INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KC-3 CURRENT DETECTOR RELAY

CAUTION *Before putting relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.*

APPLICATION

The type KC-3 is a non-directional current or fault detector which operates for all phase and ground faults to supervise the tripping of other relays. It is well suited to breaker-failure relaying for indicating the presence or lack of current flow in the circuit breaker. The relay can be applied where the phase units are to be operated indefinitely in the picked up position well below full load. Alternatively, where the relay is to be used as a fault detector (pickup above full load) the 98% or better dropout ratio of the phase units is advantageous.

These instructions apply for two relay varieties, as shown in the internal schematics of Figs. 3 and 4. The two differ only in the terminal 14 connections. The relays connected per Fig. 3 will suffice in most cases. Use the relay per Fig. 4 where the ICS-2 contact is needed for an external seal-in. Note, however, that the circuits associated with terminals 10, 11 and 14 of Fig. 4 should not be used where more than one KC-3 relay connects to a common breaker-failure timing circuit. Otherwise all of the KC-3 targets connected to this timing circuit may operate on a breaker-failure operation.

Breaker-failure relaying offers advantages over remote back-up protection. It is faster and more sensitive than remote back-up methods. In addition, it is selective, whereas remote back-up protection is frequently non-selective. Fig. 2 shows some fault conditions where breaker-failure relaying could improve the quality of back-up protection. Note that the generating-station high-voltage bus uses a breaker-and-a-half arrangement. Lines interconnect the station to systems S_1, S_2, and S_3.

If there is no malfunctioning, fault L will be cleared by line relays tripping breakers 5, 6, and 9. However, assume that the breaker-6 mechanism sticks so that current flow through breaker 6 is not interrupted. Now back-up protection must function. If remote backup is relied upon, time-delay relays must trip remote breakers 7 and 8. In addition, the local generator feed through breaker 6 must be interrupted by tripping breaker 4. However, if breaker-failure protection is installed, the fault is cleared by tripping breaker 3. Note that this provided selective tripping, since as much of the system as possible was left intact. If breakers 4, 7, and 8 must trip, the local generator is lost and unnecessary separation of the generating station from power systems S_1 and S_2 results. Also, the tapped load is interrupted unnecessarily instead of being left tied to system S_2.

Remote backup, in addition to not being selective, may not be sensitive enough because of the relatively small proportion of the total fault current following in any one line. For example, in Fig. 2 there may be very little current flow in breakers 7 and 8 for fault L because of the large current contribution by the local machines at the generating station. Thus, it may be difficult or impossible at breakers 7 and 8 to detect adjacent line faults without depending upon sequential tripping. If the generator feed is interrupted for fault L, such as by tripping breaker 4, the current through breakers 7 and 8 may increase sufficiently for the relays to operate and trip breakers 7 and 8. However, the system is by now cut to pieces, and because of the long time delay in clearing the fault, the remainder of the system may be unstable.

Although breaker-failure protection offers many advantages, remote backup cannot be completely eliminated. For example, assume that breaker 3 fails

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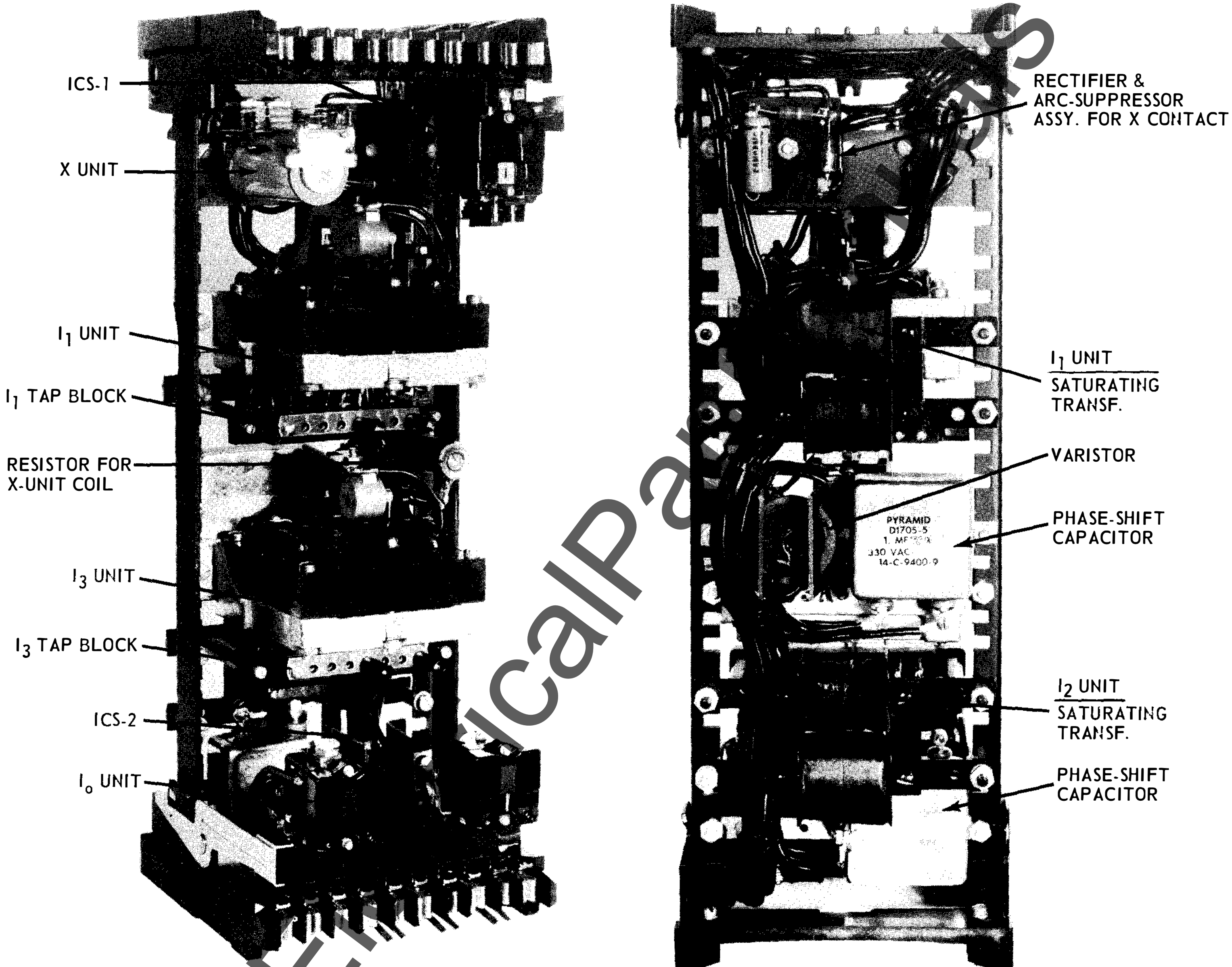


Fig. 1. Type KC-3 Relay Without Case.

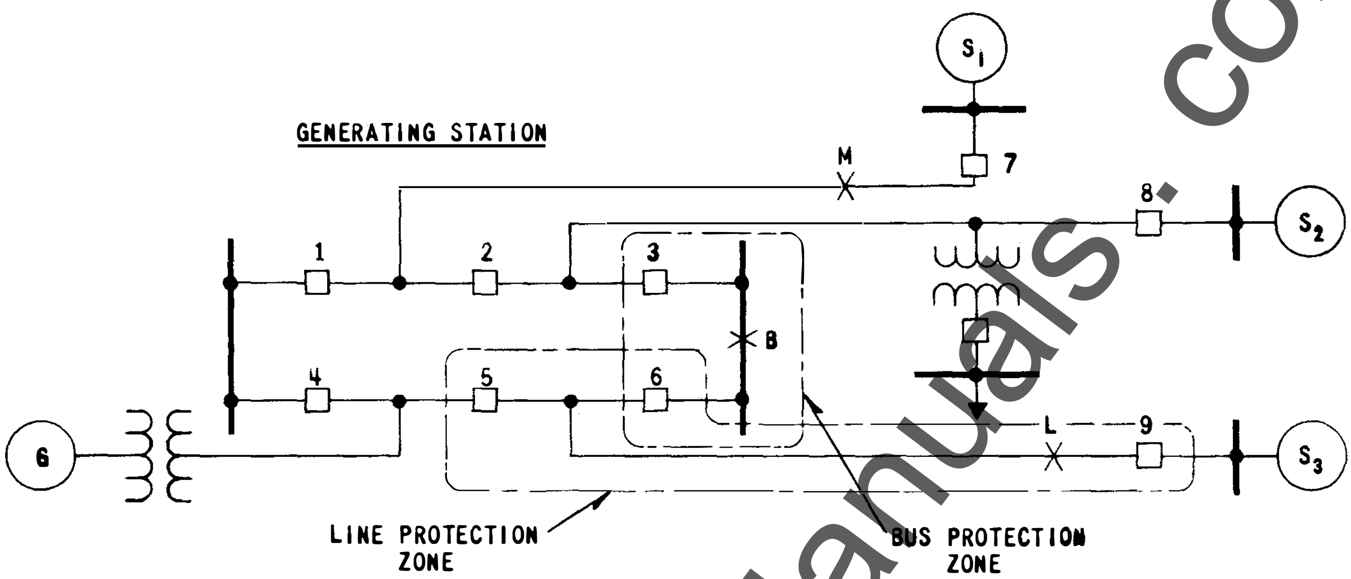


Fig. 2. Sample System to Show Advantages of Breaker-Failure Protection.

for bus-fault B in Fig. 2. Breaker-failure protection will promptly trip breaker 2, but the fault is still fed by breaker 8. Likewise, if breaker 2 fails with a line fault at M, a remote breaker must trip to clear the fault. Breaker-failure protection trips breaker 3, but breaker 8 still feeds the fault. Although breaker-failure protection does not complete the job in these examples, it does expeditiously trip the local breaker, making it easier for the remote relays to detect the fault.

CONSTRUCTION

Phase Overcurrent Unit (I_1 & I_3)

The phase overcurrent unit is an induction-cylinder unit. The time-phase relationship of the two air gap fluxes necessary for the development of torque is achieved by means of a capacitor connected in series with one pair of pole windings.

Mechanically, the overcurrent unit is composed of four basic components: a die-cast aluminum frame, an electromagnet, a moving element assembly, and a molded bridge.

The frame serves as the mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame.

The electromagnet has two pairs of coils. The coils of each pair are mounted diametrically opposite one another. In addition, there are two locating pins. The locating pins are used to accurately position the lower pin bearing, which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp.

With the contact closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

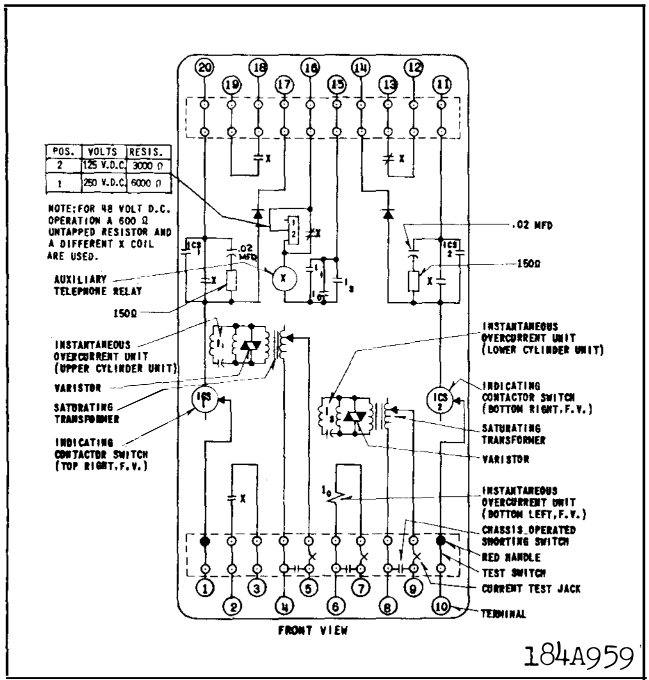


Fig. 3. Internal Schematic of the Type KC-3 Relay in FT42 Case. (For S#290B243A – Series).

