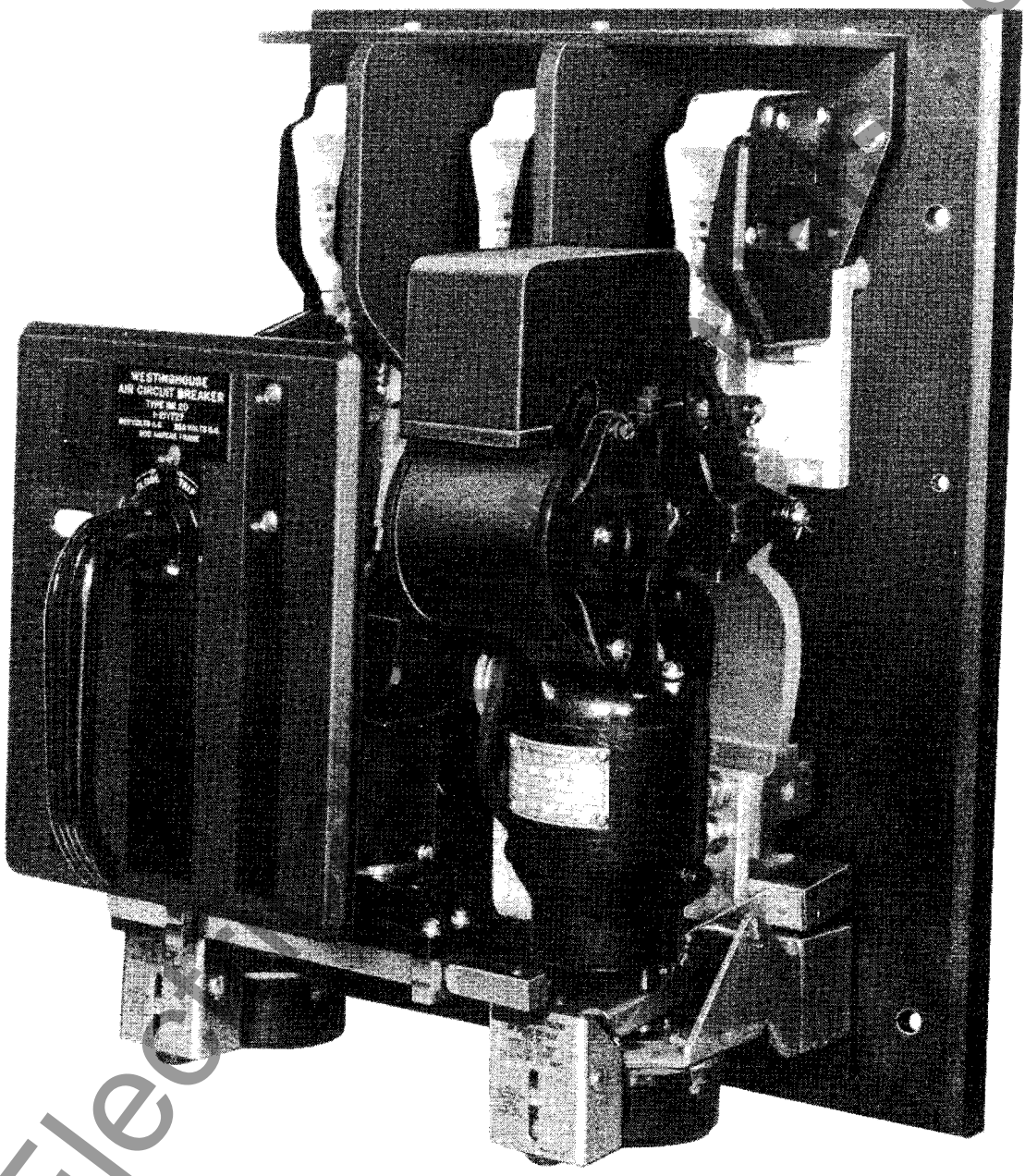
TYPE DK-25 AIR CIRCUIT BREAKER



Frontispiece

3—Pole, 600-Ampere, 600-Volt A-C., 250-Volt D-C. Breaker

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Printed in U.S.A. 11-41

I. B. 5965

Preface

It would be difficult to over-emphasize the importance of adequate care of all protective devices. To assure proper functioning, they should be the subject of periodical, systematic and intelligent inspection. Even the smallest details of required maintenance should not be neglected if costly failures of equipment and service are to be avoided. Maintenance must include occasional checks on calibration as well as on the coordination and freedom of all moving parts. The purpose of this Instruction Book on the DK circuit breakers is to provide a guide for those charged with these responsibilities. It is not possible to outline a procedure that will apply in all cases. The frequency and character of inspection will for the most part be a matter of experience. In general, light monthly inspection, with a thorough inspection semi-annually, should be a minimum. The Company will be glad to furnish such additional information as may be needed to amplify or clarify these instructions.

General

The DK air circuit breaker, complete with all attachments, is a self-contained unit, and has been mounted, adjusted and calibrated on its own permanent panel at the factory. It is designed only to be mounted in a vertical position, and all inspections for proper operation must be made with the breaker main panel held vertically.

Unpacking

Care must be exercised when unpacking to make sure that no parts are broken or damaged, and an inspection should be made immediately to check for any damage in transit. All dust and dirt should be carefully blown out of the complete assembly, especially in the closing toggle linkage, overload attachments and such other attachments as are supplied.

It is not advisable to lubricate any parts of the breaker. The lubrication supplied during factory assembly, where necessary, is a special form of grease which is used sparingly. This will be found sufficient for years of service. Additional oil will only promote the accumulation of dust and dirt. In new installations, the breaker must be carefully protected from plaster, concrete and other foreign gritty particles that may add friction to the moving parts in the toggle linkage.

Inspection

Final inspection should preferably be made with the breaker in its permanent mounting, but if this is impossible, it can be set up rigidly in a vertical position while the inspection is made.

Rotate the manual operating handle slowly in a clockwise direction to move the contacts toward the closed position. Check the movement of each arc tip through the throat of the "De-ion" arc interrupting chamber to make sure that the tips do not rub against the ceramic side plates. Continue the closing motion until the moving arc tips just touch the stationary arc tips. Check the main contact separation at approximately 5/32 inch, as shown on the two drawings 4-D-2515 and 4-D-8316. The moving arc tips of all poles should touch within 1/64 inch of each other. Continue the handle rotation to the fully closed position and watch the main contact overtravel as evidenced by rotary motion away from its stop, adjacent to the section where the shunt is attached. In the fully closed position, the gap between the main contact stop and the contact arm should be 3/32 inch minimum.

Return the manually operated handle to the neutral position and rotate counterclockwise to trip the breaker. The toggle linkage should collapse and the moving contact assembly move freely to the full open position. This is followed immediately by complete resetting of the links in the toggle mechanism. This resetting operation is accomplished entirely by gravity. For this reason the links must always be free to move without friction or binding.

Adjustment of Contacts

The arc tip adjustment should be made as shown on drawings 4-D-2515 and 4-D-8316. There is no adjustment provided for the main contacts, and under ordinary circumstances these main contacts will last the life of the breaker without repair other than occasional cleaning. Both main and arcing contacts are a high silver alloy and will neither pit nor weld under any conditions of short circuit.

Replacement of Contacts

The sub-panel, barrier and "De-ion" interrupting assembly may be removed as a unit by taking out two bolts at the outer ends of the sub-panel. This gives access to the contacts for easy inspection or replacement.

The moving arc tip can be removed by taking out the wire clip and nut on the threaded rod, removing two small screws that hold the secondary shunt to the main contact, and removing the arc tip pin. The stationary arc tip may be removed by taking out four flat head screws. The new items may be replaced in the reverse order. Take care to make proper adjustment as shown on drawings 4-D-2515 and 4-D-8316, and set all poles of the breaker at one time and then securely lock each adjusting nut with a wire clip.

The moving main contact may be removed by taking out the bolts at the upper end of the trip unit, removing two bolts from the rear that hold this lower section to the panel, and taking out the pin in the contact arm. The contact and shunt can now be removed intact and replaced in the reverse order. The stationary main contact can be removed by taking out two bolts from the rear of the panel on the flat stud, or removing the finger cluster, large contact nut, and one bolt from the rear of the panel on the drawout type. Replacement is made with a complete new upper stud.

Adjustment of Toggle Linkage

The toggle linkage in the DK circuit breaker is a series of links so arranged that the closed breaker load is transmitted through successive toggles with a reduction at each step, to the final tripping toggle where a very low, but consistent, load is maintained with one simple adjustment. This adjusting screw will be found in the front of the main frame behind the molded face plate, as shown on drawings 4-D-2515 and 4-D-8316. This adjustment is set slightly over toggle to produce a tripping load of 2 pounds at the trip rod when the breaker is fully closed. The factory adjustment should not vary in service, but can easily be checked or readjusted by reference to the sketches. For this operation, use a small spring balance applied to the left pole trip finger on the trip bar at a point in line with the plunger. This 2 pound tripping load must be maintained to insure proper tripping of the breaker by the overload trip units and other calibrated attachments.

Dual Overload Tripping Attachments

The DK circuit breaker is supplied with either of two distinct types of adjustable inverse time delay trip units:- (1) oil sucker-magnetic dual overload, and (2) thermal-magnetic dual overload. Both types are furnished in standard ratings as listed below, and both types are suitable for either a-c. or d-c. service. The oil sucker type of time delay is designed for all standard application where overcurrent tripping is desired with time delay that can be adjusted to a minimum, approaching zero time if required. The thermal type of time delay, on the other hand, is for applications which require unusually long tripping time at relatively large overloads, associated with motor starting conditions and protections. In both cases any current in excess of ten times normal rating produces instantaneous tripping. Standard current ratings are:

600	350	225	100	25
550	325	200	90	20
500	300	175	70	15
450	275	150	50	
400	250	125	35	

Characteristics of Oil Sucker-Magnetic Dual Overload

Drawing 4-D-2515 shows the arrangement of adjustments on this tripping attachment, and curve 261560 represents the characteristic inverse time delay. The 100% calibration setting by the pointer on the scale plate is the normal rating of the trip unit, and that value of current will just trip the breaker with no oil in the pot. Adjustment of the thumb screw toward the 200% calibration setting raises the minimum tripping current in minute steps as desired. Rotation of the molded pot, properly filled with oil as explained on the drawing, varies the time delay between 0 and 100%. Thus, any desired combination of minimum tripping current and time delay can be selected as desired. Drawing 4-D-2515 explains in detail the necessary adjustments for maintaining this overload attachment in service.

Characteristics of Thermal-Magnetic Dual Overload

The general arrangement of this attachment is shown on Drawing 4-D-8316 with inverse time delay characteristics on curve 258872. The 100% calibration setting of the pointer on the scale plate is the normal rating of the trip unit and that value of current will just trip the breaker in approximately 30 minutes or longer in a normal ambient temperature. Adjustment of the thumb screw toward the 150% calibration setting raises the minimum tripping current in minute steps as desired.

Ambient correction is explained on drawing 4-D-8316 as 1% increase in calibration for each 2°C. rise in temperature. The attachment is calibrated for 24°C. ambient, but if it is desired to meet the calibration characteristics of curve 258872 at 40°C., for instance, the calibration adjustment should be set at approximately 108% for minimum tripping at normal current rating.

The calibration adjustment can therefore be set as close to the normal running current of the motor as is desired, depending on ambient temperature, frequency of starting, etc. Complete protection is thus afforded under all conditions of operation.

Full details for adjustment and maintenance of the thermal-magnetic trip attachment are explained on drawing 4-D-8316.

Replacement of Overload Attachments

Both types of overload trip units may be easily removed. From the rear, take out two screws that fasten the magnet assembly to the main panel and disconnect the trip unit upper terminal where it is bolted to the main pole unit shunt section. In the case of drawout studs the finger cluster and large nut must also be removed. The trip unit may now be removed. Replacement is simply the reverse of this procedure.

After the unit is securely mounted to the panel, only one adjustment is necessary for correct operation with the breaker. This adjustment consists of setting the screw in the outer end of the trip armature lever to properly trip the breaker with a thin spacer between the armature and magnet, as explained in both drawings 4-D-2515 and 4-D-8316.

