

**INSTRUCTIONS FOR
OPERATION AND MAINTENANCE OF
TYPE KB CIRCUIT BREAKERS**

(METAL BASE)

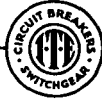


Photo 17551-R

FIG. 1—TYPE KB CIRCUIT BREAKER, MANUALLY OPERATED WITH THREE
OD MAGNETIC OVERCURRENT TRIP DEVICES

INTRODUCTION

Instructions for the operation and maintenance of type KB circuit breakers are usually furnished with each shipment.

These instructions may not cover all details or applications in connection with this equipment. Should further information be desired, or some specific problem arise which is not covered sufficiently for the purchaser's purpose, the matter should be referred to the I-T-E Circuit Breaker Company.

Filing these instructions in a readily accessible place, together with any drawings or descriptive switchgear data, will facilitate proper maintenance of the equipment and prolong its life and usefulness.



INSTRUCTIONS FOR OPERATION AND MAINTENANCE OF TYPE KB CIRCUIT BREAKERS

(METAL BASE)

APPLICATION

The type KB circuit breakers were developed for protection of feeder circuits and for use as main circuit breakers on systems where interrupting requirements do not exceed 25,000 amperes. The breaker is particularly adaptable to general industrial and switchgear applications where severe service requiring frequent opening and closing operation is encountered in general power and lighting circuits.

These breakers are available in 2, 3, and 4 pole construction. They may be manually or electrically operated and are furnished individually enclosed or switchboard mounted.

GENERAL MOUNTING CONSTRUCTION

Switchboard Mounting. Generally consists of mounting circuit breaker in a switchboard framework. A flat steel sheet or formed door is then placed over the front of the breaker compartment.

Urelite. This term applies to a circuit breaker individually enclosed within a steel box. The contacts may be closed or opened by an operating handle on the outside of the enclosure. The box cover may be easily removed for inspection of the apparatus. The breaker may be removed from the box leaving cable connections undisturbed.

The enclosure also serves as a pull box which can be secured to a wall or column, and is provided with knockouts for standard wiring conduits. The breakers are pushed in and then bolted into place. A shallow front cover with standard escutcheon cutout is bolted to flanges.

Panel Mounted Urelite. This is an individually enclosed breaker in which the cover surrounds only the front of the breaker, leaving the rear connection studs exposed.

GENERAL CIRCUIT BREAKER CONSTRUCTION

The type KB circuit breaker shown in Figure 1 is a standard 3 pole manually operated construction. For 2 pole construction, the center pole is omitted.

Each pole unit is mounted on individual insulated moldings. These moldings isolate the main current carrying structure from the metal supporting base of the circuit breaker. The metal base

forms a steel barrier between the front of the breaker and bus and cable connections.

Each pole is an assembly of a movable main contact with its protective arcing contacts. The contacts close against the upper terminal block and are connected to the lower terminal by flexible conductors. The moving contact structures are mounted on a heavy square insulated connector bar which assures that all poles will open and close at the same time.

The arc chutes surround the main and arcing contacts and are supported by mounting studs anchored to the base moldings. The arc chutes may be readily removed for inspection of the contacts.

Interphase barriers with roof provide additional insulation for adjacent poles. These barriers may also be removed conveniently after the arc chutes have been removed.

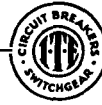
The closing and latching mechanism is enclosed in a metal housing which is fastened to a steel supporting shelf frame bolted to the breaker panel. The closing force is transmitted through a short insulating link directly to the middle of the contact arm and connector bar. The shelf frame affords a mounting support for the shunt trip and under-voltage trip when used.

Protective devices such as the dual magnetic overcurrent trip and the thermal overcurrent trip are mounted below the contact structure for each pole. When used the reverse current trip is mounted in the center for two pole and outside the right hand pole for three pole circuit breakers. The devices above act directly on the tripper bar.

The solenoid mechanism for electrically operated breakers is attached directly below the closing mechanism.

The operating handle connected directly to the breaker passes through an escutcheon which seals the necessary clearance opening in the compartment door. A position indicator which extends through the escutcheon has a two-color target colored red for breaker "closed" position and green for breaker "open" position.

The circuit breaker is mechanically trip-free so that it is impossible to hold it closed on a fault. The interrupting rating for these breakers is 25,000 RMS amperes.



SAFETY PRECAUTIONS

Before making any inspection, adjustments, or replacements, make certain all control circuits have been "DE-ENERGIZED." If the circuit breakers are mounted on pantograph mechanism, withdraw breakers completely or rack out to test position. If circuit breakers are rigidly mounted "DE-ENERGIZE" bus. Disconnect cables from leads if there is a power source on the load side.

CONTACT STRUCTURE

Main. Each pole is an assembly of a movable main contact with its protective arcing contacts. The contacts close against the upper terminal block and are connected to the lower terminal block by flexible leads.

The main moving contacts as shown in Figure 2 are two in number mounted on individual contact arms. Each contact is faced with a silver alloy insert and fastened to contact levers to which flexible conductors have been attached. These levers pivot about a bearing pin which is held in position by pressure against the contact arm through a spring link and a compression spring. When the breaker is in the open position, the lower end of the contact levers bear against the stationary main contact. One spring and its spring link are associated with each pair of contact levers. The stationary main contact is a silver alloy block fastened to the upper current stud and is positioned to engage the moving main contacts when the breaker is closed.

Arcing. The moving arcing contacts are attached to their respective conductor levers by socket head screws. These conductor levers pivot about a yoke pin which passes through side flanges of the contact arm. The yoke pin is held in place by a "U" shaped spring clip shown in Figure 2. One compression spring bears against two contact levers.

Both the moving main and arcing contacts are designed to provide a wiping action as the breaker is closed.

Each stationary arcing contact is an integral part of the arcing horn which is supported by a blow-out coil fastened to the upper terminal stud.

The moving contact structures are mounted on a heavy square insulated connector bar which assures all poles closing and opening in unison.

The correct sequence requires that the contacts close in this order, first the arcing contacts, then the main contacts. The contacts should open in

reverse sequence, but the quick action prevents observation.

Maintenance. The main and arcing contacts should be inspected at least every six months, and especially after any short circuit. The interphase barriers and arc chutes should be removed before making any examination or replacement of renewal parts.

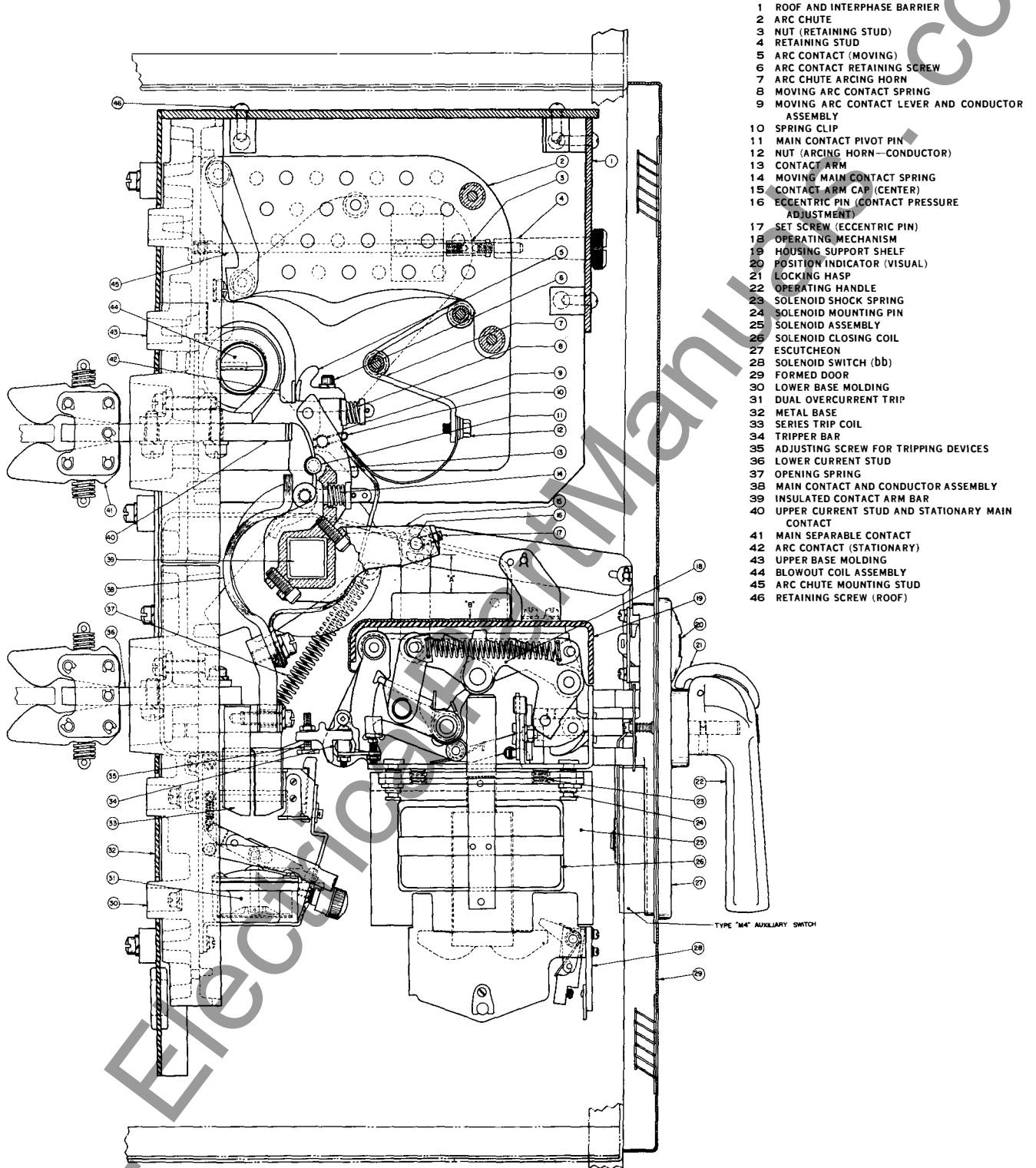
If the contacts show excessive burning, erosion, or loss of contact overlap beyond adjustment, they should be replaced. Too frequent replacements may indicate circuit conditions such as breakers opening upon currents beyond their interrupting capacity. A slight burning or "pitting" does no harm. For arcing contacts, a moderate amount of burning is to be expected, which does not interfere with proper breaker performance. Occasionally it may be necessary to dress-up the arcing contacts. This should be done sparingly with light wipes of a fine file or sandpaper. Take precautions to prevent filings or abrasive particles from falling down into the operating mechanism. Contacts badly burned should be replaced. The conductors should be inspected also to see that they are not broken or being pinched. There should be no kinks in them and the bends should not be sharp.

Overheating may be caused by loose connections between the circuit breaker and bus, or loosely bolted joints at the cable terminals. It is important not to let loose joints or undersize copper feed heat into the circuit breaker.

