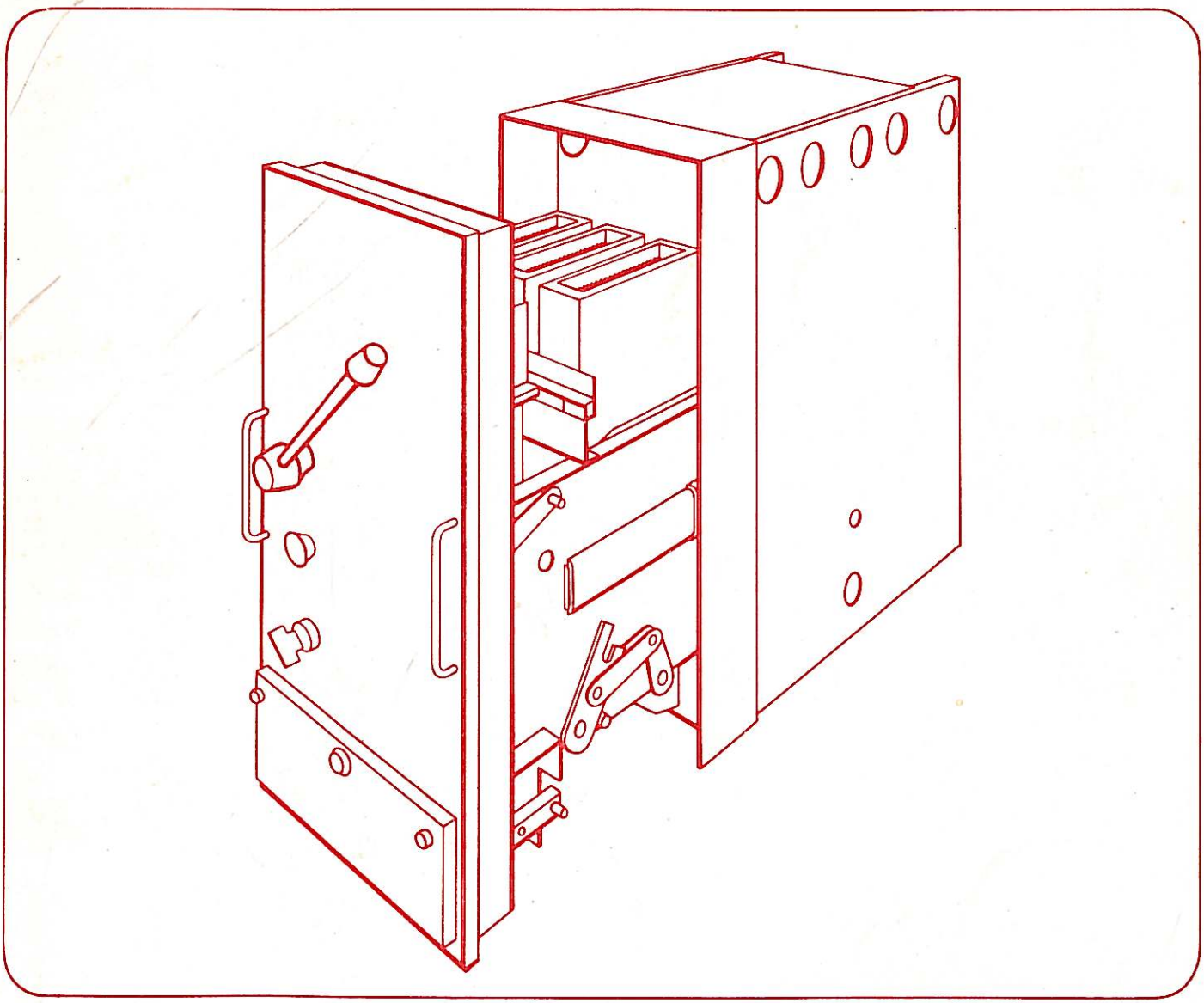
ACB 1992

TYPE OMA
AIR CIRCUIT BREAKERS

Maintenance and Service Manual



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Ottermill

MAINTENANCE & SERVICE MANUAL
TYPE 'OMA' AIR CIRCUIT BREAKER

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MAINTENANCE & SERVICE MANUAL
TYPE OMA AIR CIRCUIT BREAKERS

1. DESCRIPTION OF EQUIPMENT

1.1 General

These instructions cover a range of air circuit breakers with ventilated enclosure current ratings up to 4000 amps. and short circuit rating up to 63 kA. The breakers have been designed to give reliable mechanical and electrical service.

The contacts have been proved to be suitable for interrupting the full fault capacity, and also making on to peak currents up to 110 kA without any significant deterioration.

1.2 Frame Sizes

There are six circuit breaker frame sizes as follows:

OMA.8 — covering ratings up to 1100 amps
OMA.10 — covering ratings up to 1600 amps
OMA.12 — covering ratings up to 2000 amps
OMA.16 — covering ratings up to 2500 amps
OMA.24 — covering ratings up to 3400 amps
OMA.31 — covering ratings up to 4000 amps

Rating plates are fitted to all breakers giving the complete ratings as required by the BS Specifications, and the rating plate on the left hand side of the breaker gives the Serial Number.

The Serial Number should be quoted in all correspondence regarding the circuit breaker.

2. OPERATING INSTRUCTIONS

2.1 Spring Closing Mechanism

The breaker closing speed is independent of the operator, and is by means of a spring which is charged by the operating handle, and automatically released when fully charged. The handle is removable, and the position can be changed to suit the breaker mounting height, or the operator's requirements. An indicator on the left hand side indicates whether the breaker is closed or open. A device is fitted to prevent the spring being charged or mis-firing if the breaker is held tripped by an under-voltage release. A slow close operation can be carried out for maintenance, see Sec. 2.8.

Refer Sec. 4.9.3 for Solenoid Mechanism.

2.2 Tripping Mechanism

Manual tripping is by push button, and the breaker cannot be tripped by means of the closing handle. Overload releases will trip the breaker on over-currents or short circuit currents. The time lag for these releases, and the current setting is adjustable. An undervoltage release may be fitted, or a shunt trip release for remote tripping operation can also be fitted.

2.3 Breaker Isolation and Removal

Access to the isolating mechanism of the breaker is obtained by opening the bottom access door, and whilst doing this the circuit breaker must be tripped by pressing the push button. A racking handle is stored behind the door. Engage the handle with the racking spindle, and turn anti-clockwise until the position indication label indicates "ISOLATED". In this position the breaker is prevented from moving in or out by the racking mechanism, and the breaker can be operated by the closing handle. The secondary plugs and sockets are still in contact in this position, and thus the electrical facilities are energised, including the under-voltage release if fitted.

To inspect the breaker turn the racking handle fully anti-clockwise against the stop. The breaker can now be pulled out to the inspection position. A catch on the left hand side will prevent the breaker coming out past the inspection position. To operate the breaker in this position the lower door must first of all be shut because of the action of the interlocks. By depressing the red painted catch on the left hand side of the breaker, and pulling the breaker out, it can be removed entirely from the housing. It is important to provide suitable lifting facilities

before removing the breaker. A special hydraulic truck is available for this purpose and instructions for its use are given in 2.3.1. In the absence of the special truck, an adapted fork lift truck may be suitable. Alternatively suitable lifting hooks can be inserted in the holes on the top flange of the breaker, and the breaker can then be supported from an overhead crane.

To re-engage the breaker, support it at the correct height to easily engage the slides, and then push in the slides and push in the breaker past the catch to ensure that it cannot be pulled out by mistake. To fully re-engage ensure that the racking handle is turned fully anti-clockwise and push hard against the racking levers. Now turn the racking handle clockwise until either the "ISOLATED" or the "SERVICE" position indicator appears, depending on the position required. The racking handle should be turned until the resistance at the end of the travel is felt when returning to the "SERVICE" position.

2.3.1. **Lifting Truck**

To remove the circuit breaker from the cubicle proceed as follows:—

1. Withdraw the circuit breaker to the Inspection position as detailed in 2.3.
2. Position the truck centrally under the breaker and raise forks until the cross members are within 1" (25mm) of breaker base angles.
3. Check that the projection on the front cross member is aligned with the central slot in the breaker front base angle.
4. Depress the red latch on the L.H. side of the breaker and carefully withdraw the breaker a further 2" (50mm) approx.
5. Raise the forks until cross members engage with, and flanges embrace, breaker base angles.
6. Carefully raise the forks to take breaker weight, and fully withdraw breaker from cubicle.

To replace the Circuit Breaker.

1. With the circuit breaker located centrally on the fork cross members, slide the aluminium runners to their extreme rearward position.
2. Screw the appropriate end (M8 or 5/16" Whit) of the two special studs into the holes (one each side) in the breaker side plates. See diagram.
3. Raise the circuit breaker to the required height in the cubicle.
4. Locate the runners in the guides and slide the circuit breaker into the cubicle as far as the special studs will allow.
5. Remove the special studs from the circuit breaker side plates and stow in holes provided in truck front horizontal member (See diagram) and secure with nuts provided.
6. Lower the lifting truck platform about 2" (50mm).
7. Push the circuit breaker into the isolating position.
8. Remove truck and rack in as detailed in last paragraph of 2.3.

2.4 **Safety Shutters**

The safety shutters operate automatically when the breaker is withdrawn past the "ISOLATED" position, and screen the fixed isolating contacts. If the breaker is removed the shutters can be padlocked closed if required. The shutters can be operated independently to enable the one over the live connections to be padlocked whilst leaving the dead side accessible.

Ensure that padlocks are removed before replacing the breaker.

2.5 **Interlocks and Locks**

The breaker is interlocked to prevent access to live parts unless the circuit is dead. Also the breaker cannot be disconnected from the isolating contacts, or re-engaged with the contacts unless the breaker is in the "OPEN" position. This is achieved by interlocking the bottom access door with the trip bar and trip button. The breaker must be tripped before the door can be opened to obtain access to the racking mechanism, and the breaker cannot be re-closed whilst the door is open until the "ISOLATED" position is reached. If the breaker is racked in from the "ISOLATED" position the side interlock will again trip the breaker should it have been left closed. Note that in the "RELEASED" or inspection position the access door must be closed in order to close the breaker.

Brackets on the front cover and the bottom access door provide means of padlocking to prevent unauthorised adjustment of the overcurrent release, and also to enable the breaker to be locked in the 'ISOLATED' or 'SERVICE' position.

The manual trip push button surround also has provision for fitting a padlock to hold the button depressed, thus preventing unauthorised closing of the breaker.

Castell type interlocks, if fitted, are arranged to hold the key trapped until the breaker is tripped, and it is held tripped if the key is removed.