Electric Closing Mechanism

Electrically operated DK circuit breakers are equipped with an entirely self-contained motor mechanism mounted on the right side of the breaker frame. Two of the toggle linkage pins serve as dowels to accurately locate the mechanism insulating base. By removing three bolts, this complete assembly can be taken off the breaker without disengaging any parts except the wiring.

The closing motor is a single phase commutator type, vertical shaft motor with ball bearings sealed with lubricant that will normally last the life of the apparatus. A single reduction of speed between the motor shaft and the mechanism crank is accomplished with a worm mounted on the upper end of the motor shaft engaging a worm gear on the crank shaft. This gear assembly is lubricated on assembly sufficient for several years of normal service. An oil seal on the motor shaft prevents any oil or grease from running down into the motor windings.

The motor is designed to develop an exceptionally high torque for its size, and is therefore rated for intermittent service. If the breaker is closed more frequently than four times a minute for long periods, the motor may overheat. A centrifugal speed limiting device is built into the lower end-bell of the motor to prevent excessive speed at normal and over-voltage, and to prevent coasting of the mechanism after the limit switch has cut off the motor current.

The mechanism crank engages a hardened steel cam on the closing lever. The relative motion of the crank roller with respect to this cam surface is to produce the maximum mechanical advantage when the closing load is greatest. A limit switch segment on the mechanism crank shaft positively carries the crank roller past the cam after a closing operation, so that the breaker can be closed either manually or electrically without interference or mechanical disengagement. The only requirement is that the limit switch must be allowed to cut off the motor closing current.

One adjustment between the motor mechanism and the breaker closing lever should be checked for proper operation. Close the breaker manually and rotate the motor by hand. This is done by removing the plate at the lower end and rotating the armature in the direction of the arrow, until the crank roller is just passing over the heel of the cam. There should be from 1/64 to 1/32 inch clearance between the roller surface and the cam surface at this point. If binding occurs, the minimum closing voltage will be unduly high, and if too much clearance is present, the mechanism may fail to move the breaker toggle linkage to the completely closed position. This adjustment is maintained by adding or taking out a spacer between the molded tiebar and the cast closing lever on the right side.

The motor closing current is unusually low for this type of apparatus, and is given in the following table for standard control voltage ratings:

Voltage Rating	Closing Current at Normal Voltage	Locked Rotor Current at Normal Voltage
110 Volt, A-c.	12 Amperes	15 Amperes
220 Volt, A-c.	6 Amperes	8 Amperes
125 Volt, D-c.	6 Amperes	8 Amperes
250 Volt, D-c.	3 Amperes	5 Amperes

Shunt Trip Attachment

The shunt trip attachment, when supplied, is mounted rigidly to the breaker frame behind the molded face plate. The trip bar bracket is attached to its lower end. When the shunt trip is not supplied, its place is taken by a long trip rod held by a round case identical in outside appearance with the shunt trip case. Both types are interchangeable and can be readily removed and replaced. In replacing the shunt trip assembly, make sure the moving core and trip rod assembly is free to move without binding against the guide holes or coil.

The shunt trip is designed for intermittent duty. The tripping current must always be cut off by an auxiliary switch on the breaker. The normal tripping currents for standard control voltages are:

Voltage Rating	Tripping Current
110 Volt, A-c.	3. Amperes
220 Volt, A-c.	1.5 Amperes
125 Volt, D-c.	1. Amperes
250 Volt, D-c.	0.5 Amperes

Wiring Diagram

The standard wiring diagram for the motor mechanism and shunt trip attachments are given on drawing 4-D-9361. The motor control circuit includes a special relay as an integral part of the electrically operated breaker that prevents reclosure until after the external control switch has been opened. This prevents the breaker from pumping, if closed against a high overload or short circuit. A further feature of the control wiring is the prevention of electrically inching the breaker closed after the moving contact assembly has started to close.

Undervoltage Tripping Attachment

The undervoltage attachment is normally mounted on the main panel to the left of the breaker. It operates to trip the breaker through the trip bar if the control voltage drops to a value of 40% to 60% of rated voltage. To check the adjustment of this attachment, remove the voltage from the holding coils, hold the armature against the magnet by hand, and close the breaker. Now allow the armature to move slowly away from the magnet under action of the spring in the flexible link. The breaker should trip by this dead push. Adjustment to provide this operation is made by shortening or lengthening the flexible link detail.

When the undervoltage attachment is furnished with a time delay tripping feature, the oil dash pot should be removed by unscrewing the pot when the above adjustment is checked.

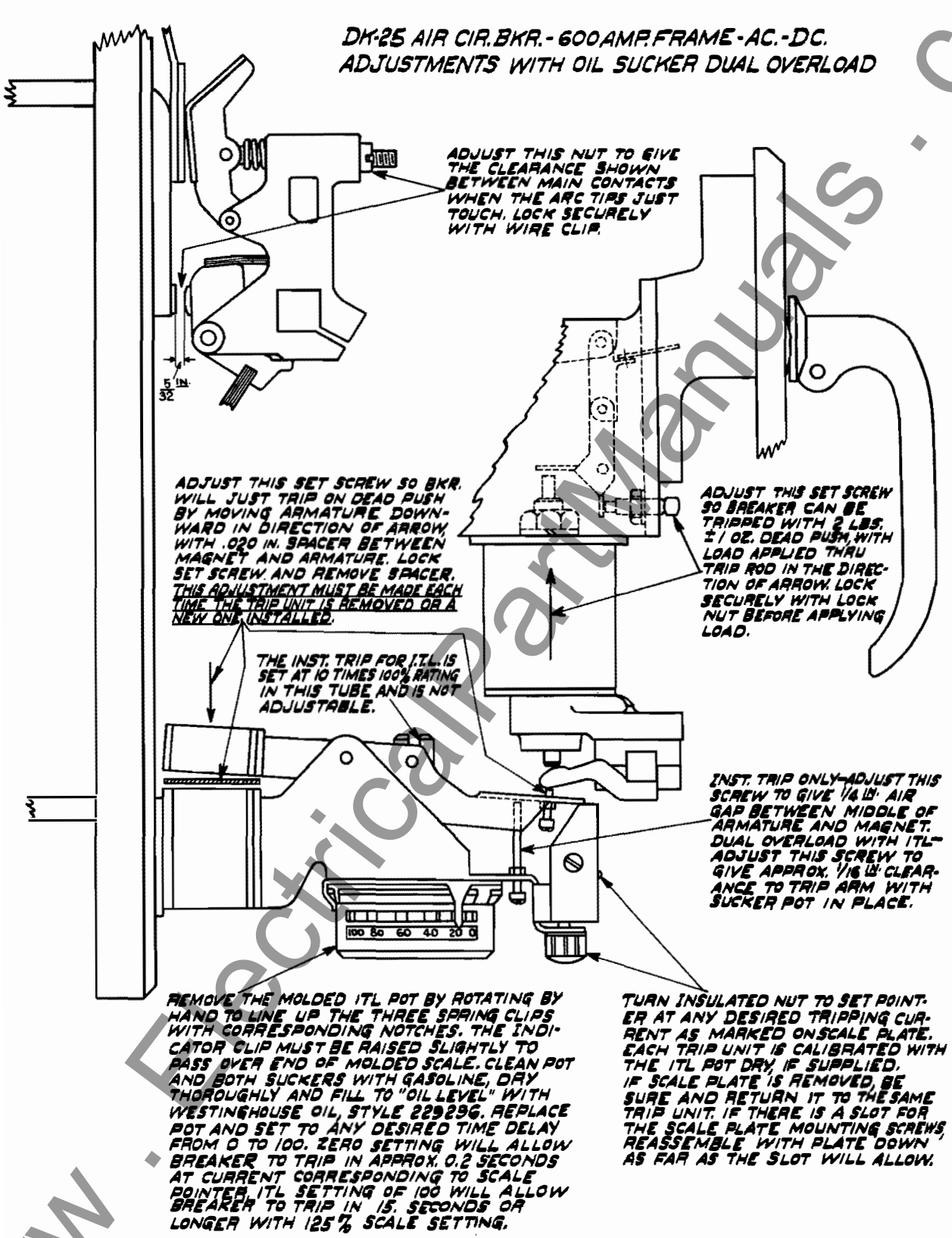
Reverse Current Attachment

The reverse current attachment is used to trip the breaker when the direction of current flow in that pole is reversed. The attachment consists of a magnet energized by a voltage coil and an armature energized by a current coil in series with one pole of the breaker. When the series coil current is flowing in the proper direction the armature tends to rotate but is restrained by a stop. When the series current is reversed the armature is rotated in the opposite direction against a spring to trip the breaker. This adjustment is calibrated and marked on the scale plate at 5%, 10%, 15%, 20% and 25% reverse current, based on normal current rating.

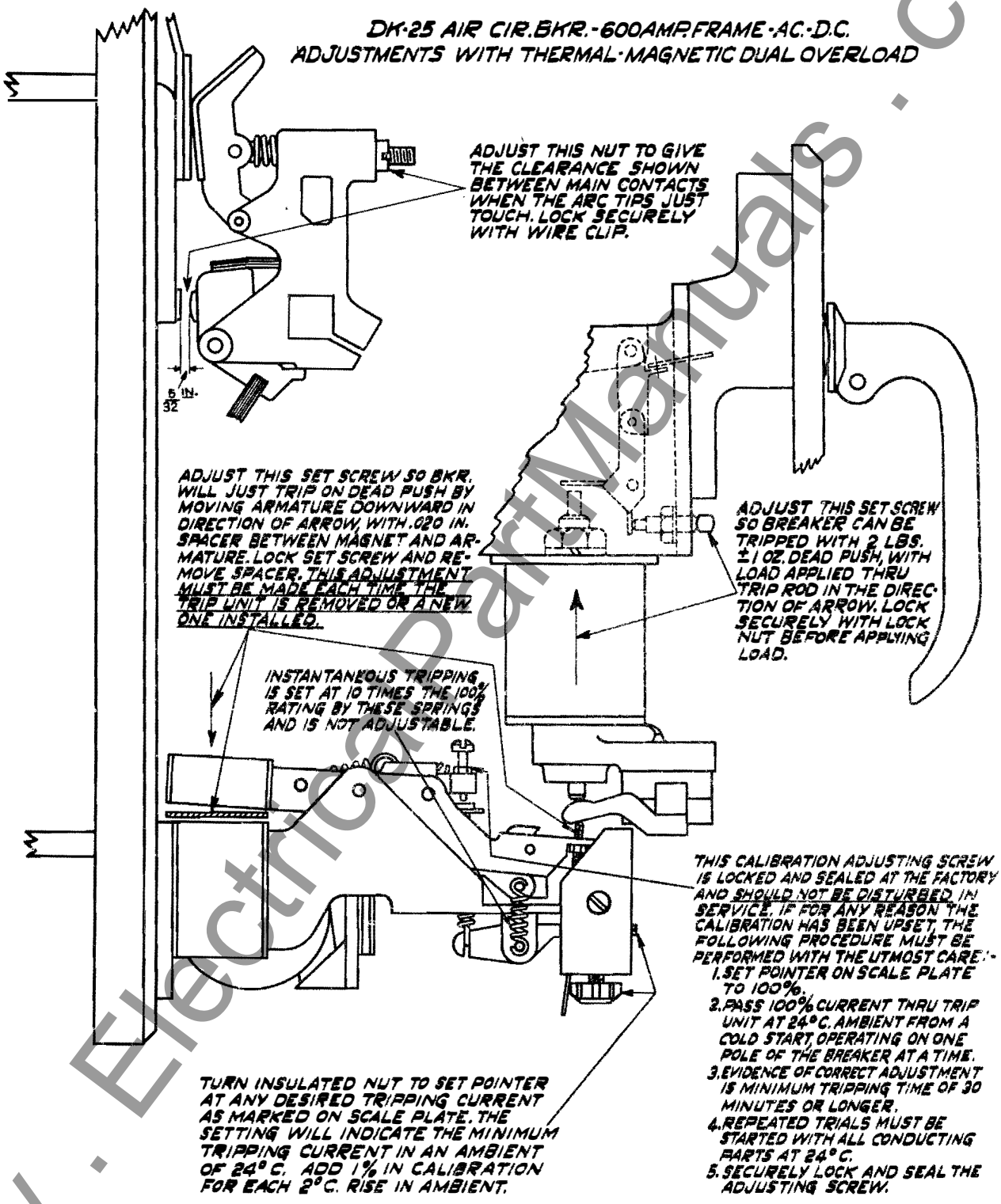
The reverse current armature is reset after a tripping operation by opening the voltage coil circuit. This can be accomplished by wiring the voltage coil through an auxiliary switch on the breaker.

