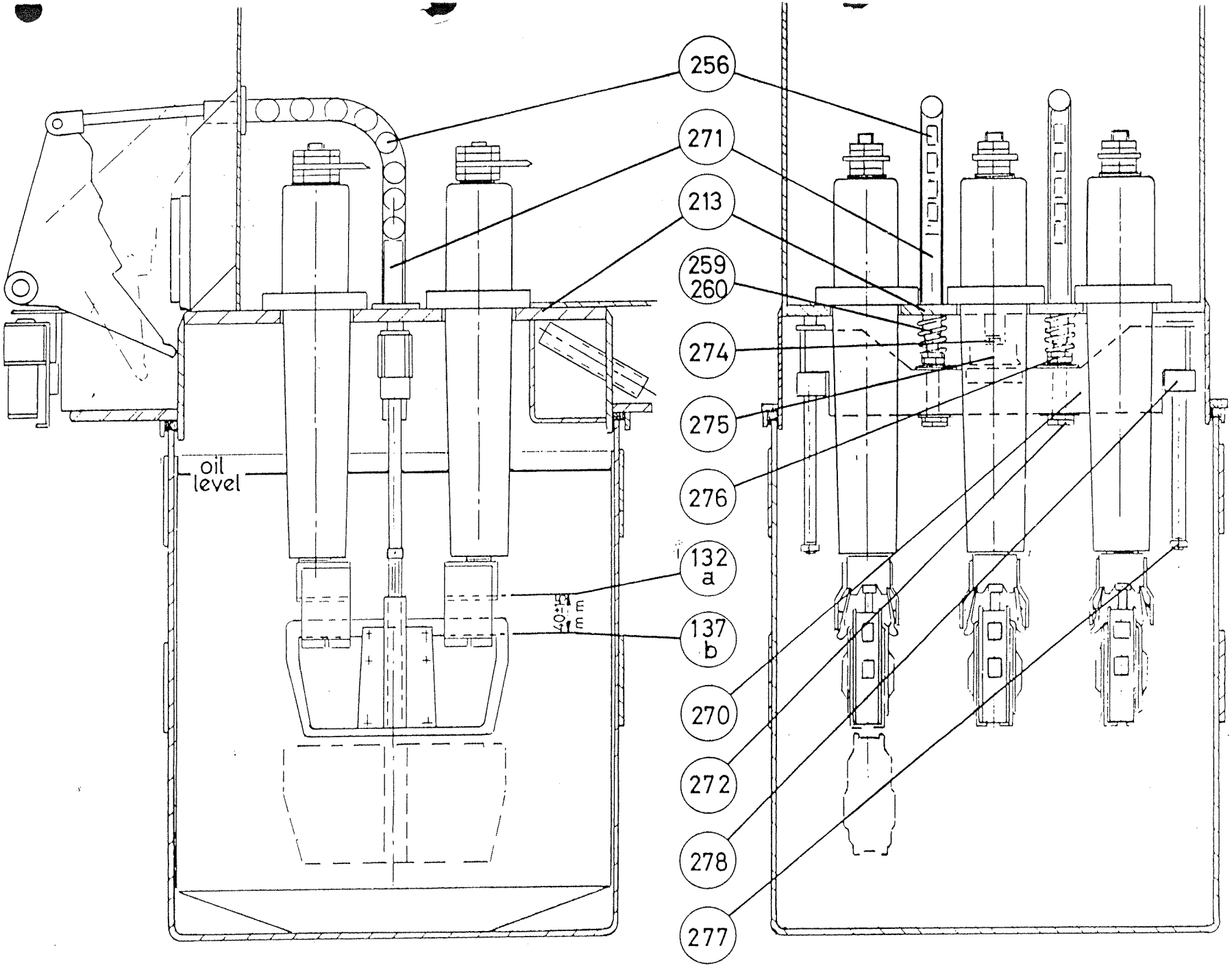
4. Remove the remaining bolts to allow the arc trap (135 to 139) to be completely dismantled. The moving arcing contacts (139) may then be trimmed or replaced and the faces of the arcing chamber (135, 136) can be cleaned.

5. When the arc trap (135 to 139) is re-assembled on the lift plate (140), it is essential that it be positioned correctly, since the fixed electrodes (134a and b) are of different lengths and the arcing chamber configuration takes account of this. To ensure that the arc trap (135 to 139) is correctly positioned, the fixing holes are offset.

The arc trap (135 to 139) is a push fit on the lift plate (140), and its replacement may require the judicious use of a hide mallet or soft wood block and hammer. Be sure to tighten all the securing nuts and bolts.



CONTACT AND DASHPOT SETTINGS



CONTACT AND DASHPOT SETTINGS

Contact and Dashpot Settings

If the complete lift plate (270, 140) or the roller chain (256) and rod (271) assembly have to be removed for any reason, the amount of contact engagement and the oil dashpot type stops should be re-checked and set on re-assembly in accordance with the dimensions given below. For greater clarity the cross sectional drawing showing rods, chain and dashpots is included to show the respective dimensional points.

With the arc trap and lift plate re-assembled and in the open or OFF position, adjust the lower lift plate locknuts (272) until the top edges of both ends of the black steel lift plate top straps (270) are the same distance below the tank top plate (213), approximately 190 mm (7.1/2 in). The contact and dashpot settings can then be adjusted as described in the relevant text.

SUMMARY OF SETTINGS	
CONTACT ENGAGEMENT Vertical dimensions from lower side edge of contact block (132A) to upper edge of ARC TRAP side plate (137B) with OCB closed	40 mm $\pm$ 1.5 mm (1.9/16 in $\pm$ 1/16 in)
OPENING DASHPOT (278) Free travel with OCB Open	1.5 mm (1/16 in).
CLOSING DASHPOT (275) Free travel with OCB Closed	3 mm (1/8 in).

The Open position of the contacts is not critical and is not separately adjustable.

OCB Oil Inspection

We recommend that the oil be inspected after the unit has operated on fault, and in any case every 12 months. Shorter periods between inspections are advised if the OCB is used for frequent on-load operation or for auto-reclose operation.

Colour alone is not a reliable guide to the condition of the oil. It is recommended that the electric strength test specified in B.S.148: 1959, Appendix "F" be applied to a sample drawn from the bottom on the tank. If the oil is changed (see "Circuit breakers: Preparation" for precautions to be adopted), wipe the inside of the tank (100) and all components which are normally under oil with a clean, dry, lint-free cloth.

For more detailed information on the maintenance of insulating oil, see B.S. Code of Practice CP.1009: 1959.

Whilst the tank (100) is off, check the OCB bushings (131) in the tank top plate (213) for damage. If damage is found, contact Yorkshire Switchgear to arrange for replacement.

Examine the tank linings for any signs of burning or delamination. If necessary, replace any damaged sections. Check vents for blockages.

Replacement of OCB Tank(100)

1. Check that the tank (100) is perfectly clean and dry and free from foreign bodies.

2. Replace the tank (100) in the OCB frame (129).

3. Fill the tank (100) with clean oil (see section "Oil Filling of Switchgear") and take a sample for testing.

4. Carry out a final check of the contact assembly (131 to 140).

5. Wind down the OCB, ensuring that the tank securing studs (181) pass through the holes in the tank lugs (182) without fouling. Hold off the lift screw interlock lever (208) to the right of the front left hand lift screw.

6. Replace and tighten up the tubular tank nuts (149) evenly.

OCB Adjustments

The operating and closing mechanisms will not normally require adjustment. However, after long service the following minor adjustments may prove necessary.

1. Trip Setting

Adjustment of the trip bar setting is carried out by movement of the small pivoted lever (122) at the front of the mechanism. The lever is held in position by two, 2BA nuts (118) which are locked together; to increase the trip setting, unlock the nuts and wind them a few flats clockwise and then re-lock them.

If any adjustment is made it is important to ensure that the setting is such that the mechanism is mechanically stable and also that consistent tripping is obtained at the normal current setting of the trip coil.

2. Toggle Setting

In the reset position the toggle links (113) are held just off the dead-centre position by an adjusting screw (117) which is accurately set during assembly and will only require a very slight adjustment after many hundreds of operations to compensate for any wear which might occur.

OCB General Lubrication

A thin film of oil is the best protection against corrosion for the operating and closing mechanisms. They should be liberally lubricated during every routine maintenance programme.

Work on the mechanism should be done with the OCB open. Liberal use of the oil is recommended after old dried lubricant is removed; the only precaution necessary is to prevent oil being deposited on the trip coil tappets (210), as the stickiness could affect the calibration.

Check that the mechanisms are free from foreign matter. Oil all bearings and sliding surfaces, particularly:

1. main catch bearing (125);

2. trip bar bearings (123); move trap bar (116) up and down whilst oiling its bearings;

3. trip hammer bearing (124);

4. the hold in catches (178) on all types of closing mechanism should also have their bearings oiled.

Where a bearing is inaccessible, oil should be allowed to run down the bearing member on to the bearing whilst the shaft is rotated, thus allowing the oil to work in.

After lubrication the OCB should be closed and tripped a number of times to assist the oil in reaching all parts.

Check the condition of the time limit fuses (258) and their contacts and clean or replace them as necessary.

The mechanisms of our OCBs are additionally sprayed with a rust preventative oil before leaving the factory.

In addition to the mechanism, the following moving parts should be lubricated with light mineral oil:

Auxiliary Switches (mechanism only: use petroleum jelly on contacts)
Isolation Interlock (222)
Lift Screw Interlock Lever (208)
Elevating Mechanism - bevel gears (205, 214), sprockets (202 etc.), chain (204), bearings.
Carriage Wheels (165).

The lift nuts (211) are of a self-lubricating synthetic material and require no attention.

Lubricating Oil Specification

Specific Gravity	0.893
Pour Point	- 15°F
Closed Flash Point	500°F
Viscosity Redwood	1400 at 70°F. 172 at 140°F.
Viscosity Index	96
Additives	2% MoS_2 + tackiness agent.

OCB Isolating Plugs and Contacts

Clean the isolating plugs (104) and contacts (103) as described under "Isolating Contact Maintenance". Smear a thin layer of petroleum jelly ("Vaseline") on the contact fingers (103).

OCB Elevating Mechanism

The elevating mechanism incorporates an adjustable jockey sprocket (202) situated adjacent to the left hand side of the OCB operating mechanism, and any slackness which develops in the chain drive should be taken up at this point using the chain adjusting screw (201).

The only components which may, in time, require to be renewed because of wear are the two bevel gears (205, 214). To remove the driven bevel (205), elevate the OCB, raise the cover (101) in the case of an outdoor OCB, remove the drive chain (204), knock out the taper pins securing the collar (212), driven bevel (205) and sprocket (205a) and screw the lift screw (203) into its housing (211) by approximately 76 mm (3 in). It will then be possible to remove the sprocket (205a) and replace the driven bevel (205). With the driven bevel (205) removed, access to the driver bevel (214) is possible. It can simply be pulled out of its bearing (206) from the rear.

After re-assembly ensure that the OCB top plate (213) is perfectly level when the unit is standing on level foundations. Make any adjustment required by removing the drive chain (204) and screwing the appropriate lift screw (203) up or down.

Completion of OCB Maintenance

Check the operation of ON/OFF indicators and all mechanical interlocks. Close and trip the circuit breaker, using the protective relay circuits where possible, and otherwise by the manual operation of the trip coil armature(s) to ensure that it is (they are) not stuck.

Give the complete unit a last visual inspection, lower the overall cover (101) in the case of an IVIO breaker, and return to service.

If possible, close and trip the breaker at least once in the service location.

SUPPLEMENTARY MAINTENANCE INFORMATION

Mal-Operation of Manually Charged & Motor Charged Spring Breakers

Occasionally, after being in service for some time, the operating mechanism of a manually charged or motor-charged spring OCB may not close the breaker when the springs are released. In this event, check the mechanism setting as described below BEFORE attempting further closures. Failure to do so may cause permanent damage to the mechanism, requiring the replacement of some components.

Whether the breaker is of the manually charged or motor charged type, charge the springs by hand as described under "To Close A Manually Charged Spring OCB". During the charging operation, note the following sequence of events.

1. Charging handle passes full charge interlock catch (157).
2. Main catch (114) engages on catch pin (121).
3. Spring hold-on catch (156) engages on charging crank pin (282) IMMEDIATELY AFTER "2".

If these events do not occur in this order, release the spring charge as described under "Discharging the OCB Springs" and adjust the main link adjuster screw (283) upwards or downwards until, by trial and error, the correct charging sequence described above is obtained.

The OCB can then be charged and closed in the normal way.

Another possible source of trouble is "bottoming" of the sidelinks (No.158 in figure 2.10). Test for this as follows:

1. Charge the springs as previously described.
2. Slow close the OCB as described on page 17.
3. Discharge the springs as described in "Discharging the OCB Springs".
4. Check that the side links (158) are not resting on the springs top plate - it should be possible to move the side links slightly to and fro. If they cannot be so moved, they are probably catching on the springs top plate.
5. If the sidelinks are catching, slow open the mechanism, remove the sidelinks, file, grind or mill approximately 1/32 in. from the bottom of each, re-assemble the mechanism and test again as in 1 to 4 above.