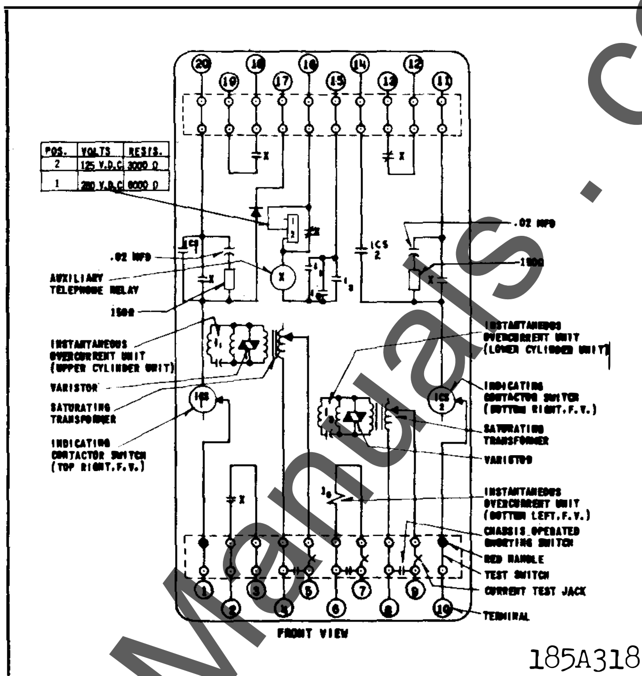


Fig. 4. Internal Schematic of the Type KC-3 Relay in FT42 Case with ICS-2 Contact to Separate Terminal.

When the current in the overcurrent unit exceeds the pick-up value the contacts close to energize the auxiliary relay (X).

A transformer and varistor assembly is used in conjunction with the overcurrent unit. The transformer is of the saturating type which limits the energy to the overcurrent unit and reduces the burden on the operating CT.

The primary of the transformer is tapped and brought out to a tap connector block for ease in changing the pick-up current of the relay. The use of a tapped transformer provides approximately the same energy level at a given multiple of pick-up current for any tap setting, resulting in one time curve throughout the range of the relay.

Across the secondary is connected a non-linear resistor known as a varistor. The effect of the varistor is to reduce the voltage peaks applied to the overcurrent unit and phase shifting capacitor.

Ground Overcurrent Unit (I_o)

The ground overcurrent unit is a small a-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts completing the auxiliary relay (X) circuit.

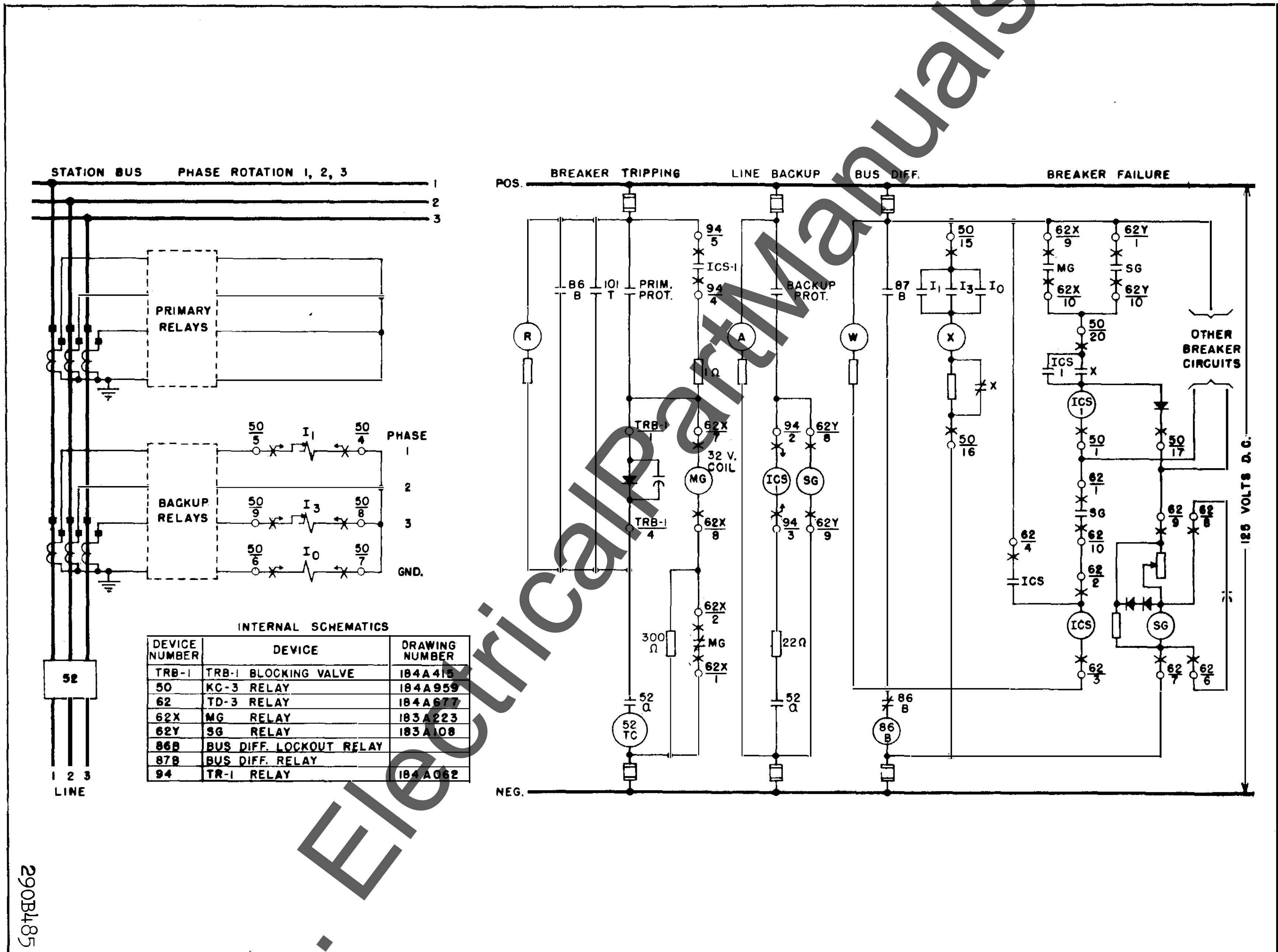
A core screw accessible from the top of the switch provides the adjustable pickup range. A calibrated scale is located to the rear of the core screw.

Auxiliary Unit (X)

The auxiliary relay is a multicontact telephone type of relay having a single coil. Four normally open contacts and one normally closed contact (all of which are electrically isolated) are brought out to the relay terminals. Two normally open contacts operate indicating contactor switches for identification of circuit operation.

Indicating Contactor Switch Unit (ICS-1 and ICS-2)

The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the



INTERNAL SCHEMATICS

DEVICE NUMBER	DEVICE	DRAWING NUMBER
TRB-1	TRB-1 BLOCKING VALVE	184A415
50	KC-3 RELAY	184A959
62	TD-3 RELAY	184A677
62X	MG RELAY	183A223
62Y	SG RELAY	183A108
86B	BUS DIFF. LOCKOUT RELAY	
87B	BUS DIFF. RELAY	
94	TR-1 RELAY	184A062

Fig. 5. External Schematic of the KC-3 Relay for Breaker-Failure Protection of a Single Bus/Single Breaker Arrangement.

front of the switch, which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

OPERATION

General

When any one of the overcurrent units (I_1, I_3 or I_0) operates, it energizes the X unit. When used for breaker-failure relaying, one or more of the X-unit contacts supervise the breaker-failure timing circuits to prevent other breakers from being unnecessarily tripped. When the proper breaker successfully interrupts the fault current the KC-3 relay quickly disables the breaker-failure timing circuit. In addition, where the line relays trip two breakers such as on a ring bus, the KC-3 selects which of the two breakers has failed. When the phase overcurrent units I_1 and I_3 are set above load-current level, the KC-3 also functions as a fault detector to prevent undesired tripping by test personnel. The following paragraphs describe KC-3 operation in more detail for different system bus connections.

Single Bus/Single Breaker Arrangement

Unless something fails, current flow in the breaker should cease shortly after the trip circuit is energized. The time interval between these two occurrences will be the breaker-interrupting time. If this interruption does not occur, breaker-failure relaying will initiate the tripping of other breakers. Fig. 5 shows how this is accomplished. Unless something fails either the primary or back-up relays initiate tripping of the faulted line breaker. Note that the primary and back-up relays connect to separate sets of current transformers and d-c supplies. This way a failure in one or the other circuits will not disable all of the protection.

When the primary protection operates it energizes 62X; the back-up protection energizes 62Y. Contacts of these two auxiliaries start the breaker-failure timer 62, through the KC-3 contact 50X. If the line breaker fails to clear the fault, contact 50X remains closed. The SG contact of timer 62 closes, energizing the bus lock-out relay 86B through 62X or 62Y and 50X contacts. Relay 86B then trips all the breakers on the bus.

The TRB-1 rectifier in the primary — protection circuits of Fig. 5 blocks the flow of red-light supervision current through the 62X coil. If the KC-3 phase overcurrent units are set above load current, a 50X contact may be inserted in series with the 62X coil to block the red-light currents. Then, the TRB-1 is not needed.

An MG-6 relay performs the 62X function in Fig. 5. Actually an SG will suffice unless a directional-comparison blocking system provides the primary protection. With this system two MG-6 contacts seal around the RRG and RRP contacts. (Refer to drawing 540D542 for the details of this arrangement.)

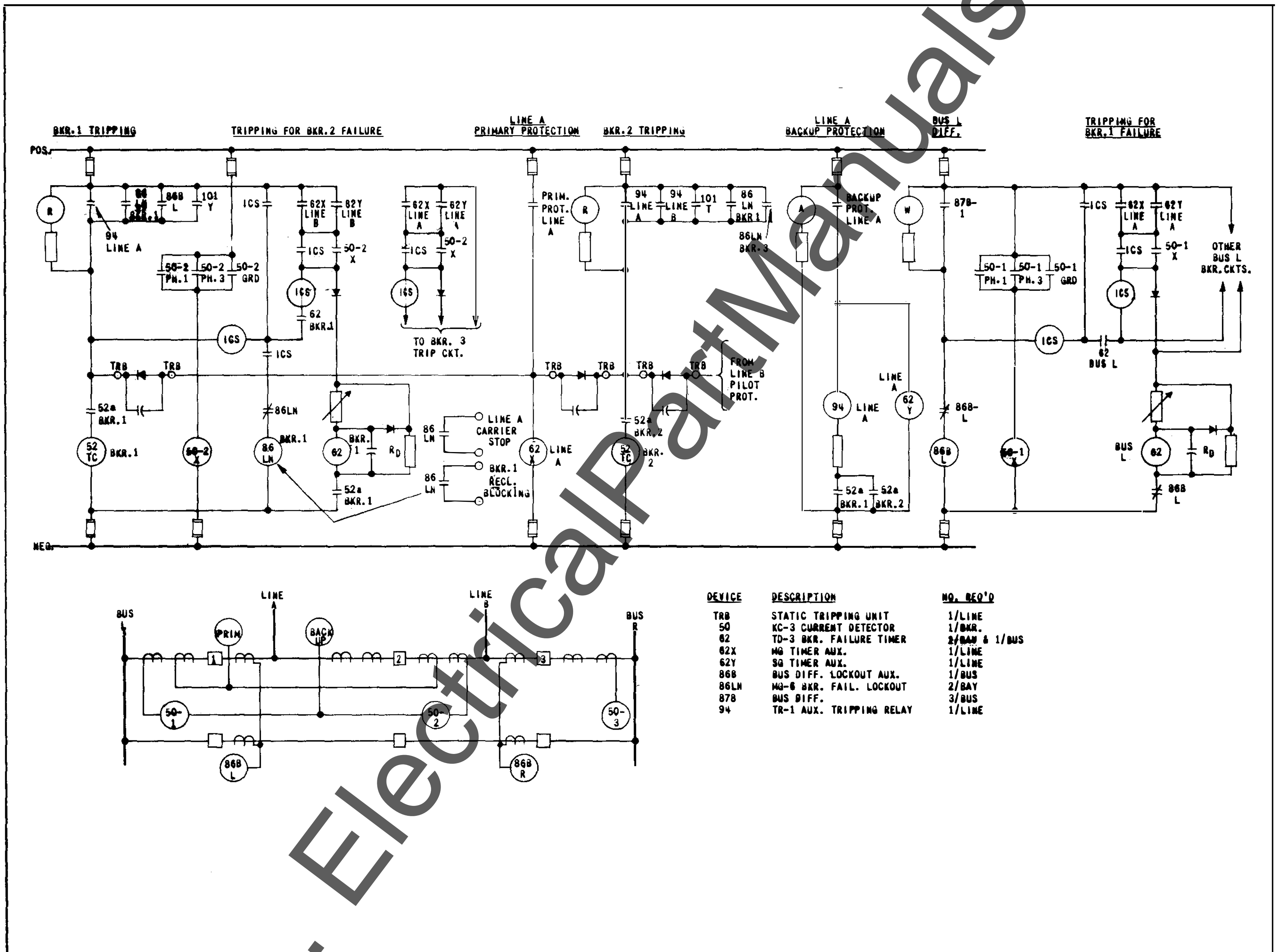
Breaker-and-a-Half Arrangement

Typical trip and control circuits for breaker-failure back-up protection for the breaker-and-a-half bus arrangement are shown in Fig. 6. The trip circuits are shown for breaker 1 and breaker 2 and the line-A protection. Similar circuits would exist for breaker 3 and line B. Protection against a breaker-1 or breaker-2 failure for line-A faults is included.