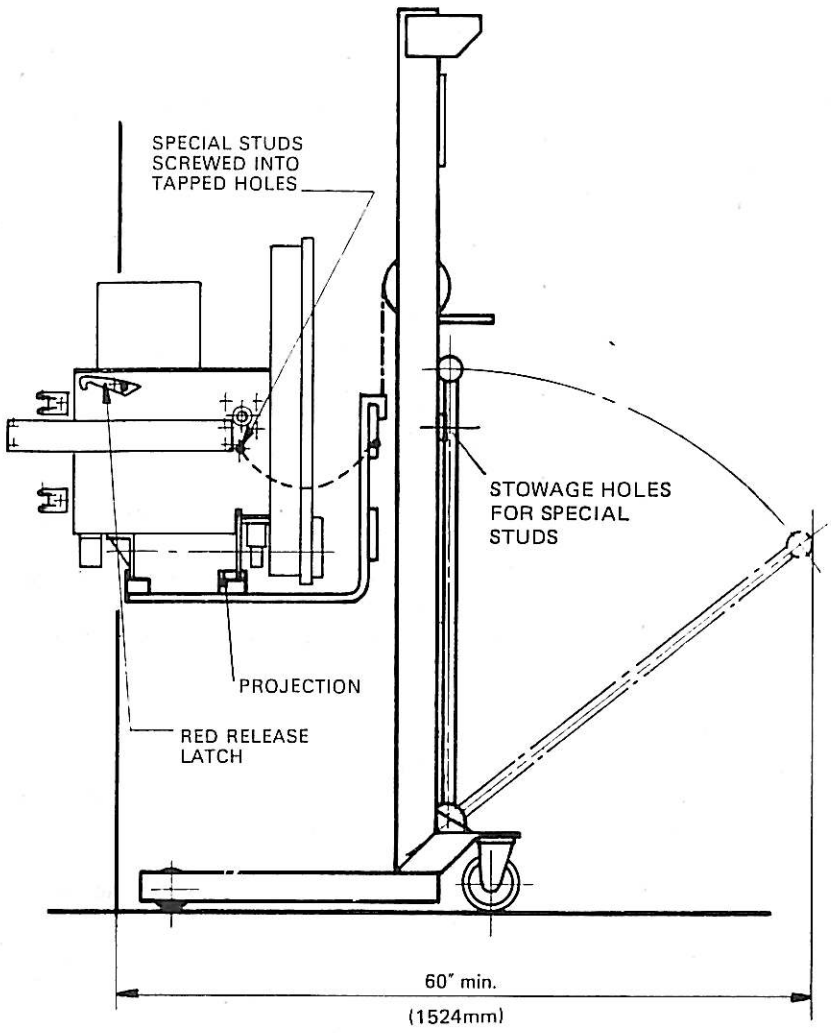


FIG. 1. DIAGRAM OF ACB. LIFTING TRUCK

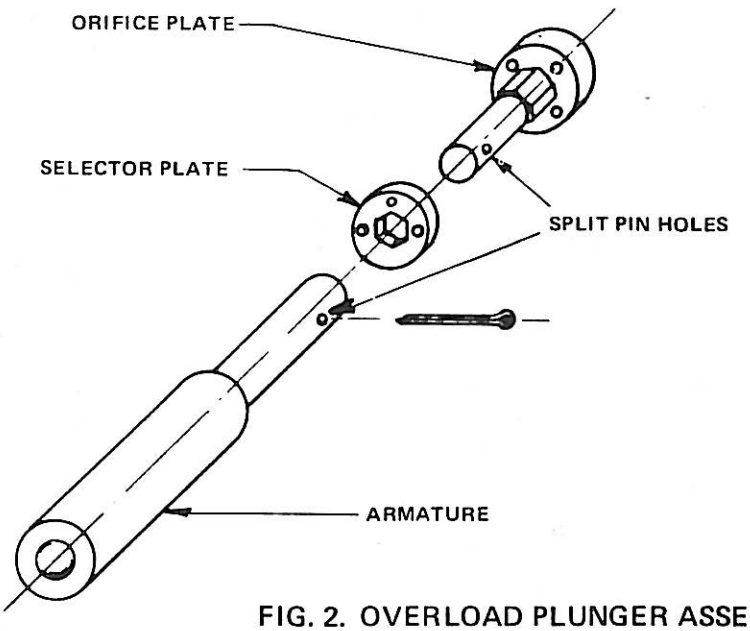


FIG. 2. OVERLOAD PLUNGER ASSEMBLY

2.6 Overcurrent Releases

The releases are of the solenoid type, where the current in the solenoid attracts a plunger which trips the breaker. At the lower end of the plunger is an orifice plate working in a dashpot containing silicone fluid having a minimum viscosity-temperature variation.

Access to the releases is via the lower door, and the retaining bar must be removed to adjust or remove the dashpots. It is best to withdraw the breaker to the inspection position before removing the dashpots. To set to the required tripping current screw the dashpot up or down until the required percent mark is level with the bottom of the dashpot housing. The tripping current settings corresponding to the marked percent values are given on the label on the inside of the cover door. Unless instantaneous tripping is required, add the silicone fluid supplied. The fluid is 1000 Centistoke viscosity, and only this type of fluid must be used. The dashpot should be filled with the fluid to bring the fluid level 7/8" (22mm) from the top of the dashpot before the plunger is added.

The plunger is supplied with the selector plate set to give a medium time lag, i.e. two holes open. It should only be changed to give a maximum time lag, i.e. no holes open, if motor starting or similar heavy overloads are expected. Some selector plates have a small hole as well as the two larger holes, and if this small hole only is open, an intermediate time lag is obtained. The time lag is changed by removing the split pin and turning the selector plate to cover the holes in the orifice plate. See Fig. 2. Replace or renew the split pin and bend the ends sufficiently to ensure that they do not foul the dashpot sides. Ensure that the orifice plate is free to float relative to the armature. Replace the dashpot locking bar with the narrow part of the keyhole slot to the top.

For normal applications the dashpot current setting should be about 125% of the maximum normal load, and short overloads will not trip the breaker because of the dashpot time lag. For heavy overloads such as motor starting it may be necessary to increase the current setting to 150% or 200% but in this case normal overload protection of the circuit will not be obtained.

2.6.1 Time Lag Curves

Figures 3, 4, and 5 show time lag curves for the range of breakers. The time lag in seconds for the breaker to trip is shown in multiples of the rated series coil current in the case of the 'OMA8' breaker and as a multiple of the C.T. primary current rating in the other cases.

Breakers are supplied with the time lag plunger set to give the short time lag shown on the curves. The long time lag is obtained by removing a split pin and turning the selector plate so that the holes are not in line with the orifice plate holes. The plunger assembly is shown in Fig. 2. The long time lag settings should not be used unless they are required for heavy motor starting loads or to obtain discrimination with other equipment. The long time lag is of the dual characteristic type and provides long time lags up to high overloads of about 10 times the rated current. Above this in the short circuit current region the time lag is appreciable reduced.

The curves are only valid if the dashpots are correctly filled with 1000 Centistoke silicone fluid in accordance with the instructions given in this manual. The fluid may be omitted from the dashpot to obtain an 'instantaneous' release.

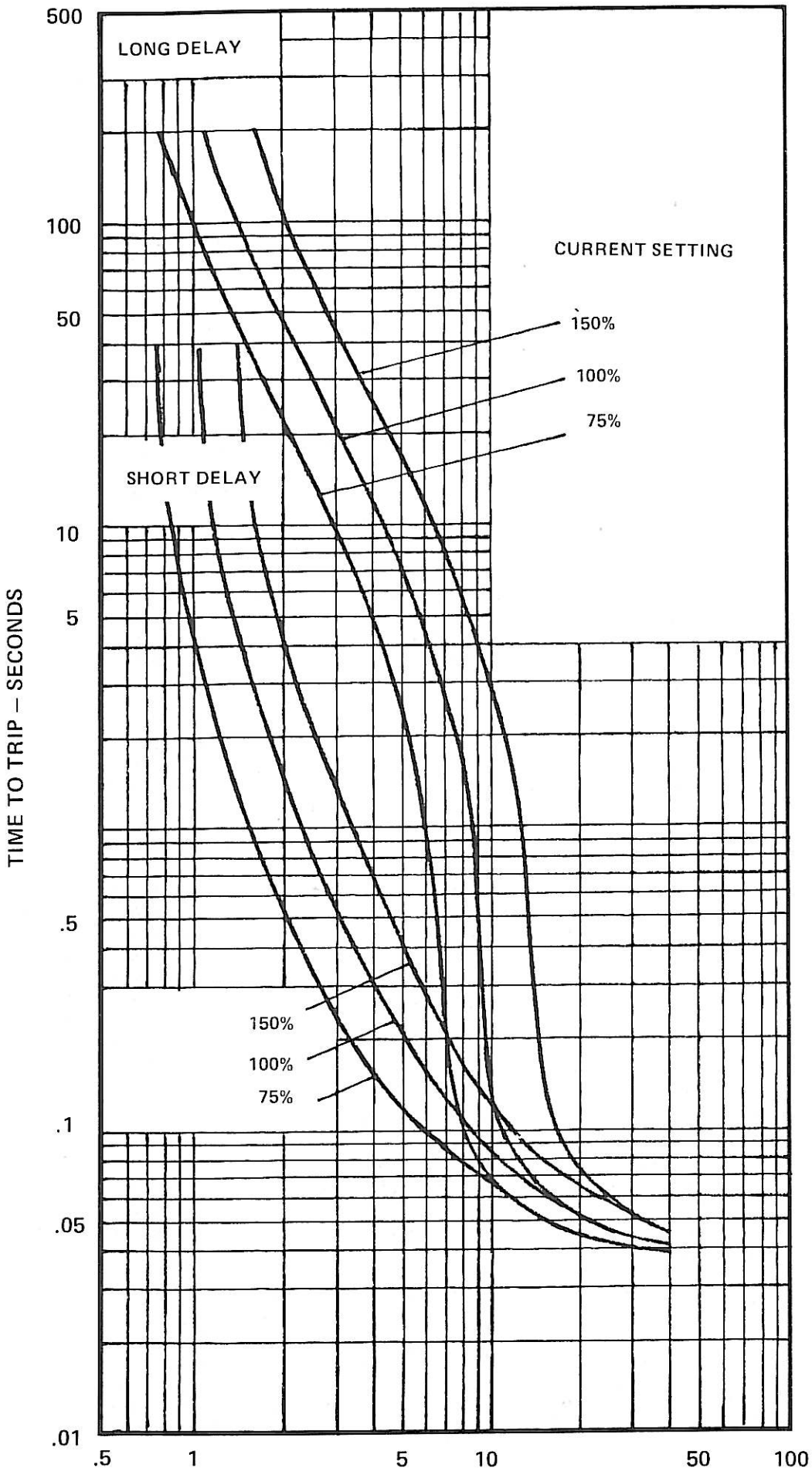
The time lag depends on the current setting of the dashpot and curves for 75%, 100%, and 150% are shown on Figs. 3 and 4. These are applicable to breakers supplied since about the middle of 1973 with dashpot calibration marks covering this range. Figs. 5a, 5b and 5c show the curves for breakers supplied prior to about the middle of 1973 with dashpot calibration marks covering the range 100% to 200%. In all cases, dashpots must not be set lower than the lowest calibration mark.

The use of the time lag curves will be clear from the following examples:

(a) 'OMA8' Breaker, 800 amp., dashpot current setting 100%, plunger time setting 'short'. For an overload of 3200 amp. i.e. 4 times 800 amp. the time lag can be estimated from Fig. 4 as 0.22 seconds. For a short circuit current of 20000 amp. i.e. 25 x 800 amp., the time lag is 0.025 seconds.

(b) 'OMA12' Breaker, 1600 amp., dashpot current setting 150%, plunger time setting 'long'. For an overload of 3200 amp. i.e. 2 x 1600 amp., the time lag is 110 seconds from Fig. 3. For a short circuit of 20000 amp. i.e. 12.5 x 1600 amp., the time lag is 1.0 seconds.

The above examples also show that the time lag characteristics are such that discrimination between breakers is possible up to fairly high short circuit currents.