APPENDIX

Contact Resistance and Closing & Opening Times

We do not recommend the measurement of opening and closing speeds or of total resistance as routine maintenance checks for a variety of reasons, notably the lack of suitable equipment for these tests in most maintenance teams' equipment. Due to the use of separate main and arcing contacts in the Caton Arc Trap arc control device, any contact erosion is confined to the arcing electrodes and has a negligible effect on overall closed contact resistance - a routine visual inspection is of far more use in determining contact erosion, which is almost invariably so slight as to warrant nothing more serious than trimming with a file.

For your guidance we quote the following figures as used during routine inspection in our works (these figures are applicable to HI-VE 12 and IVIF-13 units equipped with Spring or Spring Assisted Manual mechanisms).

Minimum closing speed:	8.3 ft/second
Minimum opening speed:	5.5 ft/second
Average opening time:	100 m.seconds from energising of trip coil to separation of arcing electrodes.
Maximum overall resistance:	500 $\mu\Omega$

IVI SPARES

3ph set Arc Trap Fixed Arcing Electrodes	/3ph set
3ph set Moving Arcing Contacts	/3ph set
3ph set Fixed Main Contacts	/3ph set
One complete Arc Trap Assembly in Oil Filled Tank	each
O.C.B. Bushing	each
O.C.B. Isolating Bushing	each
Fixed Portion receptacle bushing	each
Voltage Transformer Moving Isolating Bushing	each
Fixed Isolating Bushing	each
Primary Fuse	each

Preparation of IVIF OCB Voltage Transformer

When a horizontally isolated voltage transformer (215) is supplied for use with an IVIF type OCB, it is delivered with the VT tank empty.

1. Unpack the VT and check that the primary HV fuses (216) are in place in their receptacles inside the VT tank (three for 3-phase metering, two for single phase metering). Check also that the VT secondary fuseholders (217) each contain an HRC or re-wirable fuselink or a solid copper link. The secondary fuseholders are mounted above the VT secondary isolating contacts (229b) on the housing at the front of the VT tank.

2. Place the VT on its rails on top of the OCB CT chamber (108) with the VT isolating contacts (228b) towards the shutter (221) which covers the fixed VT receptacle insulators (230b) and contacts.

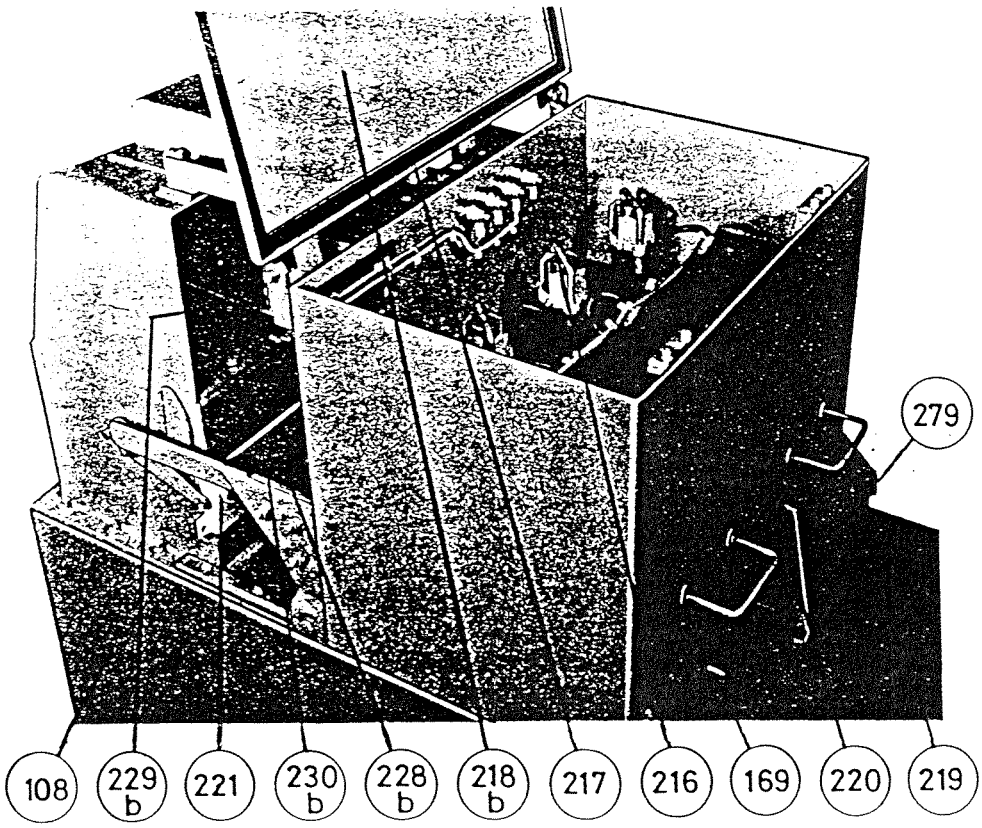
3. Unlock the VT shutter on the OCB and check that the male and female primary and secondary contacts are in alignment.

4. Fill the VT tank with approximately 36 litres (8 gallons) of switch oil (as used in the OCB tank), observing the precautions detailed under "Oil Filling of Switchgear".

5. Plug in the VT, noting that the shutter (221) opens as the VT is pushed into place, and closes as it is withdrawn.

6. Secure the OCB secondary interconnection flexible conduit (105) to the top of the VT with the saddle clamp supplied. Ensure that there is enough length to allow the VT to be withdrawn and opened, but not enough to interfere with its operation.

IVIF (horizontal) VOLTAGE TRANSFORMER (215)



To Plug-in an IVIF OCB Voltage Transformer (215)

1. Check that the oil, primary fuses (216) and secondary fuses (217) and link are in position in the VT. Fasten down the VT lid (218).

2. Check that the VT shutter (221) on the OCB is unlocked.

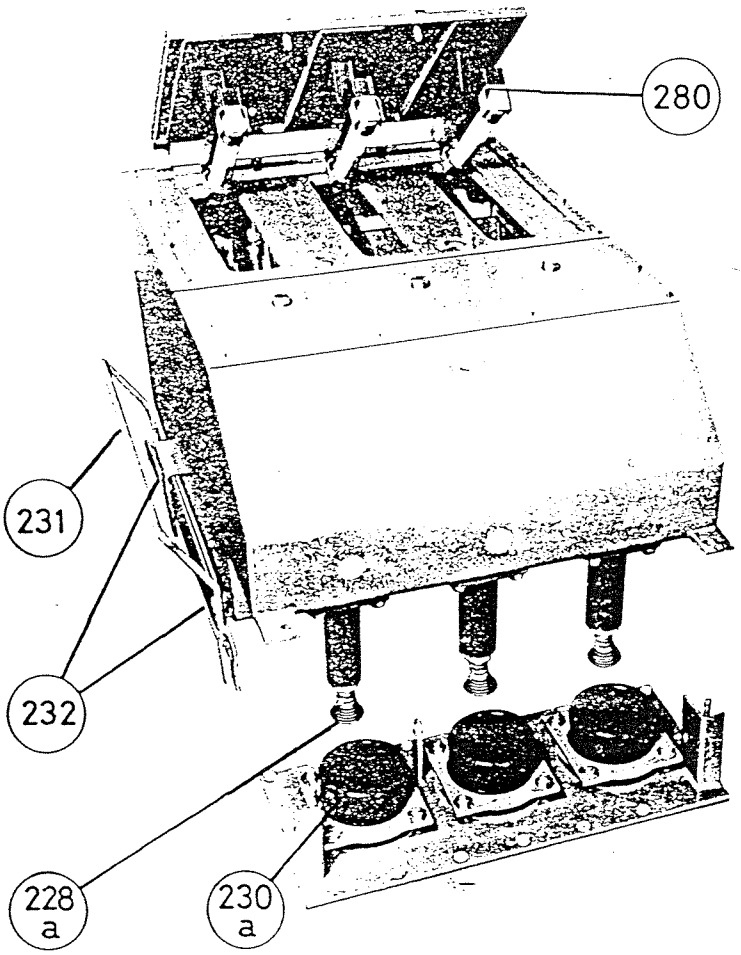
3. Hold the two handles (219) on the VT rear and push it firmly towards the OCB front, noting that the shutter (221) opens as the VT moving isolating contacts (228) approach it. The primary (228) and secondary (229) contacts will mate and the spring catch (220) at the rear of the VT tank will engage with the projection on the CT chamber top plate (108) to hold the VT in position.

To Isolate an IVIF OCB Voltage Transformer

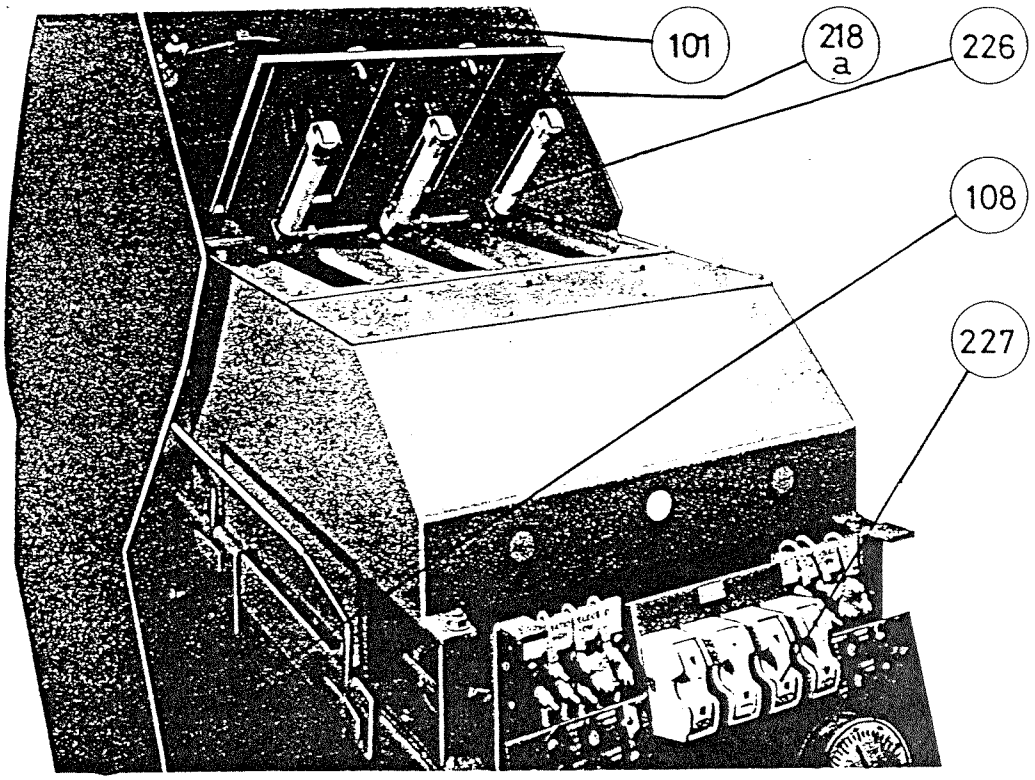
1. Release the spring catch (220) at the rear of the VT tank.

2. Hold the two handles (219) on the VT rear and pull the VT firmly back until the two rear stops (169) prevent further movement.

3. Check that the shutter (221) has closed over the fixed isolating contact receptacles (230). Padlock it shut for safety.



IVIO (vertical) VOLTAGE TRANSFORMER (225)



Preparation of IVIO OCB Voltage Transformer

When a vertically isolated voltage transformer (VT) is supplied for an IVIO type OCB, it may be delivered already fitted to the breaker or separately, according to the circumstances. In either case the VT will be empty and will require to be filled with oil.

1. Wind the OCB to maximum elevation, and swing back the main cover (101) as far as it will go. This will uncover the current transformer chamber (and the VT if it is already fitted).

2. If the VT is to be fitted wind the OCB down to the "Service" position (though with the breaker withdrawn from the switchboard). Locate the lifting handles supplied (231), one on either side of the VT, so that the tank locating lugs (232) are held between the main and wing plates of the handles. With one or more persons at each handle lift the VT and pass it back over the OCB mechanism.and above the current transformer chamber (108). Lower the VT so that its isolating contacts (228a) enter their receptacles (230a) in the current transformer chamber top plate. Take care to keep the VT level, to avoid damaging the insulators. Remove the lifting handles (231).

3. With the VT fitted, unscrew the VT cover securing nuts and lift the cover (218a) as far as it will go. The HV fuses (226) should be mounted in their spring contacts on "Permali" brackets on the underside of the cover.

4. Fill the VT tank with oil to the level shown on the outside of the tank. Observe the precautions detailed under "Oil Filling of Switchgear".

5. Replace the VT cover (218a) and screw down. Check the MV fuses (227) and secondary connections.

6. Replace the OCB main cover (101).

OCB-Mounted VT Maintenance and Fuse Renewal

Voltage Transformers normally require no maintenance other than lubrication of the wheels (279) and VT shutter (221) and a check for level and condition of the oil. This work should be undertaken when the OCB is withdrawn from the switchboard for routine maintenance.