Assuming a failure of breaker 2 for a fault on line B, the breaker-failure timer 62 associated with breaker 1 is energized by 62X or 62Y from line B. Since the KC-3 current detector 50-2 which is supplied by breaker-2 current does not drop out, 62 of breaker 1 operates to trip breaker 1. When 62-ICS is operated by breaker-1 trip current, 86LN is energized. One 86LN contact stops the transmission of a blocking signal on line A, allowing the remote pilot relays to trip the remote line-A breaker, if they detect the fault. Thus, the fault on line B is now cleared. Another 86LN contact blocks high-speed reclosing of breaker 1. Other 86LN contacts energize the breaker-1 and breaker-2 trip-coil circuits to provide for a trip-free operation should either breaker be prematurely closed in.

An essential function, the selection of the faulty breaker, is performed by the KC-3. Relays 62X and 62Y indicate that the fault has not been cleared, but they are unable to define for a line-A fault whether breaker 1 or breaker 2 is still feeding current to the fault. The 50-1 or 50-2 KC-3 performs this job.

Now, if breaker 1 fails for a fault on line A, bus L is cleared. This is accomplished by the bus L breaker-failure timer which is energized by the line-A relay 62X or 62Y contact. When 62 operates, 86B is energized to dump bus L. For this sequence, the current detector 50-1 selects the faulty breaker.



DEVICE	DESCRIPTION	NO. REQ'D
TRB	STATIC TRIPPING UNIT	1/LINE
50	KC-3 CURRENT DETECTOR	1/BKR.
62	TD-3 BKR. FAILURE TIMER	2/BAY & 1/BUS
62X	MG TIMER AUX.	1/LINE
62Y	SG TIMER AUX.	1/LINE
86B	BUS DIFF. LOCKOUT AUX.	1/BUS
86LN	MG-6 BKR. FAIL. LOCKOUT	2/BAY
87B	BUS DIFF.	3/BUS
94	TR-1 AUX. TRIPPING RELAY	1/LINE

Fig. 6. Simplified External Schematic of the Type KC-3 for Breaker-Failure Protection of a Breaker-and-a-Half Bus.

Note that the bus L timer circuit in Fig. 6 is the same as that used with the single bus/single breaker arrangement in Fig. 5. An identical timer circuit (not shown) is associated with bus R in Fig. 6. There are also timers for each bay (e.g., associated with breakers 1 and 3). These trip the appropriate outside breaker for a middle breaker failure. These timer circuits are associated with the breaker to be tripped. This same approach is used for ring buses, as will now be explained.

Ring Bus Arrangement

The circuits for the ring bus are shown in Fig. 7 with trip and control circuits outlined for breaker 2, together with line-B primary and back-up protection circuits. As with the breaker-and-a-half scheme, the primary protection uses tripping rectifiers, and the backup uses an auxiliary relay to trip two breakers. As before, the 62X and 62Y relays are operated by the primary and back-up relays, respectively.

Assume a failure of breaker 1 for a fault on line D. Line-D relay 62X or 62Y is operated and energizes breaker-2 timer. Since KC-3 50-1 remains energized by the breaker-1 current, 62 operates to trip breaker 2. The ICS unit of relay 62 also operates to energize relay 86LN during breaker-2 tripping. Relay 86LN blocks breaker-2 reclosing and sets up the breaker-2 trip circuit to provide a trip-free operation if this breaker is closed in prematurely.

Now assume that breaker 3 fails for a fault on line C. Again, breaker 2 should be tripped. Breaker-2 timer is energized through 50-3 and line-C 62X or 62Y contact. Relay 62X or 62Y indicates a line-C fault, and 50-3X selects breaker 3 as faulty. Relay 62 times out to trip breaker 2 and also to energize 86LN.

Relay 86LN cannot determine which carrier blocking signal should be interrupted, since a breaker-2 trip occurs when either breaker 1 or 3 fails. Therefore, relay 5 is used in conjunction with relay 86LN to stop carrier on line A or line B when breaker 2 trips. Relay 5 is energized by the primary relays. If breaker 1 fails for a fault on line D, relay 5 of line D is energized, setting up the line-A carrier stop circuit so that when relay 86LN is operated in the breaker-2 trip circuit, carrier blocking will be removed from line A to permit remote carrier relay tripping. Otherwise, line A continues to feed the fault through breaker 2 until a back-up relay operates or until the fault burns clear.

CHARACTERISTICS

The Phase Overcurrent Units are available in the following current ranges:

Range	Taps					
0.5 - 2 Amps.	0.5	0.75	1.0	1.25	1.5	2
1 - 4	1.0	1.5	2.0	2.5	3.0	4.0
2 - 8	2	3	4	5	6	8

The tap value is the minimum current required to just close the overcurrent relay contacts. For pickup settings in between taps refer to the section under adjustments. The pickup and dropout time curves for the phase overcurrent units and telephone relay is shown in Fig. 8. The Ground Overcurrent Unit is available in the 0.5 - 2 or 1 to 4 ampere range. The pickup setting is continuously adjustable over the range. The pickup and dropout time of the ground overcurrent unit and telephone relay is shown in Fig. 9.

Trip Circuit

The main contacts will safely close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker.

The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting of lead located in front of the tap block to the desired setting by means of a screw connection.

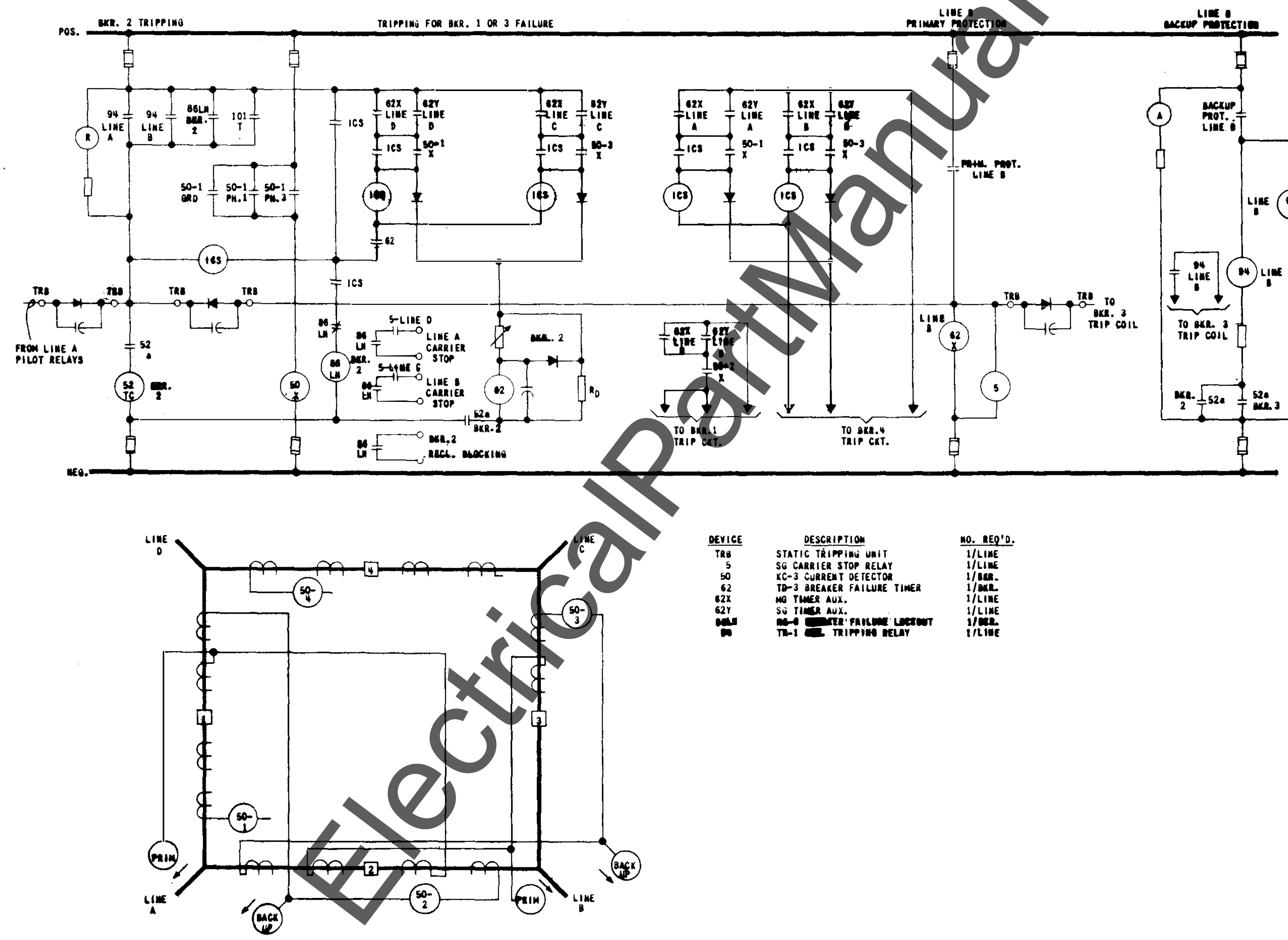
Trip Circuit Constants

Indicating Contactor Switch —
0.2 amp. tap 6.5 ohms d-c resistance
2.0 amp. tap 0.15 ohms d-c resistance

Auxiliary Relay (X)

With rated voltage applied, the contact closing time upon energization and the contact opening time upon de-energization is approximately 5 milliseconds.

The rectifiers S#508C320H14 320P silicon rectifiers have a peak inverse voltage rating of 700 volts d-c.



DEVICE	DESCRIPTION	NO. REQ'D.
TRB	STATIC TRIPPING UNIT	1/LINE
5	SG CARRIER STOP RELAY	1/LINE
50	KC-3 CURRENT DETECTOR	1/BKR.
62	TD-3 BREAKER FAILURE TIMER	1/BKR.
62X	MG TIMER AUX.	1/LINE
62Y	SG TIMER AUX.	1/LINE
[illegible]	[illegible] FAILURE LOCKOUT	1/BKR.
[illegible]	TR-1 [illegible] TRIPPING RELAY	1/LINE

Fig. 7. Simplified External Schematic of the Type KC-3 for Breaker-Failure Protection of a Ring Bus.

ENERGY REQUIREMENTS

PHASE OVERCURRENT UNIT (I_1 & I_3) – 60 CYCLES

Ampere Range	Tap	VA at Tap Value	P.F. Angle	VA at 5 Amps.	P.F. Angle
	.5	.37	39	24	46
	.75	.38	36	13	37
	1	.39	35	8.5	34
.5-2	1.25	.41	34	6.0	32
	1.5	.43	32	4.6	31
	2	.45	30	2.9	28
	1	.41	36	9.0	36
	1.5	.44	32	5.0	32
	2	.47	30	3.0	29
1-4	2.5	.50	28	2.1	27
	3	.53	26	1.5	26
	4	.59	24	0.93	24
	2	1.1	49	6.5	48
	3	1.2	43	3.3	42
2-8	4	1.3	38	2.1	37
	5	1.4	35	1.4	35
	6	1.5	33	1.1	33
	8	1.8	29	0.7	29

GROUND OVERCURRENT UNIT (I_0) – 60 CYCLES

Ampere Range	VA at Min. Pickup	VA at Max. Pickup	VA at 5 Amps.
0.5-2	4.5	32	215
1-4	4.5	32	53

Current Ratings

Rating of Phase Overcurrent Unit (I_1 & I_3)

Range	Continuous Rating (Amperes)	One Second Rating (Amperes)
.5-2	5	100
1-4	8	140
2-8	8	140

Rating of Ground Overcurrent Unit

Ampere Range	One Second Rating (Amperes)
0.5-2	18
1-4	36

SETTINGS

Phase Overcurrent Unit (I_1 & I_3)

The pickup current setting is made by means of the connector screw located on the tap plate. By placing the connector screw in the desired tap, the relay will just close its contacts at the tap value current.