OVERCURRENT RELEASE TIME LAG CURVES
TYPE OMA 10 — 31 CIRCUIT BREAKER. (75 — 150% SETTINGS)

FIG 3 CURRENT – TIMES RATED I

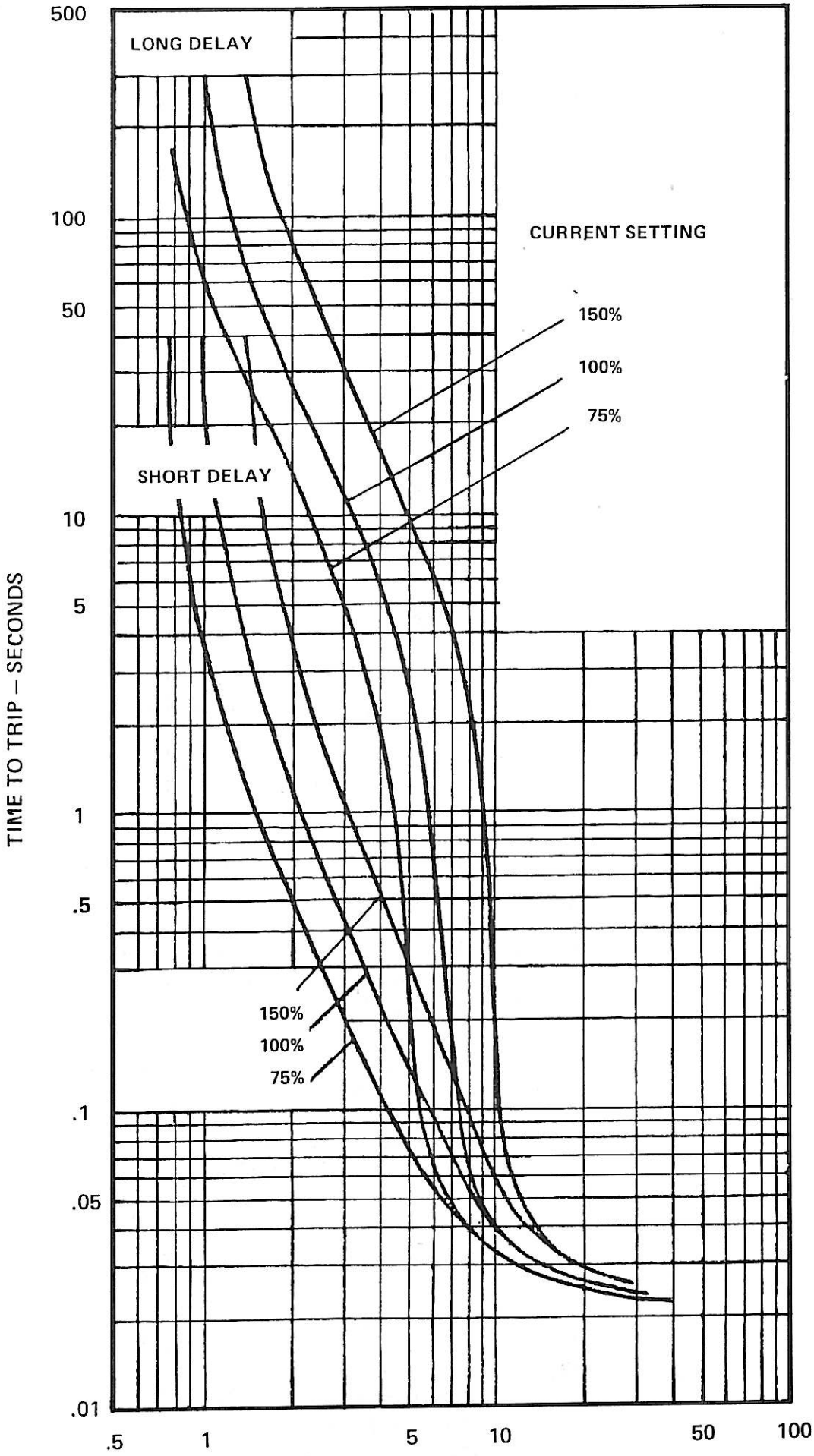


FIG 4 CURRENT – TIMES RATED I

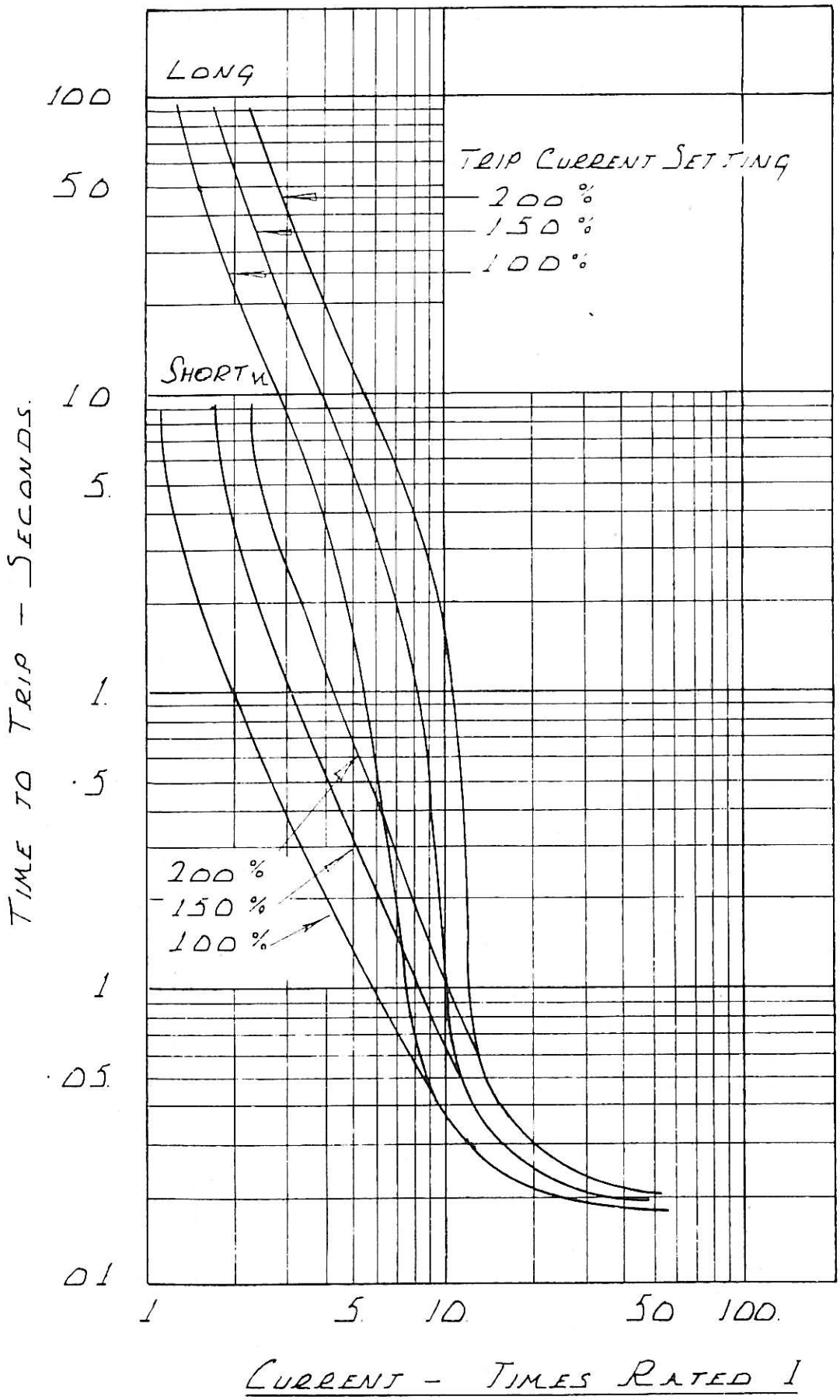


FIG. 5a OVERCURRENT RELEASE TIME LAG CURVES
TYPE OMA 8 CIRCUIT BREAKER
800 AMP SERIES TRIP (100 – 200% SETTINGS)

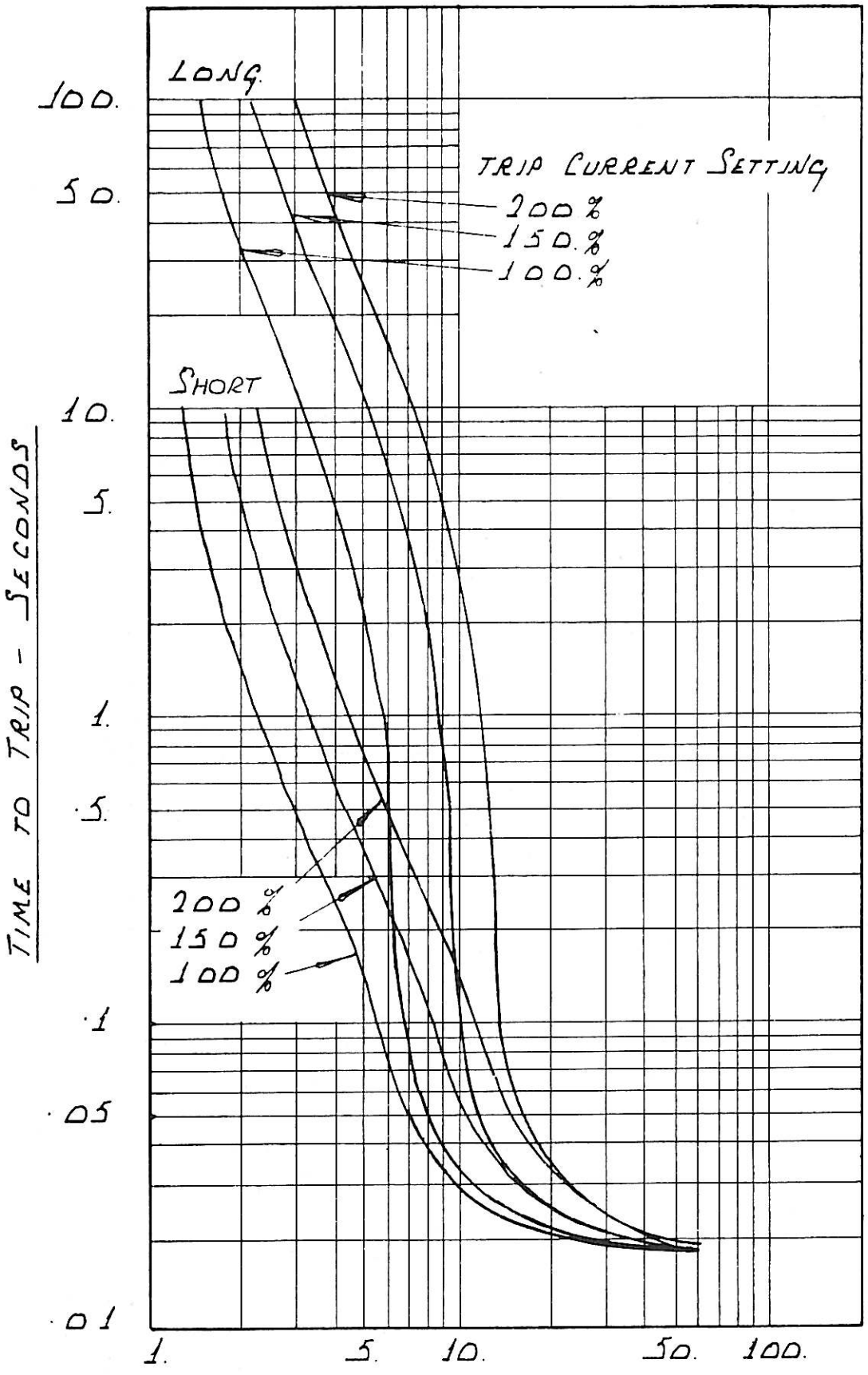


FIG. 5b OVERCURRENT RELEASE TIME LAG CURVES
TYPE OMA 8 CIRCUIT BREAKER
400, 500, 600 AMP SERIES TRIP (100 – 200% SETTINGS)