Fuses (216, 217, 226, 227) will normally require renewal only when a fault has occurred in the metering circuitry or when a surge on the HV network has threatened the VT.

IVIF VT

1. To renew HV (216) or MV (217) fuses, isolate the VT as described under "To Isolate Horizontally Isolated OCB Voltage Transformer".

2. The VT tank cover (218b) can then be unscrewed and raised to give access to the HV fuses (216). These are vertically mounted adjacent to the incoming isolating contact (228) connections. A simple spring-loaded, inverted "U"-shaped bar holds each fuse (216) in position. The bar is readily pulled aside to allow the fuse (216) to be removed or replaced.

3. MV fuses (217) are easily accessible above the isolating contacts (229) on the front of the tank.

4. If you leave the VT isolated, lock the shutter (221) closed for safety.

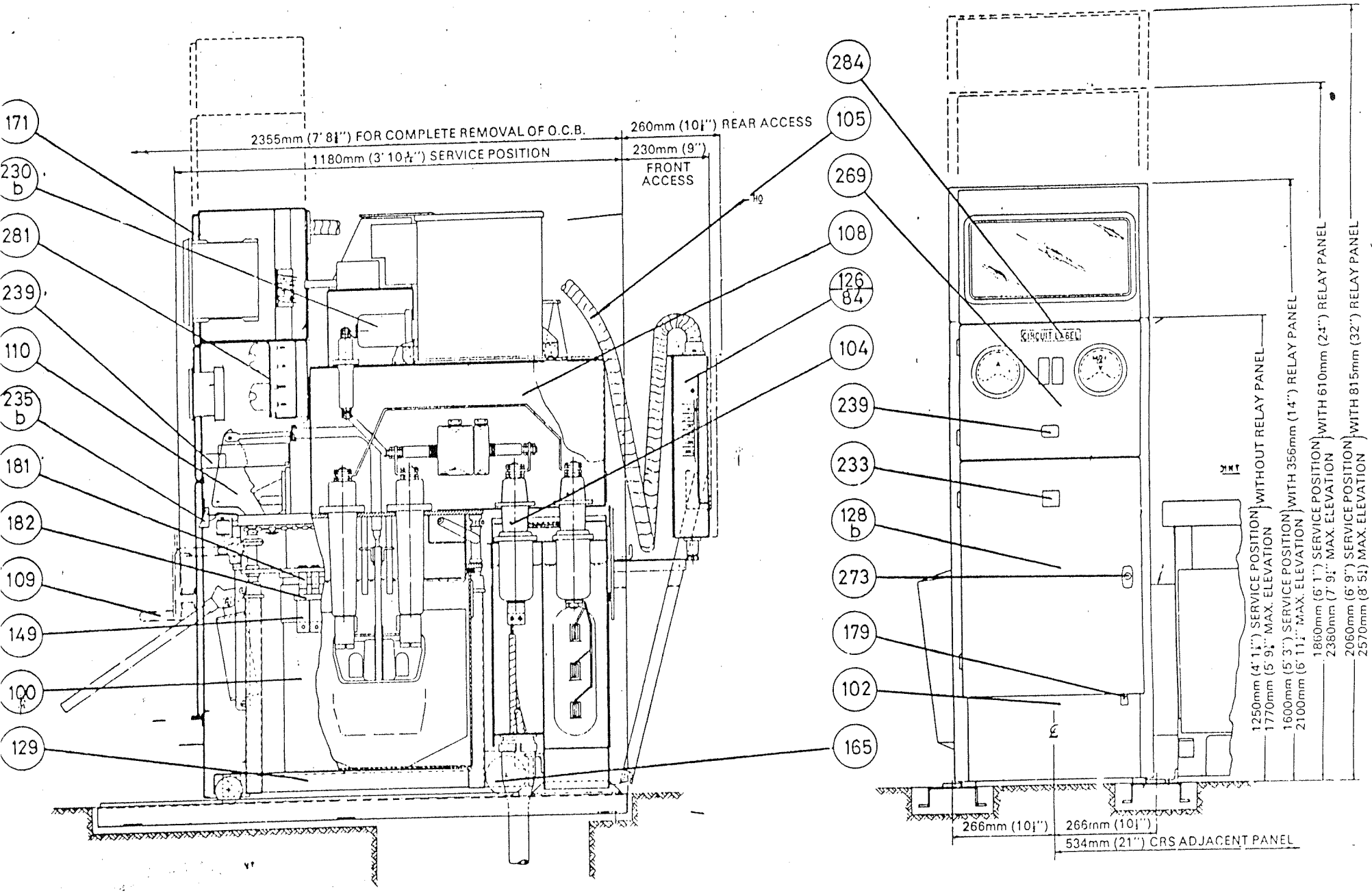
IVIO VT

1. To renew HV (226) or MV (227) fuses, isolate the OCB, wind it to maximum elevation and swing back the OCB main cover (101) as far as it will go.

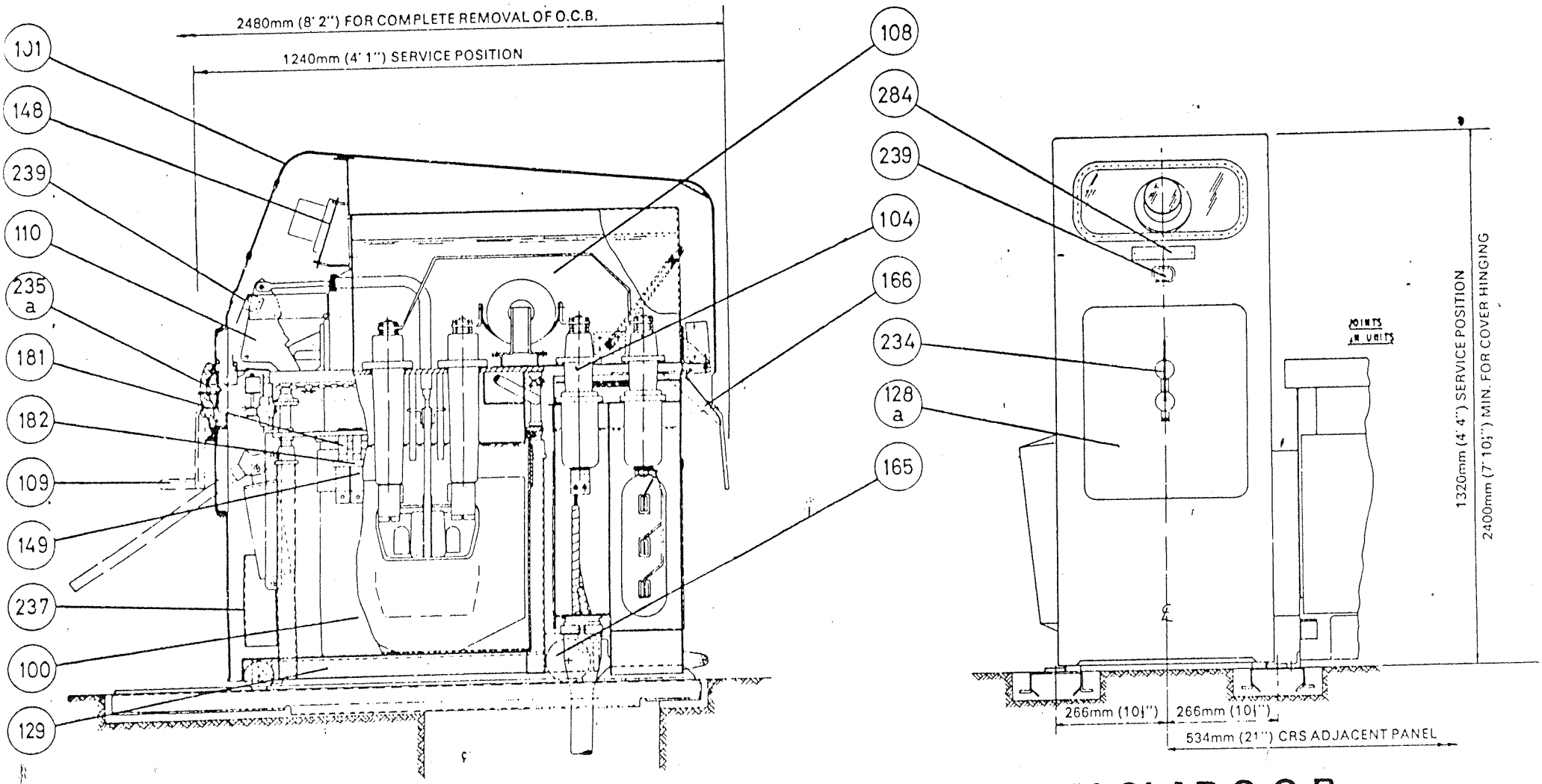
2. The VT cover (218a) can then be unscrewed and raised partially, to allow the oil to drip back into the interior, then fully to reveal the underside of the cover (218a). Replace the fuse(s) (226) and refasten the cover.

3. MV fuses (227) will be located either on the end of the VT tank remote from the HV isolating contacts, or on the OCB instrument plate at the front of the CT chamber (108).

4. Replace the OCB main cover (101).



GENERAL ARRANGEMENT OF IVIF-13 METALCLAD O.C.B.



GENERAL ARRANGEMENT OF IVIO-13 METALCLAD O.C.B.
(Equipped with S.A.M. mechanism)

(153) spring compression adjusting nuts
(154) mechanism reset springs
(155) closing springs
(156) spring hold-on catch
(157) full charge interlock catch
(158) side link
(159) oil tank label
(160) motor spring mecho
(161) drive wheel, (161a) drive wheel pin
(162) tie link
(163) automatic charging lever
(164) main link
(165) OCB carriage wheels
(166) plug protection guard
(167) charging motor
(168) spring release coil
(169) VT rear stops
(170) solenoid operating mechanism
(171) relay plate
(172) moving core adjustment (screws & packings)
(173) mechanism reset springs
(174) solenoid yoke
(175) solenoid moving core (inside coil)
(176) solenoid coil
(177) solenoid fixed core (inside coil)
(178) hold-in catch
(179) IVIF operation access door padlocking lug
(180) upper closing mechanism inner head
(181) OCB tank securing studs
(182) tank lugs
(183) tank interlock
(184) OCB setting screws on carriage
(185) spring assisted manual (SAM) operating mechanism
(186) SAM detachable closing handle
(187) SAM socket for closing handle
(188) SAM spring box cover
(189) SAM actuating springs
(190) SAM operating cam
(191) SAM upper spring plate
(192) transfer earthing equipment
(193) transfer earthing quick release fastener
(194) transfer earthing hinged portion of skirt
(195) transfer earthing pivoted interlock bar
(196) transfer earthing stops
(197a) transfer earthing plate, (197b) circuit earthing indicator
(198) transfer earthing device contacts
(199) transfer earthing "U" contact
(200) OCB elevating mechanism
(201) elevating mechanism chain adjusting screw
(202) elevating mechanism chain jockey sprocket
(203) elevating mechanism lift screw
(204) elevating mechanism drive chain
(205) elevating mechanism driven bevel gear, (205a) drive sprocket
(206) elevating mechanism driver bevel bearing
(207) isolating handle spigot
(208) lift screw interlock lever (at left of coil plate)

Key to Illustrations - OCB

(100) OCB oil tank
(101) IVIO breaker overall weatherproof cover (101a) cover safety catch
(102) IVIF breaker front cover
(103) moving main isolating contacts (103a) front cable contacts, (103b) rear busbar contacts
(104) moving main isolating contact insulators
(105) flexible conduit carrying secondary interconnections
(106)
(107)
(108) current transformer chamber
(109) detachable isolating handle
(110) upper closing mechanism
(111) lift rod
(112) main side lever
(113) toggle link
(114) main catch
(115) trip hammer
(116) trip bar
(117) toggle link adjusting screw
(118) trip bar setting adjuster
(119) trip bar roller
(120) trip hammer lever
(121) catch pin
(122) trip bar setting lever
(123) trip bar bearing
(124) trip hammer bearing
(125) main catch bearing
(126) rear wiring box
(127) relay cabinet
(128) operation access door (128a) on IVIO breaker (b) on IVIF breaker
(129) circuit breaker carriage
(130) Caton Arc Trap arc control device
(131) OCB bushings
(132) Arc Trap fixed contact blocks
(133) Arc Trap fixed main contacts
(134) Arc Trap fixed arcing electrodes
(135) Arc Trap vulcanized fibre laminations
(136) Arc Trap synthetic resin bonded paper outer plates
(137) Arc Trap moving main contact plates
(138) housings in Arc Trap moving main contact plates
(139) Arc Trap spring mounted moving arcing contacts
(140) Arc Trap densified wood lift plate
(141) portable earthing device
(142) portable earthing device plug extension
(143) portable earthing device thumb screw
(144) portable earthing device guide rod extension
(145) OCB anti-trip attachment (a) portable, (b) integral
(146) portable earthing device baseplate
(147) fixed portion shutter box rim
(148) IVIO instrument plate
(149) OCB tank nuts
(150) manually charged spring operating mechanism
(151) spring release catch
(152) lanyard release arm