If a circuit breaker has not been operated for long periods of time, a high resistance oxide or sulphide may form on the contact surfaces which may result in overheating. At regular inspection periods, this high resistance film can sometimes be removed by simply opening and closing the circuit breaker several times under load. A very light dressing with a fine file may be required under severe conditions.

Adjustments. Should the operating mechanism be removed for any reason, the contact pressure will need re-adjustment.

Manually close the breaker until the main contacts just touch. Measure the distance between the buffer block and the extreme outside tip of the contact arm cap at "A" Fig. 2. Complete the closing operation until the breaker is latched closed. Repeat measurement at "A" which should show 1/16 inch (minimum) additional travel of the contact arm cap. Should adjustment be required, trip the breaker, loosen two set screws for eccentric cam and slightly turn cam and tighten its set screws. Close the breaker and recheck overtravel distance as specified. Note. Be sure set screws are tightened after making each adjustment.



- 1 ROOF AND INTERPHASE BARRIER
- 2 ARC CHUTE
- 3 NUT (RETAINING STUD)
- 4 RETAINING STUD
- 5 ARC CONTACT (MOVING)
- 6 ARC CONTACT RETAINING SCREW
- 7 ARC CHUTE ARCING HORN
- 8 MOVING ARC CONTACT SPRING
- 9 MOVING ARC CONTACT LEVER AND CONDUCTOR ASSEMBLY
- 10 SPRING CLIP
- 11 MAIN CONTACT PIVOT PIN
- 12 NUT (ARCING HORN—CONDUCTOR)
- 13 CONTACT ARM
- 14 MOVING MAIN CONTACT SPRING
- 15 CONTACT ARM CAP (CENTER)
- 16 ECCENTRIC PIN (CONTACT PRESSURE ADJUSTMENT)
- 17 SET SCREW (ECCENTRIC PIN)
- 18 OPERATING MECHANISM
- 19 HOUSING SUPPORT SHELF
- 20 POSITION INDICATOR (VISUAL)
- 21 LOCKING HASP
- 22 OPERATING HANDLE
- 23 SOLENOID SHOCK SPRING
- 24 SOLENOID MOUNTING PIN
- 25 SOLENOID ASSEMBLY
- 26 SOLENOID CLOSING COIL
- 27 ESCUTCHEON
- 28 SOLENOID SWITCH (bb)
- 29 FORMED DOOR
- 30 LOWER BASE MOLDING
- 31 DUAL OVERCURRENT TRIP
- 32 METAL BASE
- 33 SERIES TRIP COIL
- 34 TRIPPER BAR
- 35 ADJUSTING SCREW FOR TRIPPING DEVICES
- 36 LOWER CURRENT STUD
- 37 OPENING SPRING
- 38 MAIN CONTACT AND CONDUCTOR ASSEMBLY
- 39 INSULATED CONTACT ARM BAR
- 40 UPPER CURRENT STUD AND STATIONARY MAIN CONTACT
- 41 MAIN SEPARABLE CONTACT
- 42 ARC CONTACT (STATIONARY)
- 43 UPPER BASE MOLDING
- 44 BLOWOUT COIL ASSEMBLY
- 45 ARC CHUTE MOUNTING STUD
- 46 RETAINING SCREW (ROOF)

FIG. 2—TYPE KB CIRCUIT BREAKER, DEAD FRONT, FORMED DOOR, A-C ELECTRICALLY OPERATED

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ARC CHUTE AND INTERPHASE BARRIER

The arc chutes and the interphase barrier are supported by retaining studs anchored to the breaker base moldings.

The arc chute is a magnetic blowout structure. Each arc chute consists of an assembly of insulating barriers with iron vanes on the outside which are magnetized when the breaker is opened.

This magnetic field thus set up forces the arc into the extinguishing chamber between the insulating area. A stationary arcing horn in the arc chute is electrically connected to the lower terminal side of the contacts by a conductor with its attaching screw.

The arc chutes and interphase barriers are easily taken off the breaker by removing their retaining nuts.

Before putting back any arc chute after inspecting or renewal part replacement, inspect the arc chute to see that no loose, broken or burned part is existing. Liners and side plates burned away in severe service particularly on d-c circuits require new arc chute replacement. Note. Be sure holding nut attaching the conductor to the arc chute arcing horn is securely tightened. Retaining nuts holding the arc chutes and barriers should not be forced.

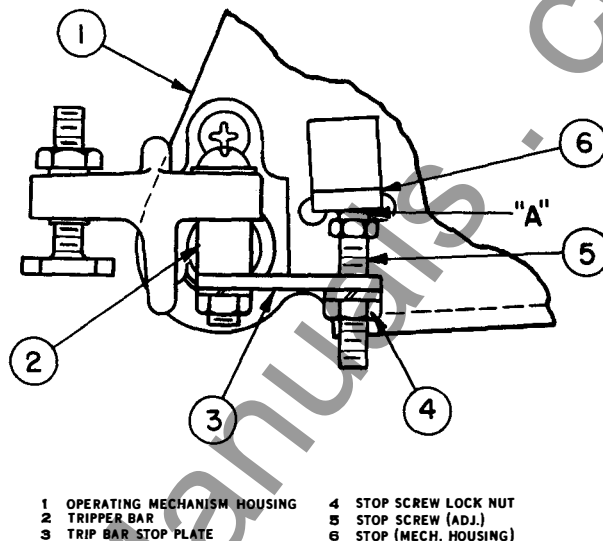
OPERATING MECHANISM

The operating mechanism as shown in Figure 2 includes the closing cams, trip free toggle latches and tripper bar. The escutcheon assembly which consists of the visual mechanism and manual operating handle can be removed with the operating mechanism, if necessary. The operating mechanism is fastened to the shelf support by six mounting screws.

The operating mechanism is mechanically trip free so that it is impossible to hold the breaker closed on a fault on which the overcurrent protective device is designed to operate. When the contacts touch under such conditions, the trip coil energizes the tripping mechanism, the toggle is released and the partly stressed opening springs return the contacts to fully open position. Breakers equipped with undervoltage or reverse current trip are trip free under conditions against which these devices give protection.

Latch Reset Adjustment. Should the breaker latch fail to reset after tripping, add a thin insulation shim (approx. 0.015 inch) under the buffer block for the contact bar operating arm at point "B" Fig. 2.

Latch Bite Adjustment. Should adjustments be necessary, proceed as follows:



Dwg. S-11581

FIG. 3—LATCH BITE ADJUSTMENT FOR OPERATING MECHANISM

1. Check freedom of latch with circuit breaker in open position. Tripper bar spring should return tripper bar stop screw against stop as shown in Fig. 3.
2. Adjust the stop screw with feeler gauge held at point "A." The breaker should trip with 0.060 inch gauge and not trip with 0.050 inch. Tighten stop screw locknut.
3. When making any latch adjustment or replacement of the operating mechanism, check the overcurrent trip travel. The time delay armature should hold on 0.030 inch and trip on 0.020. Insert feeler gauge front end of magnet at point "A" Fig. 9. The instantaneous armature should hold on 0.040 and trip on 0.030 inch. Insert feeler gauge front end of pole piece at "B" Fig. 9.

MANUAL OPERATION

To Close. The operating handle (Fig. 2) is turned clockwise (approx. 90 degrees) until the operating mechanism latch remains closed. The visual indicator will show "closed" (red). The operating handle will resume normal vertical position when released.

To Trip. The operating handle is turned counter-clockwise (approx. 45 degrees) until the operating mechanism latch releases and the visual indicator will show "open" (green).

Operation directions are also shown on the nameplate beneath the operating handle.



ELECTRICAL OPERATION

The circuit breakers may be operated electrically or manually independently of each other.

A-c Solenoid. The a-c solenoid as shown in Figure 2 is attached to the underside of the mechanism housing by four mounting pins. Four springs have been placed between the solenoid magnet frame and the mechanism housing to absorb the shock of the plunger at the end of the closing stroke. The solenoid construction consists of a magnet frame, plunger and closing coil. A rod from the plunger which extends up into the operating mechanism transmits the closing force to the toggle mechanism when the solenoid coil is energized.

D-c Solenoid. This solenoid is also attached to the mechanism housing, and is mounted to operate similarly to the a-c solenoid. See Figure 4. The construction consists of a cylindrical center section bottom plate assembly, plunger with an adjustable rod, and a closing coil.

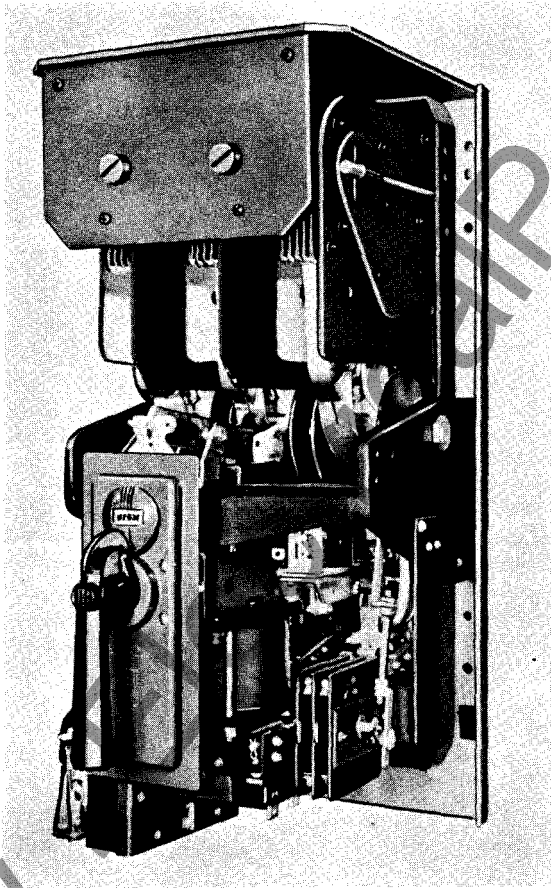


Photo 17188-R

FIG. 4—TYPE KB CIRCUIT BREAKER ARRANGED FOR ELECTRICAL OPERATION

Control Relay. A control relay as shown in Figure 6 usually mounted on the left side of the solenoid protects the solenoid against pumping or repetition of the closing stroke. As the solenoid coil is not designed for continuous service, the trip-free control relay will provide protection. A "bb" switch (Fig. 2) also attached to the solenoid is actuated by the solenoid plunger and operates in conjunction with the control relay. See section for R14 Control Relay for further information on these devices.

The wiring of the main circuit should be in accordance with the diagram accompanying the circuit breaker. Figure 5 shows a typical wiring diagram.

Adjustments. For d-c application the clearance between the top plate and the mechanism housing is maintained by four mounting bushings with two shock springs compressed between the top plate and the mechanism housing.

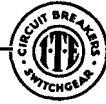
Should the plunger have too much overtravel (slamming) or not enough to allow the mechanism to latch close, remove the plunger stop pin and allow plunger to drop out. Screw in plunger rod to correct overtravel or screw out to increase plunger rod travel. Note. Turn plunger rod gradually between adjustments. Replace plunger and stop pin in this position and push plunger up until stopped. Release handle from fully closed to normally closed position. Plunger should be pushed down 0.010 to 0.030 inch. (This measurement may be made with a depth gauge).