CAUTION *Since the tap block connector screw carries operating current, be sure that the screw is turned tight.*

In order to avoid opening the current transformer circuits when changing taps under load, connect the spare tap screw in the desired tap position before removing the other tap screw from the original tap position.

Ground Overcurrent Unit (I_o)

The core screw must be adjusted to the value of pickup current desired.

Auxiliary Relay (X)

With the 125/250 volt relays the tapped resistor in series with the auxiliary relay (X) is shipped from the factory for operation on 125 volts d.c. For 250 volt operation move the lead connection from the tap position to the full resistance connection. The resistor in the 48 volt relay is not tapped.

Indicating Contactor Switch (ICS-1 and ICS-2)

Connect the lead located in front of the tap block to the desired setting by means of the connecting screw. When the relay energizes a 125-or 250-volt d-c type WL relay switch or equivalent, use the 0.2 ampere tap; for 48-volt d-c applications set in 2 tap and use WL coil S#304C209G01.

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration, and heat. Mount the relay vertically by means of the four mounting holes on the flange for semi-flush mounting or by means of the rear mounting stud or studs for projection mounting. Either a mounting stud or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench.

For detailed information, refer to I.L. 41-076.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay, no customer adjustments, other than those covered under "SETTINGS," should be required.

Acceptance Check

The following check is recommended to insure that the relay is in proper working order:

Phase Overcurrent Unit (I_1 & I_3)

1. Contact Gap — The gap between the stationary and moving contacts with the relay in the de-energized position should be approximately .020."

2. Minimum Trip Current — The pick-up of the overcurrent unit can be checked by inserting the tap screw in the desired tap hole and applying rated tap value current. The contact should close within ±5% of tap value current.

Ground Overcurrent Unit (I_O)

The core screw which is adjustable from the top of the trip unit determines the pickup value. The trip unit has a nominal ratio of adjustment of 1 to 4 and an accuracy within the limits of 10%.

The contact gap should be approximately 5/64" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

Indicating Contactor Switch (ICS-1 and ICS-2)

Close the auxiliary telephone relay contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

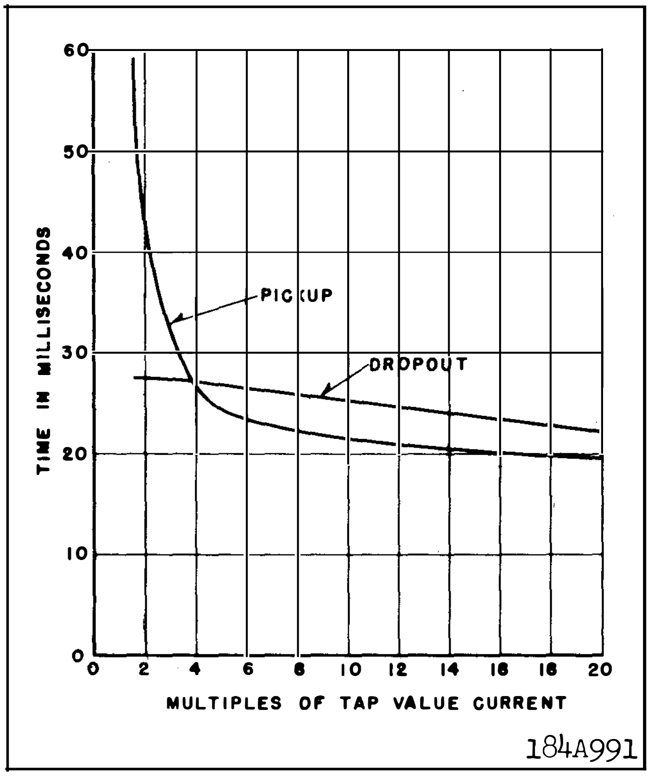


Fig. 8. Maximum Pick-Up and Drop-Out Time. Curves for the Phase Overcurrent Unit Plus Auxiliary Unit.

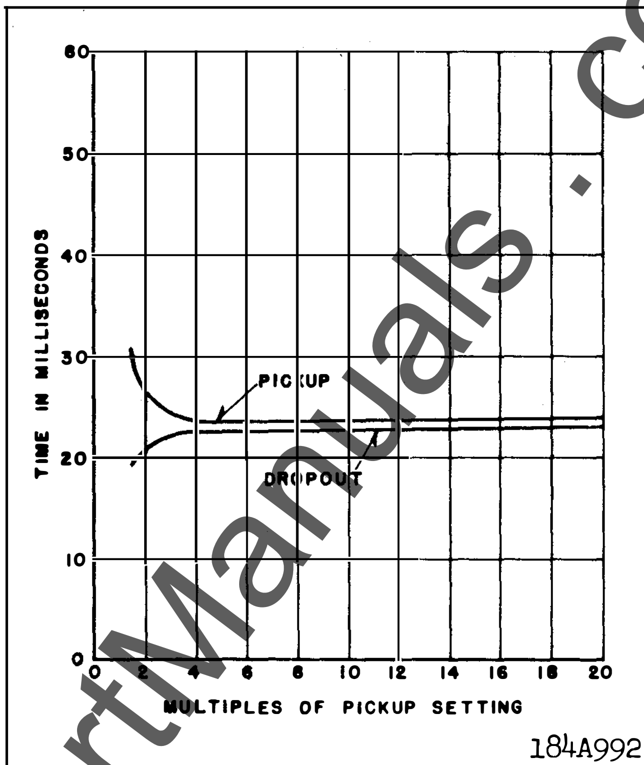


Fig. 9. Maximum Pick-Up and Drop-Out Time. Curves for the Ground Overcurrent Unit Plus Auxiliary Unit.

Auxiliary Relay (X)

Block one of the phase overcurrent cylinder unit contacts closed and apply rated d-c voltage to the proper relay terminals. Observe that all of the normally open contacts close and all the normally closed contacts open.

Routine Maintenance

All relays should be inspected periodically and the operation should be checked at least once every year or at such other time intervals as may be dictated by experience to be suitable to the particular application.

All contacts should be periodically cleaned. A contact burnisher S#182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

Calibration

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been distrubed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See "Acceptance Check").

Phase Overcurrent Unit (I_1 & I_3)

The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

The set screw in the stationary contact has been shop adjusted for optimum follow and this adjustment should not be disturbed.

1. The upper pin bearing should be screwed down until there is approximately 1/64" clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.

2. The contact gap adjustment for the overcurrent unit is made with the moving contact in the reset position, e.e., against the right side of the bridge. Advance the stationary contact until the contacts

just close. Then back off the stationary contact 2/3 of one turn for a gap of approximately .020." The clamp holding the stationary contact housing need not be loosened for the adjustment since the clamp utilizes a spring-type action in holding the stationary contact in position.

3. The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

Insert the tap screw in the minimum value tap setting and adjust the spring such that the contacts will close when energized with the required current. The pick up of the overcurrent unit with the tap screw in any other tap should be within ±5% of tap value.

If adjustment of pick-up current in between tap settings is desired, insert the tap screw in the next lowest tap setting and adjust the spring as described. It should be noted that this adjustment results in a slightly different time characteristic curve and burden.

Ground Overcurrent Unit

The core screw which is adjustable from the top of the trip unit determines the pickup value. The trip unit has a nominal ratio of adjustment of 1 to 4 and an accuracy within the limits of 10%.

The contact gap should be approximately 5/64" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

Indicating Contactor Switch (ICS-1 and ICS-2)

Close the main relay contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should be not greater than the particular ICS tap setting being used. The operation indicator target should drop freely.

To increase the pickup current remove the molded cover and bend the springs out or away from the cover. To decrease the pickup current bend the springs in toward the cover.

The contact gap should be approximately .047" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

Auxiliary Relay (X)

Block the cylinder unit contact closed. Apply rated voltage and see that all the normally open contacts close by means of a neon lamp. Also see that the normally closed contacts make a good contact with the coil de-energized by noting some deflection of the contacts. With the relay de-energized check to see that a good contact is made across the resistor in series with the coil by measuring approximately zero resistance at the resistor terminals.

The contact gap should be approximately .020". The armature rest may be adjusted slightly to achieve this, but care should be exercised so as not to affect the normally closed contacts.

The armature residual screw may be adjusted to vary contact follow of the normally open contacts but the residual gap should not be less than .002".

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.

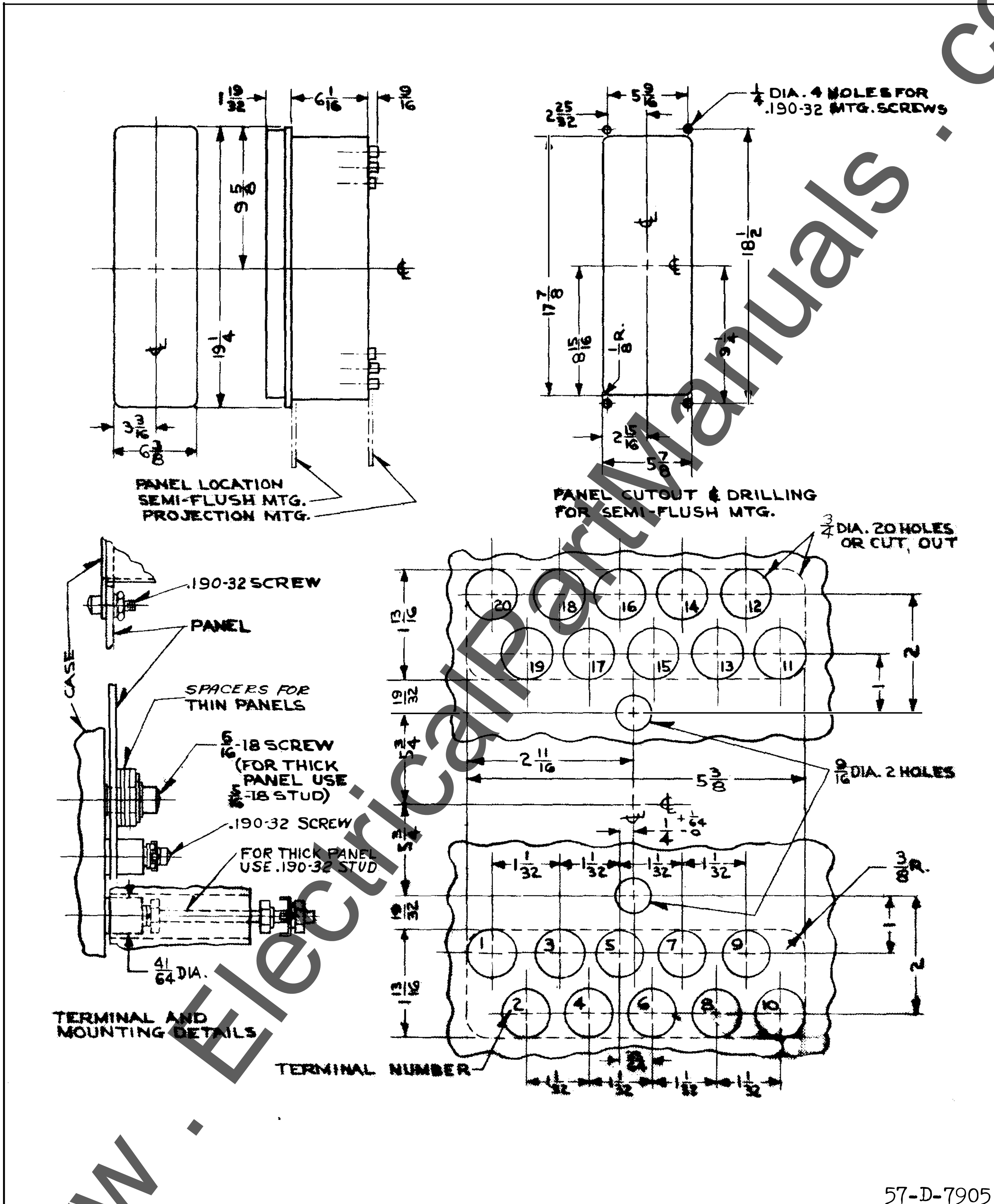


Fig. 10. Outline and Drilling Plan for the Type KC-3 Relay in FT-42 Case.