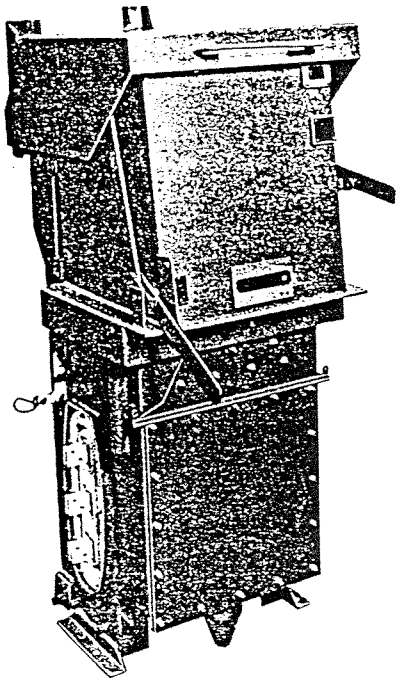
(209) trip coils
(210) trip coil tappets
(211) elevating mechanism lift nut
(212) elevating mechanism lift screw collar
(213) OCB top plate
(214) elevating mechanism driver bevel (behind 206)
(215) IVIF OCB horizontally isolated voltage transformer
(216) horizontal voltage transformer primary (HV) fuses
(217) horizontal voltage transformer secondary (MV) fuses
(218) voltage transformer hinged cover, (218a) vertical, (218b) horizontal
(219) horizontal voltage transformer handles
(220) horizontal voltage transformer spring catch
(221) horizontal voltage transformer automatic safety shutter
(222) OCB isolation interlock
(223)
(224)
(225) IVIO OCB vertically isolated voltage transformer
(226) vertical voltage transformer primary (HV) fuses
(227) vertical voltage transformer secondary (MV) fuses
(228) voltage transformer main isolating contacts, (228a) vertical, (228b) horizontal
(229) voltage transformer secondary isolating contacts, (229a) vertical, (229b) horizontal
(230) voltage transformer receptacle insulators, (230a) vertical, (230b) horizontal
(231) vertical voltage transformer lifting handles
(232) vertical voltage transformer locating lugs
(233) IVIF OCB label "FOR ACCESS TO TRIP BUTTON OPEN DOOR"
(234) IVIO OCB lockable operation access door handle and trip button cover
(235) mechanical trip button, (235a) IVIO OCB, (235b) IVIF OCB
(236) IVIF OCB elevation indicator pointer
(237) IVIO OCB elevation indicator angle
(238) SAM mechanism lower spring plate
(239) ON/OFF indication
(240) electrical trip button
(241)
(242)
(243) spring OCB manual charging handle socket
(244) spring OCB spring box assembly
(245) electrical CLOSE button
(246) Trip/Close switch
(247)
(248)
(249) spring position switch
(250) motor limit switch
(251) motor limit switch roller arm
(252) drive-wheel access hole/plate
(253) springs "OPERATIVE/NON-OPERATIVE" indicator
(254)
(255) control circuit and tripping fuses
(256) lift rod roller chain linkage
(257)
(258) time limit fuses
(259) OCB kick-off springs
(260) OCB accelerating springs
(261) side lever quadrant arm (anti-slow-close trip)

(262) nylon friction bush (anti-slow-close trip)
(263) SAM slow close release catch
(264) OCB coil plate
(265) drive levers
(266) slow closing screw jack
(267) tie bar
(268) register cavity for screw jack
(269) IVIF OCB hinged instrument plate
(270) black steel lift plate cross arm top straps
(271) roller chain rod
(272) lower lift plate locknuts
(273) IVIF operation access door handle
(274) closing dashpot screw
(275) closing dashpot plunger
(276) upper lift plate locknuts
(277) opening dashpot plungers at bottom of rods
(278) opening dashpots
(279) horizontal voltage transformer wheels
(280) vertical OCB voltage transformer HV fuse clips
(281) IVIF hinged fuse plate
(282) charging crank pin
(283) main link adjuster screw
(284) main circuit label

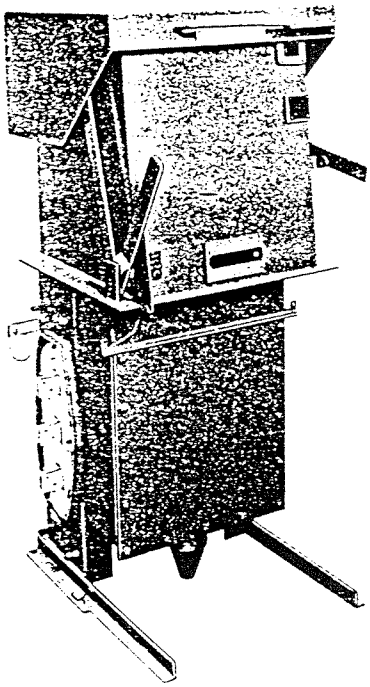
Section 4

OFS-10 AND OFS-14 METALCLAD
OIL FUSE SWITCHES

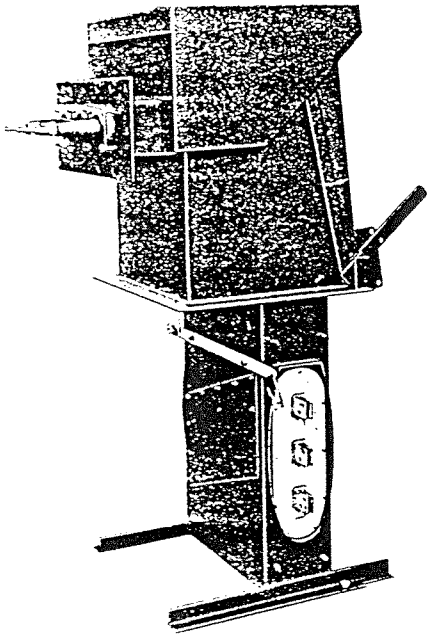
Contents



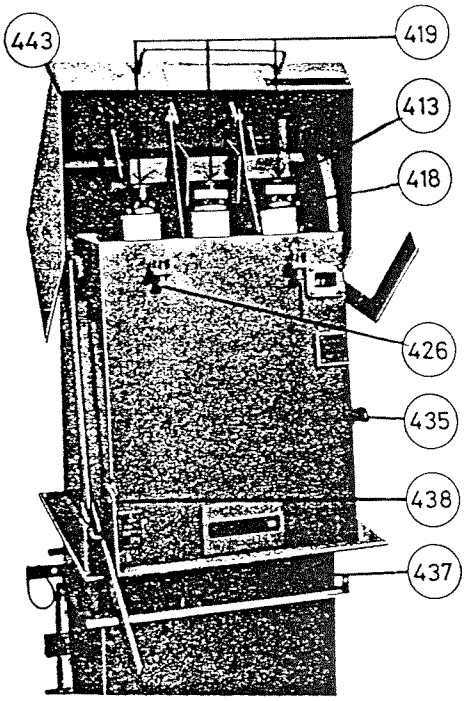
ISOLATABLE OFS-10 : SERVICE LOCATION



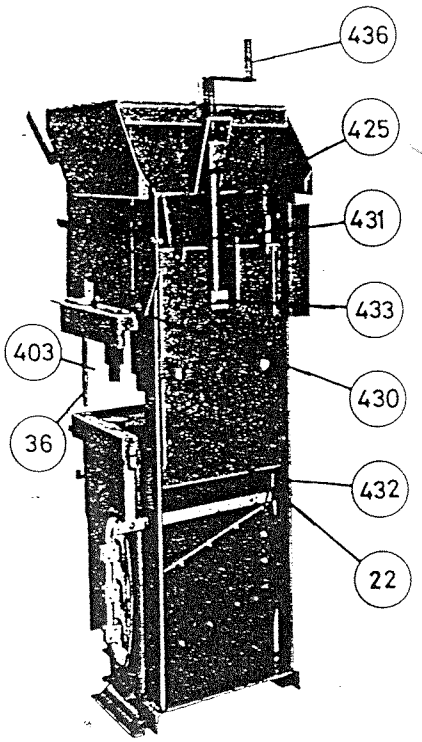
NON-ISOLATABLE OFS-10



OFS-14 WITH INTEGRAL BUSBARS & REAR FLANGE CONNECTION



FUSE REPLACEMENT



ISOLATED OFS-10

OFS-10 and OFS-14 Automatic Oil Fuse Switches.

Yorkshire Switchgear's OFS-10 and OFS-14 auotmatic oil fuse switches provide effective and economic methods of short-circuit protection for distribution transformers. Several versions have been or are being produced, notably the following.

(a) The isolatable OFS-10 is interchangeable with other switching devices (e.g. fault making oil switch, oil circuit breaker) of the same current rating which use the standard design of fixed portion. Its fuse carriage takes 254 mm (10 in) long by 63 mm (2.1/2 in) diameter fuses (400a).

(b) The non-isolatable OFS-10 (no longer available) was basically the same as the isolatable version, but had an integral compound filled busbar chamber (401) and front-access cable box (402) and cost slightly less.

(c) The non-isolatable OFS-14 with integral compound-filled busbar chamber (401) and front access cable box (402) can accommodate fuses of either 254 mm (10 in) or 359 mm (14.1/8 in) (400b) length, provided that the correct size contact cups are fitted.

(d) The non-isolatable OFS-14 with front access cable box (408) and rear HV flange connection (405) (BEBS-T1 plate C XII 'E') can be used to give direct cable box (408)-switch-cable box (407) or cable box (408) -switch-transformer connection. Again, either length of fuse (400a or 400b) can be accommodated.

(e) The non-isolatable OFS-14 with integral busbar chamber (406) and rear HV flange connection (405) (no longer available) allowed direct busbar-switch-transformer or busbar-switch-rear cable box (407) connection to be made. Again, either fuse length could be fitted.

In all types of OFS the main switch (410, 412), fuses (400) and earth switch (411, 423) are housed in a common steel, weatherproof, oil filled tank (409). Separate handles (410 & 411) give independent control of the two switches, which are mechanically interlocked to prevent incompatible switching operations.

Main Switch A load making, load breaking oil switch (410) in series with the HV fuse links (400) gives ON/OFF control of the circuit. It has an independent manual spring mechanism (412) to ensure consistently reliable operation irrespective of the operator's effort.

Provision of a trip-free mechanism (413) allows the switch to be tripped either manually or by the rupturing of any of the fuses (400b).

Positive ON/OFF indication is given through a weatherproof window aperture (414).

The main switch itself consists of three copper blades (415), pivoted on the busbar connections (416) or rear HV connections. In the ON position the blades engage spring contacts (417) in series with the fuses (400).

In accordance with the recommendations of ASTA Publication No. 22, the switch has been tested to make and break currents of five times the maximum rating of associated fuses, with the fuses temporarily replaced by solid links.

Fuses Oil immersed HRC fuses (400), to B.S.2692:1956, of standard 254 mm (10 in) or 359 mm (14.1/8 in) long by 63 mm (2.1/2 in) diameter barrel size are clip mounted on a sliding carriage (418). This performs the dual functions of providing easy access for fuse renewal and ensuring that the fuses are fully isolated before becoming accessible for replacement.

All fuses have striker pins (419) which trip the switch if any fuse blows.

Earth Switch A fault making oil switch (411) to B.S.2631:1955 controls the earthing of the outgoing circuit. Copper contact blocks (420) mounted on pivoted steel blades (421) engage spring loaded copper contacts (422). In the case of the isolatable OFS-10, these are mounted between, and connected to, the cable box moving isolating contact connections (422a). In the case of the non-isolatable OFS-10 and the non-isolatable OFS-14 with integral busbars and front cable box, they are mounted between and connected to the cable box droppers (422b). In the case of the OFS-14 with rear HV flange, they are connected to the rear flange connections (422c). N.B. In the case of the rear flange model, the earth switch only has a 5.4kA making capacity, and the flange connection must not be used for the incoming supply

As with the main switch, an independent manual spring mechanism (423) ensures reliable operation. Durable labels (424a & 424b) indicate the EARTH ON and EARTH OFF positions respectively.

Isolation Each isolatable OFS-10 is supplied complete with a hand-wound screw-jack type of isolating mechanism (425). This is mounted at the rear of the tank (409) and is interlocked (434) with the operating mechanism. As the fuse switch is lowered into the service location, guide rods (36) enter apertures (28) in the fixed portion shutter box top, aligning the switch, operating the safety shutters (5) and earthing the tank prior to the isolating contacts' (3 & 403) mating.

Isolating Contacts The 400A self-alighning isolating contacts (403) are protected and insulated by glazed porcelain bushings (404) on the switch and glazed porcelain receptacle insulators (4) on the fixed portion. Special units for 15kV service have cast epoxy resin insulators with integral stress screens.