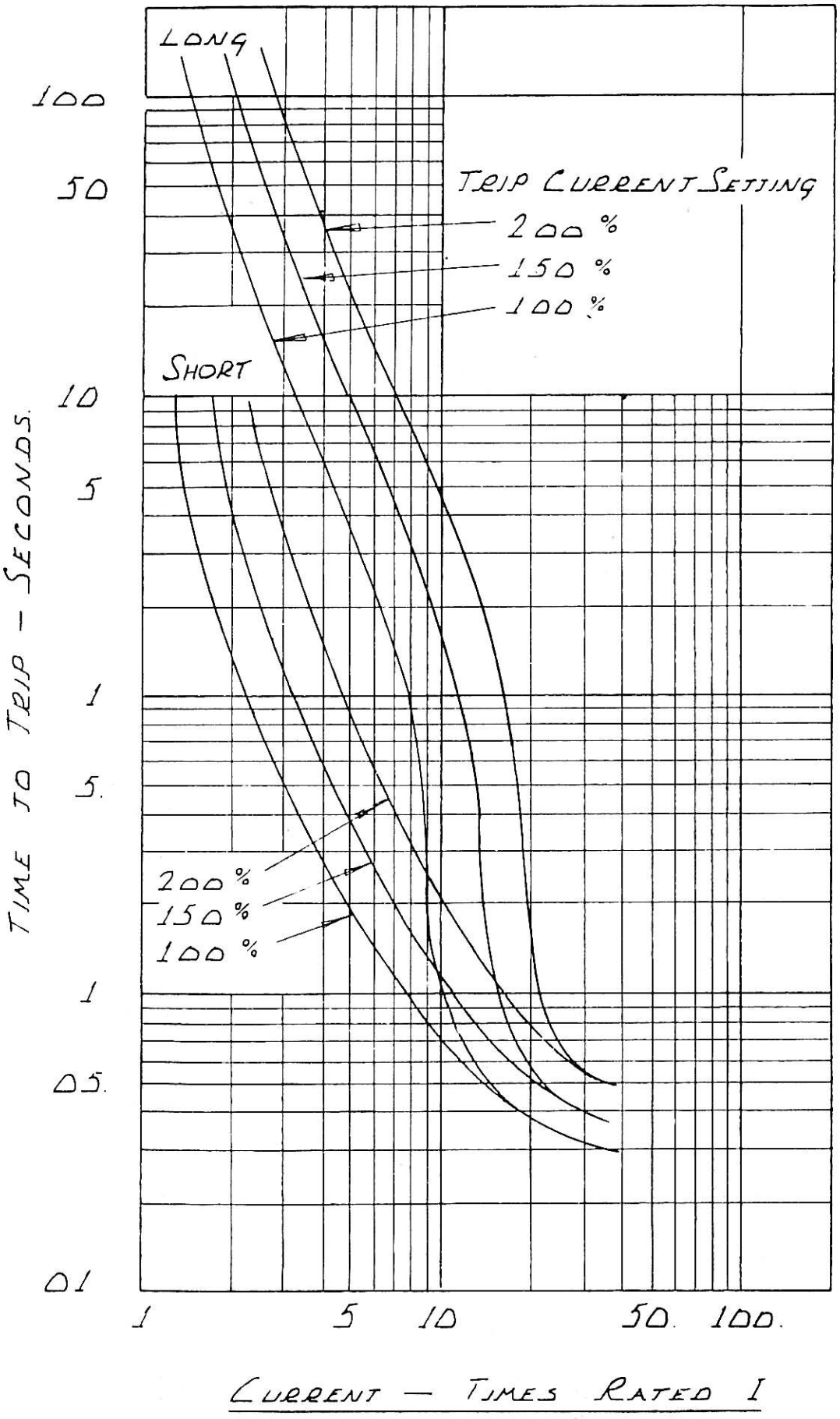


FIG. 5c OVERCURRENT RELEASE TIME LAG CURVES
TYPE OMA 12, 16, 14 AND 31 CIRCUIT BREAKER
C.T. OPERATED TRIP COIL (100 – 200% SETTINGS)

2.6.2 High Set Overcurrent Releases

Available only in the OMA8 Frame Size and set to trip the circuit breaker at approx. eight times full load current. These trips are not adjustable.

2.7 Arc Chutes

The arc chutes can be removed for inspection of the chutes or inspection of the contacts, after the breaker has been withdrawn to the inspection position. The breaker must not be put back into service, even on a temporary basis, unless the arc chutes are replaced.

The arc chutes are held in position by the insulated angle cross member at the front of the chutes. To remove this member unscrew the long studs at either end. The chutes can now be swung back on their rear hinge, lifted off the hinge pin, and then brought forward and out of the unit. See Fig. 6.

To replace the chutes, offer them top first into the unit and locate the slotted hinge bracket on the back of the chute with the hinge pin on the back connection. The chutes can then swing forward into position. Ensure that they are correctly located on the hinge, and correctly positioned centrally round the fixed contacts. The front supporting angle and the long studs can then be replaced.

2.8 Slow Closing (Spring Close Mechanism)

As the normal purpose of slow closing is to inspect and adjust the contacts, it is arranged that the arc chute fixing studs are used for the slow closing operation. First remove the arc chutes as described in Sec. 2.7 and insert the long fixing studs across the top of the mechanism spring housing through the holes provided. Push the red lever on the left hand side towards the back of the breaker as far as it will go, and then the breaker can be slow closed by the operating handle. See Fig.7. It can be partly or fully closed, and can also be slowly opened, by moving the operating handle upwards. Remember to close the bottom access door.

If the breaker is returned to the service position with the studs still in the spring top housing the breaker will not close at all, and this provides a safety feature to prevent slow closing in service.

Refer Sec. 4.9.3. for Solenoid Mechanism.

2.9 Earthing Device

The breaker can be adapted for earthing either side of the incoming circuit. Unless the breaker has been ordered originally to provide the earthing facility, certain modifications and additions will be necessary before the earthing device can be fitted.

The method of earthing is by removal of the appropriate isolating contact clusters, except for OMA 31 framesize where the appropriate plug contacts are removed and others exchanged for special extension plugs. Either operation is easily achieved by removing appropriate screws, after withdrawing the breaker to the bench.

The connections from which clusters or plugs have been removed can now be connected to the breaker earth bar, and for OMA 31 special shutter operators attached.

On re-engaging the breaker to the normal service position, (for OMA 31 an earlier indicated position), and closing the breaker, the side of the system on which contacts have not been removed or have been exchanged, will be earthed through the breaker.

Complete instructions are supplied with the earthing device.

3 COMMISSIONING

3.1 General

Before energising the system the equipment should be inspected and its operation checked. The following inspection procedure should be followed:

3.2 Preliminary Inspection

Withdraw the breaker to the inspection position (see Sec. 2.3) and remove the arc chutes (see Sec. 2.7). Check for any sign of damage to the breaker or arc chutes due to transport or any other reason. Remove any dust or wood wool etc. due to storage or packing. Remove any transport ties.

3.3 Insulation

Wipe all insulation clean and dry with a clean lint free cloth if there is any sign of dust or damp.

If the equipment is wet due to poor storage, allow to dry out thoroughly before energizing the system. If in doubt check the insulation resistance with Megger. Dry the arc chutes in warm air or a warm room.

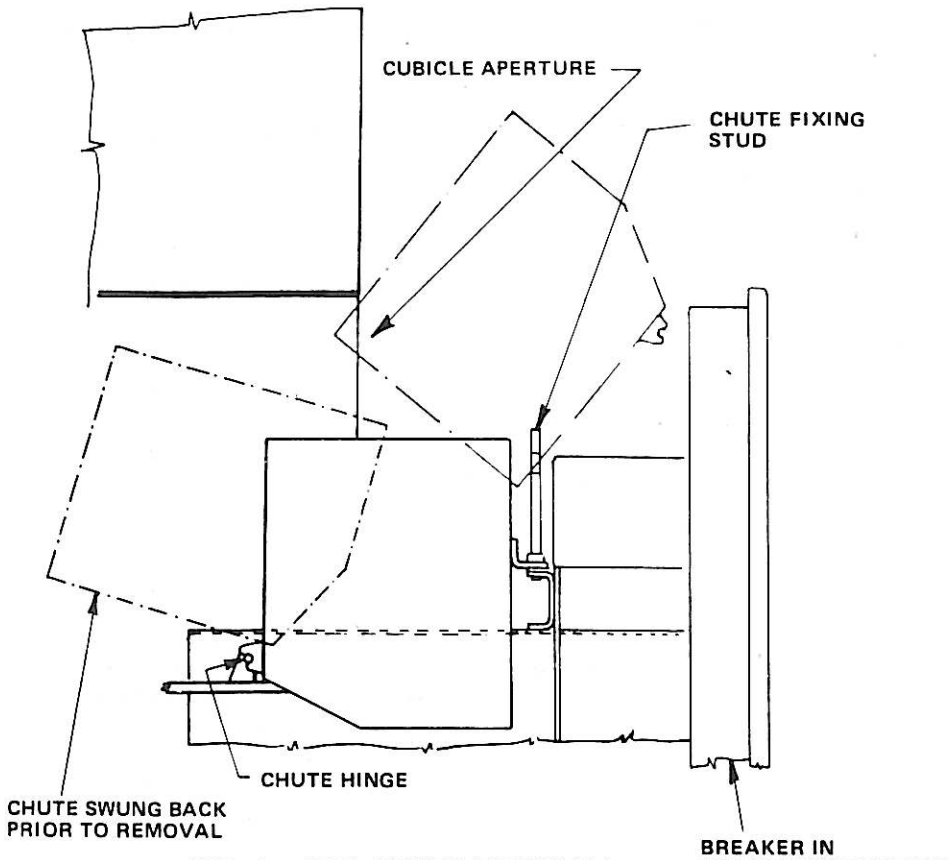


FIG. 6. ARC CHUTE REMOVAL

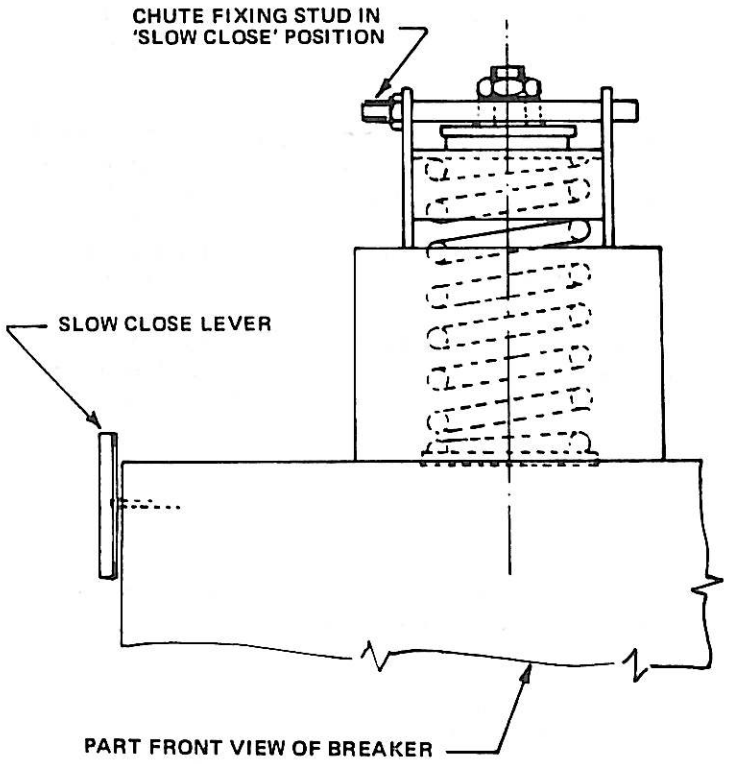


FIG. 7. BREAKER SLOW CLOSE

3.4 Contacts

Wipe the main contacts to remove any dust or foreign matter which would prevent proper contact on closing.

Slow close the breaker (see Sec. 2.8 or Sec. 4.9.3) and check that all arcing contacts touch at approximately the same time. There should not be a gap exceeding about 1/32" (0.8mm) on any arcing contact after the first contact has touched. Adjustment should not be required, but if it is necessary see Sec. 4.2.2. Remove the slow close attachments and check the breaker operation on the automatic spring close, taking care to keep hands away from any moving parts when the breaker operates.

If an undervoltage release is fitted it will be necessary to hold or tie up the plunger in order to operate the breaker.