Field Discharge Switch

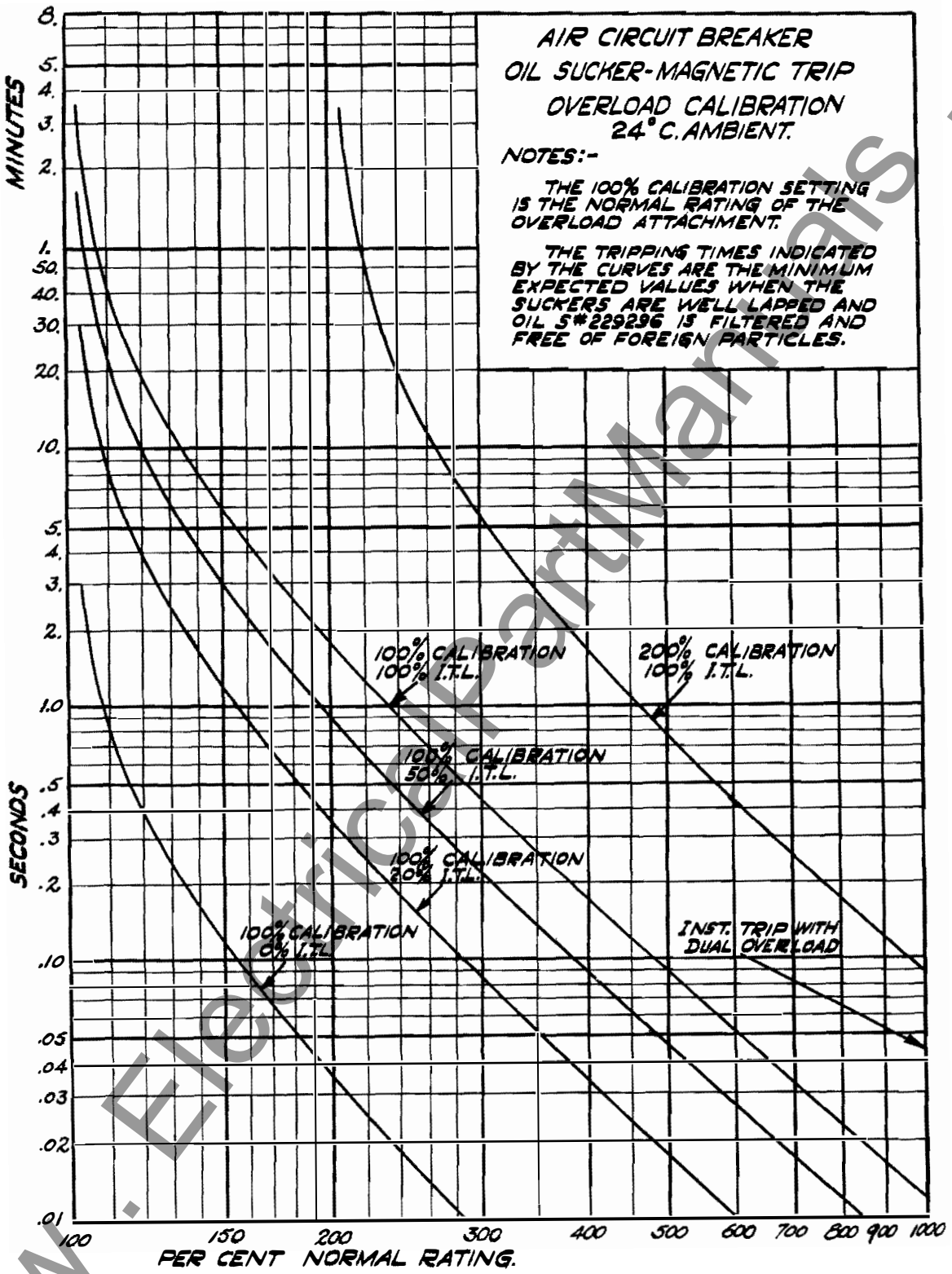
The field discharge contact is normally mounted on a two pole breaker in the space left vacant above the breaker toggle linkage. Correct adjustment in one direction is evidenced by opening of the switch contact just prior to the arc tips touching during the breaker closing motion. Similarly, the switch must make contact before the breaker contacts part during the opening motion of the breaker.



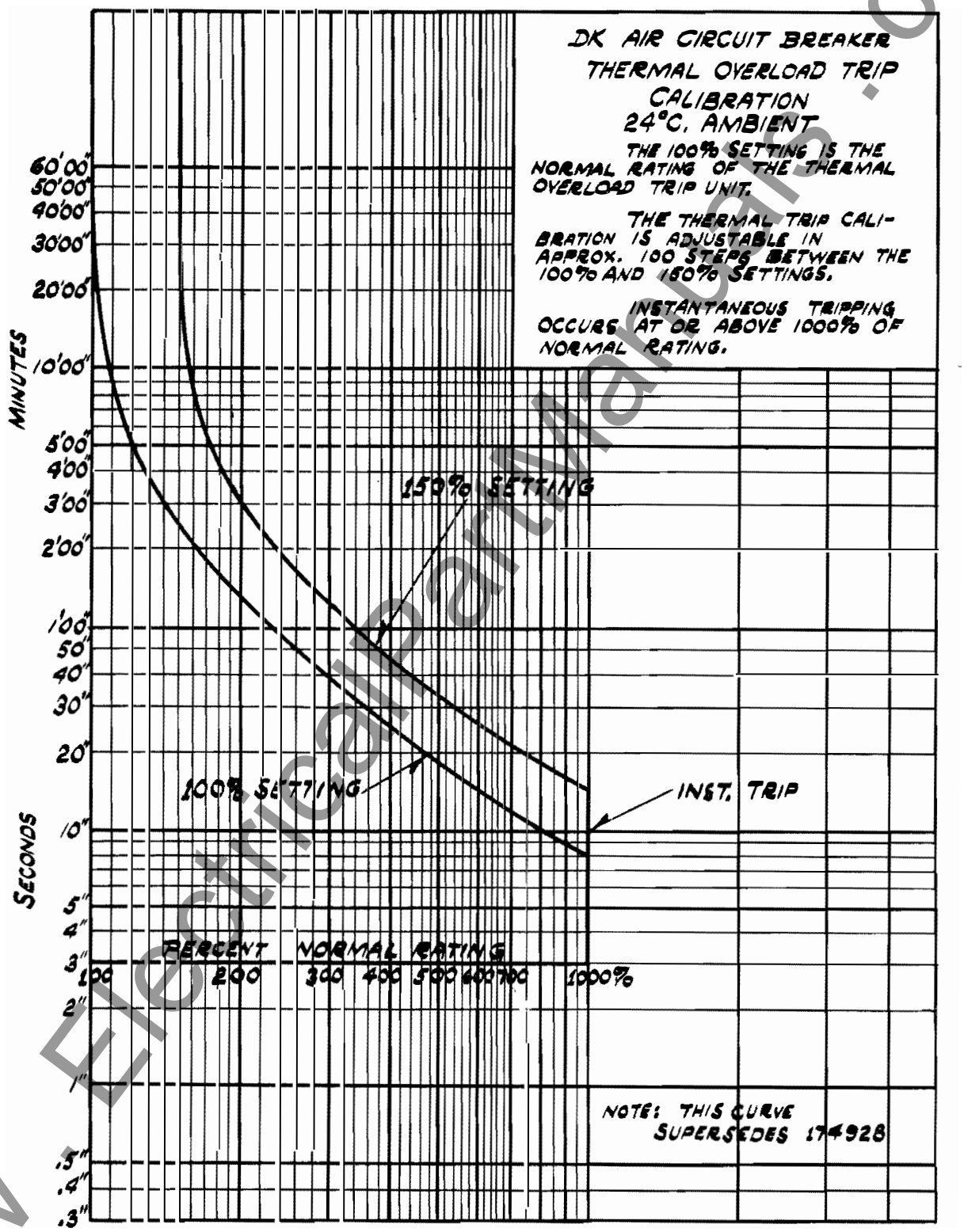
Adjustments with Oil Sucker - Magnetic Dual Overload
Drawing 4-D-2515



Adjustments with Thermal - Magnetic Dual Overload
Drawing 4-D-8316

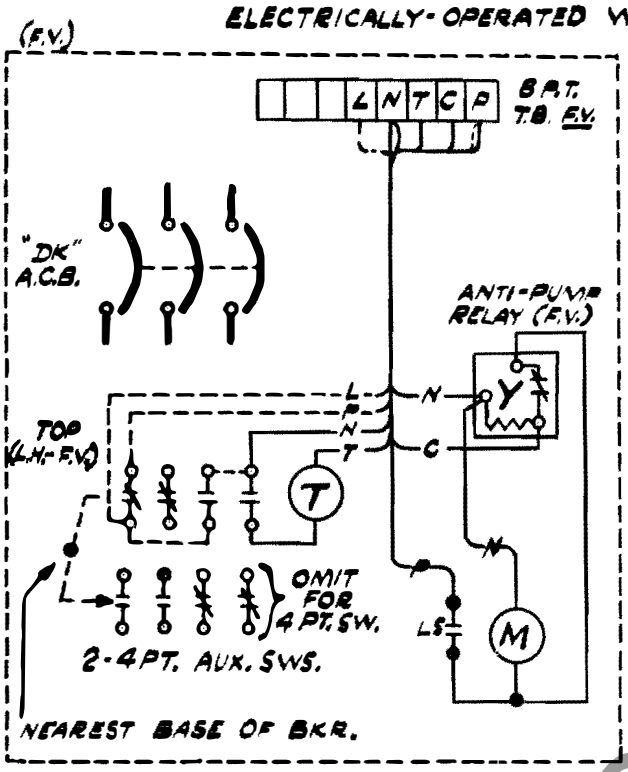


Calibration of Oil Sucker - Magnetic Dual Overload
Curve 261560



Calibration of Thermal - Magnetic Dual Overload
Curve 258872

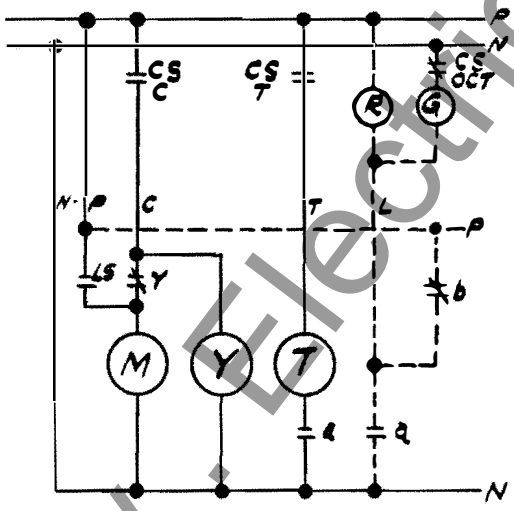
ELECTRICALLY-OPERATED WITH ANTI-PUMP RELAY



OPERATION

1- CONTROL SW CS-C CLOSES.
2- MOTOR PICKS UP THROUGH Y CONTACT.
3- LIMIT SW. LS CLOSES BEFORE BKR. STARTS TO CLOSE.
4- BKR. IN CLOSING MECHANICALLY OPERATES Y RELAY WHICH OPENS ITS CONTACT AND SEALS ITSELF IN THROUGH CONT. SW.
5- BREAKER CLOSES.
6- MOTOR CONTINUES UNTIL LS OPENS CUTTING OFF MOTOR.
7- RELEASING CONTROL SWITCH, Y WILL DEENERGISE AND WILL CLOSE ITS CONTACT.