OFS Interlocks & Padlocking

Positive interlocks incorporated in the fuse switch design ensure that:-

1. The MAIN (410) and EARTH (411) switches cannot be ON at the same time;

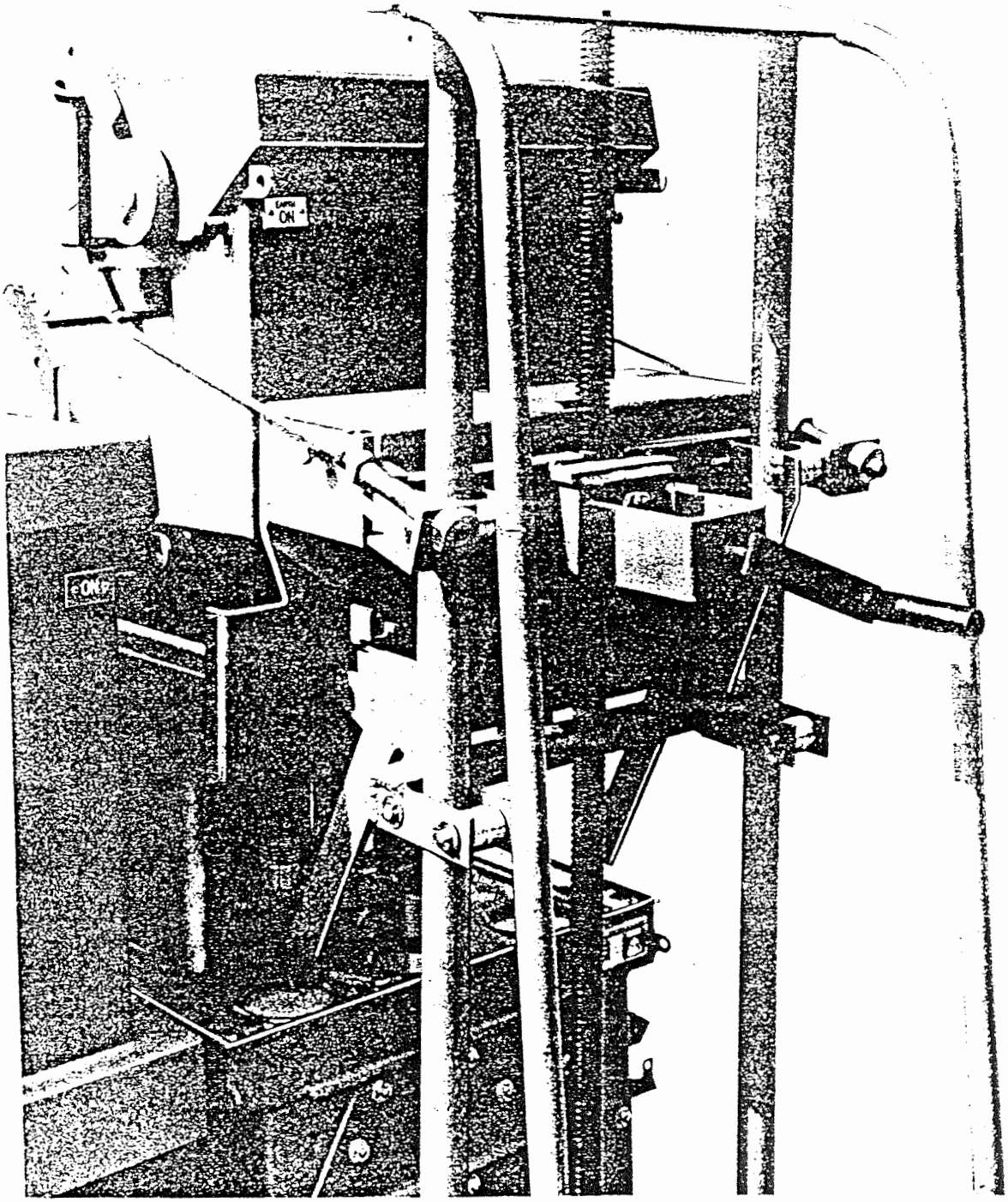
2. The isolatable OFS-10 cannot be plugged in or isolated unless the MAIN (410) switch is OFF & RESET and the EARTH (411) switch is OFF;

3. Access to the fuses (400) of an isolatable OFS-10 is possible only when the unit is fully isolated.

4. The cover (427) cannot be raised to isolate the fuses until the MAIN switch handle (410) is OFF & RESET.

Padlocking points allow the EARTH switch handle (411) to be locked in either EARTH or OFF position. The trip-free design of the MAIN switch (410) means that a single padlocking point (435) can be used to lock it in either the ON or the OFF position, but not in the RESET position.

An isolatable OFS-10 can be padlocked in the "Service" position. And, when an OFS-10 is isolated, the fixed portion automatic safety shutters (5) can be locked closed (27).



SWITCH HANDLING TRUCK
429 with OFS

Preparation of OFS-10 and OFS-14 Automatic Oil Fuse Switches

The preparation of both isolatable and non-isolatable versions is generally the same, the only difference being in the need to examine the isolating plugs (404) and the contacts (403) of the isolatable OFS-10 and mount it on its fixed frame (22).

1. Remove all packing materials and, with the operating handles (410 & 411) in the RESET and EARTH OFF positions, unfasten the cover retaining screws (426) and raise the cover (427) through approximately 50°. The fuse carriage (418), which is hinged to the underside of the cover (427), will rise with it. Check that the correct fuses (400) are in place. If not, put in fuses of the correct rating as described under "Changing the OFS Fuses".

2. Examine the mechanisms (412 & 423), bearings and contacts (415, 417, 420, 422) to check that nothing has been loosened or damaged in transit.

3. Wipe out the tank (409) with a clean, dry, lint free cloth. If necessary unfasten and remove the fuse carriage (418) during this operation, then replace it when you have finished.

   Fill the tank (409) to the marked level (428) with the switch oil (see "Oil Filling of Switchgear"). Pour oil over those parts of the mechanism which are above oil level.

4. Close and securely fasten the cover (427) and check the operation of the operating handles (410 & 411) and interlocks (434) in accordance with the "Operation" section of this manual. Leave the handles (410 & 411) set to RESET and EARTH OFF.

5. In the case of an isolatable OFS-10, raise it on its handling truck (429) or by some other means and push it back over the fixed portion. Lower the OFS so that its lower guide wheels (430) pass in front of, and its upper guide wheels (431) behind, the fixed frame guide rails (432) (the fixed frame (22) is mounted at the rear of the fixed portion).

6. When the OFS lift screw (425) rests on the fixed frame lift nut (433), remove the handling truck.

7. Check the operation of the isolation interlocks (434) (see "OFS Interlocks and Padlocking").

8. Clean the isolating plug insulators (404) and contacts (403) as described under "Isolating Contact Maintenance".

   Smear a thin layer of petroleum jelly ("Vaseline") on the contact fingers.

NOTE: Where a handling truck (429) is not available the filling of an isolatable OFS-10 is best left until the unit is in position on its fixed frame (22), but still isolated from the fixed portion.

To Plug-in an Isolatable OFS-10 Fuse Switch

(This section applies only to the isolatable OFS-10 and assumes that the unit has already been set on its fixed frame (22) as described under "Preparation of OFS-10 and OFS-14 Automatic Oil Fuse Switches").

1. Note that the OFS-10 is isolated and that the operating handles (410 & 411) are set to OFF & RESET and to EARTH OFF.

2. Remove the fixed portion rain cover (13) (if fitted) and unlock the shutter box locking slides (27, 28).

3. Fit the removable isolating handle (436) to the lift screw (425) at the rear of the OFS and wind it clockwise to lower the fuse switch.

4. Note that the guide rods (36) enter their apertures (28) in the locking slides (27) and open the shutters (15) before the moving isolating contacts (403) reach them. Keep winding until the fuse switch is fully home, then remove the isolating handle (436).

To Isolate an Isolatable OFS-10 Fuse Switch

1. Set the operating handles (410 & 411) to OFF & RESET and EARTH OFF.

2. Fit the removable isolating handle (436) to the lift screw (425) at the rear of the OFS and wind anti-clockwise to raise the fuse switch.

3. Note that the shutters (5) close as the guide rods (36) leave their apertures (28). Lock the shutter box locking slides (27) and lock the fixed portion rain cover (13) (if fitted) in position. Remove the isolating handle (436).

To Close an OFS-10 or OFS-14 Fuse Switch

1. Note that the MAIN switch (410) on the right of the OFS tank (409) is OFF (see indicator window (414)) and the EARTH switch (411) on the left of the tank (409) is OFF.

2. Unlock the MAIN switch handle (410).

3. Raise the MAIN switch handle (410) as far as it will go, to the RESET position, to engage the closing mechanism.

4. Move the MAIN switch handle (410) firmly downwards to close the switch. The indication in the tank window (414) should change to ON.

5. Lock the MAIN switch handle (410) in this position (435).

To Trip an OFS-10 or OFS-14 Fuse Switch

1. Note the indication ON in the tank window (414). Note also that the EARTH switch (411) is set to EARTH OFF.

2. Unlock the MAIN switch handle (410).

3. Raise the MAIN switch handle (410) from the ON position (but not to the RESET position). You will hear the mechanism trip to OFF and see the indication change in the tank window (414).

4. Lock the MAIN switch handle (410) in the OFF position (same padlocking point (435) as for ON).

To Earth a Transformer/Feeder through an OFS-10 or OFS-14

1. Note that the MAIN switch (410) on the right of the OFS tank (409) is OFF (see indicator window (414)) and the EARTH switch (411) on the left of the tank (409) is OFF.

2. Unlock the EARTH switch handle (411).

3. Pull the EARTH switch handle (411) smoothly but firmly to the EARTH ON position.

4. Lock the EARTH switch handle (411) in this position (437).

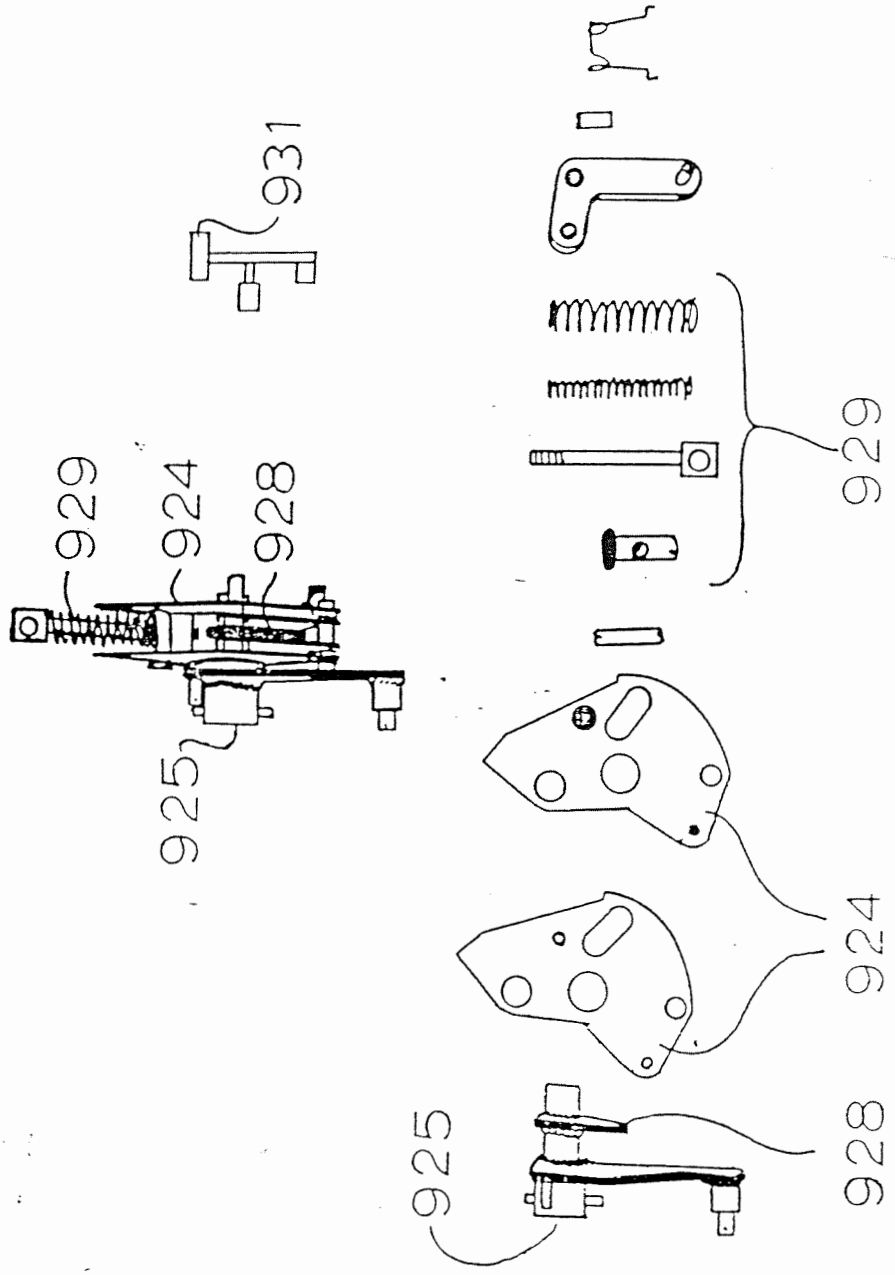
To Remove a Transformer/Feeder Earth on an OFS-10 or OFS-14

1. The right hand MAIN switch handle (410) will be OFF (see indicator window (414)) and the left hand EARTH switch (411) will be ON.