3.5 Overcurrent Release

Remove the dashpots (see Sec. 2.6) and remove the plungers and carefully wipe the dashpot and plunger clean and free from dust, using a clean lint free cloth. Unless instantaneous tripping is desired fill the dashpots with the 1000 Centistoke fluid supplied to 7/8" (22mm) from the top of the dashpot with the plunger removed. Only change the time lag setting if necessary (see Sec. 2.6). Replace the plunger and screw back the dashpots and set to the required setting. Replace the dashpot locking bar with the narrow part of the keyhole slot at the top.

3.6 Isolating Contacts and Shutters

It is desirable to inspect the isolating contacts and shutters, but this requires a suitable truck or overhead crane to do this, as it is necessary to completely remove the breaker (see Sec. 2.3). Ensure that the main supply is isolated before operating or adjusting the safety shutters.

MAINTENANCE

4.1 General

The equipment should be inspected and the operation checked every six or twelve months, or every 500 operations. Check for loose screws and check the adjustment of the mechanism and contacts. Lightly oil bearings and shafts, but only thin machine oil should be used on the tripping levers and rollers. If necessary the insulation should be wiped, and the inside of the arc shutes should be wiped.

See under separate headings for any necessary adjustments.

4.2 Contacts

4.2.1 Contact Maintenance

All contacts have arc resisting or silver inserts on the contact faces, and they need very little attention. On the OMA.8 frame size the top arcing tip requires no attention, and the main contact should be wiped or cleaned with metal polish if it appears black or oxidised. If the main contact face becomes rough due to frequent heavy current interruption the high spots only should be removed with a smooth file. Remove all filing and dust and very lightly grease the faces using BP Vaseline or proprietory contact grease.

On frame sizes OMA.10, 12, 16, 24 and 31 the top two contacts are the arcing and intermediate arcing contact, and should require no attention at all even if they appear rough and oxidised. The main contacts are the lower bridge contacts, which are silver faced, and these should only be wiped clean or any oxide removed with metal polish, taking care that all dust and lint is cleared away. Very lightly grease the faces. Slight pitting and roughness on these contacts is of no consequence.

4.2.2 Contact Adjustment

Check that all arcing contacts touch at the same time, and this is adjusted by means of the ¼" BSF locked nuts projecting from the back of the contact housing. If the locked nuts are disturbed they should be re-locked by turning one flat past the point where they are just tight. It is important that they are correctly locked to avoid the vibration during operation allowing the contacts to come out of adjustment. When all the arcing contacts are just touching, the gap on the lower contact of the same finger should be between .060" and .120" (1.5mm – 3.0mm) (See Fig. 8).

4.2.3 Fixed Contact Removal

The fixed contacts can be removed on the OMA.8 frame size by undoing the two 3/8" Whit (or M10) screws holding the contact and contact block to the connection, and then removing the 5/16" BSF countersunk socket head screws on the bench. On

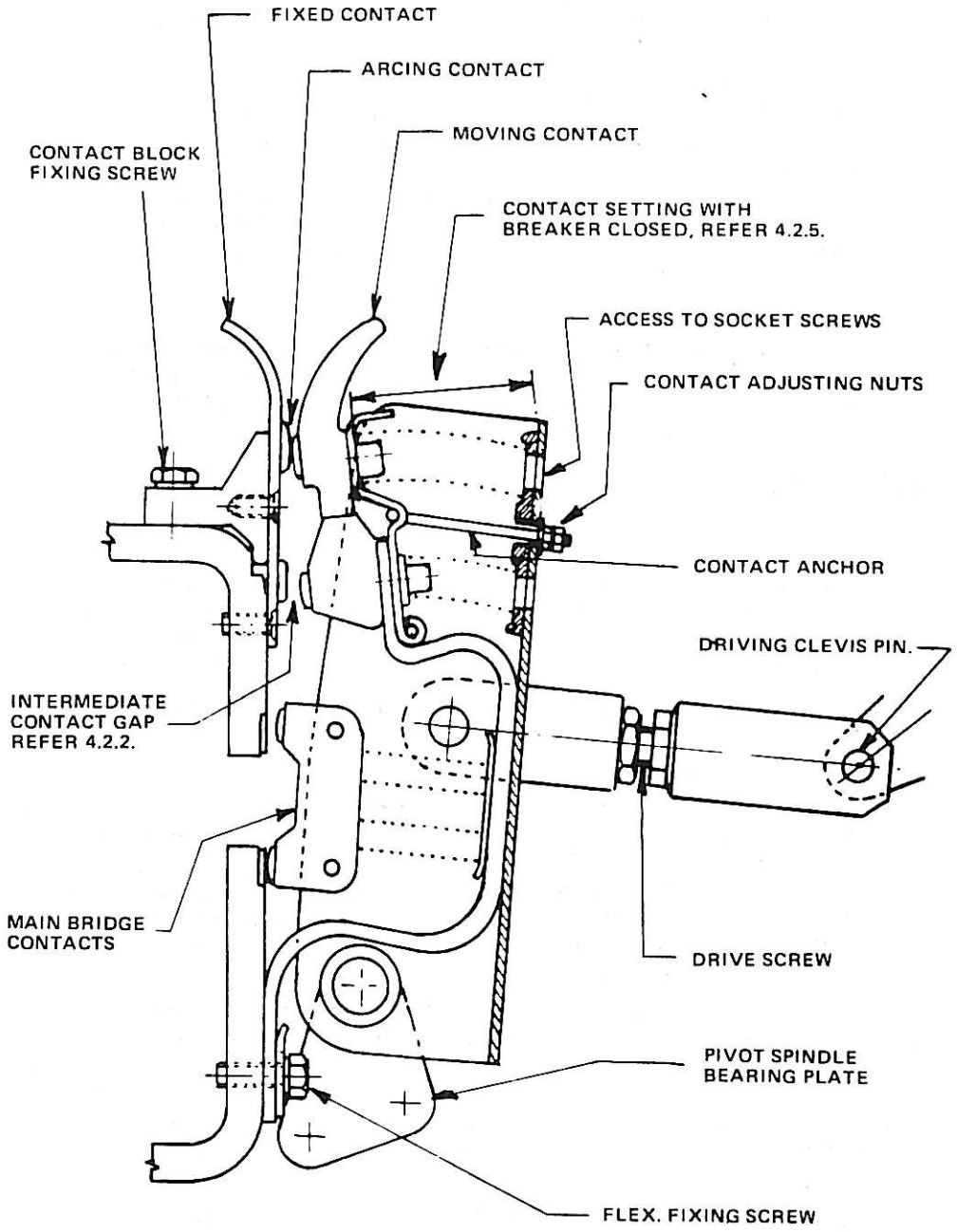


FIG. 8. CONTACT ARRANGEMENT

the OMA.10, 12, 16, 24 and 31 frame size the lower countersunk screws should be removed, and then the two 5/16" Whit. (or M8) screws holding the contact block. It is then easier to remove the top countersunk screws on the bench. When replacing these contacts it is important to tighten the countersunk screws fully by means of an extension to the socket key approximately 4" (100mm) long. The socket key size is 3/16" A/F.

4.2.4. **Moving Contact Removal**

The moving contacts are held in the housing by means of 5/16" BSF socket screws, and access for a 7/32" A/F socket key is obtained through the holes in the back of the housing. See Fig.8. The screws have to be loosened and tightened with an extension to the wrench. It is recommended that the breaker is in the closed position, with a wood block between a contact housing and the front cross member to prevent inadvertent opening of the breaker. The wrench can be inserted and the screws loosened one phase at a time. The breaker can then be slowly opened, using the slow close attachments, and the contacts removed. The contacts can be replaced in a similar way. The screws must be fully re-tightened using the extension to the wrench.

Check that the contact fingers are square in the housing, and can be depressed against the spring without undue rubbing against the insulation spacers at the side of each contact. Care is also necessary when starting the screws, to ensure that the thread is not crossed, and that the flexible connection is correctly clamped against the contact back. The screws are a special cap head screw with a nylon insert, and no substitute must be used.

4.2.5 **Contact Housing Removal**

On the OMA.10, 12, 16, 24 and 31 frame sizes if necessary the complete contact housing can be removed from the insulating side panels. For this operation the breaker should be removed from the unit on to a bench, and the contact flexes disconnected from the bottom connections by undoing the 5/16" Whit. (or M8) hexagon head screws. With the breaker in the open or nearly open position the pins connecting the insulated drive rod and the main shaft driving clevis can be removed after removing the circlips, and obtaining access through a hole in the side frame of the circuit breaker. This hole is exposed by removing the stop at the end of the aluminium slide rails and pushing the rails toward the back. The screws holding the lower carriage pivot spindle bearing plates can now be removed, and the plates and spindle swung down and forward to release the spindle from the slot in the side mouldings. The complete contact assembly can then be withdrawn upwards through the top of the breaker. See Fig.8. If a major adjustment has been made, or the insulated drive screw adjuster disturbed, it is necessary to check the contact spring compression. The breaker should be closed and a steel rule not more than ½" (12.7mm) wide inserted along the top of the contact carriage, and the setting dimension should be 1.13/16" to 1.7/8" (46 – 47.5mm) as shown in Fig. 8. This dimension can be re-set by turning the drive adjuster screw after releasing the lock nut at the clevis. It is important to re-lock the clevis nut after adjustment.

On the OMA.24 and 31 frame size duplicate drive screws are used, and these must be adjusted uniformly to keep the assembly parallel. The outer main bridge contact fingers of any phase must touch the fixed contact at the same instant.

On OMA.10, 12, 16, 24 and 31 breakers there should be a gap of approximately 3/32" (2.4mm) between the top main bridge contacts when the intermediate arcer just touches. This gap is not adjustable and should only vary due to contact burning, which is very small.

4.3 **Trip Coils**

4.3.1 Type OMA.8

To change the series trip coils on the OMA.8 frame size proceed as follows:

Rack out the breaker to the inspection position, or withdraw completely to a work bench. Remove the dashpots and plungers, and remove the small plate locating the racking shaft. Remove the screws at either side of the dashpot support plate, and this support plate can then be dropped and brought forward, noting that it must be released from the insulating tube passing through the trip coil, and released at the same time from the racking shaft. The insulating sheet and tube packing washers can then be removed. See Fig.9. Coils of 400 amp rating and below have an extra insulating support near the coil ends, and the support is bolted to the dashpot support plate. The bolts must be removed before the support plate is removed.

The coil ends are bolted to the connections with ½" Whit. (or M12) bolts which may be removed, using a box spanner, and the coil then dropped down. Note the tubular spacer between the two connections, and ensure that this is left in place.