TYPE R14 CONTROL RELAY

For electrically operated circuit breakers, control relays as shown in Figure 6 with heavy duty contacts are generally required to control the relatively large currents drawn by the closing coils. Standard control switch contacts are not designed to handle the current required for solenoid closing coil.

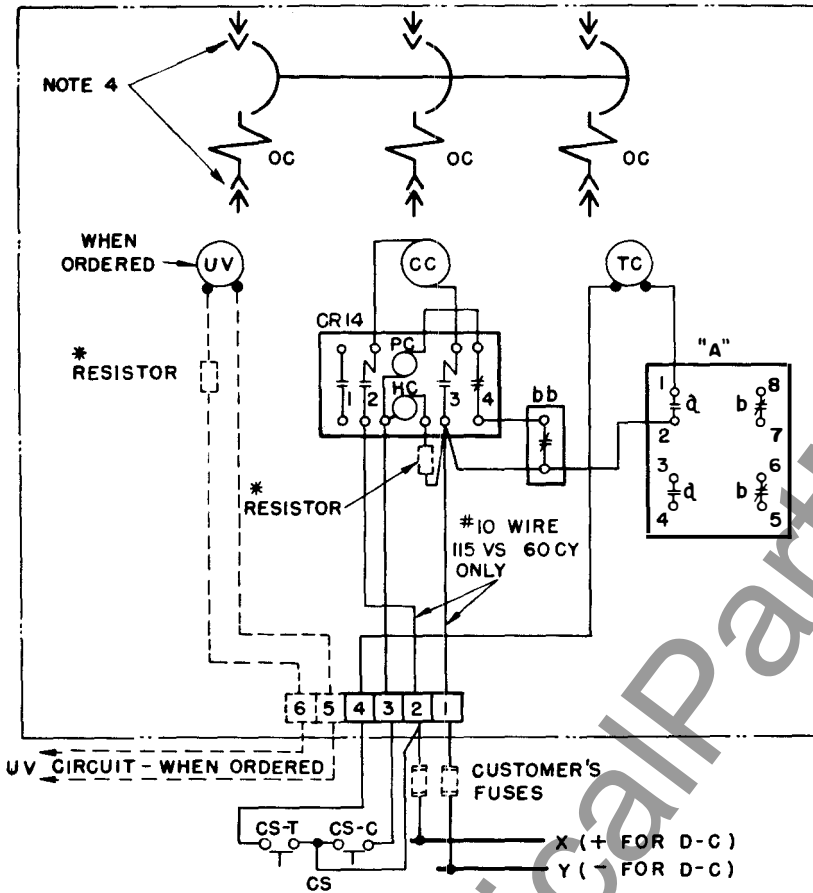
Inasmuch as all air circuit breakers are electrically trip free, the breaker contacts may be tripped to full open position at any point in the closing stroke of the solenoid. As long as the solenoid coil remains energized, the solenoid plunger will continue its motion to fully operated position regardless of whether circuit breaker contacts have been tripped open or not.

The simplest form of control relay, has a single pick-up coil. The relay contacts remain closed and



ELECTRICAL DIAGRAMS

FRONT OF BOARD - CONNECTION DIAGRAM



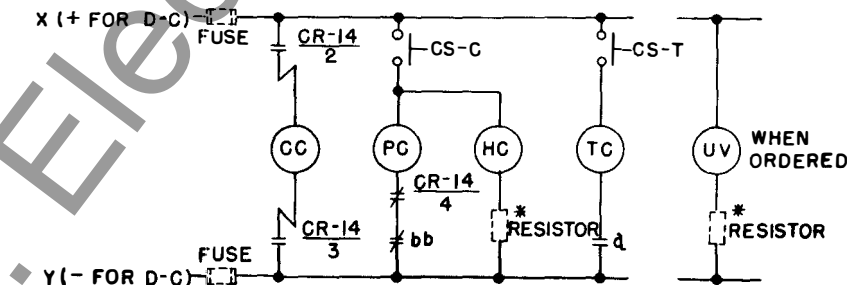
LEGEND

- 8—CONTACT CLOSED WHEN CIRCUIT BREAKER IS CLOSED.
- b—CONTACT CLOSED WHEN CIRCUIT BREAKER IS OPEN.
- bb—CONTACT CLOSED WHEN CLOSING SOLENOID IS IN NON-OPERATIVE POSITION.
- CC—CLOSING COIL.
- CR-14—CLOSING CONTROL RELAY (TRIP FREE).
- CR-14/1 } CONTACTS CLOSE WHEN PICKUP COIL IS
- CR-14/2 } ENERGIZED.
- CR-14/3 } ENERGIZED.
- CR-14/4—CONTACT OPEN ONLY WHEN PICKUP COIL IS DE-ENERGIZED & HOLDING COIL IS ENERGIZED.
- CS—CONTROL SWITCH.
- CS-C—CONTROL SWITCH CLOSE CONTACT—MAINTAINED OR MOMENTARY.
- CS-T—CONTROL SWITCH TRIP CONTACT.
- HC—HOLDING COIL OF CLOSING CONTROL RELAY.
- OC—OVERCURRENT TRIP COIL (OMIT FOR NON-AUTOMATIC).
- PC—PICKUP COIL OF CLOSING CONTROL RELAY.
- TC—SHUNT TRIP COIL.
- UV—UNDERVOLTAGE TRIP COIL.

NOTES: 1—USE AWG #14 STRANDED WIRE (EXCEPT AS NOTED):

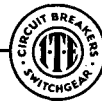
- *2—RESISTOR REQUIREMENTS PER #175091.
- 3—POLE POSITIONS READING LEFT TO RIGHT: ONE POLE BREAKER USES #2 POLE ONLY. TWO POLE BREAKER USES #1 & #3 POLES. THREE POLE BREAKER USES #1—#2 & #3 POLES. FOUR POLE BREAKER USES #1—#2 & #3 POLES AS SHOWN & #4 POLE IN ADDITION.
- 4—DISCONNECT DEVICES ON INDIVIDUALLY ENCLOSED PULL OUT BREAKERS ONLY.
- 5—SWITCH "A" IS MOUNTED ON BACK OF POSITION INDICATOR HOUSING. STANDARD ARRANGEMENT OF CONTACTS AS SHOWN. CUSTOMER TO WIRE DIRECTLY TO EXTRA CONTACTS OF SWITCH.

SCHEMATIC DIAGRAM



Dwg. 177722 - Rev. 2

FIG. 5—TYPICAL DIAGRAM OF CONNECTIONS FOR TYPE KB CIRCUIT BREAKER, ELECTRICALLY OPERATED, A-C OR D-C CONTROL WITH SHUNT TRIP AND UNDERVOLTAGE TRIP, 4 CONTACT AUXILIARY SWITCH



the closing coil is energized as long as the control switch button is depressed. The solenoid cannot attempt to reclose until the control switch button is opened and reclosed so that there is no danger of reclosing against a short circuit. However, there is danger of burning out the closing coil and relay pick-up coil unless the control switch is of the momentary contact type and is depressed for a very short time only.

A non-repeat control relay has an armature on which the blowout, float and auxiliary contacts, are mounted. This armature is attracted by either the pick-up or holding coil, but is normally held in a neutral position by a spring. When both coils are energized at the same instant by the control switch, the stronger or pick-up coil attracts the armature and energizes the circuit breaker closing coil through the relay contacts. At the end of the solenoid plunger stroke, a "bb" switch opens the pick-up coil circuit and allows the weaker or holding coil to attract the armature. The armature opens the relay contacts as it passes to the holding coil magnet. The armature remains attracted to the holding coil as long as the control switch button is depressed. The relay cannot be made to attempt another closing operation until the control button is released.

It should be noted that the trip free relay described above must be used with a momentary

contact control switch, because the solenoid plunger may return to the open position, thus closing the "bb" switch and causing the momentarily rated pick-up coil to burn out.

For use with maintained contact control switch, an auxiliary contact is added to the non-repeat control relay, and is placed in series with the pick-up coil. This auxiliary contact is closed when the armature is in the neutral position (control switch contact open). Closed when armature is attracted to pick-up coil (breaker closing) and open when armature is attracted to holding coil (closing operation complete "bb" switch open or closed, control switch contact closed). In this way the pick-up coil is protected against burn-out when the control button is maintained.

An earlier type of non-repeat relay omitted the float contact and had holding coils designed only for momentary service. These relays were limited to momentary contact control to avoid burn-out of holding coil and failure of pick-up coil on reclosing of the solenoid switch.

Adjustments. To adjust the position of the armature, loosen two adjusting nuts. Turn the nuts until the position of the armature is such that the armature will move to the pick-up magnet when both coils are energized simultaneously. When the pick-up coil is de-energized the armature should move to the holding magnet.

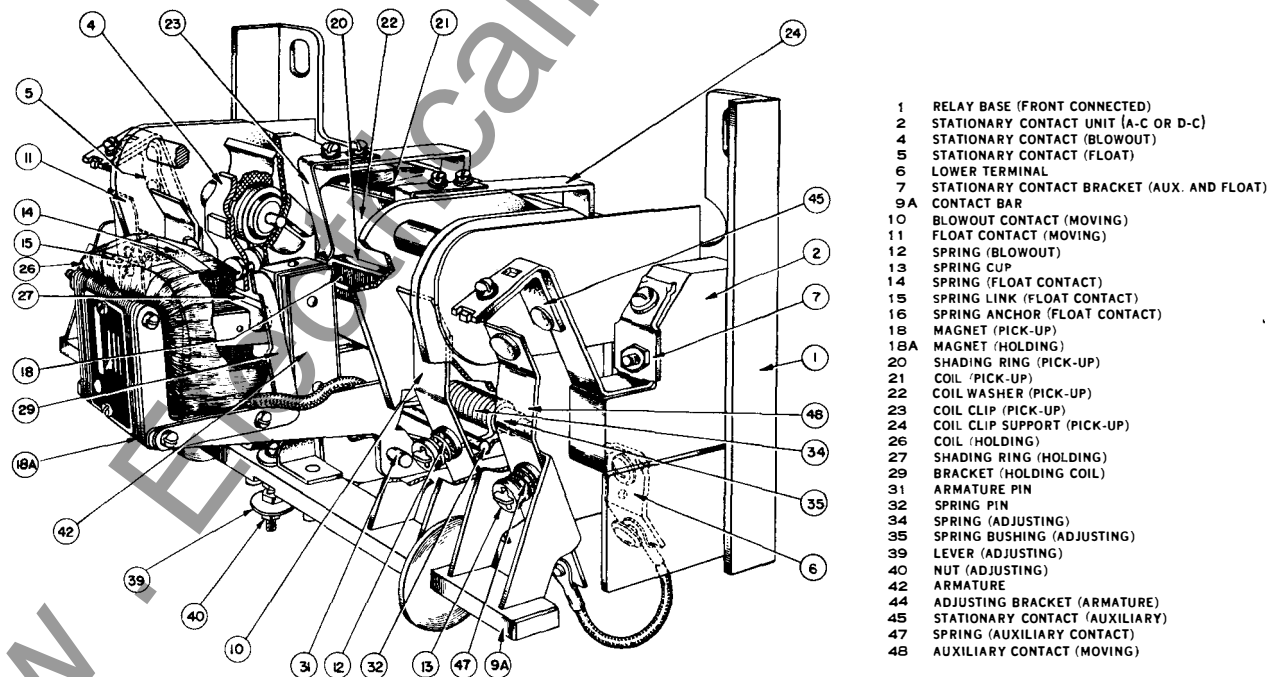
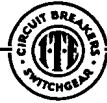


FIG. 6—TYPE R14 CONTROL RELAY

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SHUNT TRIP

Numerous instances arise where it is desirable to be able to trip the circuit breakers electrically without regard to the load conditions in the circuit or from a remote point. Electrically operated circuit breakers are equipped with a shunt trip device. The device may also be added to manually operated circuit breakers.