2. Unlock the EARTH switch handle (411).

3. Push the EARTH switch handle (411) smoothly but firmly to the EARTH OFF position.

4. Lock the EARTH switch handle (411) in this position (438).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Fuse Operation of OFS-10 or OFS-14 on Fault

If any fuse (400) operates to clear a fault, a striker pin (419) is ejected from its top end. This raises the trip bar (413), trips the MAIN switch (410, 412) and prevents the mechanism's being reset until the faulty fuse (or fuses) (400) has (or have) been replaced.

Replacement of OFS-10 or OFS-14 Fuses

(Note: Since this operation requires that the MAIN switch (410) be reset, fuses (400) should only be changed on a non-isolatable OFS when it can be closed to ON immediately afterwards).

The OFS-10 and OFS-14 can be fitted with oil immersed fuses (400) to BS.2692: 1956 without the need for tools. The OFS-10 can only accommodate the 254 mm (10 in) long by 63 mm (2.1/2") dia. barrel size fuse. However, the OFS-14 can accommodate either this size or the 359 mm (14.1/8 in) long version, provided that the correct size contact cups (439) are fitted.

To change the fuse size of an OFS-14 the three lower contact retaining cups (439) must be replaced by three of the appropriate type; this operation does require tools and further details are available on request.

1. Note that the right hand main switch (410) is OFF (see indicator window (414)) and the left hand EARTH switch (411) is OFF.

2. Unlock the MAIN switch handle (410) and raise it fully to the RESET position.

3. Isolate the isolatable OFS-10 and lock off the shutters (5, 27).

4. Unfasten the screws (426) securing the fuse switch cover (427) and raise the cover through approximately 50°. It will raise the fuse carriage (418) with it.

5. Raise the trip bar (413) and the hinged contact clips (440) of all three fuses (400). Remove and destroy or discard all three fuses, since any which have not blown may nonetheless have suffered some damage during the fault.

6. Insert the bottom contact (i.e. the end without a striker pin, as indicated on the fuse body) of each new fuse in turn into its lower retaining cup (439) in the carriage (418). Press each fuse firmly down to ensure that it is satisfactorily seated. Secure the hinged clips (440) firmly over the tops of the fuses.

7. Lower the trip bar (413) across the fuse strikers (419).

8. Release the spring-loaded carriage retaining clip (441), which is pivoted to the right hand lift arm (442), and re-insert the carriage (418) by gently lowering the cover (427).

9. Fasten the cover retaining screws (426).

10. Plug an isolatable OFS-10 into the fixed portion after unlocking the shutters (5, 27).

11. The OFS can now be closed.

Maintenance of OFS Fuse Switch

Before undertaking maintenance work on an isolatable OFS-10, operate the MAIN switch (410) to OFF and RESET and EARTH switch (411) to OFF. Isolate the switch and lock the busbar and feeder safety shutters closed (5, 27).

In the case of a non-isolatable OFS the associated transformer/feeder and busbars/feeder should be made dead and earthed at all possible supply points. Any fixed portions of isolated isolatable switchgear on the same or any associated switchboard should have the safety shutters locked closed (5, 27).

Once these precautions have been observed, the routine inspection/maintenance procedure set out below should be undertaken.

1. Clean the outside of the equipment as a matter of good practice and to prevent dirt entering the equipment when the covers are removed.

2. Open and remove the fuse switch cover (427), disconnect the fuse carrier links (442) from the cover, remove the carrier (418) and examine the fuse-switch contacts (415, 417, 420, 422). Replace any contacts which are in any way defective.

3. Inspect the fuse links (400) for signs of mechanical or thermal damage. Replace any that show such signs. Replace the fuse carriage (418).

4. Check all fittings and clampings, particularly those associated with moving parts, for tightness.

5. Inspect and clean all insulation. Use clean, non-fibrous cloths.

6. As all mechanisms are in oil or oil vapour, lubrication is unnecessary. However, switch oil should be poured over all parts above oil level in the tank.

7. Sample and test the switch oil as prescribed in B.S.148. Top up as necessary, taking precautions as described in "Oil Filling of Switchgear".

8. Inspect all weather seal gaskets (443) and replace any which show signs of deterioration or ageing.

9. Check that no foreign objects are left in the tank, the oil level is correct and all gaskets are seating properly, then replace, close and tighten the cover (426, 427).

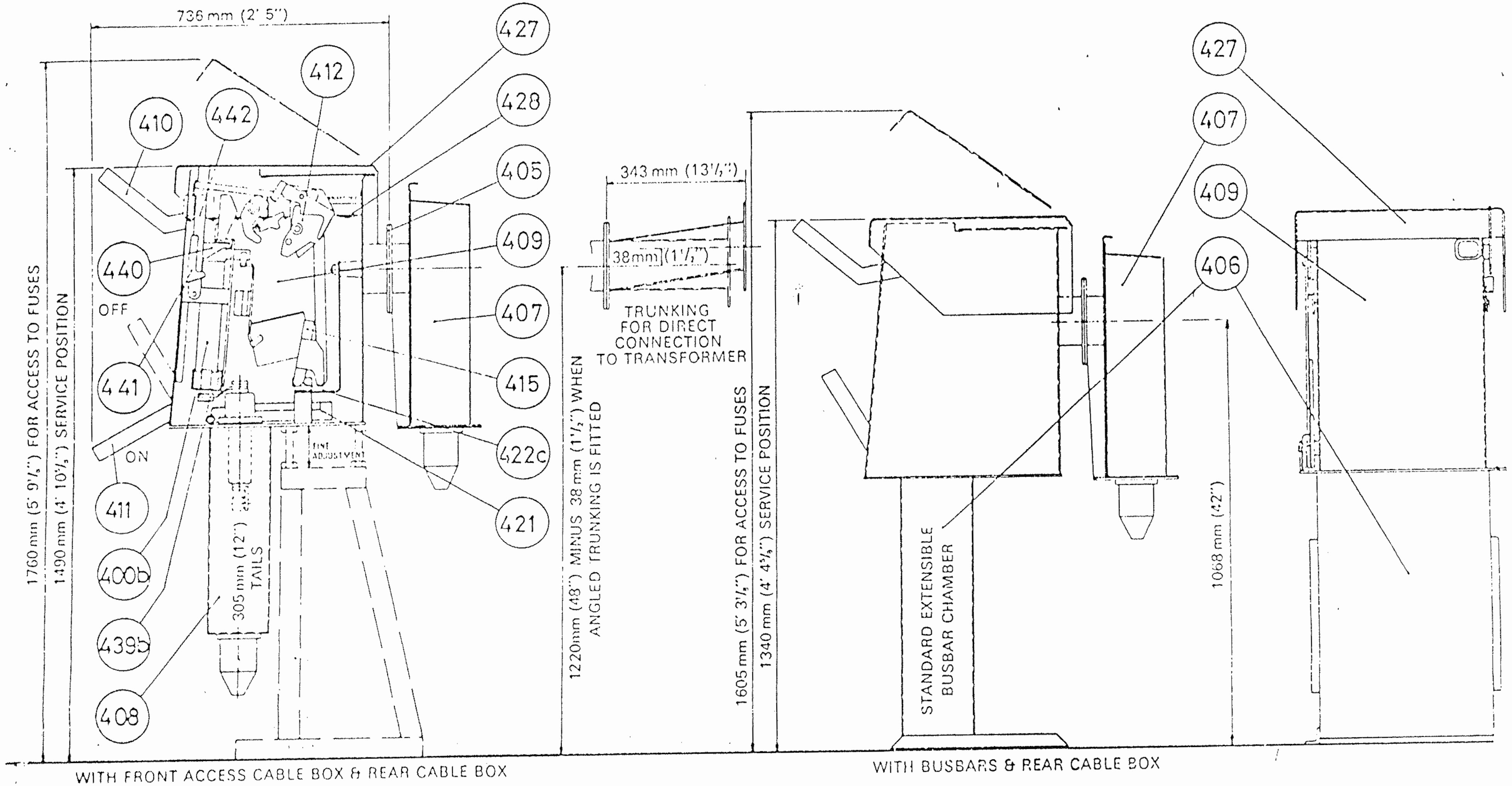
10. Lubricate all external pivot points on cover (427), handles (410, 411), interlocks (434), isolating mechanism and lift screw (22, 425) with a good quality oil. Where the lift nut (433) is of phosphor bronze it should be greased.

11. Touch up all external parts on which the finish has been damaged.

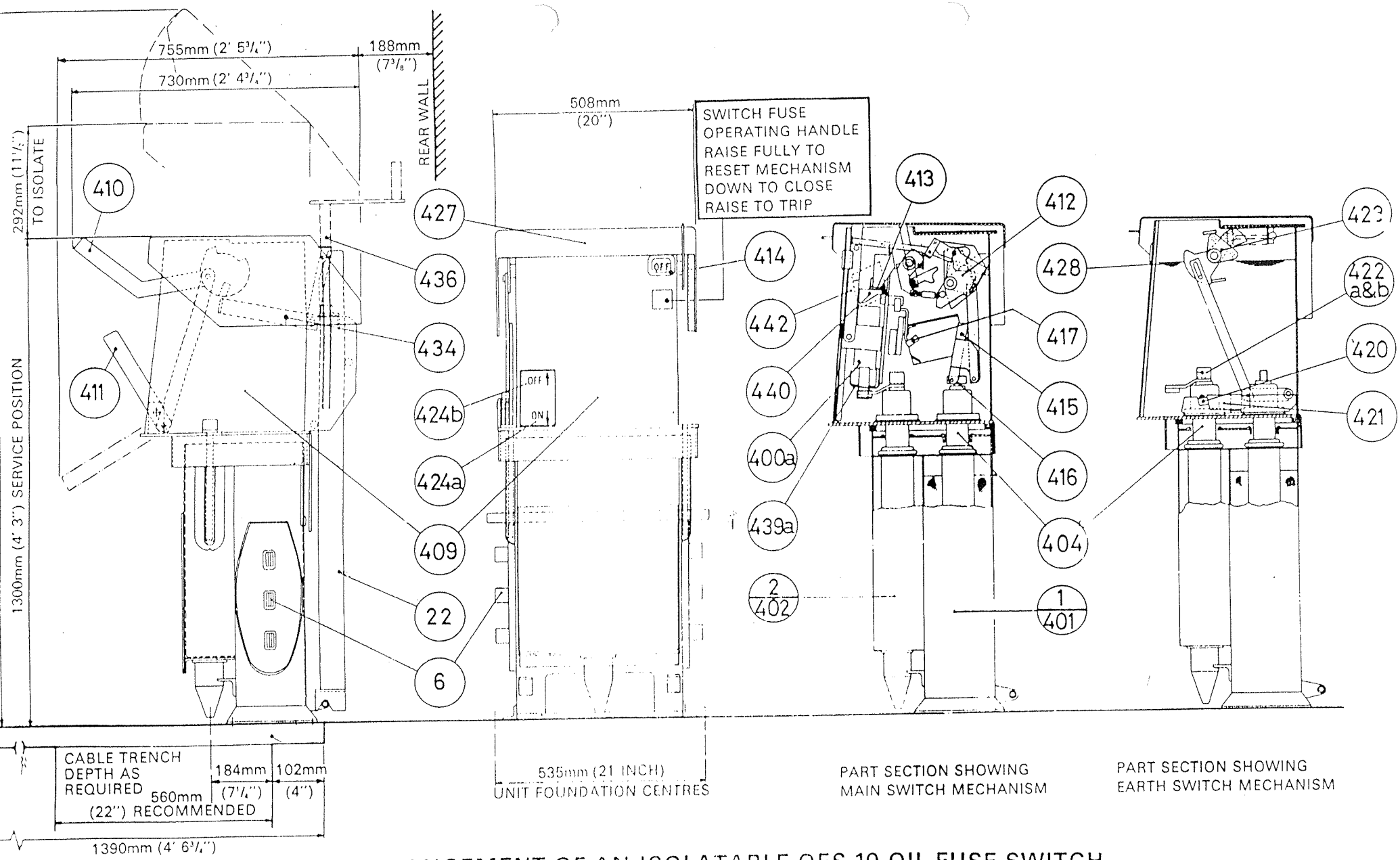
12. Check the operation of switches (410, 411) and interlocks (434).

13. Clean the isolating plug insulators (404) and contacts (403) of an isolatable OFS-10 and smear with petroleum jelly ("Vaseline") as described under "Isolating Contact Maintenance".