CONTROL VOLTAGE:- 115V., 230V. A-C.
" " 125V., 250V. D-C.
EQUIPTMENT TO BE ORDERED TO SUIT



LEGEND

M = MOTOR
Y = ANTI-PUMP RELAY
LS = LIMIT SWITCH
T = TRIP COIL
a = BREAKER AUX. SWITCH CLOSES WHEN BKR. IS CLOSED.
b = BREAKER AUX. SWITCH OPENS WHEN BKR. IS CLOSED.
Y = Y RELAY CONTACT, CLOSED WHEN RELAY IS DEENERGIZED AND OPEN WHEN RELAY IS ENERGIZED.
CS-C = CONTROL SW. "CLOSE" CONTACT.
CS-T = " " "TRIP" "
CS-OCT = CONTROL SWITCH "LAMP CUTOUT" CONTACT.

NOTE:- DOTTED CONNS. SUPPLIED ONLY WHEN ORDERED

Wiring Diagram - Drawing 4-D-9361

TYPE DK-15 AND DK-25 AIR CIRCUIT BREAKER

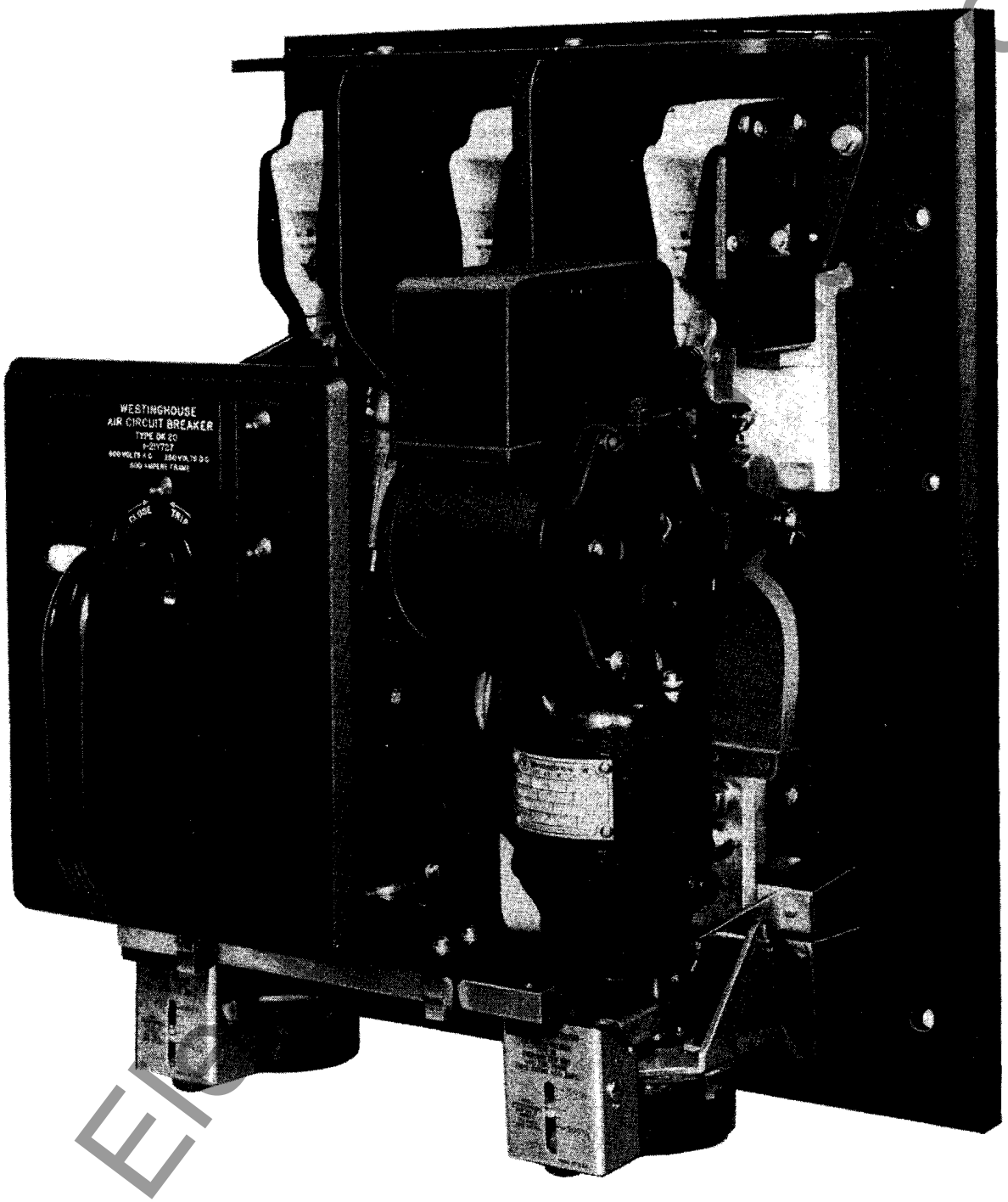


Fig. 1—3-Pole, 600-Ampere, 600-Volt A-C., 250-Volt D-C. Breaker

Instruction Book 5965-E

Westinghouse Electric Corporation
East Pittsburgh, Pa.

Printed in U.S.A.

Preface

It would be difficult to over-emphasize the importance of adequate care of all protective devices. To assure proper functioning, they should be the subject of periodical, systematic and intelligent inspection. Even the smallest details of required maintenance should not be neglected if costly failures of equipment and service are to be avoided. Maintenance must include occasional checks on calibration as well as on the coordination and freedom of all moving parts. The purpose of this Instruction Book on the DK circuit breakers is to provide a guide for those charged with these responsibilities. It is not possible to outline a procedure that will apply in all cases. The frequency and character of inspection will for the most part be a matter of experience. In general, light monthly inspection, with a thorough inspection semi-annually, should be a minimum. The Company will be glad to furnish such additional information as may be needed to amplify or clarify these instructions.

Type DK-15 and DK-25 Air Circuit Breaker

General

The DK air circuit breaker, complete with all attachments, is a self-contained unit, and has been mounted, adjusted and calibrated on its own permanent panel at the factory. It is designed only to be mounted in a vertical position, and all inspections for proper operation must be made with the breaker main panel held vertically.

Unpacking

Care must be exercised when unpacking to make sure that no parts are broken or damaged, and an inspection should be made immediately to check for any damage in transit. All dust and dirt should be carefully blown out of the complete assembly, especially in the closing toggle linkage overload attachments and such other attachments as are supplied.

It is not advisable to lubricate any parts of the breaker. The lubrication supplied during factory assembly, where necessary, is a special form of grease which is used sparingly. This will be found sufficient for years of service. Additional oil will only promote the accumulation of dust and dirt. In new installations, the breaker must be carefully protected from plaster, concrete and other foreign gritty particles that may add friction to the moving parts in the toggle linkage.

Inspection

Final inspection should preferably be made with the breaker in its permanent mounting, but if this is impossible, it can be set up rigidly in a vertical position while the inspection is made.

Rotate the manual operating handle slowly in a clockwise direction to move the contacts toward the closed position. Check the movement of each arc tip through the throat of the "De-ion" arc interrupting chamber to make sure that the tips do not rub against the ceramic side plates. Continue the closing motion until the moving arc tips just touch the stationary arc tips. Check the main contact separation at approximately 1/8 inch, as shown on Figs. 2 and 3. Continue the handle rotation to the fully closed position and watch the main contact overtravel as evidenced by rotary motion away from its stop, adjacent to the section where the shunt is attached.

Return the manually operated handle to the neutral position and rotate counterclockwise to trip the breaker. The toggle linkage should collapse and the moving contact assembly move freely to the full open position. This is followed immediately by complete resetting of the links in the toggle mechanism. This resetting operation is accomplished entirely by gravity. For this reason the links must always be free to move without friction or binding.

Adjustment of Contacts

The arc tip adjustment should be made as shown in Figs. 2 and 3. There is no adjustment provided for the main contacts, and under ordinary circumstances these main contacts will last the life of the breaker without repair other than occasional cleaning. Both main and arcing contacts are a high silver alloy.

Replacement of Contacts

The sub-panel, barrier and "De-ion" interrupting assembly may be removed as a unit by taking out two bolts at the outer ends of the sub-panel. This gives access to the contacts for easy inspection or replacement.

The moving arc tip can be removed by taking out the wire clip and nut on the threaded rod, removing two small screws that hold the secondary shunt to the main contact, and removing the arc tip pin. The stationary arc tip may be removed by taking out four flat head screws. The new items may be replaced in the reverse order. Take care to make proper adjustment as shown in Figs. 2 and 3, and set all poles of the breaker at one time and then securely lock each adjusting nut with a wire clip.

The moving main contact may be removed by taking out the bolts at the upper end of the trip unit, removing two bolts from the rear that hold this lower section to the panel, and taking out the pin in the contact arm. The contact and shunt can now be removed intact and replaced in the reverse order. The stationary main contact can be removed by taking out two bolts from the rear of the panel on the flat stud, or removing the finger cluster, large contact nut, and one bolt from the rear of the panel on the drawout type. Replacement is made with a complete new upper stud.

Adjustment of Toggle Linkage

The toggle linkage in the DK circuit breaker is a series of links so arranged that the closed breaker load is transmitted through successive toggles with a reduction at each step, to the final tripping toggle where a very low, but consistent, load is maintained with one simple adjustment. This adjusting screw will be found in the front of the main frame behind the face plate, as shown in Figs. 2 and 3. This adjustment is set slightly over toggle to produce a light tripping load. The factory adjustment should not vary in service, but can easily be checked or readjusted by reference to the sketches. For this operation, use a small spring balance applied to the left pole trip finger on the trip bar at a point in line with the plunger. This 2 pound tripping load must be maintained to insure proper tripping of the breaker by the overload trip units and other calibrated attachments.

Dual Overload Tripping Attachments

The DK circuit breaker is supplied with either of two distinct types of adjustable inverse time delay trip units:- (1) oil sucker-magnetic dual overload, and (2) thermal-magnetic dual overload. Both types are suitable for either a-c. or d-c. service. The oil sucker type of time delay is designed for all standard application where overcurrent tripping is desired with time delay that can be adjusted to a minimum, approaching zero time if required. The thermal type of time delay, on the other hand, is for applications which require unusually long tripping time at relatively large overloads, associated with motor starting conditions and protections. In both cases any current in excess of ten times normal rating produces instantaneous tripping.

Characteristics of Oil Sucker-Magnetic Dual Overload

Fig. 2 shows the arrangement of adjustments on this tripping attachment, and Fig. 6 represents the characteristic inverse time delay. The 100% calibration setting is the normal rating of the trip unit, and that value of current will just trip the breaker with no oil in the pot. Adjustment of the thumb screw toward the 200% calibration setting raises the minimum tripping current in minute steps as desired. Rotation of the molded pot, properly filled with oil as explained on the drawing, varies the time delay between 0 and 100%. Thus, any desired combination of minimum tripping current and time delay can be selected as desired.

Characteristics of Thermal-Magnetic Dual Overload

The general arrangement of this attachment is shown in Fig. 3 with inverse time delay characteristics in Fig. 7. The 100% calibration setting of the pointer on the scale plate is the normal rating of the trip unit and that value of current will just trip the breaker in approximately 30 minutes or longer in a normal ambient temperature. Adjustment of the thumb screw toward the 150% calibration setting raises the minimum tripping current in minute steps as desired.

Ambient correction is explained in Fig. 3 as 1% increase in calibration for each 2°C. rise in temperature. The attachment is calibrated for 24°C. ambient, but if it is desired to meet the calibration characteristics of Fig. 5 at 40°C., for instance, the calibration adjustment should be set at approximately 108% for minimum tripping at normal current rating.

The calibration adjustment can therefore be set as close to the normal running current of the motor as is desired, depending on ambient temperature, frequency of starting, etc. Complete protection is thus afforded under all conditions of operation.

Full details for adjustment and maintenance of the thermal-magnetic trip attachment are explained in Fig. 3.