The shunt trip device as in Figure 7 consists of a tripping magnet and armature. When the circuit is energized, the tripping magnet operates the armature which releases the latch and opens the breaker. In order to prevent the operating coil of the shunt trip device from burning out following the opening of the breaker, an auxiliary contact is provided to disconnect the coil from the circuit as the breaker opens. (Further information for this auxiliary switch is in Bulletin IB-1003-M4 & ML.)

The shunt trip may be operated by any convenient source of potential such as a storage battery or control transformer.

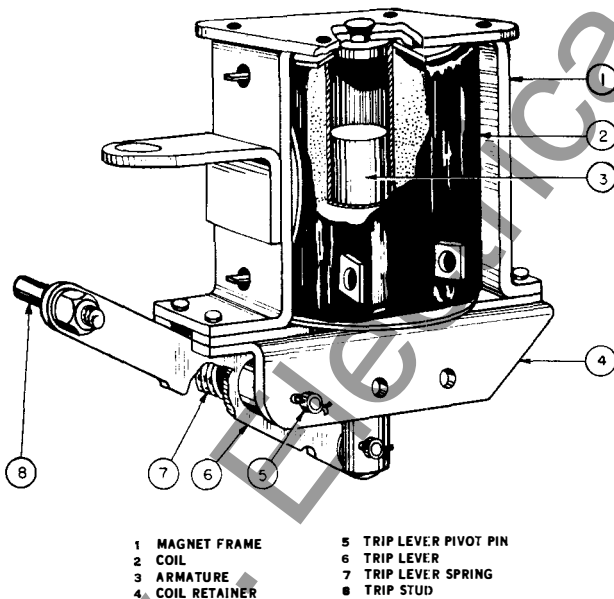
Note. Since the shunt trip device is operated by completing a normally open circuit, grounds or faults in the control wiring would not be evident until the device failed to work when called upon to open the circuit breaker. Where these hazards to

control wiring may occur an undervoltage device is recommended because it operates upon the opening of a normally closed circuit. An objection to this type of trip is that the breaker will open every time the main power source is disconnected if energized on the main source of power.

INSTANTANEOUS OVERCURRENT TRIP

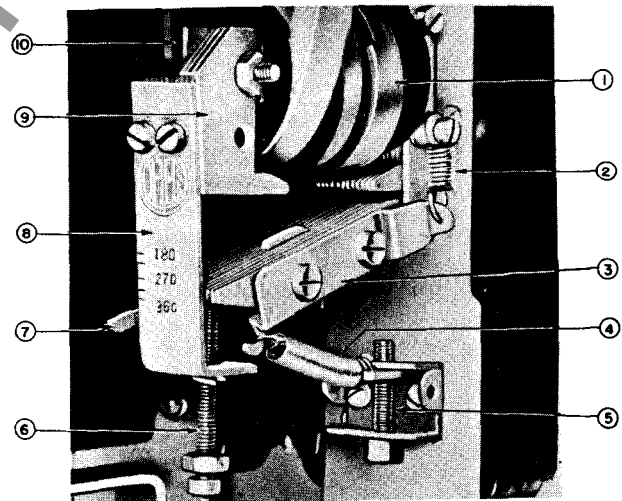
The instantaneous overcurrent trip (Fig. 8) is a direct acting device which operates to trip the breaker instantaneously at all values of current above a predetermined calibrated value. The device is series connected, so that all the current that flows through the circuit breaker flows through the trip coils. Normal calibration is 80 to 160 per cent of the breaker rating.

The device consists of a laminated iron electro-magnet and a pivoted armature, a calibration spring with an adjusting screw, a movable stop for adjusting the gap between the armature and the magnet, a calibration plate with tripping current value points relative to various positions of the armature. When load conditions are such, the current flowing is less than that for which the armature is set. Should current exceed the operating value corresponding to the armature setting, the armature is forcibly drawn to the magnet. Just before the armature reaches the magnet it strikes a push pin which rises to rotate the bar tripper.



- | | |
|-----------------|------------------------|
| 1 MAGNET FRAME | 5 TRIP LEVER PIVOT PIN |
| 2 COIL | 6 TRIP LEVER |
| 3 ARMATURE | 7 TRIP LEVER SPRING |
| 4 COIL RETAINER | 8 TRIP STUD |

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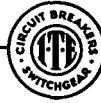


- | | |
|--------------------------|------------------------------|
| 1 SERIES TRIP COIL | 6 ARMATURE STOP SCREW |
| 2 SPRING (ANTI-RATTLE) | 7 INDEX FINGER (CALIBRATION) |
| 3 ARMATURE | 8 CALIBRATION PLATE |
| 4 SPRING (CALIBRATION) | 9 MAGNET |
| 5 CALIBRATION ADJ. SCREW | 10 PUSH PIN (TRIPPING) |

Photo 14904-A

FIG. 7—SHUNT TRIP DEVICE FOR TYPE KB CIRCUIT BREAKERS

FIG. 8—INSTANTANEOUS TRIP DEVICE FOR TYPE KB CIRCUIT BREAKERS

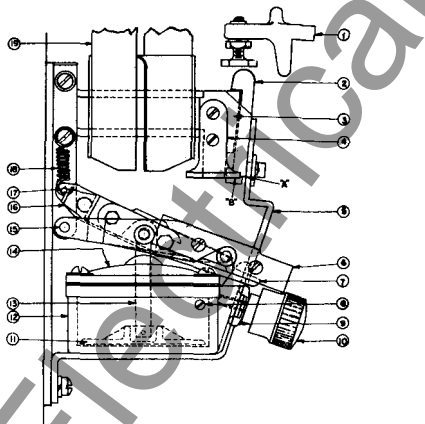


Adjustments. Currents at which the armature will pick-up instantaneously is regulated by raising or lowering the adjusting nut for the calibration spring. The armature lowest position determines the highest current setting that can be maintained continuously without tripping. Adjustment can be made by raising or lowering the armature stop screw.

DUAL MAGNETIC OVERCURRENT TRIP

The dual overcurrent trip device shown in Fig. 9 combines moderate overcurrent protection with instantaneous short circuit protection. The device is mounted on the circuit breaker directly beneath the pole with which it is associated. Since all poles are rigidly connected for opening and closing, response of the tripping device of one pole to an overcurrent or short circuit will cause the opening of all poles.

On continuous overloads, the armature is attracted to a magnet. After a pre-determined time delay an adhesive disc separates from the adhesive surface of oil cup. This allows the armature which is connected to disc by link, to move upward to strike a push pin and trip the circuit breaker. The instantaneous armature straddles the time delay armature. When a short circuit (set at 8 times continuous ampere current rating d-c and 12 times a-c) occurs, armature moves independently to trip circuit breaker.



- | | |
|----------------------------|------------------------------|
| 1 TRIPPER BAR | 11 ADHESIVE DISC (MOVING) |
| 2 PUSH PIN (TRIPPER) | 12 OIL CUP |
| 3 MAGNET | 13 LINK |
| 4 POLE PIECE (INST.) | 14 COVER (OIL CUP) |
| 5 SUPPORT BRACKET | 15 PIN (INST. ARMATURE) |
| 6 ARMATURE (INSTANTANEOUS) | 16 ARMATURE (TIME DELAY) |
| 7 POINTER | 17 PIN (TIME DELAY ARMATURE) |
| 8 SCREW (OIL INSERT) | 18 ANTI-RATTLE SPRING |
| 9 CLAMP (CAL. KNOB) | 19 SERIES COIL |
| 10 KNOB (CALIBRATION) | |

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FIG. 9—DUAL MAGNETIC OVERCURRENT TRIP DEVICE FOR TYPE KB CIRCUIT BREAKERS

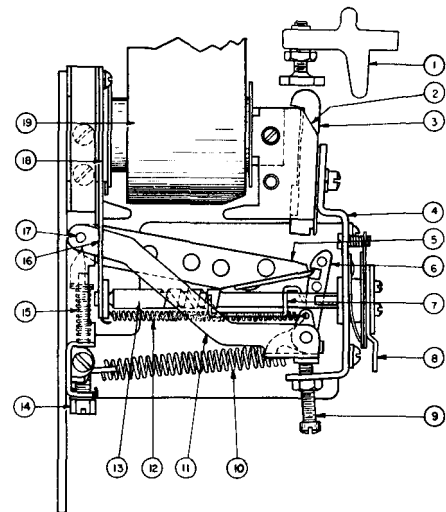
Adjustments. The trip unit is set for a value of current slightly above the maximum steady load. If breaker trips under normal working conditions, lower the oil cup slightly, after loosening knob. Pointer on armature will indicate on support bracket the current value at which breaker will trip after a time delay.

Maintenance. Before putting circuit breaker into service, clean oil cup with carbon tetrachloride and dry thoroughly. Remove knob and support bracket after removing screws and stud. Allow armature to drop and remove pin. Remove screws to release cup from cover.

Caution. When handling, do not scratch adhesive surfaces of cup and disc. Insert ½ ounce of oil from container supplied. Replace cover, reassemble device, and set the knob at the predetermined calibration setting. Clean cup at least once a year to insure proper service. When fresh oil is needed send order with nameplate data to factory.

DUAL THERMAL MAGNETIC OVERCURRENT TRIP

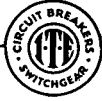
The dual thermal magnetic overcurrent trip in Fig. 10 is designed for standard a-c circuit breakers when used on individual motor circuits. The device provides direct acting inverse time operation.



- | | |
|------------------------------|-----------------------|
| 1 TRIPPER BAR | 11 LATCH SUPPORT |
| 2 MAGNET | 12 SPRING (LATCH) |
| 3 PUSH PIN (TRIPPING) | 13 ADJUSTING ROD |
| 4 CALIBRATION PLATE ASSEMBLY | 14 ADJUSTING SCREW |
| 5 ARMATURE | 15 ANTI-RATTLE SPRING |
| 6 LATCH | 16 THERMAL ELEMENT |
| 7 ADJUSTING ROD NUT | 17 PIN (ARMATURE) |
| 8 CAL. ADJ. LEVER | 18 HEATER |
| 9 STOP SCREW (ADJ.) | 19 SERIES COIL |
| 10 SPRING | |

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FIG. 10—DUAL THERMAL MAGNETIC OVERCURRENT TRIP DEVICE FOR TYPE KB CIRCUIT BREAKERS



When dual thermal overcurrent trip devices are used, the adjustment varies the current tripping point and the time delay simultaneously so as to closely follow the heating curve of overloaded circuits. This combined adjustment makes it impossible to accurately rate the tripping range. The approximate tripping range is 100 to 150 per cent of continuous ampere rating.