14. The OFS can now be returned to service.



GENERAL ARRANGEMENT OF A NON ISOLATABLE
OES 14 UNIT (REAR H.V. FLANGE)



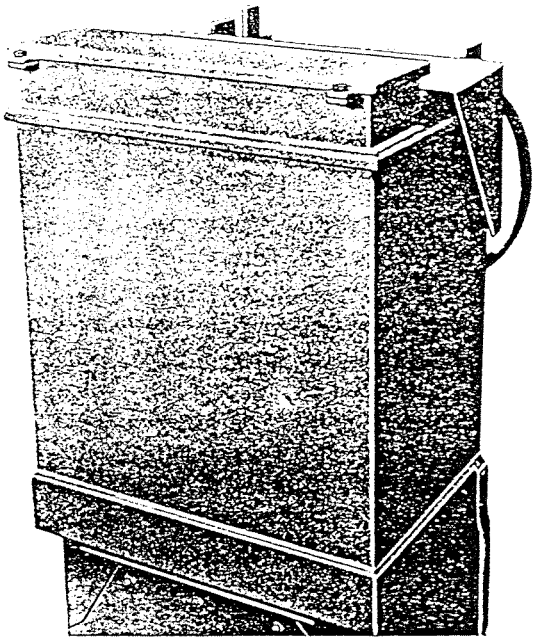
GENERAL ARRANGEMENT OF AN ISOLATABLE OFS-10 OIL FUSE SWITCH
(Non Isolatable OFSs differ only in details)

Key to Illustrations (OFS-10 and OFS-14)

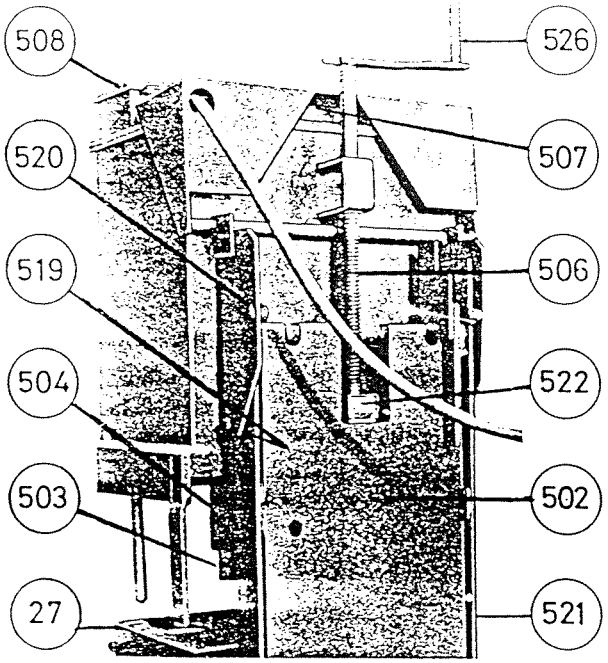
(400) fuses, (400a) 254 mm (10 in), (400b) 359 mm (14.1/8 in).
(401) integral compound-filled busbar chamber
(402) integral front cable box on non-isolatable OFS-10 or OFS-14 with integral busbars
(403) moving main isolating contacts
(404) moving main isolating contact insulators
(405) OFS-14 rear HV flange connections
(406) integral busbars
(407) rear flange-mounted cable box
(408) integral front cable box on OFS-14 with rear flange connection
(409) steel, oil filled tank
(410) main switch handle
(411) earth switch handle
(412) main switch mechanism
(413) trip-free mechanism lift bar
(414) ON/OFF indicator in window
(415) main switch blades
(416) main switch blade pivots on busbar connections or rear HV connections
(417) main switch fixed spring contacts
(418) fuse carriage
(419) fuse striker pins
(420) earth switch moving copper contact blocks
(421) steel blades carrying (420)
(422) earth switch fixed copper contacts
  (422a) on isolatable OFS-10 moving cable box isolating contacts
  (422b) on non-isolatable OFS-10 and 14 front cable box droppers
  (422c) on non-isolatable OFS-14 rear flange connections
(423) earth switch mechanism
(424a) EARTH ON label
(424b) EARTH OFF label
(425) isolating mechanism screw
(426) main cover retaining screws
(427) main cover
(428) oil level
(429) handling truck
(430) OFS lower guide wheels
(431) OFS upper guide wheels
(432) fixed frame guide rails
(433) fixed frame isolating mechanism lift nut
(434) isolation interlocks
(435) main switch padlock point
(436) removable isolating handle
(437) EARTH ON padlock point
(438) EARTH OFF padlock point
(439) contact cups, (439a) 254 mm (10 in), (439b) 359 mm (14.1/8 in)
(440) hinged fuse contact clips
(441) fuse carriage retaining clip
(442) fuse carriage lift arms
(443) weatherseal gaskets

BUSBAR MOUNTED
VOLTAGE TRANSFORMER

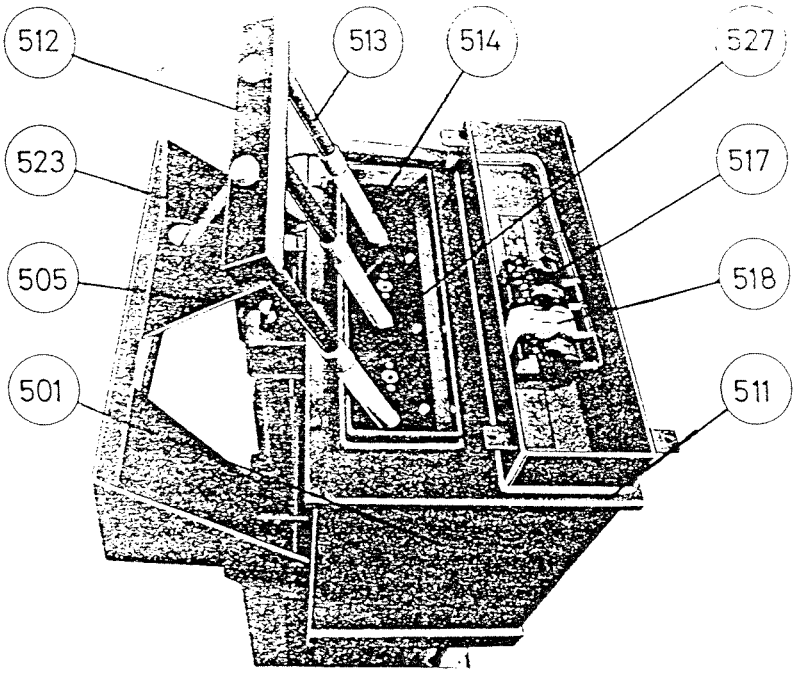
Contents



BUSBAR VOLTAGE TRANSFORMER (500)
IN SERVICE LOCATION



REAR VIEW OF ISOLATED
BUSBAR V.T.



ISOLATED BUSBAR V.T. SHOWING
ACCESS TO FUSES

Preparation of Busbar Mounted Voltage Transformer

The busbar mounted voltage transformer (VT) (500) is housed in a weatherproof metalclad tank (501) with three self-aligning isolating contacts (503), protected by glazed porcelain or epoxy resin bushings (504). The VT plugs into the standard fixed portion in the same way as an oil switch or fuse switch, but does not, of course, have feeder isolating contacts. Although the raising gear operates in the same way as that fitted to fuse switches and oil switches, the fixed frame (502) at the rear of the fixed portion varies in detail from those supplied for other equipment, and is not interchangeable with them.

Busbar mounted V.Ts are delivered empty, and must be filled with oil before being put into service.

1. Unpack the VT, hinge back the interlock cover (505) adjacent to the lift screw (506) and remove the primary (507) and secondary (508) fuses access covers.

2. On the inner cover (527) is a densified wood bar with two knurled screws. This is the HV fuse carrier handle (512). Unscrew the knurled screws and pull the bar straight up to reveal the HV fuse carriers (513) with the fuses (514) screwed to the ends. Check that the fuses are securely screwed in position.

3. The tank (501) interior will have been cleaned before despatch; fill with switch oil to the marked level, observing the precautions detailed under "Oil Filling of Switchgear".

4. Replace the HV fuse carrier assembly (512, 513, 514) and screw the knurled screws into place.

5. Check that the secondary fuses (517) and solid link (518) are in their respective fuseholders. Replace and fasten down the primary and secondary fuses access covers (507, 508).

6. Put the interlock cover (505) down so as to prevent access to the primary fuses cover (507). Raise the VT on a switch handling truck or by some other means and place it so that the lower VT guide wheels (519) pass in front of, and the upper VT guide wheels (520) pass behind, the fixed frame guide rails (521) (the fixed frame is mounted at the rear of the fixed portion).

7. Lower the VT until its lift screw (506) rests on the fixed frame lift nut (522).

8. Clean the isolating plugs (504) and contacts (503) and apply petroleum jelly ("Vaseline") to the contacts as described under "Isolating Contact Maintenance".

9. All secondary wiring will have been completed before delivery, but the secondary interconnections must be made off. The interconnecting single core wiring passes through a flexible conduit (523) from the VT to the rear wiring box or relay cabinet. The length of the conduit should be sufficient to allow the VT to be isolated or plugged in, but not so long as to foul the isolating equipment or shutters.

10. Check that the main cover (511) and secondary fuses cover (508) are secured closed. Padlock the secondary fuses cover (508) if the VT is in an outdoor or consumer's substation.

The VT is now ready to be put into service.

To Plug-in a Busbar Mounted Voltage Transformer

(It is assumed that the VT has already been set on its fixed frame as described under "Preparation of Busbar Mounted Voltage Transformer").

1. Note that the VT is isolated, the main cover (511) and primary (507) and secondary (508) fuses access covers are fastened closed, and the pivoted interlock cover (505) at the top of the VT is set so as to prevent access to the primary fuses access cover (507).

2. Remove the fixed portion rain cover (13) (if fitted) and unlock the shutter box locking slides (27).

3. Fit the removable isolating handle (526) to the lift screw (506) at the rear of the VT and wind it clockwise to lower the unit.

4. Note that the guide rods (36) enter their apertures (28) in the locking slides (27) and open the shutters (5) before the moving isolating contacts (503) reach them. Keep winding until the VT is fully home, then remove the isolating handle (526).

To Isolate a Busbar Mounted Voltage Transformer

1. Fit the removable isolating handle (526) to the lift screw (506) at the rear of the VT and wind anti-clockwise to raise it.

2. Note that the shutters (5) close as the guide rods (36) leave their apertures (28). Lock the shutter box locking slides (27) and lock the fixed portion rain cover (13) (if fitted) in position.

3. Remove the isolating handle (526).

Busbar Mounted VT Maintenance and Fuse Renewal

Voltage Transformers normally require no maintenance other than the lubrication of the isolating mechanism. Maintenance of fixed portions is discussed elsewhere.

Fuses will normally require renewal only when a fault has occurred in the metering circuitry or when a surge on the H.V. network has threatened the VT.

1. Isolate the VT as described under "To Isolate a Busbar Mounted Voltage Transformer". Lock the shutters (5) closed. Remove the isolating handle (526).

2. Clean the outside of the equipment as a matter of good practice and to prevent dirt entering the VT when the covers are removed.

3. Unlock the secondary fuses access cover (508), unfasten its securing screws and raise the cover to give access to the M.V. fuses (517). Check the M.V. fuses and renew as necessary.

4. Hinge back the interlock cover (505) adjacent to the lift screw (506) to give access to the primary fuses cover (507). Unfasten and remove this. Take a sample of tank oil for testing and top up the level if necessary.

5. Unscrew the two knurled nuts securing the H.V. fuses lift bar (512). Lift out the bar and fuses (514), pausing to allow the oil to drip back into the tank. Check the fuses for tightness. Renew any which have blown. Replace the assembly and tighten down the knurled screws. Wipe up any spilled oil.

6. Inspect the weatherseal gaskets (516) in the covers and replace any which show signs of deterioration or ageing. Replace and fasten the primary fuses access cover (507) and pivot the interlock cover (505) back into position. Close, screw and lock the secondary fuses access cover (508).

7. Lubricate the cover hinges, interlock pivot, isolating mechanism and lift screw (506) with a good quality oil. Where the lift nut (522) is of phosphor bronze it should be greased.

8. Touch up any damaged paintwork (see "Paintwork").

9. Clean the isolating contacts (503) and insulators (504) and smear the contacts with petroleum jelly ("Vaseline") as described under "Isolating Contact Maintenance".

10. Unlock the fixed portion shutter box locking slides (27) and plug-in the VT as described under "To Plug in a Busbar Mounted Voltage Transformer".

Key to Illustrations - Busbar Mounted Voltage Transformer

(500) busbar mounted voltage transformer
(501) VT tank
(502) special fixed frame
(503) iso contacts
(504) iso bushings
(505) interlock cover
(506) lift screw
(507) HV fuses cover
(508) MV fuses cover
(509)
(510)
(511) main cover
(512) HV fuse carrier handle
(513) HV fuse carrier
(514) HV fuses
(515)
(516)
(517) MV fuses
(518) MV link
(519) lower VT guide wheels
(520) upper VT guide wheels
(521) fixed frame guide rails
(522) lift nut
(523) flexible conduit
(524)
(525)
(526) removable isolating handle
(527) inner tank cover

AFS-14 METALCLAD AUTOMATIC SWITCH FUSE

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AFS-14 Automatic Switch Fuse

The Yorkshire Switchgear type AFS-14 automatic switch fuse is an addition to the well known range of IVI metalclad switchgear and embodies the isolatable feature already established. It is therefore interchangeable with existing equipment of similar current rating.