Replacement of Overload Attachments

Both types of overload trip units may be easily removed. From the rear, take out two screws that fasten the magnet assembly to the main panel and disconnect the trip unit upper terminal where it is bolted to the main pole unit shunt section. In the case of drawout studs the finger cluster and large nut must also be removed. The trip unit may now be removed. Replacement is simply the reverse of this procedure.

After the unit is securely mounted to the panel, only one adjustment is necessary for correct operation with the breaker. This adjustment consists of setting the screw in the outer end of the trip armature lever to properly trip the breaker with a thin spacer between the armature and magnet, as explained in Figs. 2 and 3.

Electric Closing Mechanism

Electrically operated DK circuit breakers are equipped with an entirely self-contained motor mechanism (fig. 11) mounted on the right side of the breaker frame. Two of the toggle linkage pins serve as dowels to accurately locate the mechanism insulating base. By removing three bolts this complete assembly can be taken off the breaker without disengaging any parts except the wiring.

The closing motor is a single phase commutator type, vertical shaft motor with ball bearings sealed with lubricant that will normally last the life of the apparatus. A single reduction of speed between the motor shaft and the mechanism crank is accomplished with a worm mounted on the upper end of the motor shaft engaging a worm gear on the crank shaft. This gear assembly is lubricated on assembly sufficient for several years of normal service. An oil seal on the motor shaft prevents any oil or grease from running down into the motor windings.

The motor is designed to develop an exceptionally high torque for its size, and is therefore rated for intermittent service. If the breaker is closed more frequently than once every 3 minutes for long periods, the motor may overheat. A centrifugal speed limiting device is built into the lower end-bell of the motor to prevent excessive speed at normal and overvoltage, and to prevent coasting of the mechanism after the limit switch has cut off the motor current.

The mechanism crank engages a hardened steel cam on the roller lever. The relative motion of the crank roller with respect to this cam surface is to produce the maximum mechanical advantage when the closing load is greatest. A limit switch segment on the mechanism crank shaft positively carries the crank roller past the cam after a closing operation, so that the breaker can be closed either manually or electrically without interference or mechanical disengagement. The only requirement is that the limit switch must be allowed to cut off the motor closing current.

One adjustment between the motor mechanism and the breaker roller lever should be checked for proper operation. Close the breaker manually and rotate the motor by hand. This is done by removing the plate at the lower end and rotating the armature in the direction of the arrow, until the crank roller is just passing over the heel of the cam. There should be from 1/64 to 1/32 inch clearance between the roller surface and the cam surface at this point. If binding occurs, the minimum closing voltage will be unduly high, and if too much clearance is present, the mechanism may fail to move the breaker toggle linkage to the completely closed position. This adjustment is maintained by adding or taking out a spacer between the molded tiebar and the cast roller lever on the right side.

The motor closing current is given in the following table for standard control voltage ratings:

Voltage Rating	Closing Current at Normal Voltage
110 Volt, A-c.	30 Amperes
220 Volt, A-c.	15 Amperes
125 Volt, D-c.	30 Amperes
250 Volt, D-c.	15 Amperes

Shunt Trip Attachment

The shunt trip attachment, when supplied, is mounted rigidly to the breaker frame behind the face plate. The trip bar bracket is attached to its lower end. When the shunt trip is not supplied, its place is taken by a long trip rod held by a case identical in outside appearance with the shunt trip case. Both types are interchangeable and can be readily removed and replaced. In replacing the shunt trip assembly, make sure the moving core and trip rod assembly is free to move without binding against the guide holes or coil.

The shunt trip is designed for intermittent duty. The tripping current must always be cut off by an auxiliary switch on the breaker. The normal tripping currents for standard control voltages are:

Voltage Rating	Tripping Current
110 Volt, A-c.	7 Amperes
220 Volt, A-c.	4 Amperes
125 Volt, D-c.	2.5 Amperes
250 Volt, D-c.	1.5 Amperes

Wiring Diagram

The standard wiring diagram for the motor mechanism and shunt trip attachments are given in Fig. 10. The motor control circuit can be supplied with a special relay as an integral part of the electrically operated breaker that prevents reclosure until after the external control switch has been opened. See Fig. 8. This prevents the breaker from pumping if closed against a high overload or short circuit. A further feature of the control wiring is the prevention of electrically inching the breaker closed after the moving contact assembly has started to close.

Undervoltage Tripping Attachment

The undervoltage attachment is normally mounted on the main panel to the left of the breaker. It operates to trip the breaker through the trip bar if the control voltage drops to a value of 35% to 60% of rated voltage. To check the adjustment of this attachment, remove the voltage from the holding coils, hold the armature against the magnet by hand, and close the breaker. Now allow the armature to move slowly away from the magnet under action of the spring in the flexible link. The breaker should trip by this dead push. Adjustment to provide this operation is made by shortening or lengthening the flexible link detail.

When the undervoltage attachment is furnished with a time delay tripping feature, the oil dash pot should be removed by unscrewing the pot when the above adjustment is checked. Always connect the undervoltage coils to the line side of the breaker.

Reverse Current Attachment

The reverse current attachment (Fig. 12-13) is used to trip the breaker when the direction of current flow in that pole is reversed. The attachment consists of a magnet energized by a voltage coil and an armature energized by a current coil in series with one pole of the breaker. When the series coil current is flowing in the proper direction the armature tends to rotate but is restrained by a stop. When the series current is reversed the armature is rotated in the opposite direction against a spring to trip the breaker. This adjustment is calibrated and marked on the scale plate at 10%, 15%, 20% and 25% reverse current, based on normal current rating.

The reverse current armature is reset after a tripping operation by opening the voltage coil circuit. This can be accomplished by wiring the voltage coil through an auxiliary switch on the breaker.

Field Discharge Switch

The field discharge contact (Fig. 13-14) is normally mounted on a two pole breaker in the space left vacant above the breaker toggle linkage. Correct adjustment in one direction is evidenced by opening of the switch contact just prior to the arc tips touching during the breaker closing motion. Similarly, the switch must make contact before the breaker contacts part more than 1/8" during the opening motion of the breaker.

Auxiliary Switch

The DK auxiliary switch shown in Fig. 9 is a compact molded assembly supplied in either 4 to 8 poles and is rigidly mounted on the side of the main breaker frame. Each pole consists of two silver posts in the sections which carry the terminal screws on the reverse side. The moving contact is a silver bridging member, spring mounted on the sliding bar, and with an eccentric rolling motion such that adequate wiping action takes place when the switch contact is made.

The terminal screws are readily accessible on the completely assembled breaker and adequate wiring space is provided from the switch assembly through wiring holes to the rear of the main panel.

Each four point switch is normally assembled with two "make" and two "break" contacts, but any pole may be reversed by removing the sliding bar and inverting the bridging member, thus making possible any desired arrangement.