The device is designed particularly for tripping a circuit breaker during overcurrent, single phase overcurrent and short circuit conditions. Its characteristics permit full voltage motor starting even when the accelerating period is abnormally long.

This device consists of a series coil, a magnet and an armature which provides power for direct tripping of the circuit breaker. Time delay is produced by an inductively heated bi-metal strip which permits the armature to trip the breaker on normal overloads, only after a selected time delay. This time is adjustable by moving a pointer around a scale with an insulated knob. The armature trips the breaker instantaneously on all currents about twelve times the breaker rated current.

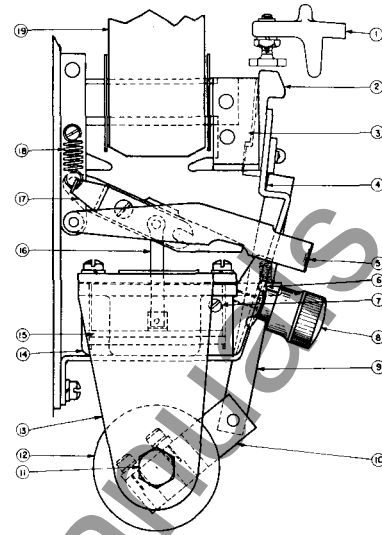
Applied to the side of the thermal magnetic device will be found a diagram showing tripping curves for various settings of the adjustment knob. These curves are typical only and are to be used as guides in the adjustment of the device. All other adjustments are made at the factory and should not be changed without specific instructions.

Adjustments. When putting the circuit breaker in service, set the pointer about 1 setting for a lighting circuit or 2.5 setting for a motor circuit and close the breaker. If the breaker trips on normal in-rush current, gradually increase the setting until it stays closed. Always check final adjustment after breaker has reached full load operating temperature. A change in load conditions or a large change in room temperature may require readjustment.

SELECTIVE OVERCURRENT TRIP

The selective overcurrent trip as shown in Figure 11 is a direct acting series connected device that operates after a long time delay (measured in seconds) on moderate overcurrents, and in much shorter time (measured in cycles) above a pre-set current value. Several different accurately timed delay bands in the short circuit current range permit breakers in series to operate selectively on fault currents.

Current is carried from the contacts through flexible conductors, then through the series trip coils to the lower studs. The series trip coil surrounds the upper leg of the overcurrent magnet.



- | | |
|-------------------------------|-------------------------------|
| 1 TRIPPER BAR | 11 SCREW (TIMER MTG.) |
| 2 PUSH PIN (TRIPPER) | 12 TIMER MECHANISM |
| 3 MAGNET | 13 CUP COVER AND TIMER SUPT. |
| 4 SUPPORT BRACKET | 14 OIL CUP |
| 5 ARMATURE (SHORT TIME DELAY) | 15 ADHESIVE DISC |
| 6 CLAMP (CAL. KNOB) | 16 LINK |
| 7 SCREW (OIL INSERT) | 17 ARMATURE (LONG TIME DELAY) |
| 8 KNOB (CALIBRATION) | 18 ANTI-RATTLE SPRING |
| 9 LINK | 19 SERIES COIL |
| 10 CRANK ARM | |

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FIG. 11—SELECTIVE OVERCURRENT TRIP DEVICE FOR
TYPE KB CIRCUIT BREAKERS

The device consists of a standard dual overcurrent trip assembly and a mechanical timer suspended by a support bracket below the long time delay cup. A link is connected to the outside armature and to the crank arm of the timer. The long time delay armature (inside) is linked to a movable disc inside the oil cup.

Short Time Delay. The short time delay determines trip selectivity by use of a gear escapement mechanism, which consists of a geared escapement mechanism actuated by the short time delay armature. The short time armature air gap has been set at the factory and should not be disturbed unless necessary.

The short time delay assembly is of a geared escapement type with a large gear reduction, and a small double pawl armature, so that for a very short time a fair number of oscillations of the double pawl is required.

Since the time delay characteristics of this timer are inversely proportional to the applied torque, the setting of the trip band is obtained by leverage of the timer crank arm and the short time delay armature. At the end of the time delay stroke the actuating gear runs out of engagement, and tripping is accomplished by impact.



Short Time Delay Adjustment consists of increasing the number of oscillations of the double pawl in a greater than direct ratio as the time is increased. As the armature is released later in its stroke with the air gap reduced, the magnetic forces are greater with subsequent less time delay per oscillation. When a shorter time delay is required, the number of oscillations will therefore be very small and consistency in time reduced.

The escapement assembly has been designed to be "non-adjustable" in the field, and it is recommended that adjustments not be changed. Factory should be consulted for instructions for changing from one band to another.

Long Time Delay Maintenance. Clean the oil cup at least once a year to insure proper service. Any indication of improper long time delay action may be due to insufficient amount of time delay oil in the cup. Remove screw (side of oil cup) and insert ½ ounce of oil. Oil supplied by the I-T-E Circuit Breaker Company is recommended. This is a silicone oil furnished in containers of a ½ ounce. When reordering oil specify number 51266-A1 and amount required.

Long Time Delay Adjustment. Loosen knob and adjust oil cup to desired calibration setting. Variations of the armature air gap is indicated by graduations on the support bracket, which means the pick-up value of a free armature. The calibration range of the tripping adjustment is 80-160 per cent of the ampere rating of the circuit breaker.

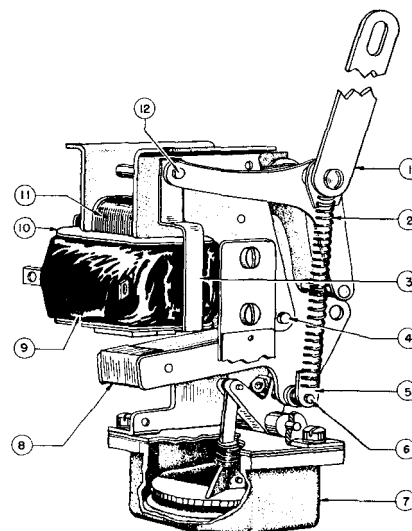
UNDERVOLTAGE TRIP

In certain instances it is desirable to interrupt a circuit in case the voltage falls below a predetermined value. For example, a direct current motor should be started only through a resistance in order to limit the current in the armature. If the power supply should fail, allowing the motor to slow down or completely stop, and then be restored with the starter in the running position, dangerous currents would flow in the armature. These excess currents may not only damage the motor, but may also cause injury to the driven machine.

Instantaneous. In the undervoltage device as shown in Fig. 12 a coil surrounds an electromagnet connected directly to the line and attracts a pivoted armature. (The time delay is omitted for the instantaneous trip device.)

The armature is spring loaded by the breaker mechanism. When the voltage on the coil falls below a certain value, the magnetic pull on the armature is reduced and the armature is moved to the open air gap position by the spring. The force of the spring is at the same time transmitted to the tripper bar and the latch is released to trip the breaker. When the breaker opens, the armature is returned to the closed air gap position. The drop-out voltage is approximately 30-60 per cent of the normal circuit voltage.

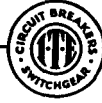
Time Delay. When it is required that the breaker remain closed for a short interval following voltage failure the addition of an oil film delay device is available and added to the device previously described. Its addition delays the operation of the undervoltage trip for a definite predetermined time



- | | |
|----------------------|---------------------------|
| 1 OPERATING LINK | 7 OIL CUP |
| 2 RESET SPRING | 8 ARMATURE |
| 3 COIL RETAINER | 9 COIL |
| 4 ARMATURE HINGE PIN | 10 COIL INSULATING WASHER |
| 5 LOWER SPRING LINK | 11 MAGNET |
| 6 LOWER LINK PIN | 12 SPRING ARM PIVOT PIN |

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FIG. 12—UNDERVOLTAGE TRIP DEVICE FOR TYPE KB CIRCUIT BREAKERS



interval. If the normal circuit conditions do not restore during the interval, the circuit breaker will trip in its customary manner. The time delay is approximately 3 seconds at no voltage.

Maintenance-Time Delay. The time delay cups should be cleaned and oil renewed every six months.

Remove the four cup attaching screws. Remove cup and gasket. Do not mar the adhesive surfaces of either disc. Clean cup and adhesive discs with carbon tetrachloride and dry thoroughly. Refill cup with oil 1/8" from bottom of cup (1/2 ounce is specified) with oil supplied with breaker. Oil furnished by the manufacturer is recommended.

REVERSE CURRENT TRIP

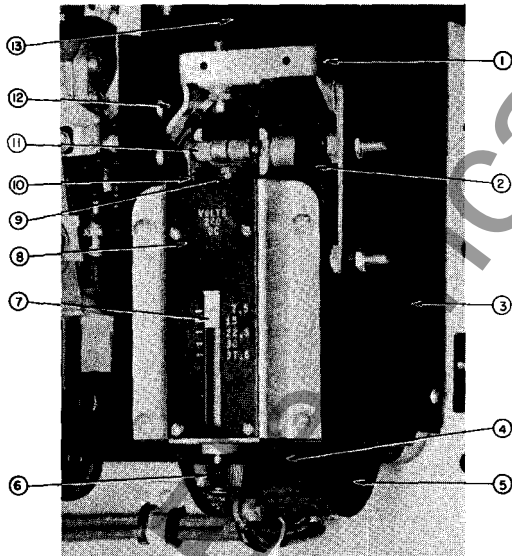
In order to protect direct current equipment, a device to trip the circuit breaker when the current reverses is desirable. Generators operated in parallel, or those used to charge batteries, should be protected with a reverse current device as shown in Fig. 13. If one generator were to lose its terminal voltage, the other generators or storage batteries

would feed power into the disabled machine and tend to operate it as a motor.

The reverse current device consists of two magnetic systems, one energized by a series coil carrying the main current, the other by a shunt coil upon which the circuit potential is impressed. These two systems interact in much the same manner as that of the field and armature in a direct current motor. The polarity of the shunt coil system remains constant. The magnetic field of the series coil causes the armature to press against a stop screw when the current is flowing in the normal direction.

When reversed, the action of the series magnetic field is reversed, the armature rotates in the opposite direction and trips the breaker through its mechanical connection with the breaker trip mechanism. This device will trip on any reverse current in excess of the calibration setting. The calibration range of tripping adjustment is 5-25 per cent of the ampere rating of the circuit breaker. The tripping action requires that 70 per cent voltage be maintained.