WESTINGHOUSE ELECTRIC CORPORATION

RELAY DEPARTMENT **NEWARK, N. J.**

Printed in U. S. A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KC-3 CURRENT DETECTOR RELAY

CAUTION *Before putting relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.*

APPLICATION

The type KC-3 is a non-directional current or fault detector which operates for all phase and ground faults to supervise the tripping of other relays. It is well suited to breaker-failure relaying for indicating the presence or lack of current flow in the circuit breaker. The relay can be applied where the phase units are to be operated indefinitely in the picked up position well below full load. Alternatively, where the relay is to be used as a fault detector (pickup above full load) the 98% or better dropout ratio of the phase units is advantageous.

These instructions apply for two relay varieties, as shown in the internal schematics of Figs. 3 and 4. The two differ only in the terminal 14 connections. The relays connected per Fig. 3 will suffice in most cases. Use the relay per Fig. 4 where the ICS-2 contact is needed for an external seal-in. Note, however, that the circuits associated with terminals 10, 11 and 14 of Fig. 4 should not be used where more than one KC-3 relay connects to a common breaker-failure timing circuit. Otherwise all of the KC-3 targets connected to this timing circuit may operate on a breaker-failure operation.

Breaker-failure relaying offers advantages over remote back-up protection. It is faster and more sensitive than remote back-up methods. In addition, it is selective, whereas remote back-up protection is frequently non-selective. Fig. 2 shows some fault conditions where breaker-failure relaying could improve the quality of back-up protection. Note that the generating-station high-voltage bus uses a breaker-and-a-half arrangement. Lines interconnect the station to systems S_1, S_2, and S_3.

If there is no malfunctioning, fault L will be cleared by line relays tripping breakers 5, 6, and 9. However, assume that the breaker-6 mechanism sticks so that current flow through breaker 6 is not interrupted. Now back-up protection must function. If remote backup is relied upon, time-delay relays must trip remote breakers 7 and 8. In addition, the local generator feed through breaker 6 must be interrupted by tripping breaker 4. However, if breaker-failure protection is installed, the fault is cleared by tripping breaker 3. Note that this provided selective tripping, since as much of the system as possible was left intact. If breakers 4, 7, and 8 must trip, the local generator is lost and unnecessary separation of the generating station from power systems S_1 and S_2 results. Also, the tapped load is interrupted unnecessarily instead of being left tied to system S_2.

Remote backup, in addition to not being selective, may not be sensitive enough because of the relatively small proportion of the total fault current following in any one line. For example, in Fig. 2 there may be very little current flow in breakers 7 and 8 for fault L because of the large current contribution by the local machines at the generating station. Thus, it may be difficult or impossible at breakers 7 and 8 to detect adjacent line faults without depending upon sequential tripping. If the generator feed is interrupted for fault L, such as by tripping breaker 4, the current through breakers 7 and 8 may increase sufficiently for the relays to operate and trip breakers 7 and 8. However, the system is by now cut to pieces, and because of the long time delay in clearing the fault, the remainder of the system may be unstable.

Although breaker-failure protection offers many advantages, remote backup cannot be completely eliminated. For example, assume that breaker 3 fails

SUPERSEDES I.L. 41-776B
*Denotes change from superseded issue

EFFECTIVE DECEMBER 1966

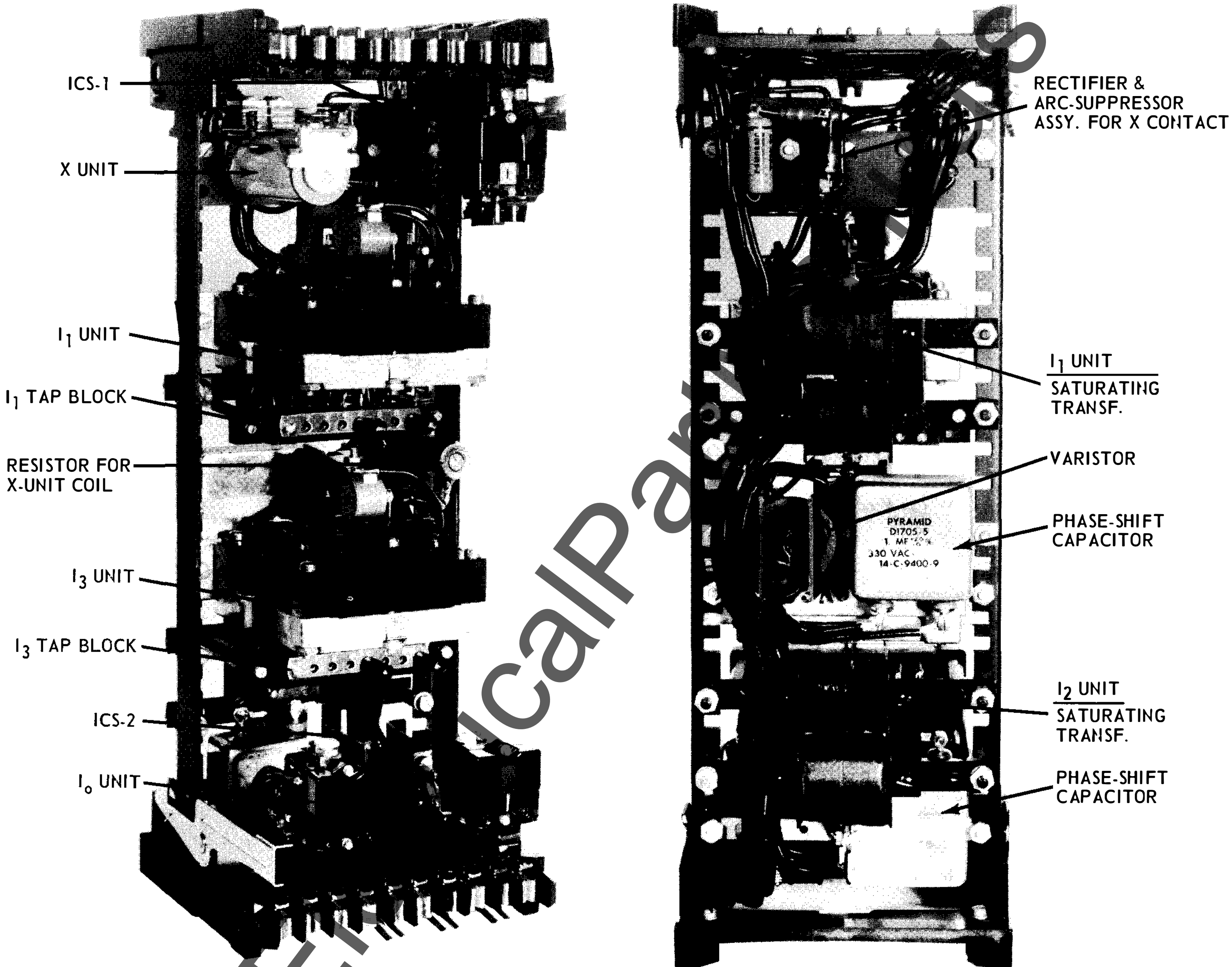


Fig. 1. Type KC-3 Relay Without Case.

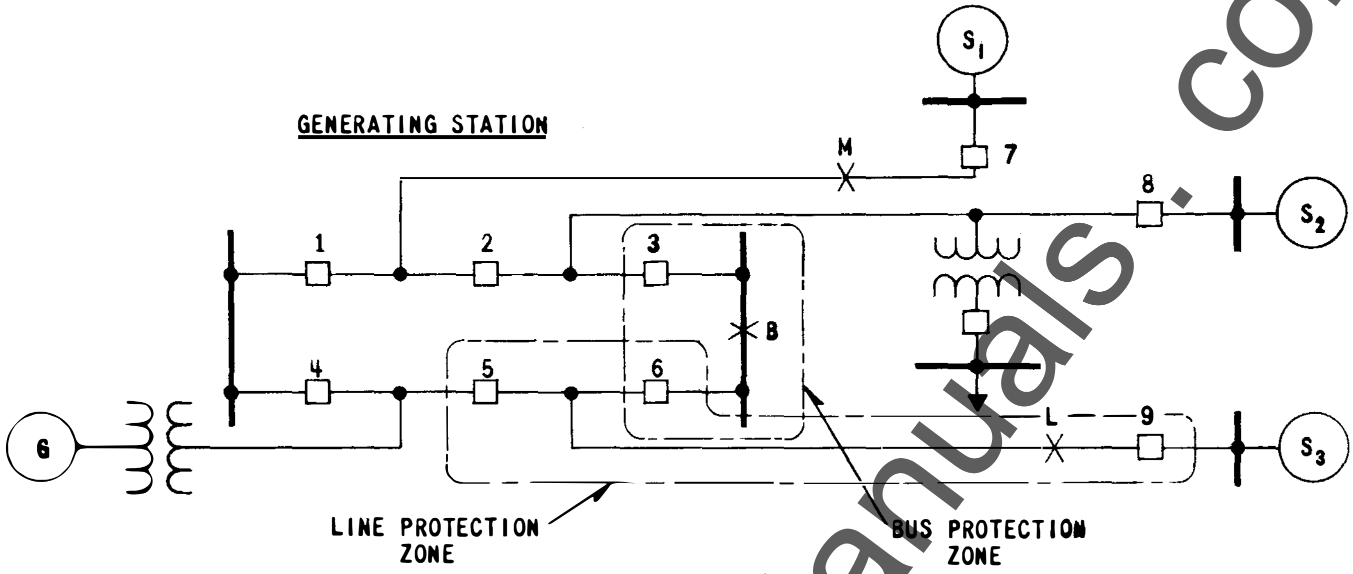


Fig. 2. Sample System to Show Advantages of Breaker-Failure Protection.

for bus-fault B in Fig. 2. Breaker-failure protection will promptly trip breaker 2, but the fault is still fed by breaker 8. Likewise, if breaker 2 fails with a line fault at M, a remote breaker must trip to clear the fault. Breaker-failure protection trips breaker 3, but breaker 8 still feeds the fault. Although breaker-failure protection does not complete the job in these examples, it does expeditiously trip the local breaker, making it easier for the remote relays to detect the fault.

CONSTRUCTION

Phase Overcurrent Unit (I_1 & I_3)

The phase overcurrent unit is an induction-cylinder unit. The time-phase relationship of the two air gap fluxes necessary for the development of torque is achieved by means of a capacitor connected in series with one pair of pole windings.

Mechanically, the overcurrent unit is composed of four basic components: a die-cast aluminum frame, an electromagnet, a moving element assembly, and a molded bridge.

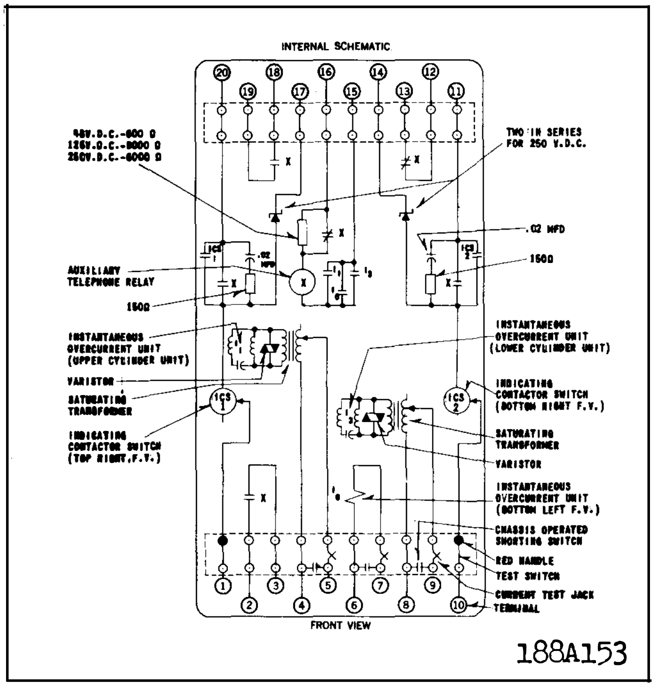
The frame serves as the mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame.

The electromagnet has two pairs of coils. The coils of each pair are mounted diametrically opposite one another. In addition, there are two locating pins. The locating pins are used to accurately position the lower pin bearing, which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp.