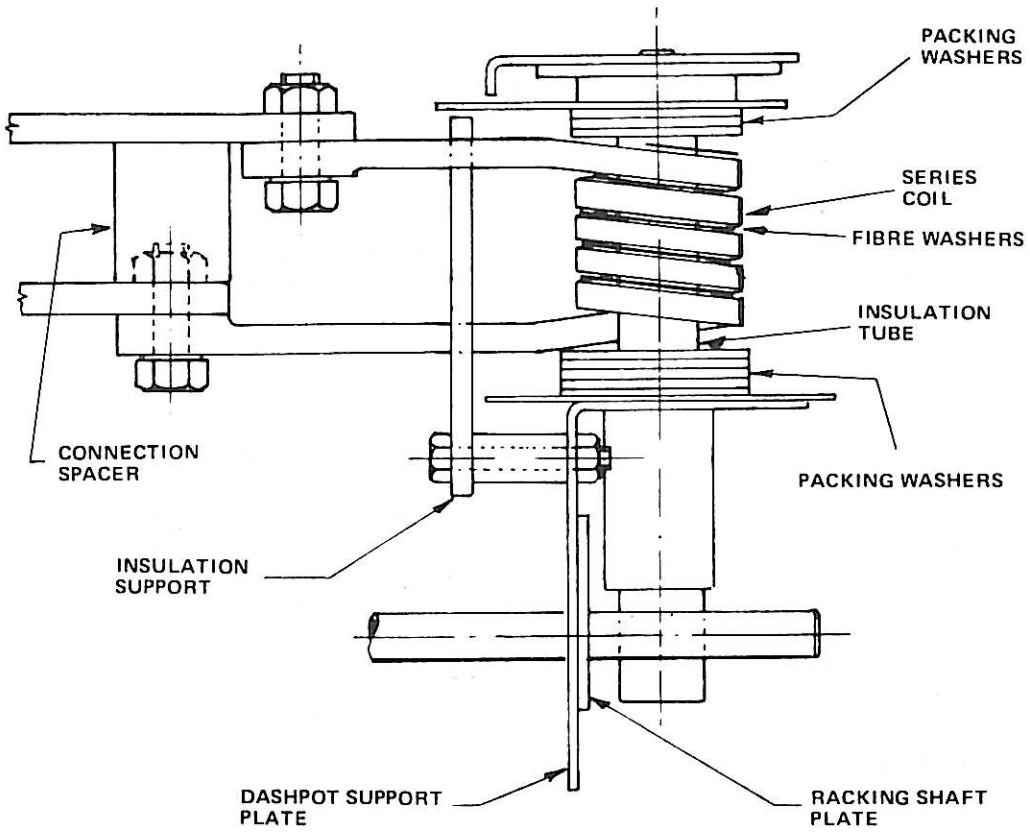


FIG. 9. O.M.A. 8. TRIP COIL

Check that the fibre washers are in place between the turns of the replacement coil. The new coil can then be placed over the insulating tube, ensuring that the tube is fully lifted into the top washers, the bottom washers and insulating sheet should be added, and the dashpot support loosely bolted into position. The ½" Whit. (or M12) screws can then be inserted and tightened, but ensure that these are the correct length for the coil ends. The dashpot support screws can then be tightened, the plunger and dashpots returned, and the racking shaft release plate fixed back.

4.3.2 Type OMA.10, 12, 16, 24 and 31

On frame size OMA.10, 12, 16, 24 and 31 the trip coils are wire wound coils operated by the current transformers, and the leads should first of all be disconnected from the terminal block, noting the wire ferrule numbers and their positions. The coil is then removed in a similar way to the Type OMA.8 coils, taking care on re-assembly that there are two washers underneath the coil. If a washer has to be left off because of a big replacement coil it should be from the top.

4.4 Isolating Contacts

The isolating contact fingers can be removed as a cluster after completely withdrawing the circuit breaker to a workbench, except for the OMA.31 frame size. Remove the two hexagon headed side fixing screws, and then the contact cluster can be pulled off the connection. The contact fingers are silver plated and require no attention or maintenance. Should a spring retainer holding the springs on the ¼" dia. brass spindles become damaged it must be replaced with the correct component, which requires a suitable tool for assembly.

The fixed isolating contacts must not be touched unless suitable safety precautions have been taken to ensure that the circuit is dead and cannot be accidentally energized. By opening the safety shutters the contact face can be inspected, and should it be tarnished it can be cleaned with metal polish and wiped clean. The surface must then be lightly greased with BP Vaseline or a proprietory contact grease. Minor pressure marks or scratches on the silver plated surface can be ignored.

4.5 Current Transformers

Except in the case of the OMA.31 frame size to change the current transformers it is necessary first to remove the isolating contact cluster as described in Sec.4.4. The current transformer leads must be disconnected at the terminal blocks after noting the ferrule numbers. The wiring harness ties will have to be cut and can be later replaced with a similar tie or twine. By removing the insulating washer the transformer can be slid off the insulation round the main connection and a new transformer slid on in its place. Return the insulating washer and refix the isolating contact cluster. It is important to carefully check the current transformer wiring and the trip coil wiring, as faulty connections here can prevent the breaker tripping on an overload or short circuit.

4.6 Releases

4.6.1 Undervoltage Release

The undervoltage release is fitted on the right hand side of the mechanism(*must be fitted in accordance with Fig.10.*) and is arranged to trip the breaker on a falling voltage when the voltage has dropped to a value between 70% and 30% of the rated voltage. The release will re-set when the voltage has risen to between 80% and 90% of the rated voltage. Until the device has re-set the breaker cannot be closed. A check that the release will trip the breaker can be made by closing the breaker in the inspection position with the release energized from a separate supply via its terminal block. Disconnecting the release should trip the breaker. Should the breaker fail to trip, and inspection of the release indicates that it appears to be mechanically satisfactory, it will be necessary to check the spring force on the release.

After removing the front panel (see Sec. 4.8.1) it is possible to check the spring force by means of a small spring balance and a wire or string loop tied to the release operating rod. The spring force should be a minimum of 2½ lbs. (1.13 kgs.) and this should trip the breaker. If necessary the complete undervoltage assembly can be removed by removing the split pin and spindle connecting it to the trip bar, and removing the nuts holding the assembly to the breaker cross member. If the release is satisfactory, but the breaker does not trip, it will be necessary to check the mechanism tripping assembly as described in Sec. 4.9.

If the release becomes noisy it will be due to the magnet face failing to seat correctly, due to damage or dirt, or mechanical mal-alignment. If no reason can be seen for mechanical mal-alignment the device should be operated a few times by energizing and breaking the supply. If this fails to cure the trouble the device must be removed and dismantled for inspection, and if necessary replaced.

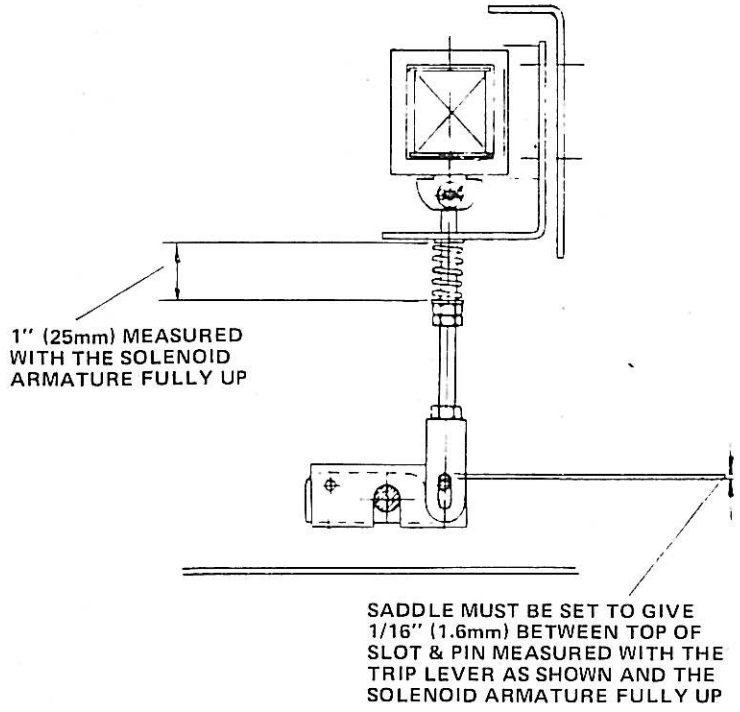


FIG. 10. UNDERVOLTAGE RELEASE.

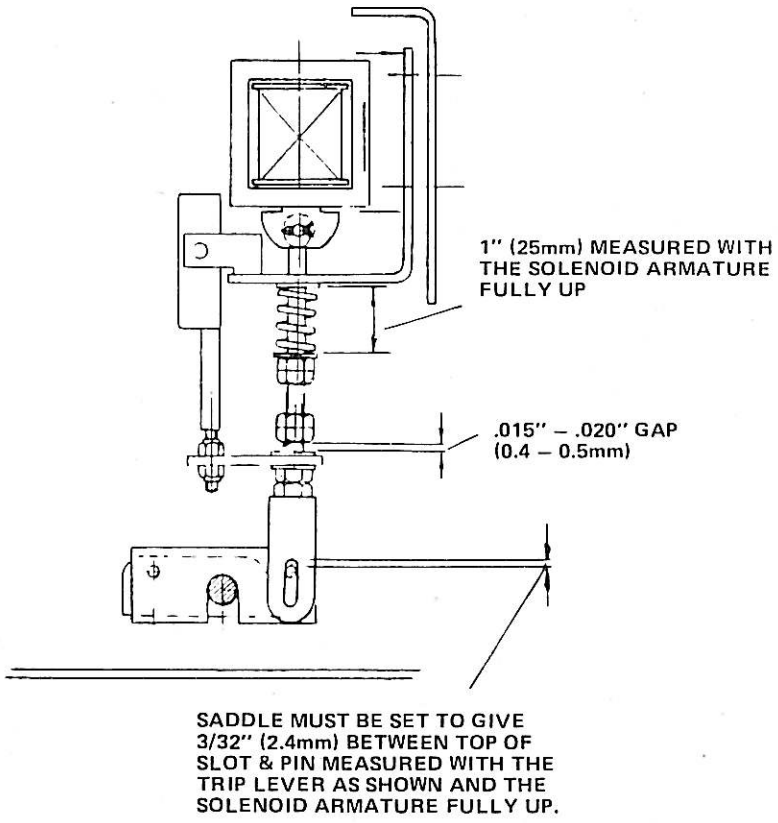


FIG. 11. UNDERVOLTAGE RELEASE WITH MECHANICAL TIME DELAY.

A mechanical time lag device can be supplied with the undervoltage release which will give a small non adjustable tripping delay. The assembly must be mounted and set as illustrated in Fig. 11. Failure to set the adjustments to the dimensions indicated will result in the release becoming noisy.

4.6.2 Shunt Trip Release

The maintenance programme should include checking the shunt trip by applying a suitable voltage between 80% and 120% rated voltage, and if the breaker fails to trip the circuit should first be carefully checked. The coil is short time rated, and the supply is cut off by an auxiliary switch after the breaker trips. When testing, the coil must not be energized for more than one or two minutes at a time. Ensure that the electrical circuit and switch circuit is correct, and visually inspect the device, which is fitted on the right hand side of the mechanism, for possible mechanical causes of failure. If further investigations are required the front panel must be removed, (see Sec. 4.8.1) and then the release operating rod can be disconnected from the trip bar by removing the split pin and spindle. Check that the slot in the saddle is 1/16" (1.6mm) clear of the pin. Fig. 12 refers. The operation of the device should again be checked, and if the magnet is attracted with reasonable force it will be necessary to check the mechanism tripping force as described in Sec. 4.9.

4.7 Auxiliary Circuits

4.7.1 Auxiliary Switch

The auxiliary switch drive should be inspected for mechanical adjustment, refer Fig.13. and the pivots oiled. If the switch is the type with accessible contacts they should be wiped if necessary and lightly smeared with BP Vaseline or proprietory contact lubricant.

4.7.2 Auxiliary Plugs & Sockets

The auxiliary plugs and socket contacts are in units of four, and are located underneath the circuit breaker. They have a self cleaning action. The plugs should be lightly greased and if they appear oxidised they can be cleaned by engaging and isolating the breaker a few times.

4.7.3 Secondary Wiring

The secondary wiring terminals should be checked for tightness at terminal blocks, instruments, auxiliary switch terminals and secondary contacts etc. It is vital that the trip circuits are correct and terminations tight, as failure of the connections could lead to the breaker failing to open in the event of a heavy overload or short circuit.

NOTE that the fixed secondary contact terminal blocks are located at the rear of the circuit breaker housing, and are only accessible from the rear of the switchboard after ensuring that all circuits are dead.

4.8 Front Cover & Interlocks

4.8.1 Front Cover Removal

The front cover, complete with indicators, is held in position by four 3/8" Whit. (or M10) studs, and after removing the nuts, washers, springs and spacers the cover can be withdrawn from the breaker. NOTE, however, that if there are any instruments on the front cover the wiring should first be disconnected at the terminal block.