Reverse Current Trip Adjustment. Adjust the trip screw, so that the breaker will hold with 0.015 inch feeler gauge and will trip with 0.0075 with armature held against the pole piece (Fig. 13.).



- | | |
|--------------------------------|--------------------------|
| 1 TRIP LEVER | 8 CALIBRATION PLATE |
| 2 POLE PIECE (R. H.) | 9 ARMATURE STOP SCREW |
| 3 BARRIER | 10 CALIBRATION SPRING |
| 4 SHUNT COIL | 11 ARMATURE |
| 5 SHUNT COIL INSULATING WASHER | 12 POLE PIECE |
| 6 CALIBRATION KNOB | 13 TRIPPER (TRIPPER BAR) |
| 7 CALIBRATION INDICATOR | |

Photo 15287-A

FIG. 13—REVERSE CURRENT TRIP DEVICE FOR TYPE KB CIRCUIT BREAKERS

TYPE OD-1 AND OD-2 OVERCURRENT TRIP DEVICES

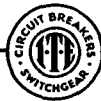
The dual overcurrent device consists of the following basic elements in two combinations.

- ELEMENT 1. Long time delay of dual or selective trip using a silicone oil displacement dash pot.
- ELEMENT 2. Short time delay of selective trip using a geared timer.
- ELEMENT 3. Instantaneous trip of dual overcurrent trip.

Type OD1 is comprised of elements 1 and 3.
Type OD2 is comprised of elements 1 and 2.

APPLICATION

The type OD1 and OD2 overcurrent trip devices are applicable to a-c circuit breakers up to and including 6000 amperes and to d-c breakers up to and including 1600 amperes with either series or transformer tripping as design warrants.



FUNCTIONS

The delay of element 1 is measurable in seconds, minutes and hours, and that of element 2 in cycles. Element 3 operates with no intentional delay.

MECHANICAL DESCRIPTION

The device is shown in Fig. 14. Tripping current flows through the coil surrounding the upper leg of the magnet and supplies the tripping force. The two armatures pivot on a common pin and are attracted to the magnet with a force, the value of which depends upon the current and the number of turns in the coil. Tripping of the circuit breaker is obtained by having either armature trip screw strike the breaker trip finger. A resonant silencer is incorporated on the long time delay armature for alternating current application. Both armatures have fixed air gaps and use tension springs for calibration of pick up values. The long time delay dashpot is linked to one armature. Delay is obtained by the displacement of the silicone oil from one side of the piston to the other. After the armature has completed not more than half its stroke, the piston enters an unrestrained portion of the cylinder, allowing the armature to strike the trip finger with impact. The magnitude of time delay is a function of the distance that the piston moves in the restrained portion of the cylinder. Due to a highly responsive check valve, the armature resets rapidly (in less than 1 second) and, therefore, successive tripping attempts both current and time delay, are in accordance with calibrated values.

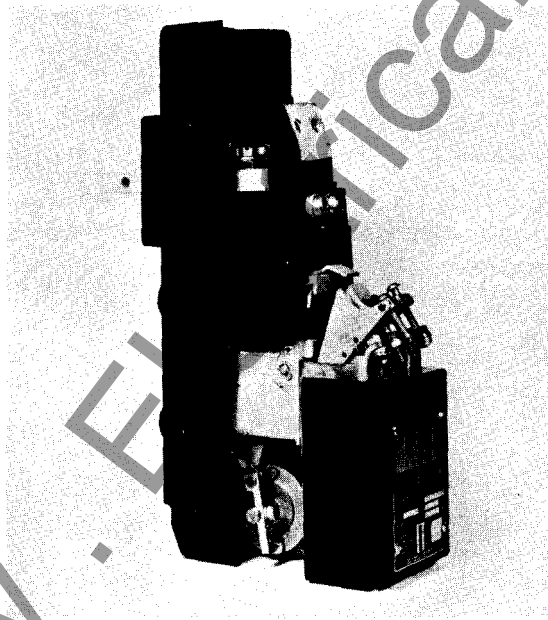


Photo. 17457

FIG. 14—TYPE OD-2 OVERCURRENT TRIP DEVICE

The short time delay timer is also constructed in a manner that permits impact trip, since time delay is included in the first half of the armature stroke. Due to instantaneous reset of the armature after a partial tripping stroke, minimum operating current is required on successive tripping attempts.

ELECTRICAL CHARACTERISTICS

Element 1 is calibrated and adjustable for minimum operating currents of 80 to 160% of the ampere rating of the circuit breaker with time delay adjustments to any of the three standard NEMA operating bands.

Element 2 is calibrated and adjustable for minimum operating currents of 500%, 750%, and 1000% of the ampere rating of the circuit breaker with time delay adjustments to any of the three standard NEMA short time operating bands.

Element 3 is calibrated and adjustable for minimum operating currents of 800%, 1200%, and 1500% of circuit breaker rating.

ADJUSTMENTS

Minimum operating current adjustments are made by turning the appropriate calibration knob on the front of the device.

Long time delay adjustment has been factory set and locked. Should adjustment be required, flatten corner of lock plate and turn spring loaded screw so that the long time delay indicator moves in the required direction. Refer to applicable characteristic curves TD-3304C, TD-3305C, or TD-3306C for setting the long time band indicator.

Short time delay is factory set according to one of the three NEMA bands and the coil rating of the breaker. The factory should be consulted for instructions for changing from one band to another. These bands are represented by TD-3307C, TD-3308C, and TD-3309C.

Armature air gap adjustment is factory set and must not be changed.

Armature tripping travel. When checking or making this adjustment, insert feeler shims at point "A" Fig. 15 parallel to armature face. Breaker should trip with 0.020 inch gauge and not trip with 0.030 inch gauge. Make sure set screws are tightened after making this adjustment and operate breaker a few times to insure correct adjustment.

SPARE PARTS

Due to the high precision expected of this device, assembly and calibration must be extremely accurate. It is, therefore, recommended that no attempt be made to repair or replace parts of the unit. A replacement unit may be obtained from the factory.

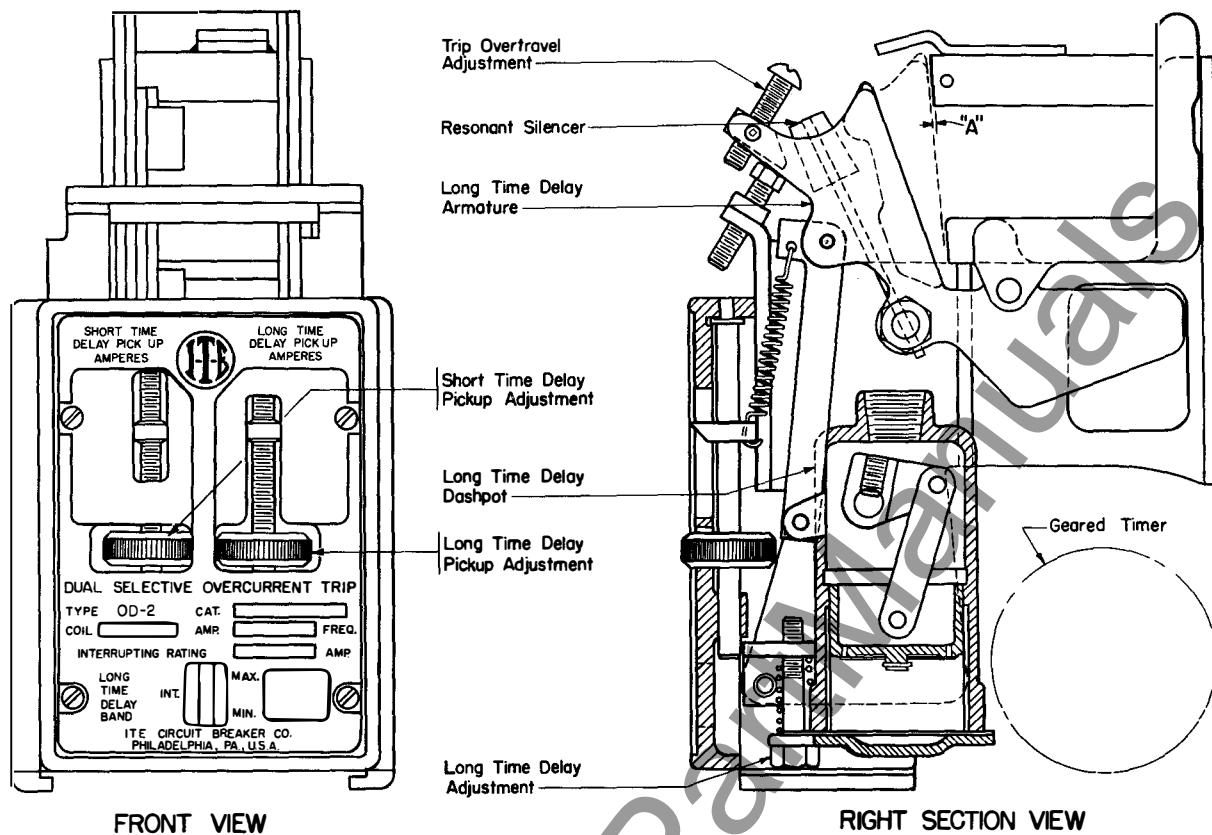
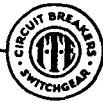