With the contact closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.



** Fig. 3. Internal Schematic of the Type KC-3 Relay in FT42 Case. (For S#290B243A – Series).*

When the current in the overcurrent unit exceeds the pick-up value the contacts close to energize the auxiliary relay (X).

A transformer and varistor assembly is used in conjunction with the overcurrent unit. The transformer is of the saturating type which limits the energy to the overcurrent unit and reduces the burden on the operating CT.

The primary of the transformer is tapped and brought out to a tap connector block for ease in changing the pick-up current of the relay. The use of a tapped transformer provides approximately the same energy level at a given multiple of pick-up current for any tap setting, resulting in one time curve throughout the range of the relay.

Across the secondary is connected a non-linear resistor known as a varistor. The effect of the varistor is to reduce the voltage peaks applied to the overcurrent unit and phase shifting capacitor.

Ground Overcurrent Unit (I_o)

The ground overcurrent unit is a small a-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts completing the auxiliary relay (X) circuit.

A core screw accessible from the top of the switch provides the adjustable pickup range. A calibrated scale is located to the rear of the core screw.

Auxiliary Unit (X)

The auxiliary relay is a multicontact telephone type of relay having a single coil. Four normally open contacts and one normally closed contact (all of which are electrically isolated) are brought out to the relay terminals. Two normally open contacts operate indicating contactor switches for identification of circuit operation.

Indicating Contactor Switch Unit (ICS-1 and ICS-2)

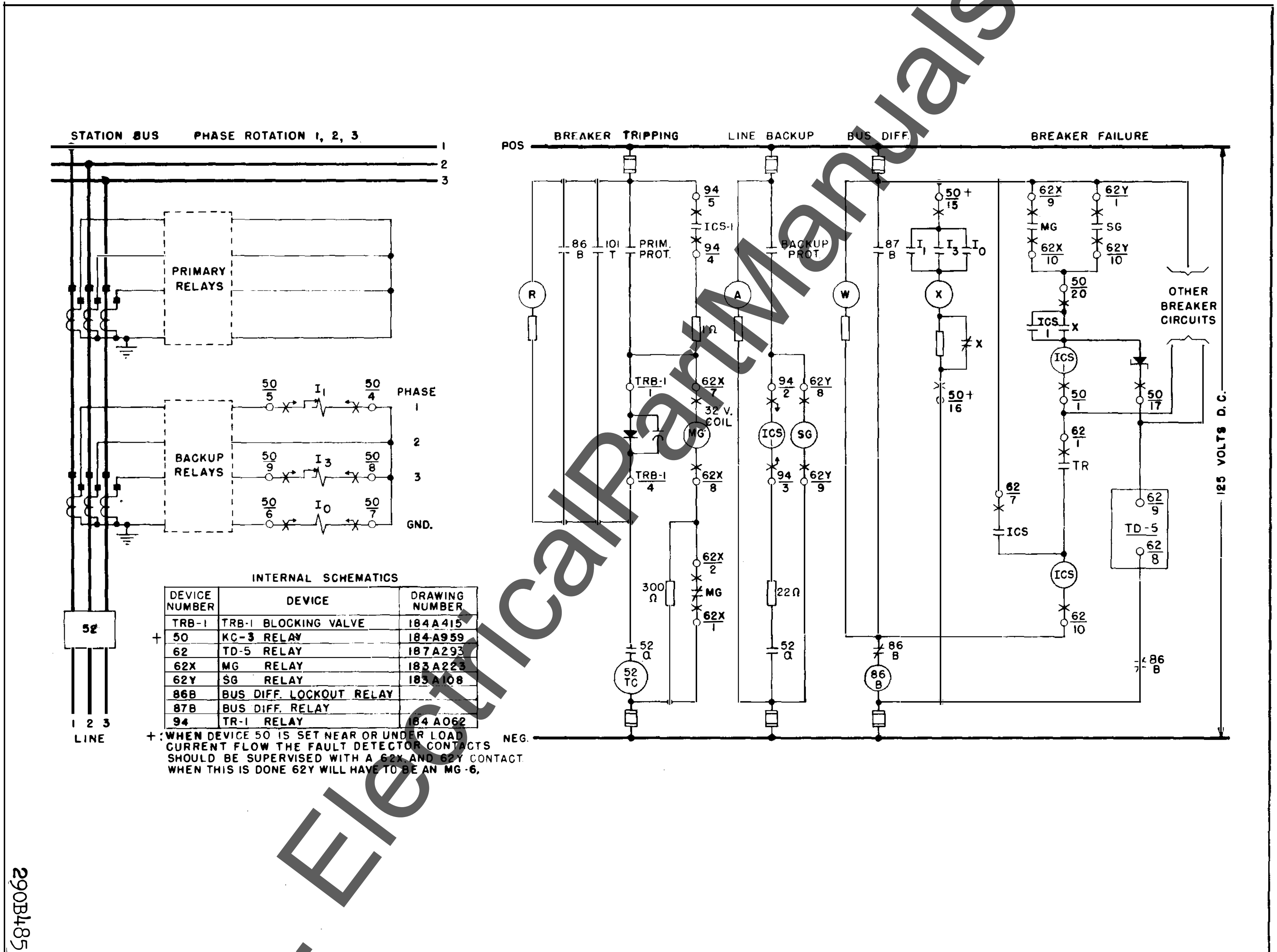
The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch, which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

OPERATION

General

When any one of the overcurrent units (I_1, I_3 or I_o) operates, it energizes the **X** unit. When used for breaker-failure relaying, one or more of the **X**-unit contacts supervise the breaker-failure timing circuits to prevent other breakers from being unnecessarily tripped. When the proper breaker successfully interrupts the fault current the KC-3 relay quickly disables the breaker-failure timing circuit. In addition, where the line relays trip two breakers such as on a ring bus, the KC-3 selects which of the two breakers has failed. When the phase overcurrent units I_1 and I_3 are set above load-current level, the KC-3 also functions as a fault detector to prevent undesired tripping by test personnel. The following paragraphs describe KC-3 operation in more detail for different system bus connections.



INTERNAL SCHEMATICS

DEVICE NUMBER	DEVICE	DRAWING NUMBER
TRB-1	TRB-1 BLOCKING VALVE	184A415
+ 50	KC-3 RELAY	184A959
62	TD-5 RELAY	187A293
62X	MG RELAY	183A223
62Y	SG RELAY	183A108
86B	BUS DIFF. LOCKOUT RELAY	
87B	BUS DIFF. RELAY	
94	TR-1 RELAY	184A062

+: WHEN DEVICE 50 IS SET NEAR OR UNDER LOAD CURRENT FLOW THE FAULT DETECTOR CONTACTS SHOULD BE SUPERVISED WITH A 62X AND 62Y CONTACT. WHEN THIS IS DONE 62Y WILL HAVE TO BE AN MG-6.

* *Fig. 4 External Schematic of the KC-3 Relay for Breaker-Failure Protection of a Single Bus/Single Breaker Arrangement.*

Single Bus/Single Breaker Arrangement

Unless something fails, current flow in the breaker should cease shortly after the trip circuit is energized. The time interval between these two occurrences will be the breaker-interrupting time. If this interruption does not occur, breaker-failure relaying will initiate the tripping of other breakers. Fig. 5 shows how this is accomplished. Unless something fails either the prinary or back-up relays initiate tripping of the faulted line breaker. Note that the primary and back-up relays connect to separate sets of current transformers and d-c supplies. This way a failure in one or the other circuits will not disable all of the protection.

When the primary protection operates it energizes 62X; the back-up protection energizes 62Y. Contacts of these two auxiliaries start the breaker-failure timer 62, through the KC-3 contact 50X. If the line breaker fails to clear the fault, contact 50X remains closed. The SG contact of timer 62 closes, energizing the bus lock-out relay 86B through 62X or 62Y and 50X contacts. Relay 86B then trips all the breakers on the bus.

The TRB-1 rectifier in the primary — protection circuits of Fig. 5 blocks the flow of red-light supervision current through the 62X coil. If the KC-3 phase overcurrent units are set above load current, a 50X contact may be inserted in series with the 62X coil to block the red-light currents. Then, the TRB-1 is not needed.

An MG-6 relay performs the 62X function in Fig. 5. Actually an SG will suffice unless a directional-comparison blocking system provides the primary protection. With this system two MG-6 contacts seal around the RRG and RRP contacts. (Refer to drawing 540D542 for the details of this arrangement.)

Breaker-and-a-Half Arrangement

Typical trip and control circuits for breaker-failure back-up protection for the breaker-and-a-half bus arrangement are shown in Fig. 6. The trip circuits are shown for breaker 1 and breaker 2 and the line-A protection. Similar circuits would exist for breaker 3 and line B. Protection against a breaker-1 or breaker-2 failure for line-A faults is included.

Assuming a failure of breaker 2 for a fault on line B, the breaker-failure timer 62 associated with breaker 1 is energized by 62X or 62Y from line B. Since the KC-3 current detector 50-2 which is supplied by breaker-2 current does not drop out, 62 of breaker 1 operates to trip breaker 1. When 62-ICS is operated by breaker-1 trip current, 86LN is energized. One 86LN contact stops the transmission of a blocking signal on line A, allowing the remote pilot relays to trip the remote line-A breaker, if they detect the fault. Thus, the fault on line B is now cleared. Another 86LN contact blocks high-speed reclosing of breaker 1. Other 86LN contacts energize the breaker-1 and breaker-2 trip-coil circuits to provide for a trip-free operation should either breaker be prematurely closed in.

An essential function, the selection of the faulty breaker, is performed by the KC-3. Relays 62X and 62Y indicate that the fault has not been cleared, but they are unable to define for a line-A fault whether breaker 1 or breaker 2 is still feeding current to the fault. The 50-1 or 50-2 KC-3 performs this job.

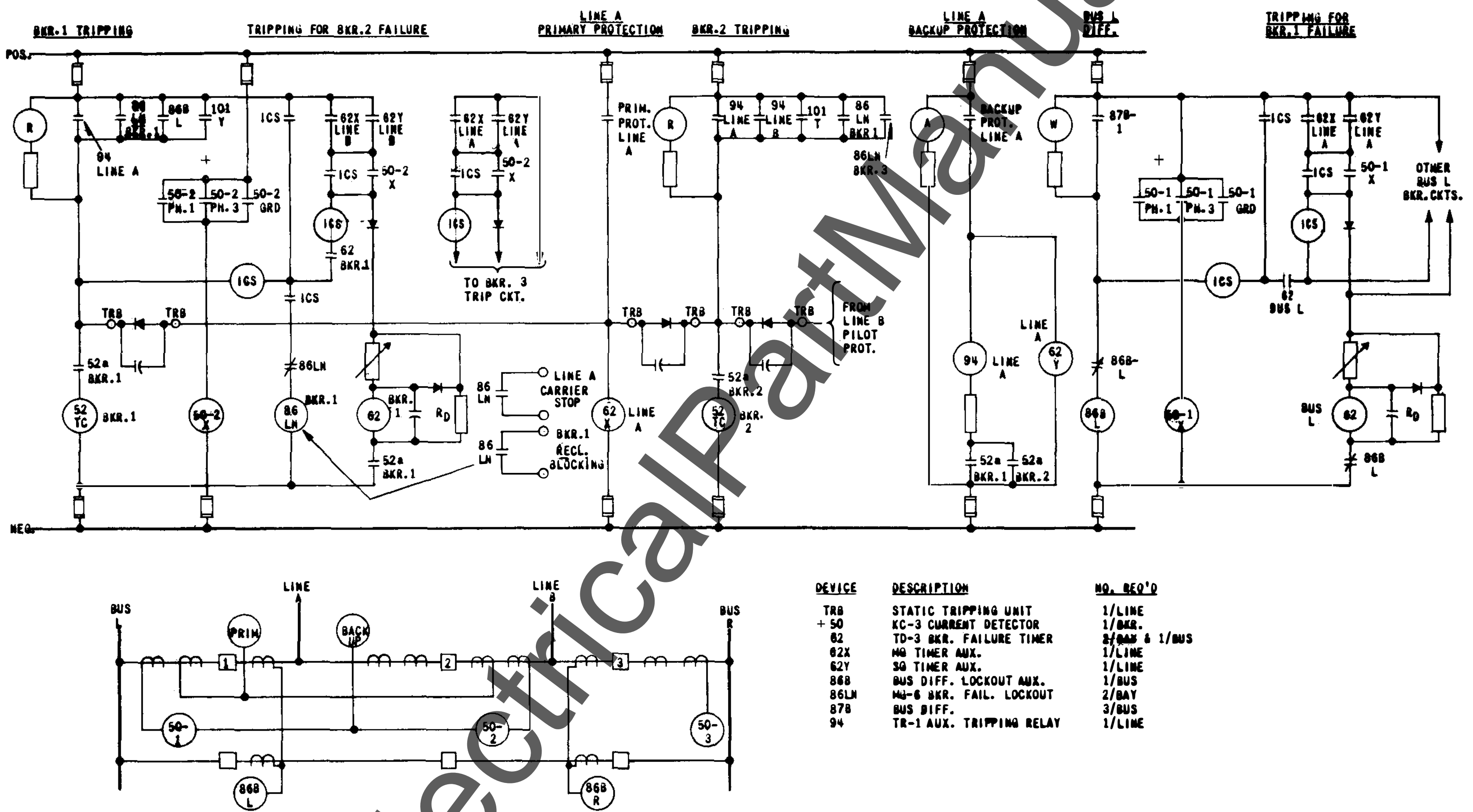
Now, if breaker 1 fails for a fault on line A, bus L is cleared. This is accomplished by the bus L breaker-failure timer which is energized by the line-A relay 62X or 62Y contact. When 62 operates, 86B is energized to dump bus L. For this sequence, the current detector 50-1 selects the faulty breaker.