When replacing the cover it is necessary to first locate it in position at the end of the studs, and then push it into position carefully after correctly locating the various interlock and indicator drives. The bottom door interlock operating screw must go over the top of the bottom interlock arm. The push button trip lever must go over the top of the trip bar screw. The ON/OFF indicator stud at the bottom of the slide must go above the operating lever. The position indicator operating stud must go below the operating arm. The nuts are to be screwed up to allow the cover to be pulled 1/8" (3mm) against the springs and then the nuts locked up.

4.8.2 ON/OFF Indicator

The ON/OFF indicator should only require adjusting if an operating screw has come loose, and in this case proceed as follows:

The top 2BA (or M5) screw is adjusted and locked to centralise the OFF indication in the aperture. The operating lever pivot is adjusted in the slot to centralise the ON indication with the breaker closed. This fixing must be tight. For safe working this adjustment must be done using the slow close facilities, and taking care to avoid injury if the breaker trips open.

4.8.3 Position Indicator

The breaker position indicator should only be out of adjustment if the operating

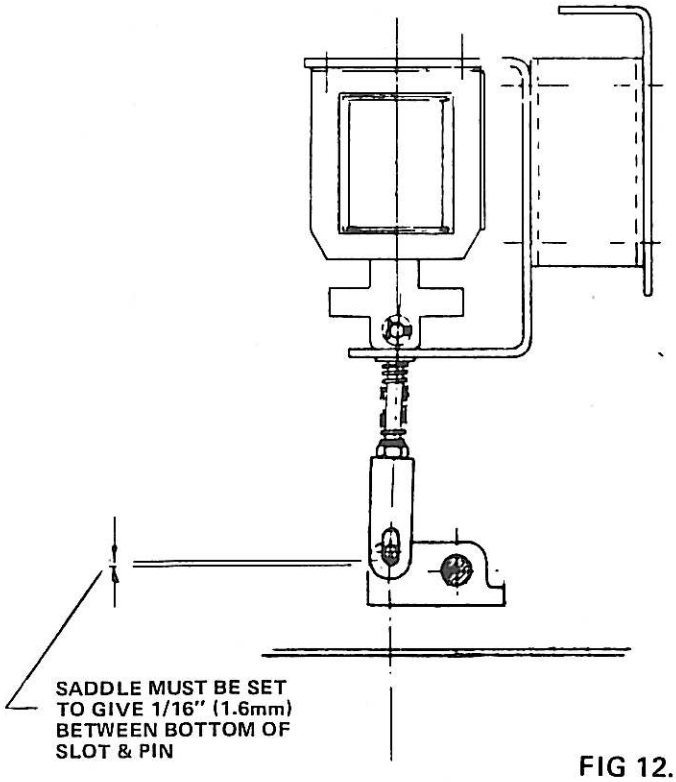


FIG 12. SHUNT TRIP

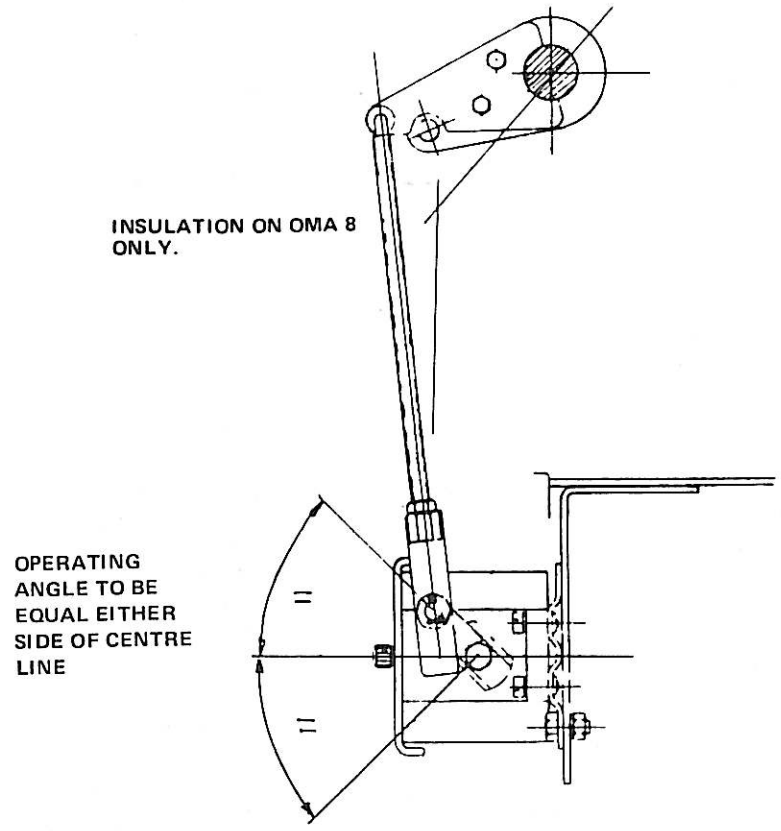


FIG. 13. AUXILIARY SWITCH

cam on the right hand side of the housing has moved in its fixing slots, or the adjust ing screw has come loose. Check that the wire stop holds the operating roller just below the entry to the cam. Rack the breaker to the "ISOLATED" position, which is approximately 1.7/8" (48mm) out from the "SERVICE" position, and where the racking mechanism has just held the breaker so that it cannot be withdrawn. The OBA (or M6) round headed screw on the indicator operating lever must be adjusted and locked so that the "ISOLATED" reads in the centre of the aperture when the roller is on the third horizontal cam face counting from the bottom. Lateral adjustment of the cam on the OBA (or M6) fixings is now made to bring the "SERVICE" position into the centre of the window at the end of the racking in operation.

4.8.4 Interlocks

The interlock settings should not be disturbed, and only if one of the operating screws or the operating cam on the housing has become loose or been disturbed should any action be taken.

Check that with the circuit breaker in the "SERVICE" position there is a small clearance between the nut on the top of the vertical interlock operating rod and the corresponding face of the trip bar casting. See Fig.14. If this gap exceeds about 3/32" (2.4mm) re-adjust this to approximately 1/16" (1.6mm).

With the breaker racked in check and set the overload screw on the door interlock to give a clearance of 1/32" to 1/16" (0.8 to 1.6mm) to the top of the interlock operating lever pivotted to the circuit breaker. With the front cover removed, and the circuit breaker racked fully in, there should be a small clearance of 1/32" to 1/16" (0.8 to 1.6mm) between the interlock roller and the sloping face of the cam fixed to the right hand side of the breaker housing. See Fig. 14. This face can be adjusted by releasing the three fixing screws and sliding the cam. The clearance can be checked by means of a length of 1/16" (1.6mm) dia. wire bent at the end to form a guage. It is important that the screws are properly tightened after this adjustment.

Depressing the trip button should trip the circuit breaker before it is possible to open the access door, and this is re-set if necessary by adjusting the roundheaded screw on the trip bar casting. If this screw is re-set ensure also that with a standard padlock fitted through the trip button surround, which holds the button depressed, that the breaker cannot then be closed. If the trip button fails to release the door due to damage to the mechanism, the two small screws in the door can be removed to defeat the interlock.

When the interlocks are correctly set, if the breaker is racked in while in the ON position it will automatically trip out before the isolating contacts engage. With the breaker in the ON position, and racked into the service position, if the push button door interlock fails and the door is opened without first tripping the breaker, the opening of the door will automatically trip the breaker.

Note that the slow close feature has a self-contained interlock so that if the slow close rods are left in position and the breaker re-engaged in the service position, it is not possible to operate the circuit breaker. This results from the slow close mechanism catch being re-set to the correct position by means of a screw on the left hand side of the housing returning the red operating lever to the correct position as the circuit breaker is racked in.

4.9 Mechanism

4.9.1 General

With the removal of the front panel access to the mechanism is obtained for routine oiling of the bearings, and access to the tripping latch for inspection and oiling with light machine oil. If a check on the tripping force is necessary it can be done by means of a small spring balance and a string or wire loop round the trip bar interlock casting. The loop should be about 1" (25mm) from the trip bar centre line, and a fairly vertical pull is necessary, when the trip load should not exceed 2½ lbs (1.13 kgs). If a higher value is obtained oiling of the trip catch bearings and the roller bearings and linkage should rectify this.

All tappet locking nuts must be tight and should seat on the tappet heads without a gap exceeding .015" (0.4mm) on any tappet. If for any reason the tappet screws are completely re-adjusted it is necessary to check that the top of the trip lever prop is about 1/32" to 1/16" (0.8 to 1.6mm) above the top of the trip roller. Fig. 15.

If erratic tripping of the circuit breaker occurs immediately on closing, the probable cause would be the failure of the trip bar to return to the correct position, or maladjustment of the interlocks causing tripping due to mechanical shock. First check the trip bar seating and tappets and trip catch setting, as described previously. If this is in order check the side interlock adjustment, as described in Sec. 4.8.4. Also check

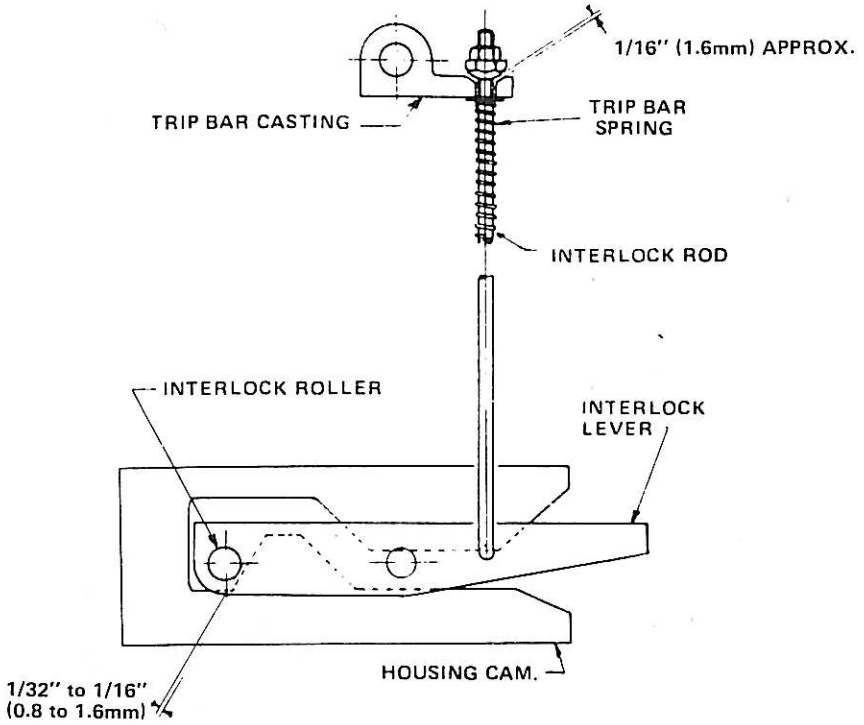


FIG. 14. INTERLOCK SETTING

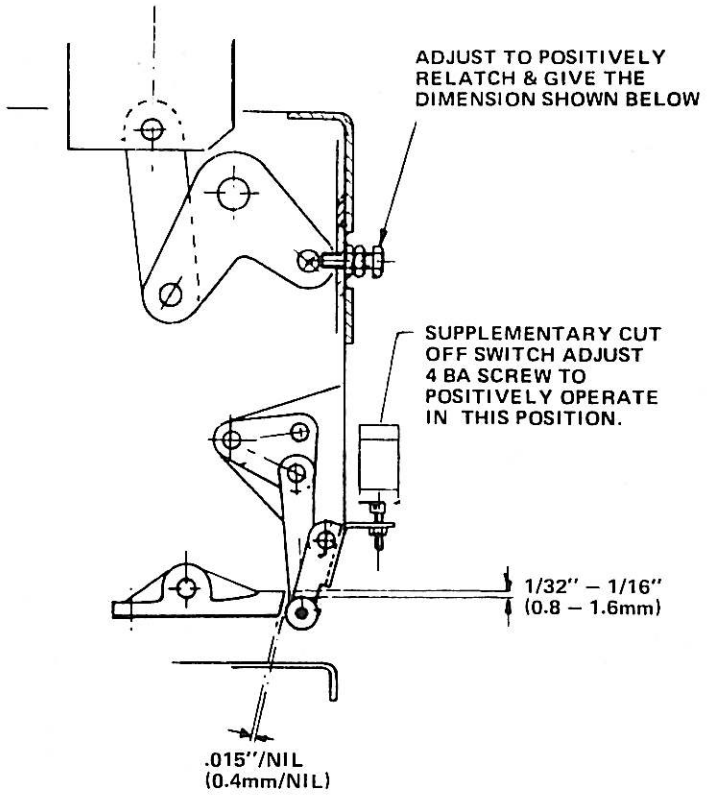


FIG. 15 RELATCHING SETTING

that the trip bar return spring on the interlock rod, Fig.14. is exerting about ½lb. (.23 kg) pressure.