FIG. 15—Type OD-1, OR OD-2 OVERCURRENT TRIP DEVICE

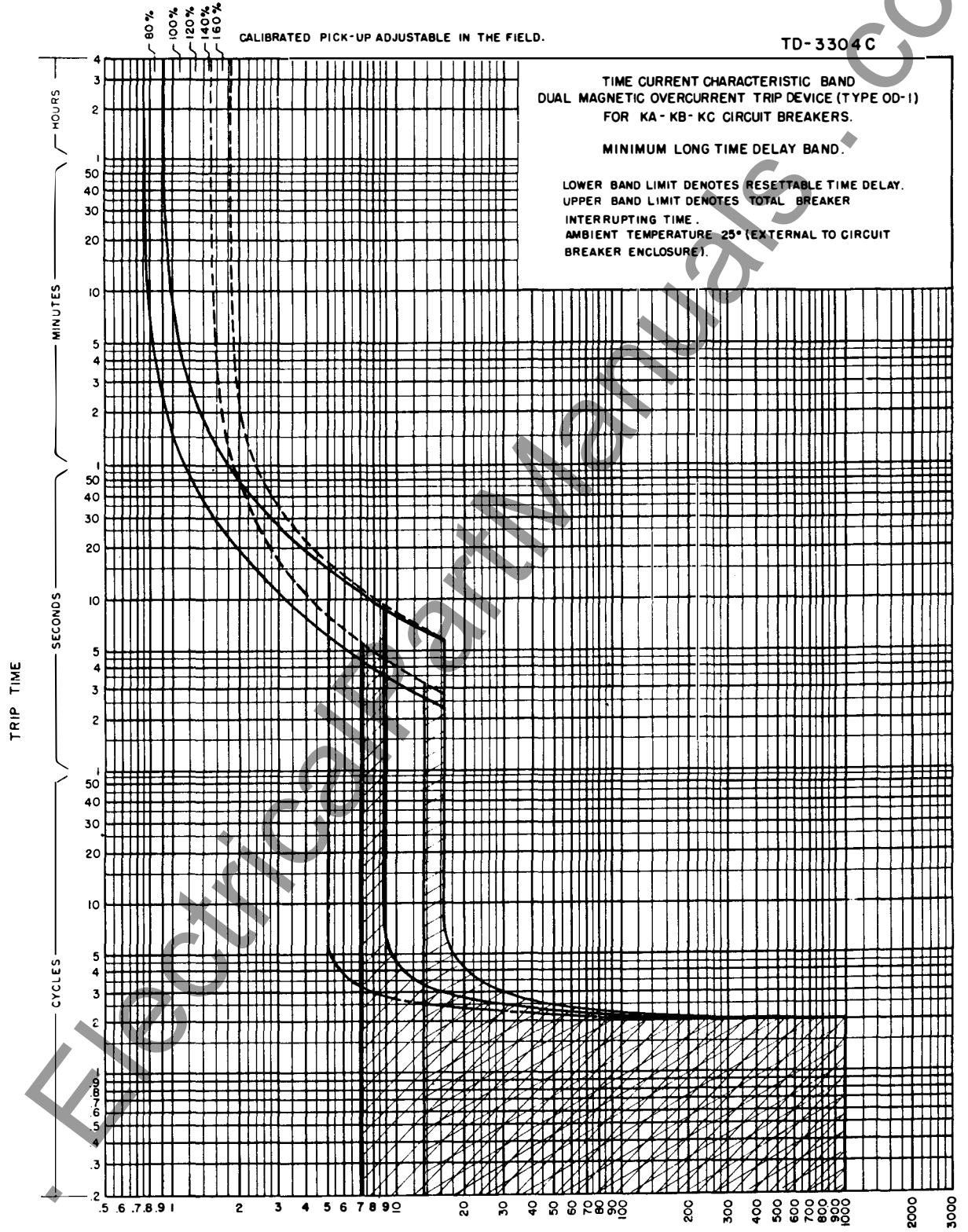
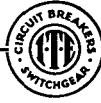
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SPARE PARTS

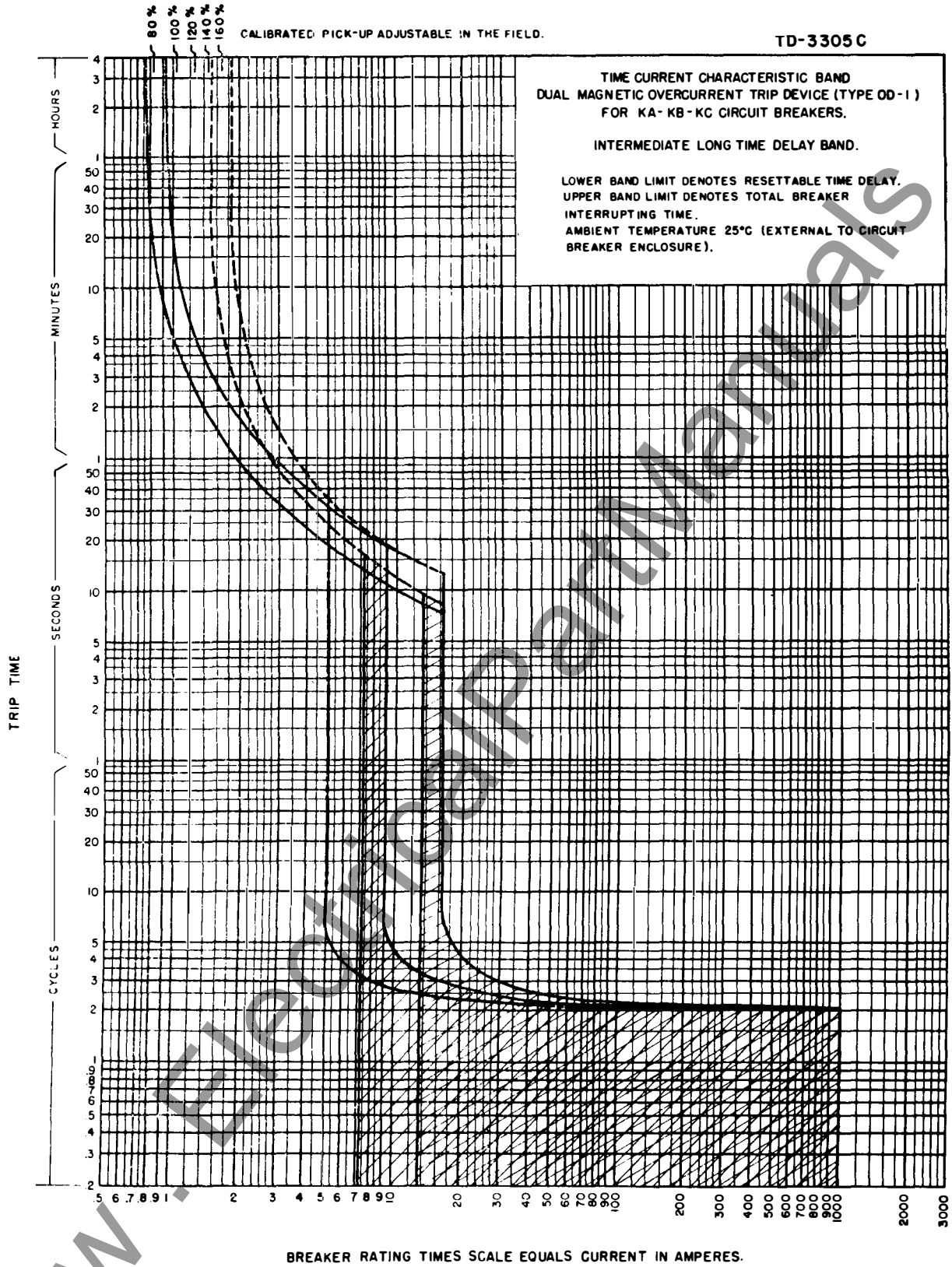
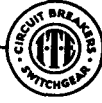
It is recommended that sufficient spare parts be carried in stock to enable the operators of circuit breakers to promptly replace any worn, broken or damaged parts. Should renewal parts be required, refer to Bulletin RP-1400-KB. The figure indexes in this bulletin are for instruction description only.

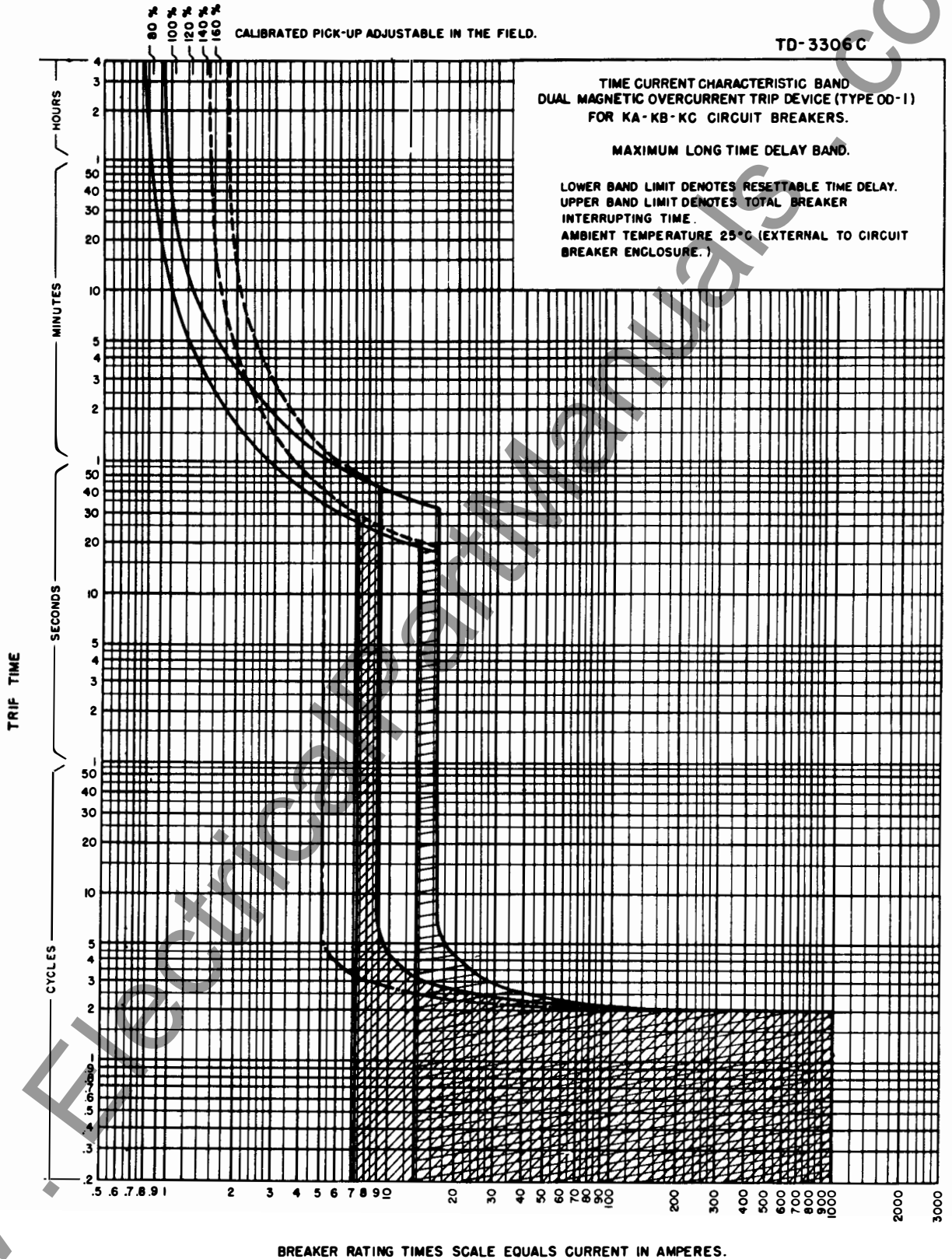
In conclusion it is again strongly urged that the manufacturer's instructions for each circuit breaker be carefully read and followed.

Portions of this Instruction Bulletin as to text and calibration ratings are in accordance with the National Electrical Manufacturers Association Standards, dated April 1951.