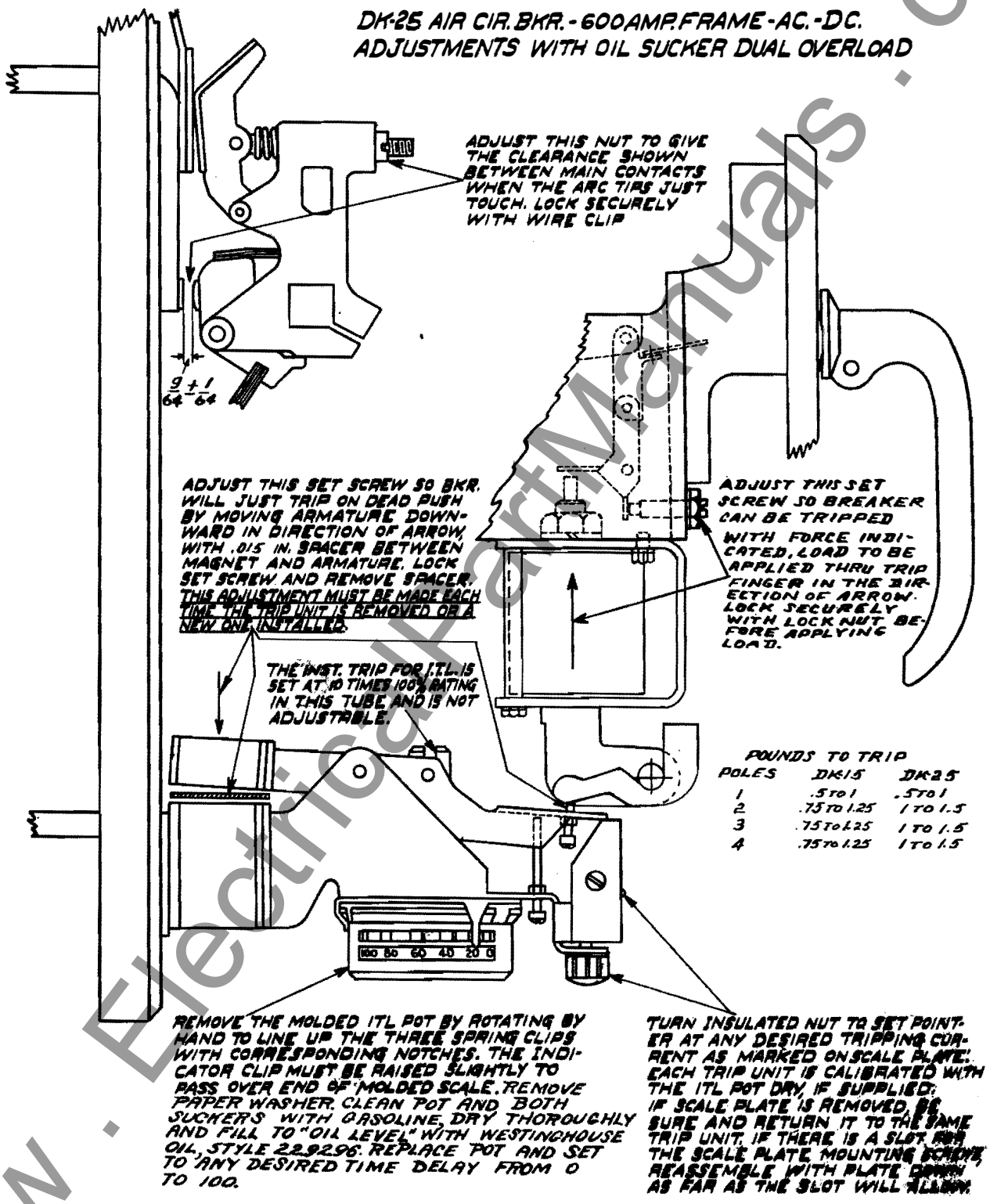


Fig. 2 - Adjustments with Oil Sucker Magnetic Dual Overload
Drawing 4-D-2515-5

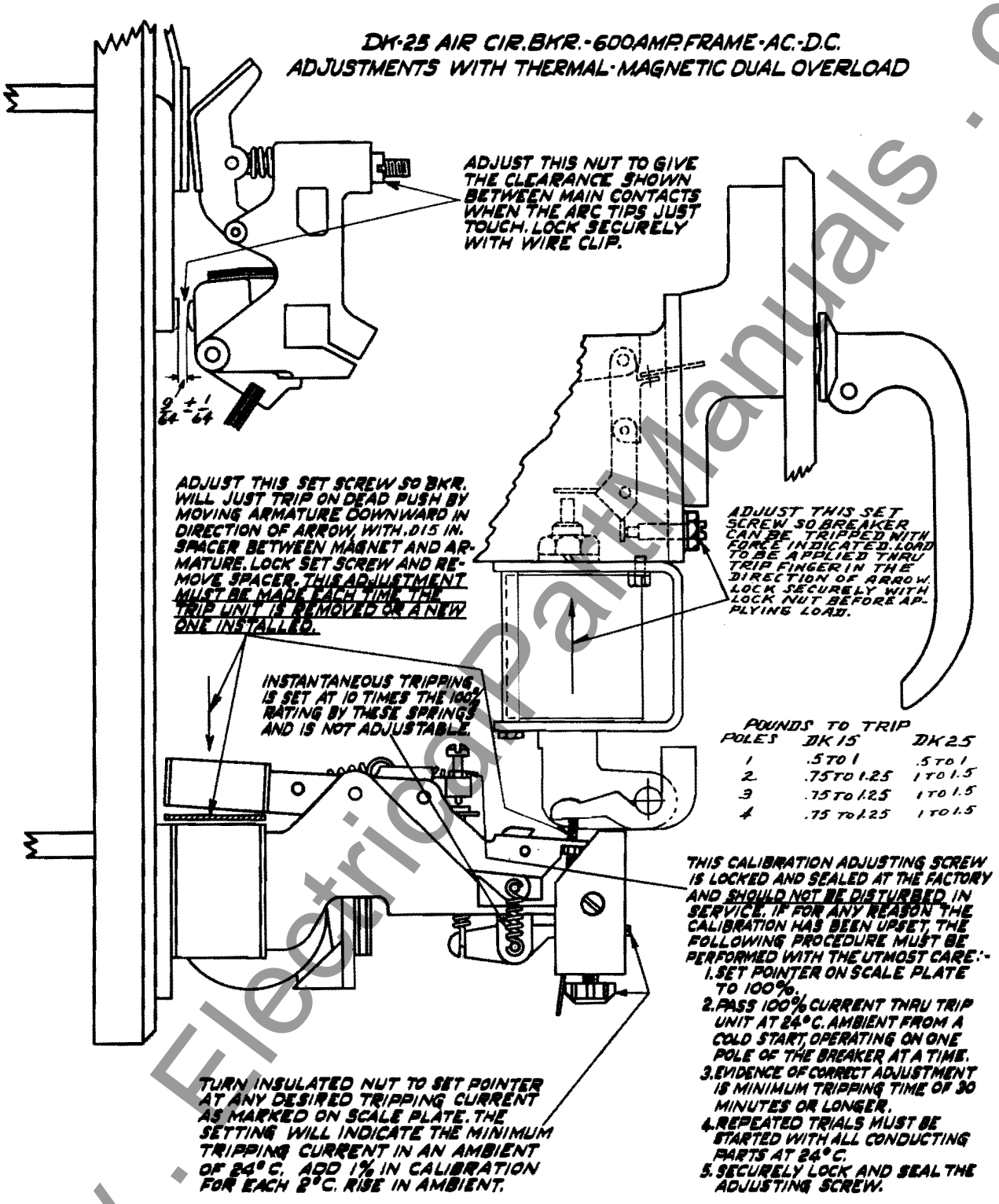
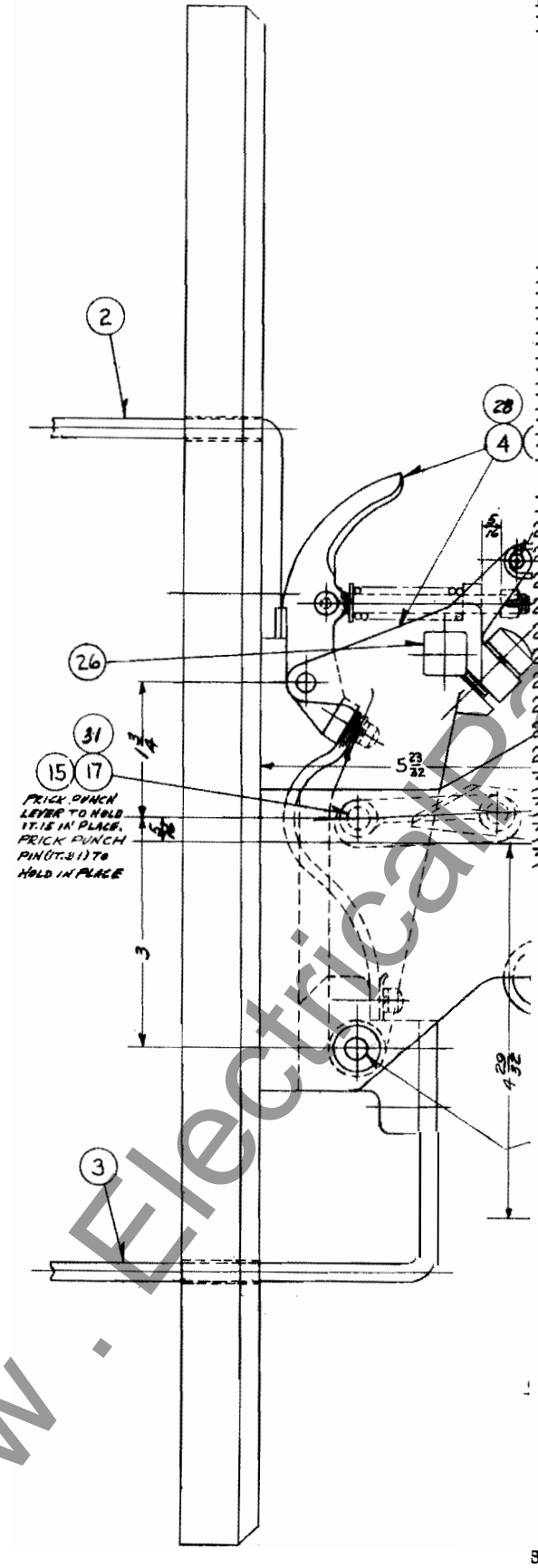


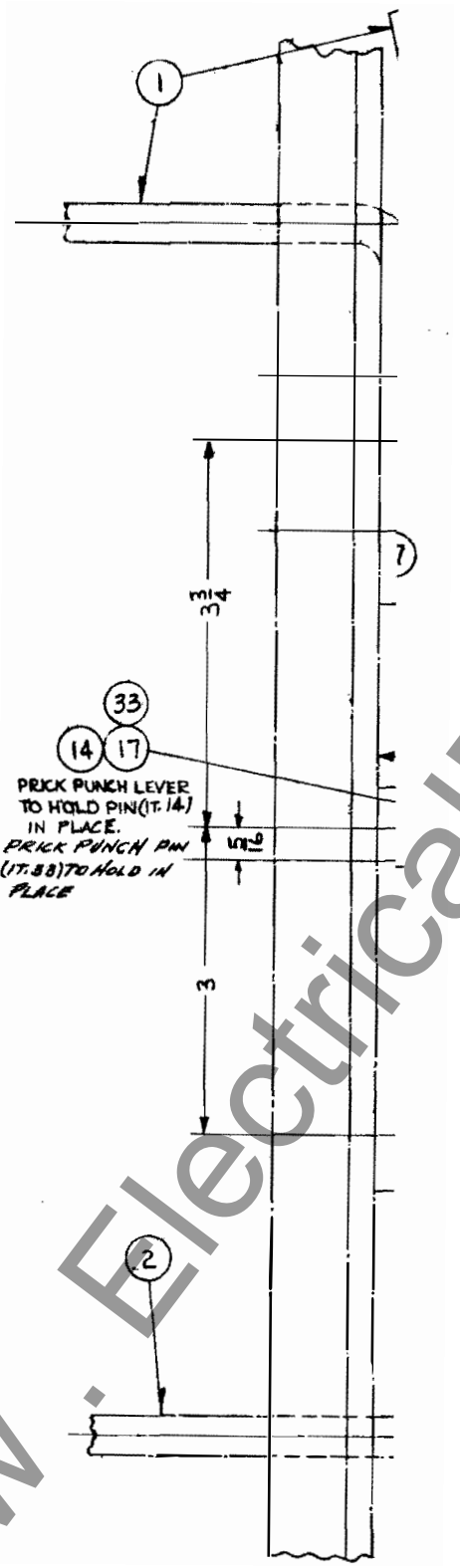
Fig. 3 - Adjustments with Thermal-Magnetic Dual Overload
Drawing 4-D-8316-3



Ref No.	Description
1	Shunt Trip
2	Upper Stud
3	Lower Stud
4	Moving Contact Assembly
5	Moving Contact Assembly
6	Cross Bar Lever
8	Linkage Assembly
9	Roller Lever
10	Spring (Accelerating)
11	Spring (Closing Lever Reset)
12	Spring (Trigger)
14	Pin
15	Pin
16	1/16 x 1/2 Steel Cotter Pin
17	Grease #4739
18	3/8-16 x 7/8 Fillister Head Steel Machine Screw
19	3/8 Steel Lock Washer
20	.164 Wide Brass Washer
21	Headless Set Screw
22	1/4-20 Steel Lock Nut
23	1/4 Steel Lock Washer
24	Pin
25	1/16 x 3/8 Steel Cotter Pin
26	Cross Bar
27	Pin
28	Moving Contact Assembly
29	Frame
30	Linkage Assembly
31	Pin (5/16 Nickel Steel)
32	Pin (5/16 Stainless Steel)
33	Pin (5/32 Nickel Steel)

sm Assembly (With or Without Current Parts)
Drawing 14-A-5153-5

Typ



Ref No.	Description
1	Upper Stud
2	Lower Stud
3	Cross Bar
4	Shunt Trip
5	Moving Contact Assembly
6	Moving Contact Assembly
7	Cross Bar Lever
9	Linkage Assembly
10	Roller Lever
11	Spring (Accelerating)
12	Spring (Roller Lever Reset)
13	Spring (Trigger)
14	Pin (5/16 x 2 17/32 Nickel Steel)
15	Pin (Copper Alloy) (5/16 x 3 21/32)
17	Grease #4739
18	1/16 x 1/2 Steel Cotter Pin
19	.164 Wide Brass Washer
20	Pin
22	1/16 x 3/8 Steel Cotter Pin
23	Headless Set Screw
24	1/4 Steel Lock Washer
25	1/4-20 Steel Lock Nut
26	3/8-16 x 1-1/4 Hexagon Head Steel Bolt
27	3/8 Steel Lock Washer
28	Linkage Assembly
29	Time Delay and Shunt Trip Unit
30	Moving Contact Assembly
31	Main Frame
32	Linkage Assembly
33	Pin (5/16 x 2 9/16 Nickel Steel)
34	Pin (5/16 x 3 21/32 Stainless Steel)
35	Pin (5/32 x 2 Nickel Steel)

- Mechanism Assembly (With or Without Current Parts)
Drawing 14-A-5857-10)