The rebound latches on the inside of the mechanism housing, and the main shaft stops, on the centre clevis on the main shaft, should not normally require adjustment. If for any reason adjustment is required, the position of the rebound catch relative to the spindle should be checked through the sighting hole in the mechanism side, and the spindle should be approximately in the middle of the catch recess when the breaker is open. This position is adjusted by screwing the rebound stop screws in or out by means of a screwdriver in the slot in the end of the screw. When the position is correct the screws should be re-locked. This adjustment is critical and can affect other parts of the mechanism.

4.9.2 Spring Closing

Automatic closing of the circuit breaker on charging the spring is controlled by a firing screw, which is accessible through the large hole in the top front cross member, as shown in Fig.16. Should the breaker not close on charging the spring, or should it close before the spring top has travelled down to within about 1/8" (3mm), of the full stroke, the firing screw should be checked for adjustment. Screwing it in will fire the spring earlier, and conversely screwing it out will fire the breaker later. If the trouble is due to the screw coming loose, the re-adjustment should be made by screwing the screw fully in, and by trial and error unscrewing it until the breaker just closes on charging the spring. The screw should then be screwed out a further half turn and locked.

The stroke of the spring is controlled by the plate and nut on the top of the spring housing. This is set to give a stroke of approximately 1.9/16" (40mm) but on circuit breakers with the step in the lever face as shown in Fig. 17 it is set so that the bottom spring flange is 1/32" (0.8mm) clear of the top of the driving lever when the breaker is closed. The setting should not be disturbed.

With the mechanism re-latched and a slight pressure on the handle there should be a gap between the trip roller and the nylon screw of between 1/32" and 1/16" (0.8mm and 1.6mm).

4.9.3 Solenoid Close

Electrical operation of the solenoid mechanism can be checked in the "ISOLATED" position.

The coil and, in the case of a rectified supply being used, the rectifier, are short time rated. Duration of the solenoid current is automatically controlled via a cut off switch (which is mounted on the mechanism side plate) and an anti-pump relay in the control circuit. The cut off switch is adjusted to operate just prior to the solenoid armature reaching the top of its stroke. This adjustment is not critical, but can be checked on slow closing the circuit breaker. Any adjustment necessary can be made on the 4BA striker screw. If for any reason it is found necessary to check the solenoid current, this switch can be over-ridden but current must not be sustained through the coil for a period longer than 5 secs. in any hour.

A supplementary cut off switch, which is located behind the front panel, is operated by the circuit breaker mechanism when in the tripped position. Operation of this switch is adjusted by a 4BA striker screw.

The solenoid coil and series resistors are designed to match the supply specified. If operated from any other source, the short circuit capacity of the circuit breaker may be impaired.

The gap between the tripping latch and roller is set by means of the two 5/16" BSW (or M8) screws on the front angle. See Fig. 15.

Slow closing of the mechanism can be achieved by removing the front panel cover plate, which may be padlocked in situ and using the slow close handle provided. Should the circuit breaker be in the inspection or withdrawn position, it will be necessary to close the overload access door. If an undervoltage release is fitted this will have to be over-ridden.

This manual slow-close feature is only for emergency or maintenance use such as checking auxiliary circuits or inspecting and adjusting the breaker main contacts. This operation is therefore generally made in either 'ISOLATED' or inspection positions. If it becomes necessary to make this operation in the 'SERVICE' position the breaker must be closed *quickly and positively* after taking full precautions to ensure that no faults or overloads exist on the circuit. The making capacity of the breaker is greatly reduced when slow closing.

Mechanical adjustment of the solenoid mechanism will not be necessary unless disturbed. Re-setting can be carried out in accordance with Figs. 15 & 18.

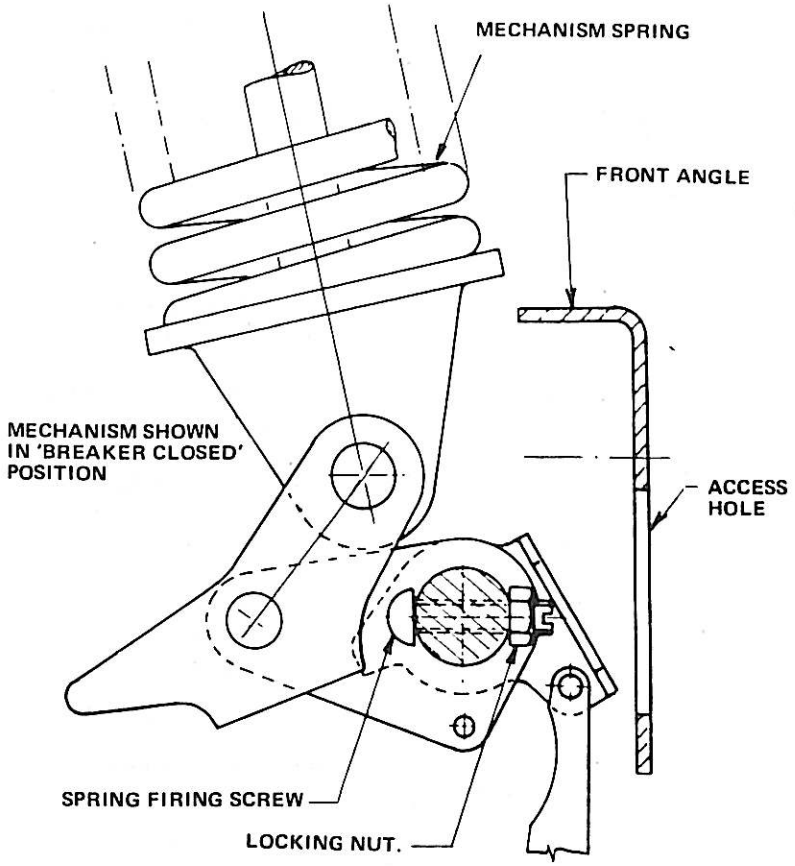


FIG. 16. SPRING FIRING ADJUSTOR

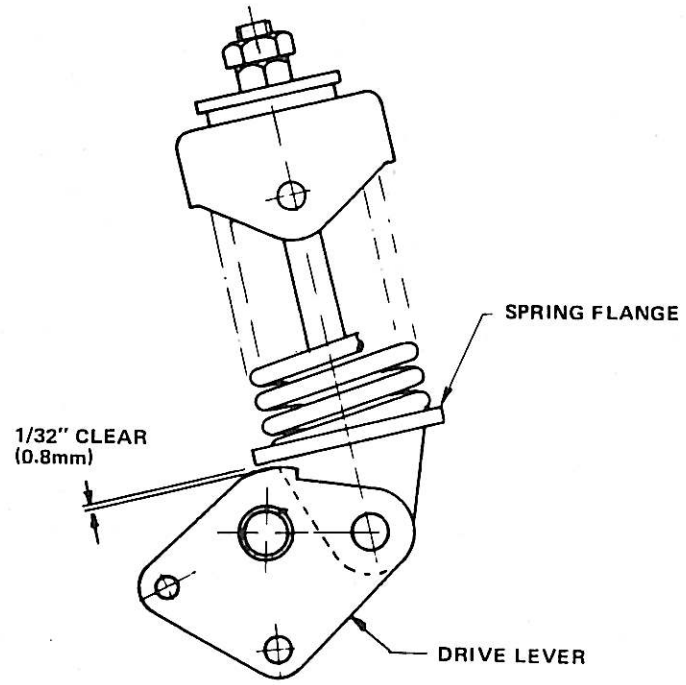


FIG. 17. SPRING STROKE SETTING

Coil replacement can be effected as follows:

1) Rack out circuit breaker to the inspection position and remove front panel.

2) Remove coil assembly from circuit breaker. (Four 3/8" Whit (or M10) screws)

3) Drive out 3/16" dia. spring pins securing the four ½" Whit. (or M12) hex. headed screws.

4) Mark screws for identification and remove together with washers and shock absorbing pads. Fig.18 refers.

5 PROCEDURE AFTER SHORT CIRCUIT INTERRUPTION

After a heavy short circuit current has been interrupted the breaker should be isolated and any carbon wiped from the insulation or inside of the arc chutes. Any metal deposits should be scraped from the inside faces of the arc chutes. The contacts should not require attention, except to clean the contact faces as described in Sec. 4.2.1. The dashpots should be removed and inspected, and the fluid level re-adjusted if necessary.

The cause of the fault should be ascertained before re-closing the breaker.

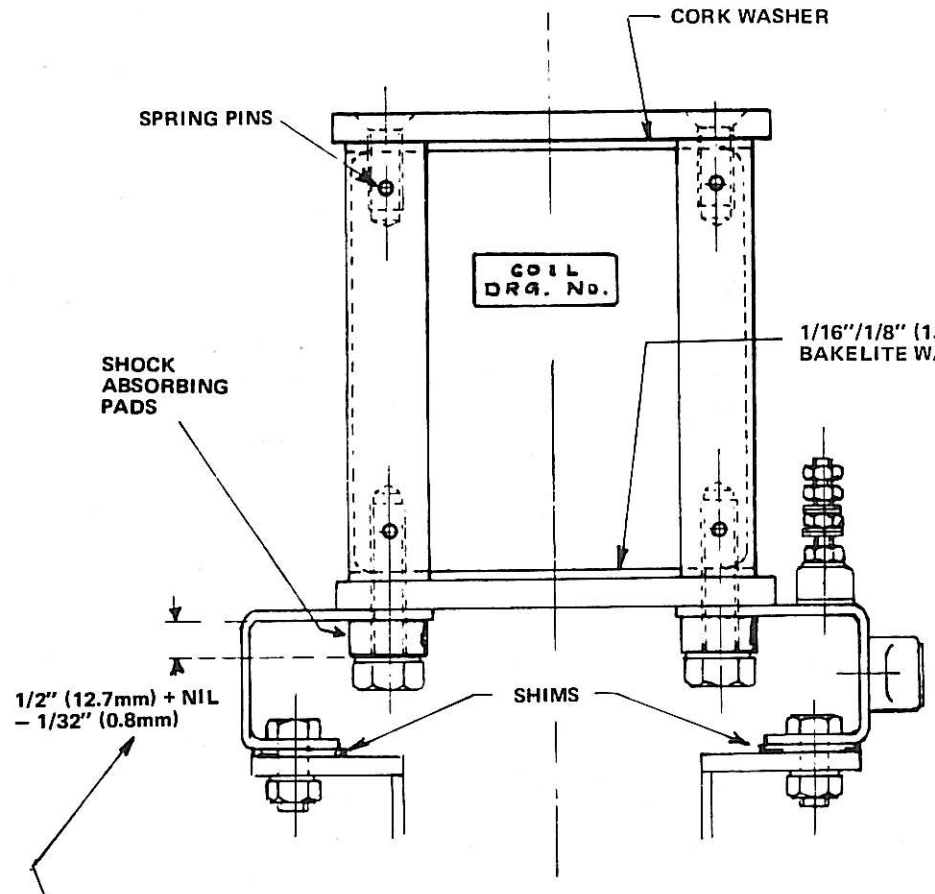


FIG. 18. SOLENOID SETTING