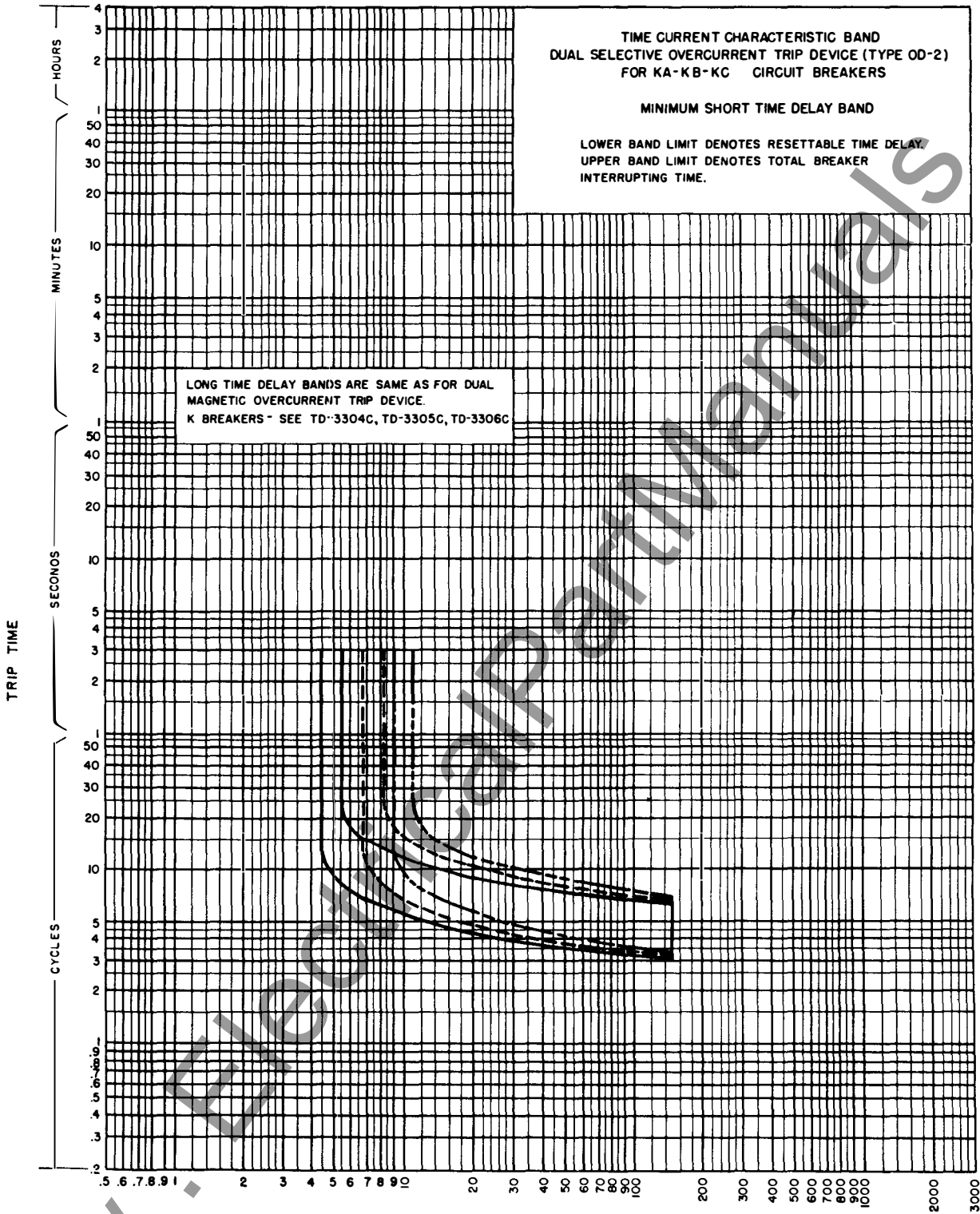
BREAKER RATING TIMES SCALE EQUALS CURRENT IN AMPERES.







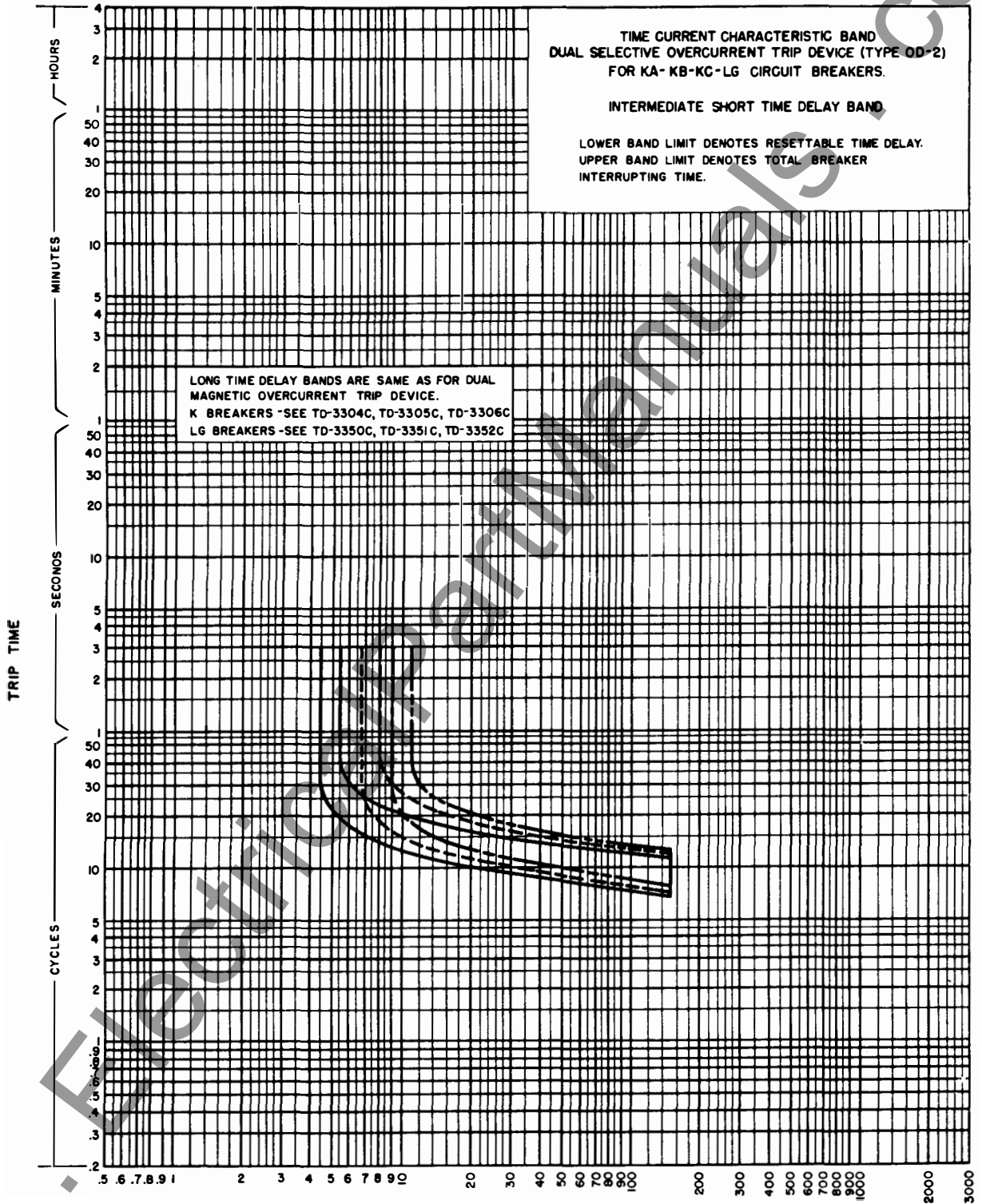
TD-3307C



BREAKER RATING TIMES SCALE EQUALS CURRENT IN AMPERES



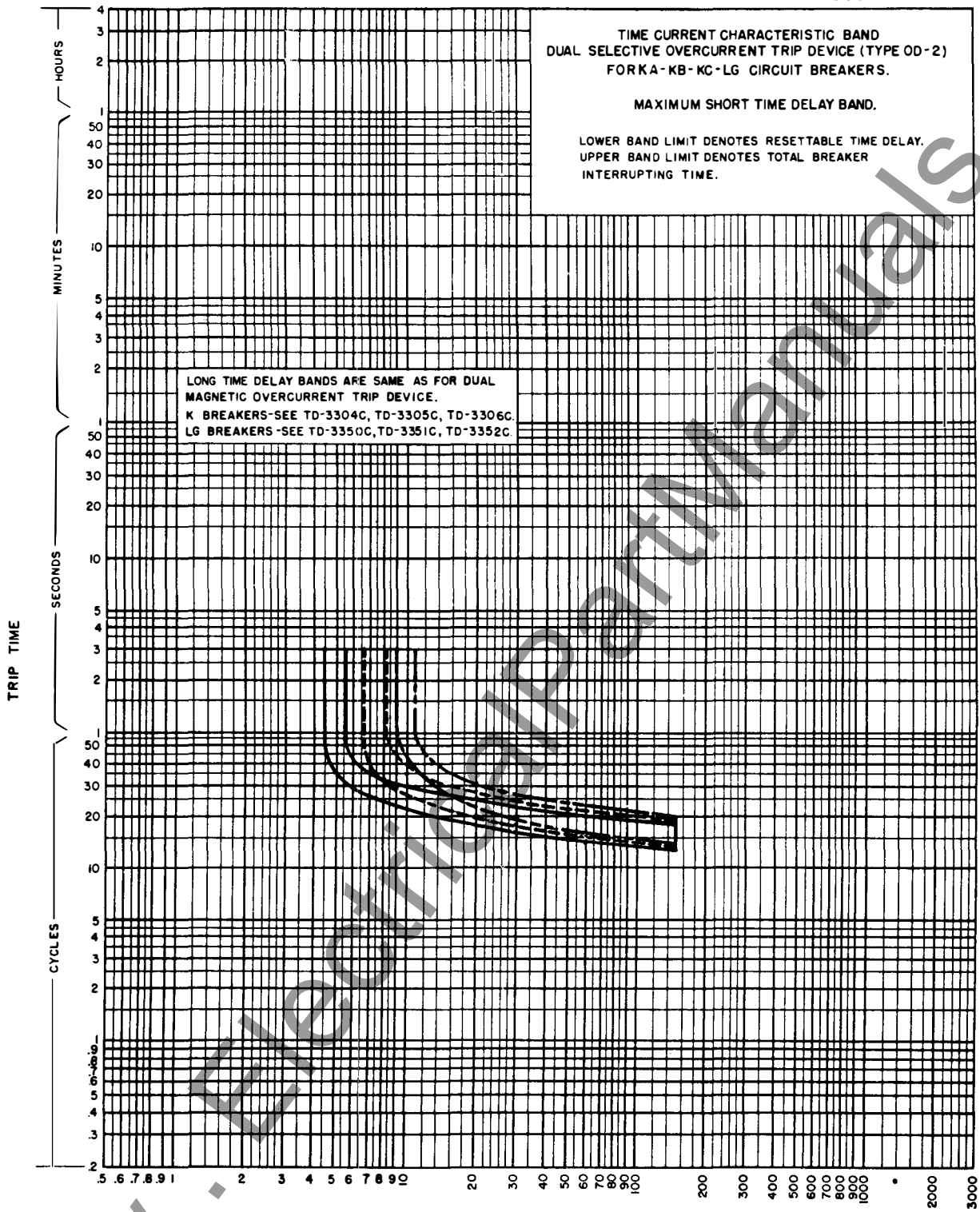
TD-3308C



BREAKER RATING TIMES SCALE EQUALS CURRENT IN AMPERES



TD-3309C



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