Note that the bus L timer circuit in Fig. 6 is the same as that used with the single bus/single breaker arrangement in Fig. 5. An identical timer circuit (not shown) is associated with bus R in Fig. 6. There are also timers for each bay (e.g., associated with breakers 1 and 3). These trip the appropriate outside breaker for a middle breaker failure. These timer circuits are associated with the breaker to be tripped. This same approach is used for ring buses, as will now be explained.

Ring Bus Arrangement

The circuits for the ring bus are shown in Fig. 7 with trip and control circuits outlined for breaker 2, together with line-B primary and back-up protection circuits. As with the breaker-and-a-half scheme, the primary protection uses tripping rectifiers, and the backup uses an auxiliary relay to trip two breakers. As before, the 62X and 62Y relays are operated by the primary and back-up relays, respectively.

Assume a failure of breaker 1 for a fault on line D. Line-D relay 62X or 62Y is operated and energizes breaker-2 timer. Since KC-3 50-1 remains energized by the breaker-1 current, 62 operates to trip breaker 2. The ICS unit of relay 62 also operates to energize relay 86LN during breaker-2 tripping. Relay 86LN blocks breaker-2 reclosing and sets up the breaker-2 trip circuit to provide a trip-free operation if this breaker is closed in prematurely.



DEVICE	DESCRIPTION	NO. REQ'D
TRB	STATIC TRIPPING UNIT	1/LINE
+ 50	KC-3 CURRENT DETECTOR	1/BKR.
62	TD-3 BKR. FAILURE TIMER	2/BAY & 1/BUS
62X	MG TIMER AUX.	1/LINE
62Y	SG TIMER AUX.	1/LINE
86B	BUS DIFF. LOCKOUT AUX.	1/BUS
86LN	MG-6 BKR. FAIL. LOCKOUT	2/BAY
87B	BUS DIFF.	3/BUS
94	TR-1 AUX. TRIPPING RELAY	1/LINE

+: WHEN DEVICE 50 IS SET NEAR OR UNDER LOAD CURRENT FLOW THE FAULT DETECTOR CONTACTS SHOULD BE SUPERVISED WITH A 62X AND 62Y CONTACT WHEN THIS IS DONE 62Y WILL HAVE TO BE AN MG-6

* *Fig. 5 Simplified External Schematic of the Type KC-3 for Breaker-Failure Protection of a Breaker-and-a-Half Bus.*

Now assume that breaker 3 fails for a fault on line C. Again, breaker 2 should be tripped. Breaker-2 timer is energized through 50-3 and line-C 62X or 62Y contact. Relay 62X or 62Y indicates a line-C fault, and 50-3X selects breaker 3 as faulty. Relay 62 times out to trip breaker 2 and also to energize 86LN.

Relay 86LN cannot determine which carrier blocking signal should be interrupted, since a breaker-2 trip occurs when either breaker 1 or 3 fails. Therefore, relay 5 is used in conjunction with relay 86LN to stop carrier on line A or line B when breaker 2 trips. Relay 5 is energized by the primary relays. If breaker 1 fails for a fault on line D, relay 5 of line D is energized, setting up the line-A carrier stop circuit so that when relay 86LN is operated in the breaker-2 trip circuit, carrier blocking will be removed from line A to permit remote carrier relay tripping. Otherwise, line A continues to feed the fault through breaker 2 until a back-up relay operates or until the fault burns clear.

CHARACTERISTICS

The Phase Overcurrent Units are available in the following current ranges:

Range	Taps					
0.5 - 2 Amps.	0.5	0.75	1.0	1.25	1.5	2
1 - 4	1.0	1.5	2.0	2.5	3.0	4.0
2 - 8	2	3	4	5	6	8

The tap value is the minimum current required to just close the overcurrent relay contacts. For pickup settings in between taps refer to the section under adjustments. The pickup and dropout time curves for the phase overcurrent units and telephone relay is shown in Fig. 8. The Ground Overcurrent Unit is available in the 0.5 - 2 or 1 to 4 ampere range. The pickup setting is continuously adjustable over the range. The pickup and dropout time of the ground overcurrent unit and telephone relay is shown in Fig. 9.

Trip Circuit

The main contacts will safely close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker.

The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting of lead located in front of the tap block to the desired setting by means of a screw connection.

Trip Circuit Constants

Indicating Contactor Switch —
0.2 amp. tap 6.5 ohms d-c resistance
2.0 amp. tap 0.15 ohms d-c resistance

Auxiliary Relay (X)

With rated voltage applied, the contact closing time upon energization and the contact opening time upon de-energization is approximately 5 milliseconds.

The rectifiers S#508C320H14 320P silicon rectifiers have a peak inverse voltage rating of 700 volts d-c.

SETTINGS

Phase Overcurrent Unit (I_1 & I_3)

The pickup current setting is made by means of the connector screw located on the tap plate. By placing the connector screw in the desired tap, the relay will just close its contacts at the tap value current.

CAUTION *Since the tap block connector screw carries operating current, be sure that the screw is turned tight.*

In order to avoid opening the current transformer circuits when changing taps under load, connect the spare tap screw in the desired tap position before removing the other tap screw from the original tap position.

Ground Overcurrent Unit (I_o)

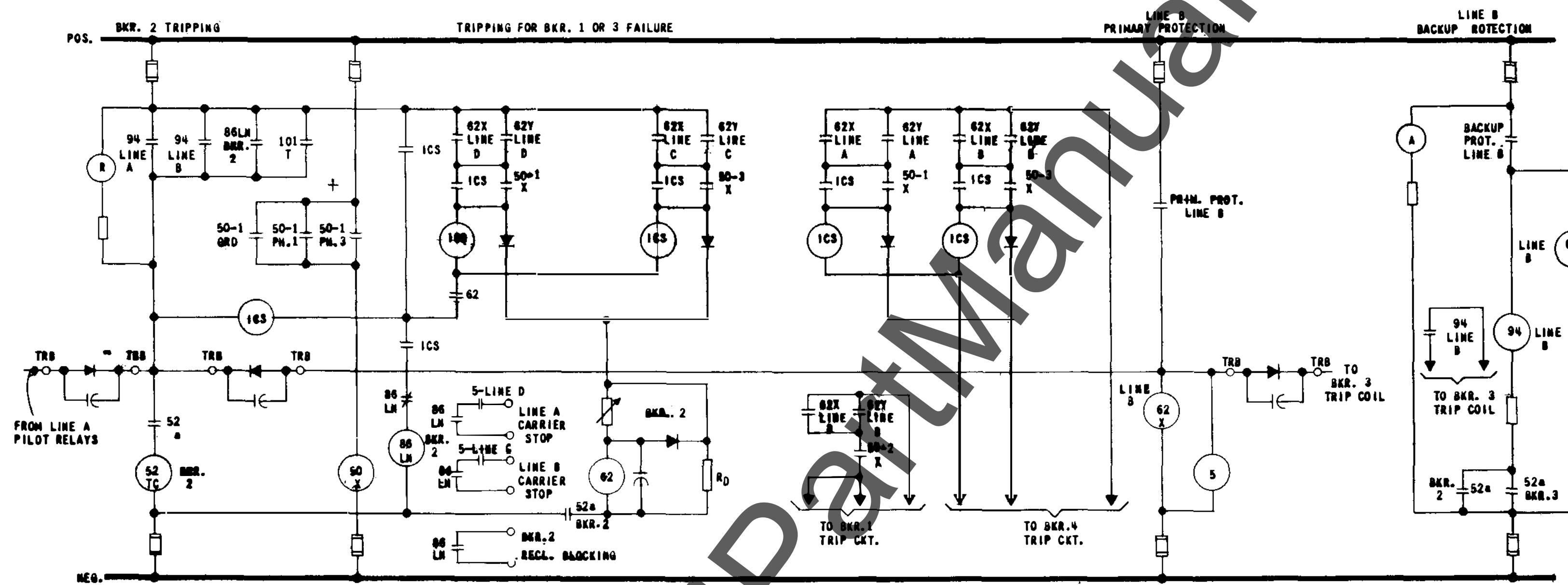
The core screw must be adjusted to the value of pickup current desired.

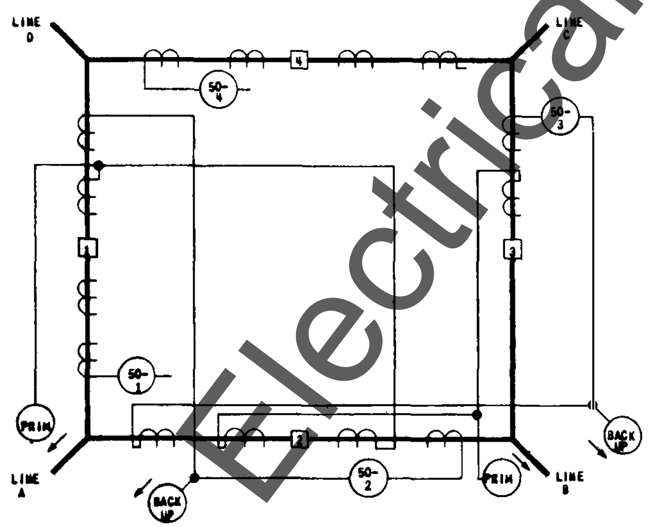
Indicating Contactor Switch (ICS-1 and ICS-2)

Connect the lead located in front of the tap block to the desired setting by means of the connecting screw. When the relay energizes a 125-or 250-volt d-c type WL relay switch or equivalent, use the 0.2 ampere tap; for 48-volt d-c applications set in 2 tap and use WL coil S#304C209G01.

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration, and heat. Mount the relay vertically by means of the four mounting holes on the flange for semi-flush mounting or by means of the rear mounting stud or studs for projec-





DEVICE	DESCRIPTION	NO. REQ'D.
RB	STATIC TRIPPING UNIT	1/LINE
5	SG CARRIER STOP RELAY	1/LINE
+50	KC-3 CURRENT DETECTOR	1/BKR.
62	TD-3 BREAKER FAILURE TIMER	1/BKR.
62X	MG TIMER AUX.	1/LINE
62Y	SG TIMER AUX.	1/LINE
86LN	MG-6 BREAKER FAILURE LOCKOUT	1/BKR.
94	TR-1 AUX. TRIPPING RELAY	1/LINE

+: WHEN DEVICE 50 IS SET NEAR OR UNDER LOAD CURRENT FLOW THE FAULT DETECTOR CONTACTS SHOULD BE SUPERVISED WITH A 62X AND 62Y CONTACT WHEN THIS IS DONE 62Y WILL HAVE TO BE AN MG-6

* Fig. 6 Simplified External Schematic of the Type KC-3 for Breaker-Failure Protection of a Ring Bus.