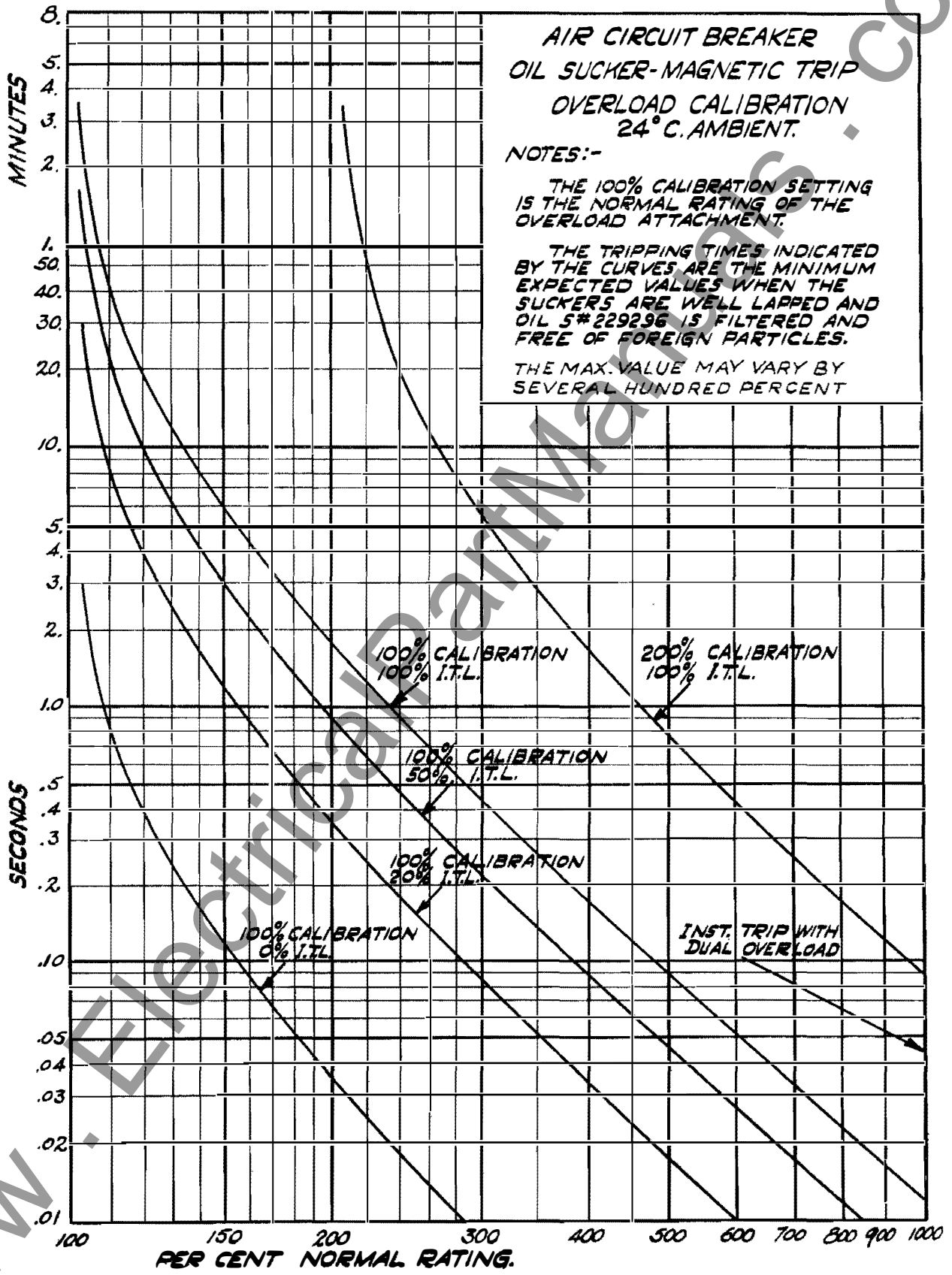


Fig. 6 Oil Sucker Magnetic Trip Overload Calibration
Curve 261560

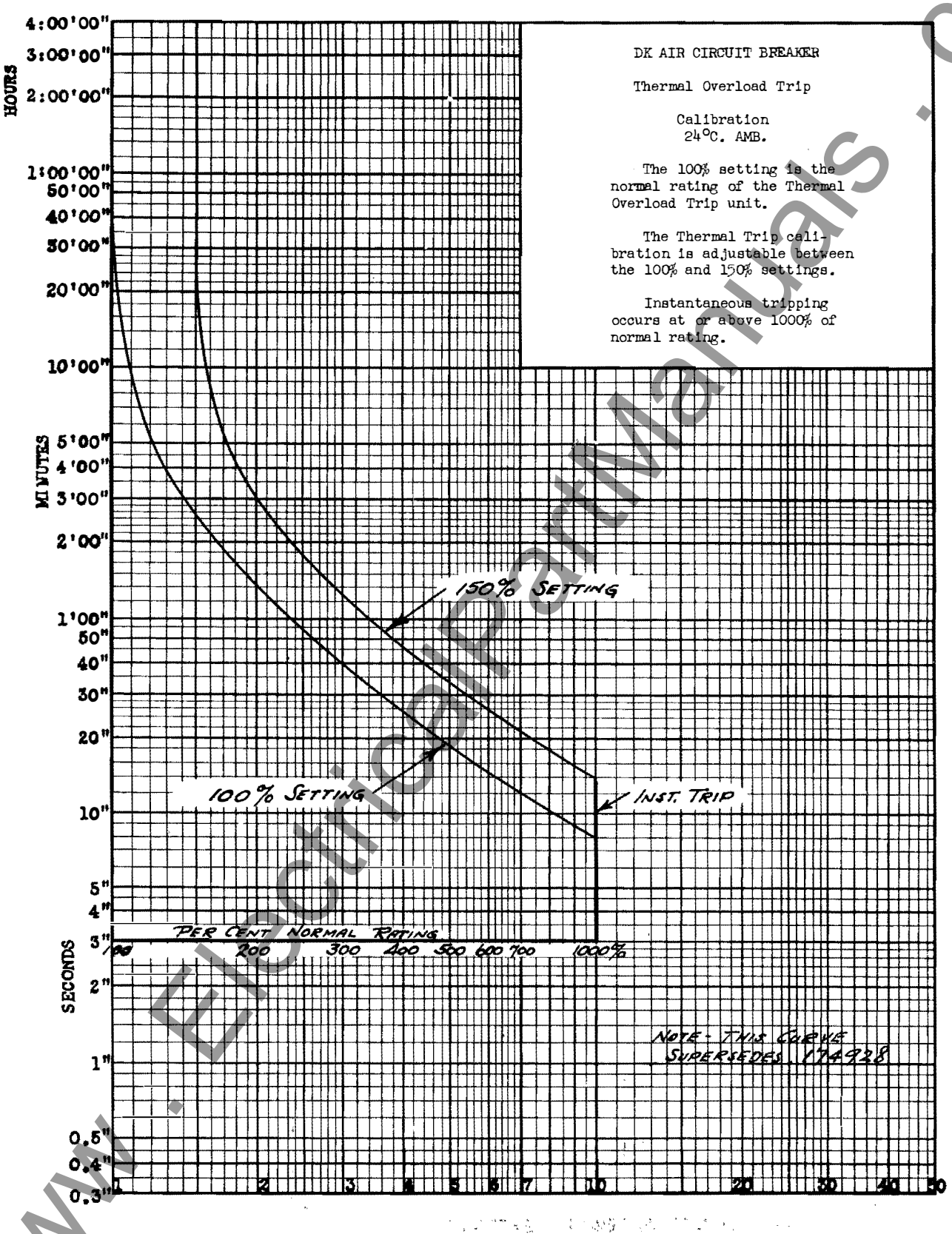


Fig. 7 Thermal Overload Trip Calibration
Curve 258872

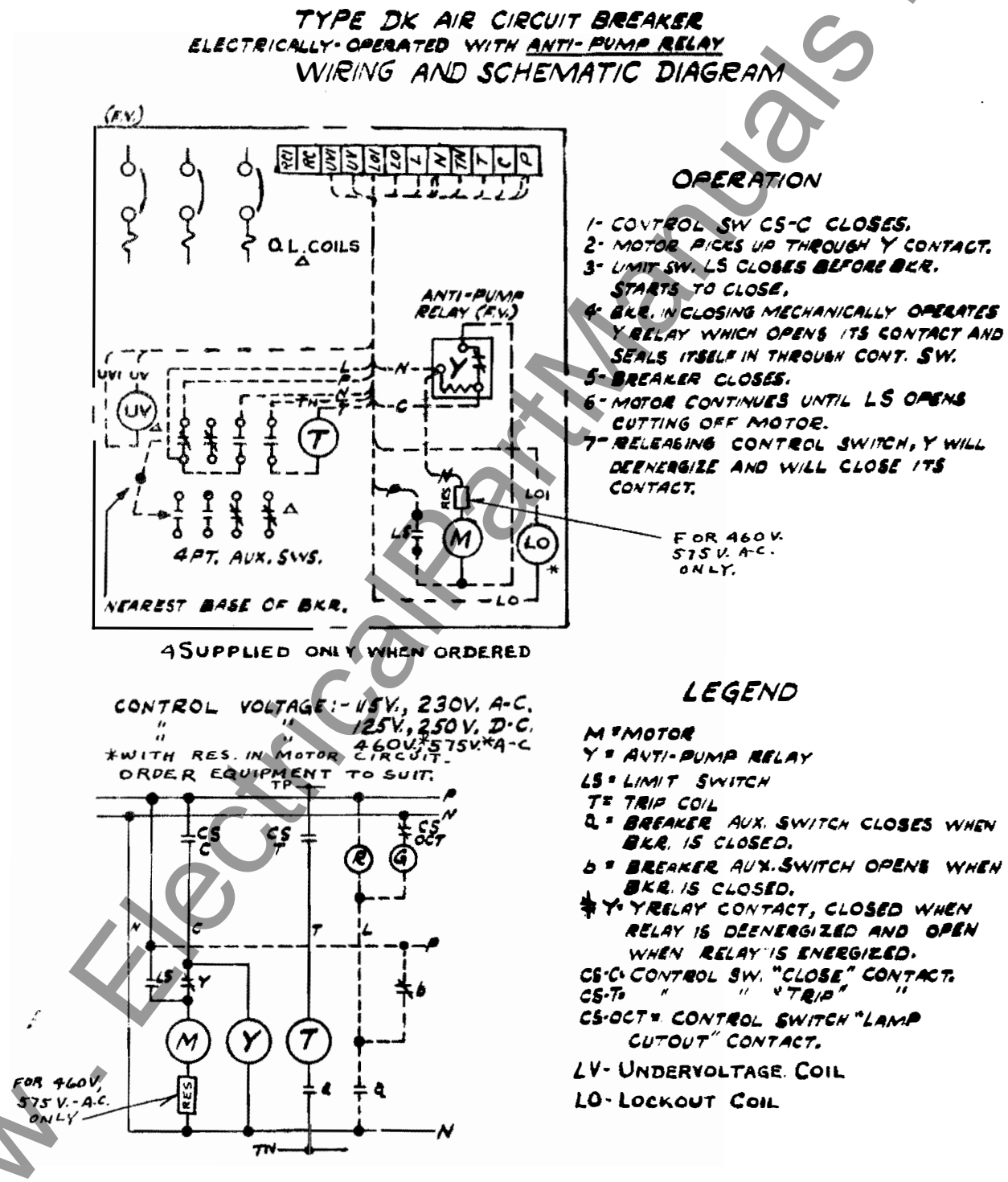


Fig. 8 - Wiring and Schematic Diagram With Anti-Pump Relay
Drawing 5-D-8339-6

Ref. No.	Description
1	Auxiliary Switch
2	Auxiliary Switch
3	Lever
4	Link
5	Link
6	Bracket
7	Link
8	Breaker Center Pole
9	Indicator Assembly
10	Spacer S# 898 756 + Fin
11	1/4-20 x 3/4 Hexagon Head Steel Bolt
12	1/4 Standard Lock Washer
13	1/4-20 x 1/2 Hexagon Head Steel Bolt
14	1/4-20 Hexagon Steel Machine Screw Nut
15	Shakeproof Lockwasher
16	.190-32 x 1/2 Fillister Head Steel Machine Screw
17	Washer S# 779354 + Fin
18	3/32 x 3/8 Steel Cotter Pin
19	Pin
20	Lock Washer
21	Washer S# 779355 + Fin
25	Link
26	Switch Assembly