Designed to take advantage of the higher current ratings possible with air insulated fuse links the AFS-14 unit consists of a basic metalclad weatherproof housing fitted with 400A isolating plugs suitable for installing in any standard busbar/cable box fixed portion. The main and earth switches are housed in an oil-filled tank, whilst the fuses are accommodated in air in an enclosure in front of the oil tank. Separate handles give independent control of the two switches, which are mechanically interlocked to prevent incompatible switching operations.

Main Switch The main switch, connected in series with the fuse links, is a load breaking/load making oil switch with trip free characteristic and complete with spring assisted manual closing mechanism. ON/OFF condition is indicated through a window aperture. In accordance with the recommendations of A.S.T.A. publication No.22 the switch has been tested for currents up to five times the maximum rating of associated fuses. Provision of a trip-free mechanism allows the switch to be tripped either manually or by the rupturing of any of the fuses.

The main switch itself consists of three copper blades, pivoted on the busbar bushings. In the ON position the blades engage spring contacts in series with the fuses.

Fuses Fuse links to B.S.2692: 1955 are of standard 14" x 3" dia. barrel size and accommodated in a one piece assembly moulded in epoxy resin. All fuses are fitted with a striker pin feature which automatically trips the main switch when a fuse operates and thereby isolates all three phases; moreover, as the ejected pin(s) prevent the resetting of the switch mechanism all blown fuses must be replaced before the switch can be returned to the closed position. The contact assembly is so arranged that the fuse elements can only be fitted with the striker pin end to the trip bar.

Earth Switch A fault making oil switch to B.S.2631: 1955 controls the earthing of the outgoing circuit. Copper contact blocks mounted on pivoted steel blades engage spring loaded copper contacts which are mounted between, and connected to, the front isolating contact bushings.

As with the main switch, an independent manual spring mechanism ensures reliable operation. Durable labels indicate the EARTH ON and EARTH OFF positions respectively.

Isolation Each isolatable AFS-14 is supplied complete with a hand-wound screw-jack type of isolating mechanism. This is mounted at the rear of the tank and is interlocked with the operating mechanism. As the switch unit is wound down into the service location, guide rods enter apertures in the fixed portion shutter box top to align the switch, open the automatic safety shutters and earth the switch tank and body prior to the mating of the isolating contacts.

Isolating Contacts The 400A self-aligning isolating contacts are mounted on glazed porcelain bushings below the switch tank and in glazed porcelain receptacles in the fixed portion.

AFS Interlocks & Padlocking

Positive interlocks are incorporated to ensure the following:

1. MAIN switch and EARTH switch cannot both be in the 'ON' position at the same time.

2. The unit cannot be plugged in or isolated unless the MAIN switch is 'OFF' with the handle in the 'RESET' position and the EARTH switch is 'OFF'.

3. Access to the fuse elements is possible only with the unit fully isolated.

Provision is available for:

(i) Locking both operating handles in either 'ON' or 'OFF' position.

(ii) Locking the main cover to prevent unauthorised access to the fuse elements.

(iii) Locking the unit in the service position.

Preparation of AFS-14 Automatic Switch Fuse

Before mounting the switch on its fixed portion:

1. Remove all packing materials and, with the operating handles in the RESET and EARTH OFF positions, unfasten and raise the front cover. Check that the correct fuses are in place. If not, put in fuses of the correct rating as described under "Charging the AFS Fuses".

2. Open the oil tank and examine the mechanisms, bearings and contacts to check that nothing has been loosened or damaged in transit.

3. Wipe out the tank with a clean, dry, lint free cloth.

   Fill the tank to the marked level with the switch oil (see "Oil Filling of Switchgear"). Pour oil over those parts of the mechanism which are above oil level.

4. Close and securely fasten the covers and check the operation of the operating handles and interlocks in accordance with the "Operation" section of this manual. Leave the handles set to RESET and EARTH OFF.

5. Raise the unit on a handling truck or by some other means and push it back over the fixed portion. Lower the AFS so that its lower guide wheels pass in front of, and its upper guide wheels behind, the fixed frame guide rails (the fixed frame is mounted at the rear of the fixed portion).

6. When the AFS lift screw rests on the fixed frame lift nut, remove the handling truck.

7. Check the operation of the isolation interlocks (see "AFS Interlocks & Padlocking").

8. Clean the isolating plug insulators and contacts as described under "Isolating Contact Maintenance".

   Smear a thin layer of petroleum jelly ("Vaseline") on the contact fingers.

NOTE: Where a handling truck is not available the filling of an AFS-14 is best left until the unit is in position on its fixed frame but still isolated from the fixed portion.

To Plug-in an Isolatable AFS-14 Switch Fuse

(This section applies only to the isolatable AFS-14 and assumes that the unit has already been set on its fixed frame as described under "Preparation of AFS-14 Automatic Switch Fuse").

1. Note that the AFS-14 is isolated and that the operating handles are set to OFF and RESET and to EARTH OFF.

2. Remove the fixed portion rain cover (if fitted) and unlock the shutter box locking slides.

3. Fit the removable isolating handle to the lift screw at the rear of the AFS and wind it clockwise to lower the switch fuse.

4. Note that the guide rods enter their apertures in the locking slides and open the shutters before the moving isolating contacts reach them. Keep winding until the switch fuse is fully home, then remove the isolating handle.

To Isolate an Isolatable AFS-14 Switch Fuse

1. Set the operating handles to OFF & RESET and EARTH OFF.

2. Fit the removable isolating handle to the lift screw at the rear of the AFS and wind anti-clockwise to raise the fuse switch.

3. Note that the shutters close as the guide rods leave their apertures. Lock the shutter box locking slides and lock the fixed portion rain cover (if fitted) in position. Remove the isolating handle.

To Close an AFS-14 Switch Fuse

1. Note that the MAIN switch on the right of the AFS tank is OFF (see indicator window) and the EARTH switch on the left of the tank is OFF.

2. Unlock the MAIN switch handle.

3. Raise the MAIN switch handle as far as it will go, to the RESET position, to engage the closing mechanism.

4. Move the MAIN switch handle firmly downwards to close the switch. The indication in the tank window should change to ON.

5. Lock the MAIN switch handle in this position.

To Trip an AFS-14 Switch Fuse

1. Note the indication ON in the tank window. Note also that the EARTH switch is set to EARTH OFF.

2. Unlock the MAIN switch handle.

3. Raise the MAIN switch handle from the ON position (but not to the RESET position). You will hear the mechanism trip to OFF and see the indication change in the tank window.

4. Lock the MAIN switch handle in the OFF position (same padlocking point as for ON).

To Earth a Transformer/Feeder through an AFS-14

1. Note that the MAIN switch on the right of the OFS tank is OFF (see indicator window) and the EARTH switch on the left of the tank is OFF.

2. Unlock the EARTH switch handle.

3. Pull the EARTH switch handle smoothly but firmly to the EARTH ON position.

4. Lock the EARTH switch handle in this position.

To Remove a Transformer/Feeder Earth on an AFS-14

1. The right hand MAIN switch handle will be OFF (see indicator window) and the left hand EARTH switch will be ON.

2. Unlock the EARTH switch handle.

3. Push the EARTH switch handle smoothly but firmly to the EARTH OFF position.

4. Lock the EARTH switch handle in this position.

Fuse Operation of AFS-14 on Fault

If any fuse operates to clear a fault, a striker pin is ejected from its top end. This raises the trip bar, trips the MAIN switch and prevents the mechanism's being reset until the faulty fuse (or fuses) has (or have) been replaced.

Replacement of AFS-14 Fuses

1. Note that the right hand main switch is OFF (see indicator window) and the left hand EARTH switch is OFF.

2. Unlock the MAIN switch handle and raise it fully to the RESET position.

3. Isolate the unit and lock off the shutters.

4. Unfasten the screws securing the fuse switch cover and raise the cover to give access to the fuses.

5. Raise the trip bar, unfasten the fuse securing clips and replace all three fuses, since any which have not blown may nonetheless have suffered some damage during the fault.

6. Fasten each new fuse in place on the fastenings provided.

7. Lower the trip bar (413) across the fuse strikers (419).

8. Close and fasten the cover.

9. Plug the AFS-14 into the fixed portion after unlocking the shutters.

10. The AFS can now be closed as normal.

Maintenance of AFS Switch Fuse

Before undertaking maintenance work on an isolatable AFS-14, operate the MAIN switch to OFF & RESET and EARTH switch to OFF. Isolate the switch and lock the busbar and feeder safety shutters closed.

Once these precautions have been observed, the routine inspection/ maintenance procedure set out below should be undertaken.

1. Clean the outside of the equipment as a matter of good practice and to prevent dirt entering the equipment when the covers are removed.

2. Open the fuses cover and examine the fuse-switch contacts. Clean any contacts which are dirty.

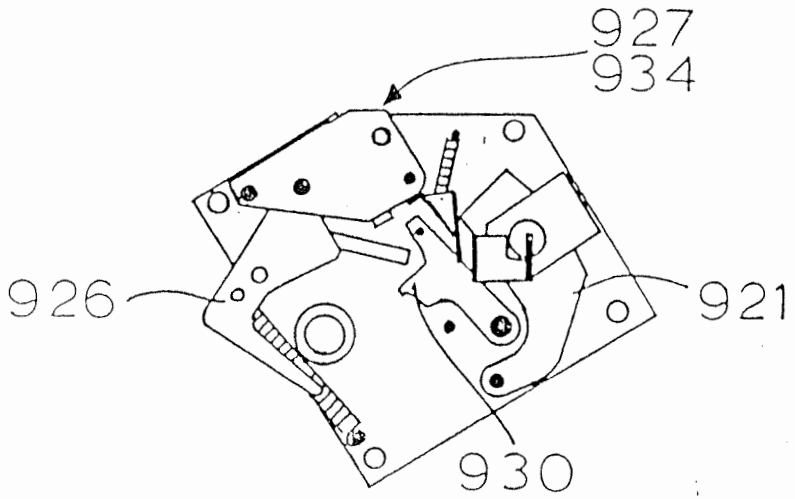
3. Inspect the fuse links for signs of mechanical or thermal damage. Replace any that show such signs. Lubricate the trip bar bearings.

4. Open the oil tank cover. Check all fittings and clampings, particularly those associated with moving parts, for tightness.

5. Inspect and clean all insulation. Use clean, non-fibrous cloths.

6. Switch oil should be poured over all parts above oil level in the tank.

7. Sample and test the switch oil as prescribed in B.S.148. Top up as necessary, taking precautions as described in "Oil Filling of Switch-gear".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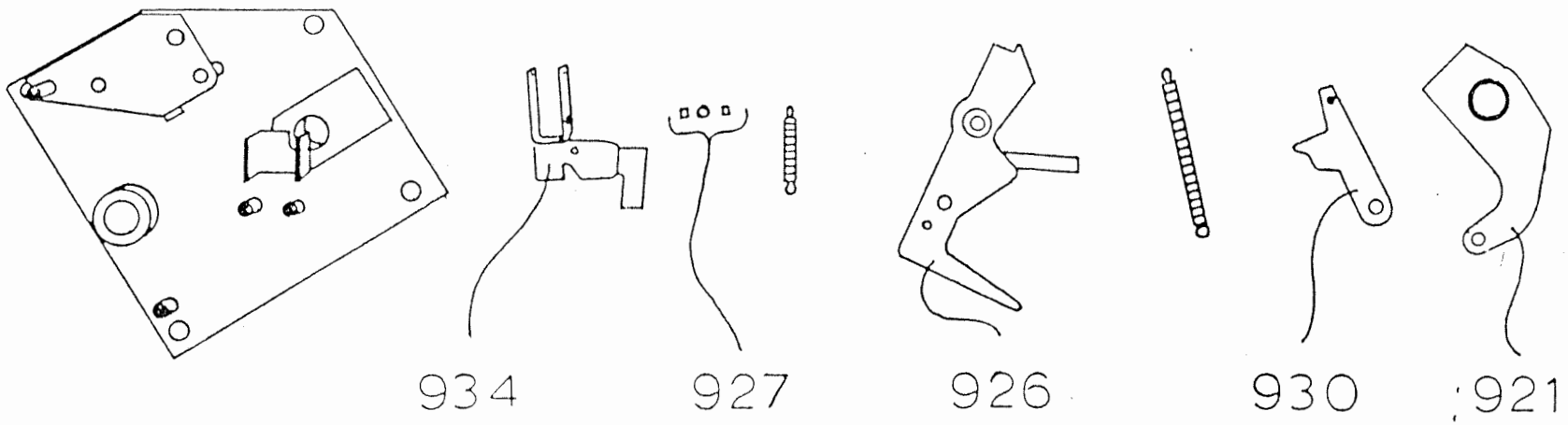
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