ENERGY REQUIREMENTS

PHASE OVERCURRENT UNIT (I_1 & I_3) – 60 CYCLES

Ampere Range	Tap	VA at Tap Value	P.F. Angle	VA at 5 Amps.	P.F. Angle
	.5	.37	39	24	46
	.75	.38	36	13	37
	1	.39	35	8.5	34
.5-2	1.25	.41	34	6.0	32
	1.5	.43	32	4.6	31
	2	.45	30	2.9	28
	1	.41	36	9.0	36
	1.5	.44	32	5.0	32
	2	.47	30	3.0	29
1-4	2.5	.50	28	2.1	27
	3	.53	26	1.5	26
	4	.59	24	0.93	24
	2	1.1	49	6.5	48
	3	1.2	43	3.3	42
2-8	4	1.3	38	2.1	37
	5	1.4	35	1.4	35
	6	1.5	33	1.1	33
	8	1.8	29	0.7	29

GROUND OVERCURRENT UNIT (I_0) – 60 CYCLES

Ampere Range	VA at Min. Pickup	VA at Max. Pickup	VA at 5 Amps.
0.5-2	4.5	32	215
1-4	4.5	32	53

Current Ratings

Rating of Phase Overcurrent Unit (I_1 & I_3)

Range	Continuous Rating (Amperes)	One Second Rating (Amperes)
.5-2	5	100
1-4	8	140
2-8	8	140

Rating of Ground Overcurrent Unit

Ampere Range	One Second Rating (Amperes)
0.5-2	18
1-4	36

tion mounting. Either a mounting stud or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench.

For detailed information, refer to I.L. 41-076.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay, no customer adjustments, other than those covered under "SETTINGS," should be required.

Acceptance Check

The following check is recommended to insure that the relay is in proper working order:

Phase Overcurrent Unit (I_1 & I_3)

1. Contact Gap – The gap between the stationary and moving contacts with the relay in the de-energized position should be approximately .020."

2. Minimum Trip Current – The pick-up of the overcurrent unit can be checked by inserting the tap screw in the desired tap hole and applying rated tap value current. The contact should close within ±5% of tap value current.

Ground Overcurrent Unit (I_0)

The core screw which is adjustable from the top of the trip unit determines the pickup value. The trip unit has a nominal ratio of adjustment of 1 to 4 and an accuracy within the limits of 10%.

The contact gap should be approximately 5/64" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

Indicating Contactor Switch (ICS-1 and ICS-2)

Close the auxiliary telephone relay contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

Auxiliary Relay (X)

Block one of the phase overcurrent cylinder unit contacts closed and apply rated d-c voltage to the proper relay terminals. Observe that all of the normally open contacts close and all the normally closed contacts open.

Routine Maintenance

All relays should be inspected periodically and the operation should be checked at least once every year or at such other time intervals as may be dictated by experience to be suitable to the particular application.

All contacts should be periodically cleaned. A contact burnisher S#182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

Calibration

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been distrubed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See "Acceptance Check").

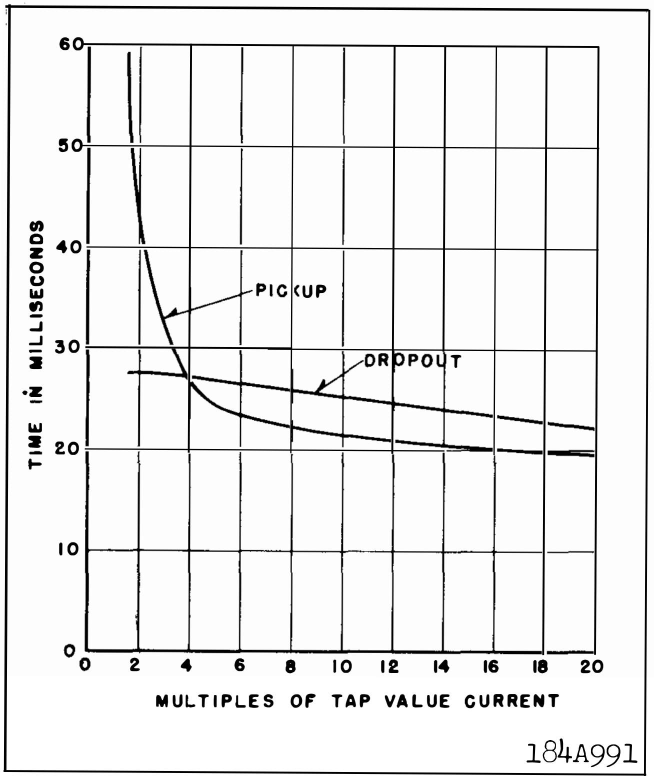
Phase Overcurrent Unit (I_1 & I_3)

The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

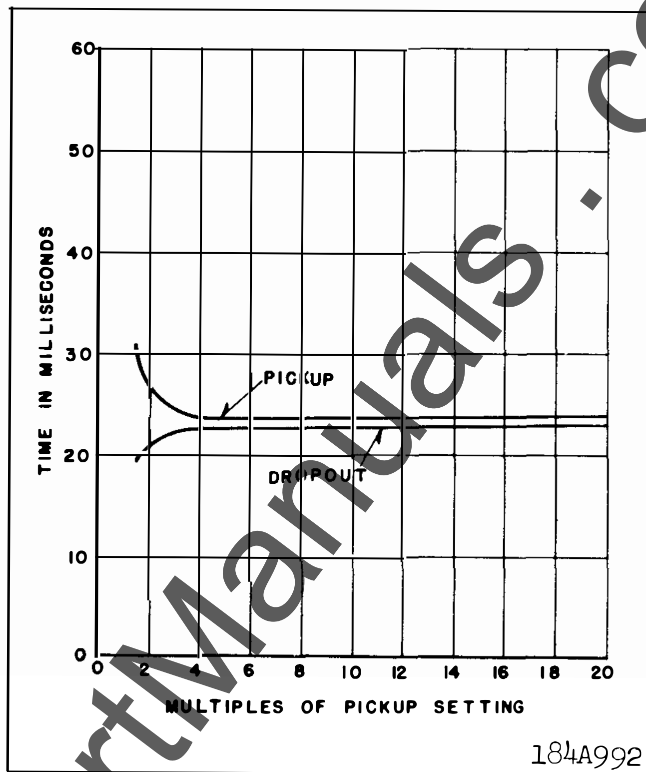
The set screw in the stationary contact has been shop adjusted for optimum follow and this adjustment should not be disturbed.

1. The upper pin bearing should be screwed down until there is approximately 1/64" clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.

2. The contact gap adjustment for the overcurrent unit is made with the moving contact in the reset



* *Fig. 7 Maximum Pick-Up and Drop-Out Time. Curves for the Phase Overcurrent Unit Plus Auxiliary Unit.*



* *Fig. 8 Maximum Pick-Up and Drop-Out Time. Curves for the Ground Overcurrent Unit Plus Auxiliary Unit.*

position, e.e., against the right side of the bridge. Advance the stationary contact until the contacts just close. Then back off the stationary contact 2/3 of one turn for a gap of approximately .020." The clamp holding the stationary contact housing need not be loosened for the adjustment since the clamp utilizes a spring-type action in holding the stationary contact in position.

3. The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

Insert the tap screw in the minimum value tap setting and adjust the spring such that the contacts will close when energized with the required current. The pick up of the overcurrent unit with the tap screw in any other tap should be within ±5% of tap value.

If adjustment of pick-up current in between tap settings is desired, insert the tap screw in the next lowest tap setting and adjust the spring as described. It should be noted that this adjustment results in a slightly different time characteristic curve and burden.

Ground Overcurrent Unit

The core screw which is adjustable from the top of the trip unit determines the pickup value. The trip unit has a nominal ratio of adjustment of 1 to 4 and an accuracy within the limits of 10%.

The contact gap should be approximately 5/64" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

Indicating Contactor Switch (ICS-1 and ICS-2)

Close the main relay contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should be not greater than the particular ICS tap setting being used. The operation indicator target should drop freely.

To increase the pickup current remove the molded cover and bend the springs out or away from the cover. To decrease the pickup current bend the springs in toward the cover.

The contact gap should be approximately .047" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

Auxiliary Relay (X)

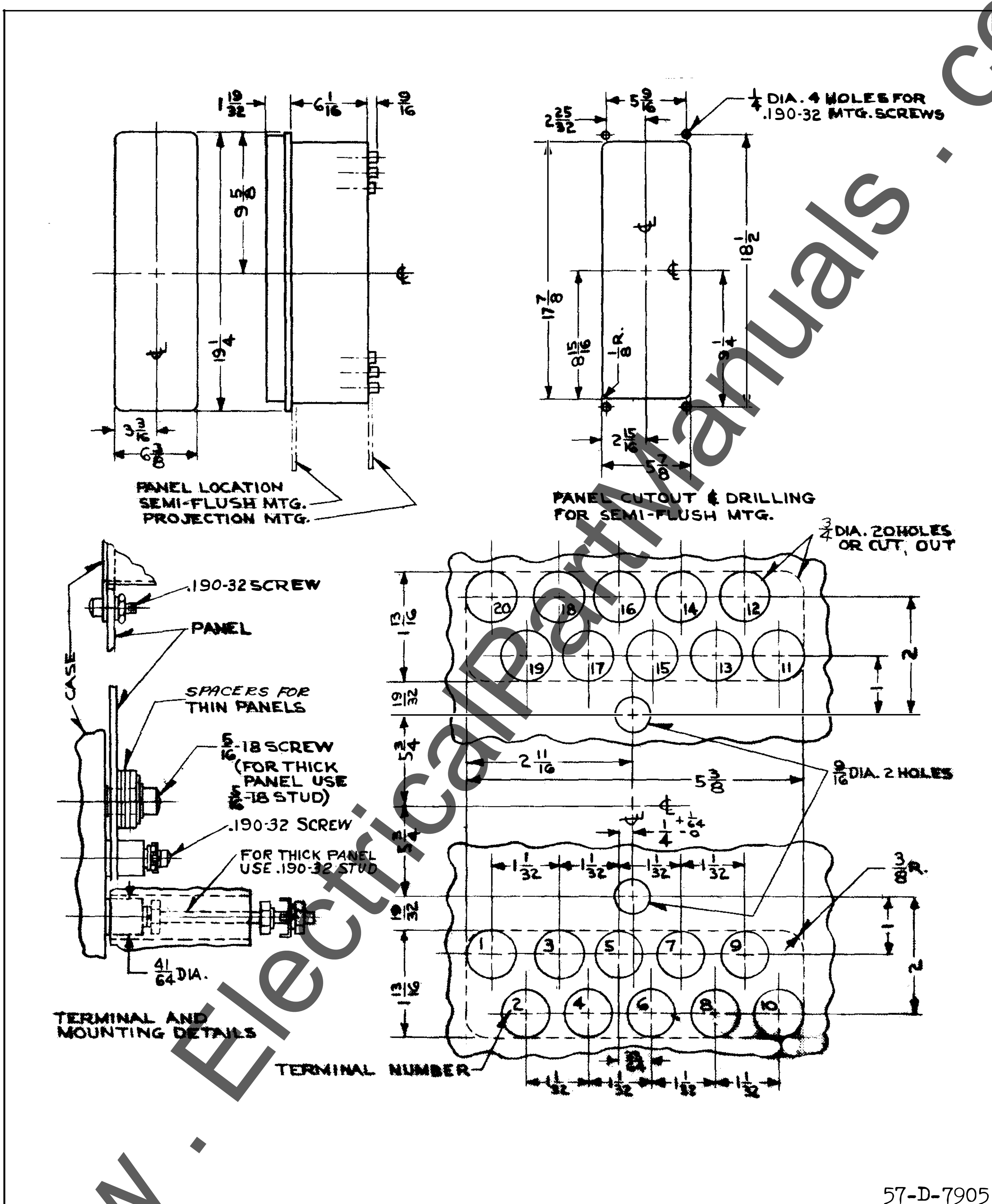
Block the cylinder unit contact closed. Apply rated voltage and see that all the normally open contacts close by means of a neon lamp. Also see that the normally closed contacts make a good contact with the coil de-energized by noting some deflection of the contacts. With the relay de-energized check to see that a good contact is made across the resistor in series with the coil by measuring approximately zero resistance at the resistor terminals.

The contact gap should be approximately .020". The armature rest may be adjusted slightly to achieve this, but care should be exercised so as not to affect the normally closed contacts.

The armature residual screw may be adjusted to vary contact follow of the normally open contacts but the residual gap should not be less than .002".

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.



* *Fig. 9 Outline and Drilling Plan for the Type KC-3 Relay in FT-42 Case.*

WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

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