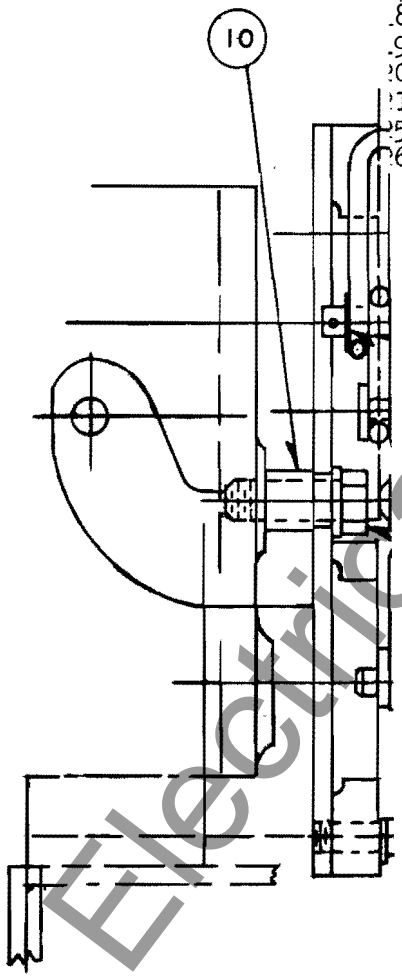
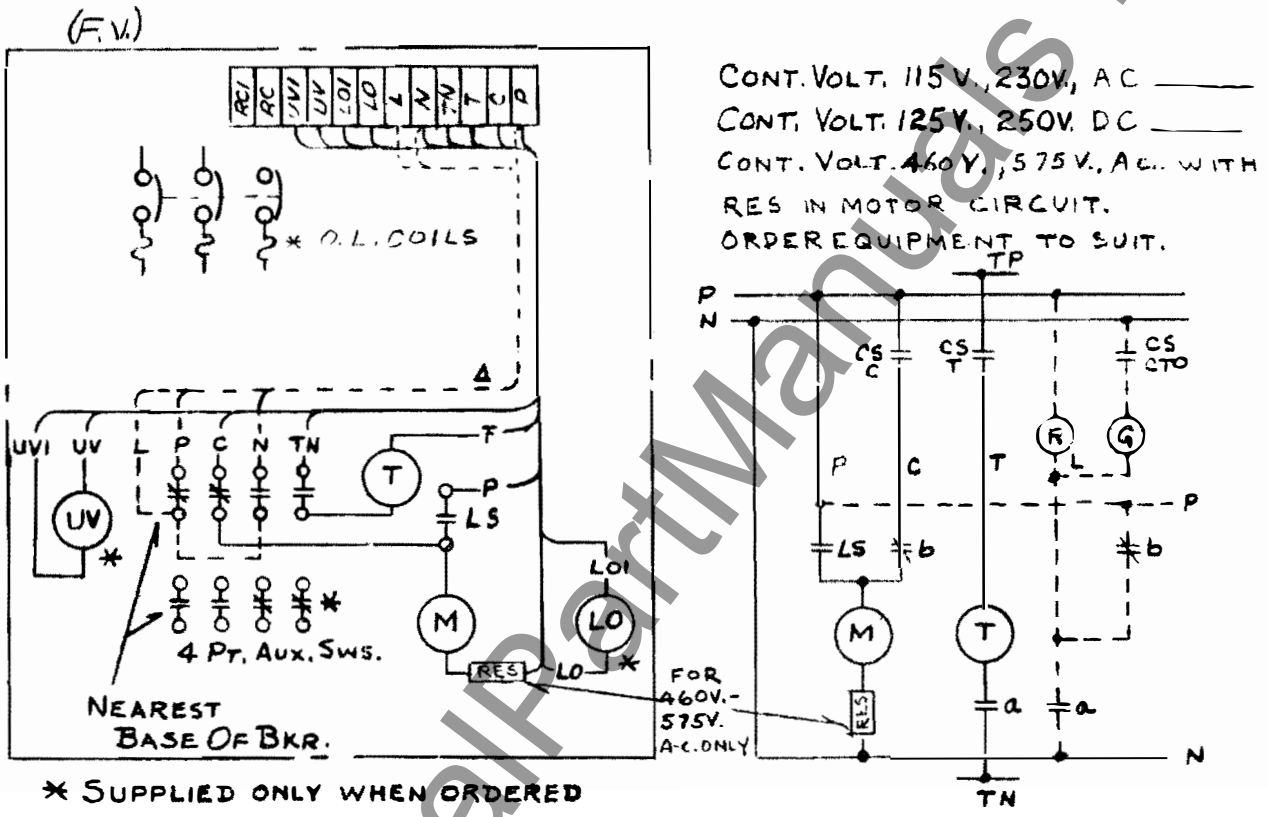


Fig. 9 - Auxiliary Switch and Mounting Assembly
Drawing 7-B-9438-10

TYPE "DK" AIR CIRCUIT BREAKER
ELECTRICALLY OPERATED
WIRING AND SCHEMATIC DIAGRAM



* SUPPLIED ONLY WHEN ORDERED

Δ DOTTED CONN. SUPPLIED ONLY WHEN ORDERED.

OPERATION

1. CONTROL SW. CS-C CLOSES.
2. MOTOR STARTS THROUGH BKR. AUX. SW. b.
3. LIMIT SW. CLOSES BEFORE BKR. STARTS TO CLOSE.
4. BKR. IN CLOSING OPENS AUX. SW. b.
5. RELEASE CONTROL SW. CS AFTER BKR. STARTS TO CLOSE.
6. BKR. CLOSES.
7. MOTOR RUNS UNTIL LS OPENS.

LEGEND

M - MOTOR
LS - LIMIT SW.
T - TRIP COIL
a - BKR. AUX. SW. CLOSED WHEN BKR. IS CLOSED.
b - BKR. AUX. SW. OPEN WHEN BKR. IS CLOSED.
CS - CONTROL SW. (C-CLOSE, T-TRIP, CTO-LAMP CUTOUT)
UV - UNDERVOLTAGE COIL
LO - LOCKOUT COIL

Fig. 10 - Wiring and Schematic Diagram Without Anti-Pump Relay
Drawing 5-D-8338-6

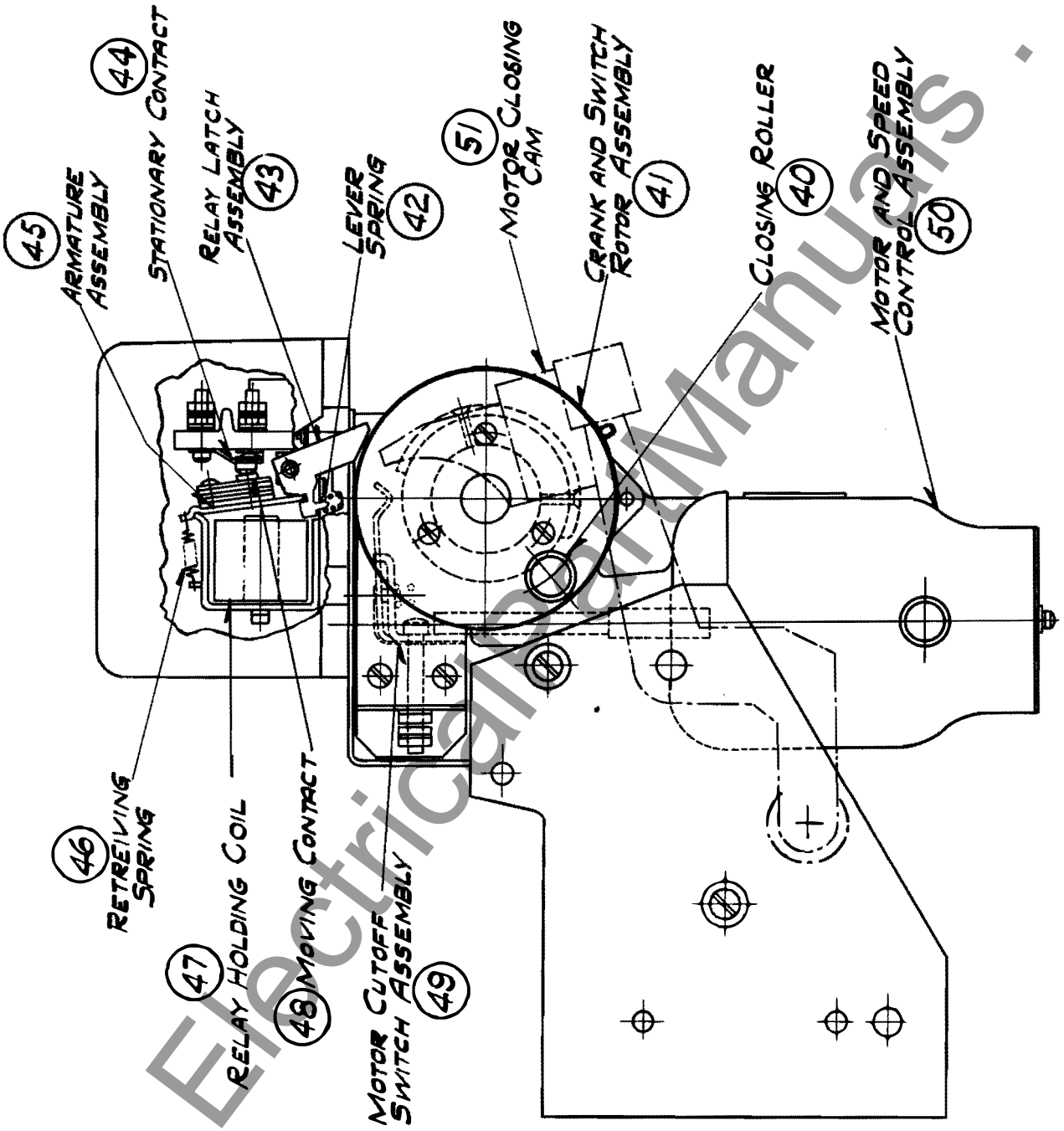


Fig. 11 - Motor Mechanism and Anti-Pump Assembly
Drawing 4-D-8494-3

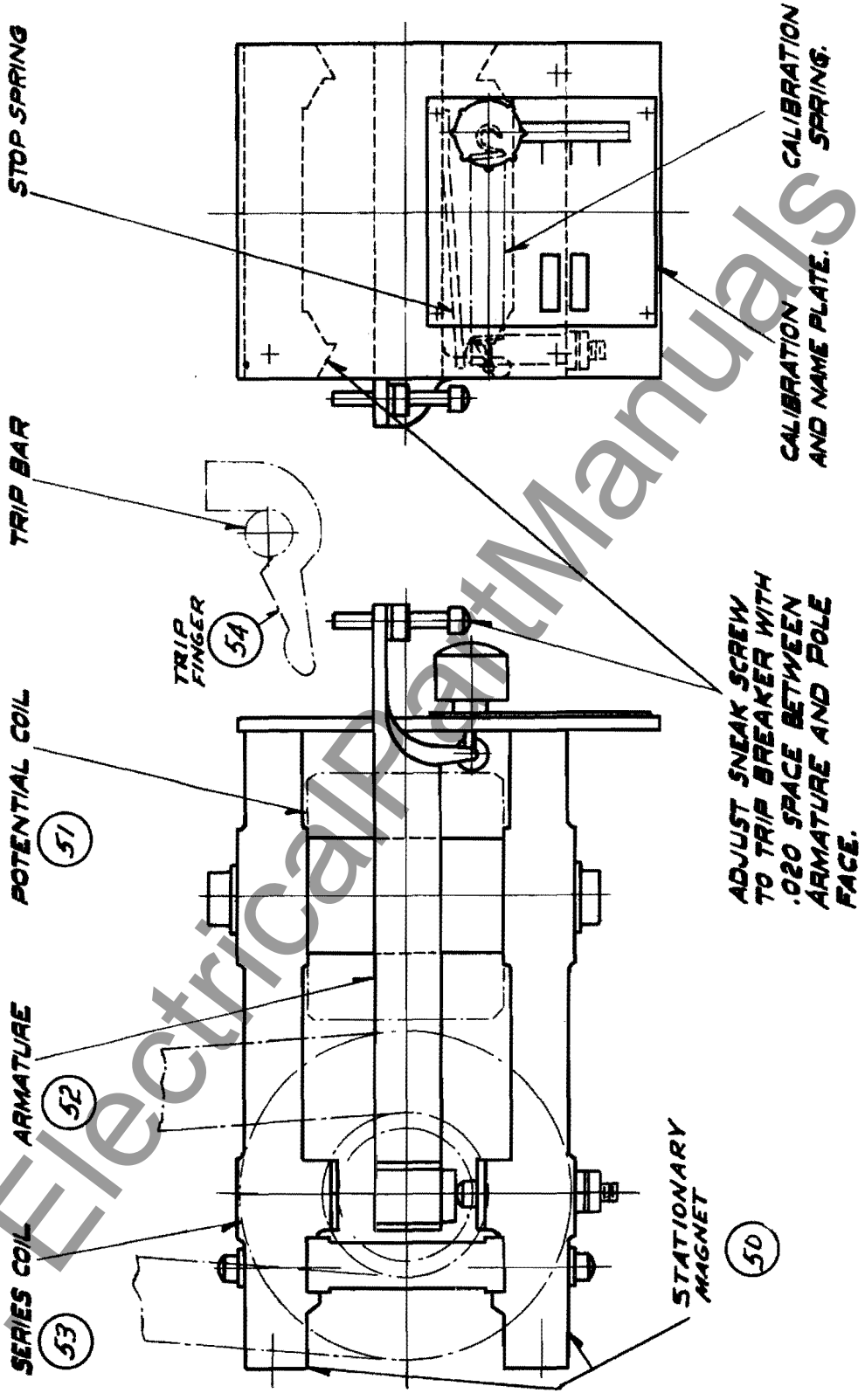


Fig. 12 - Reverse Current Trip
Drawing 8-D-2969

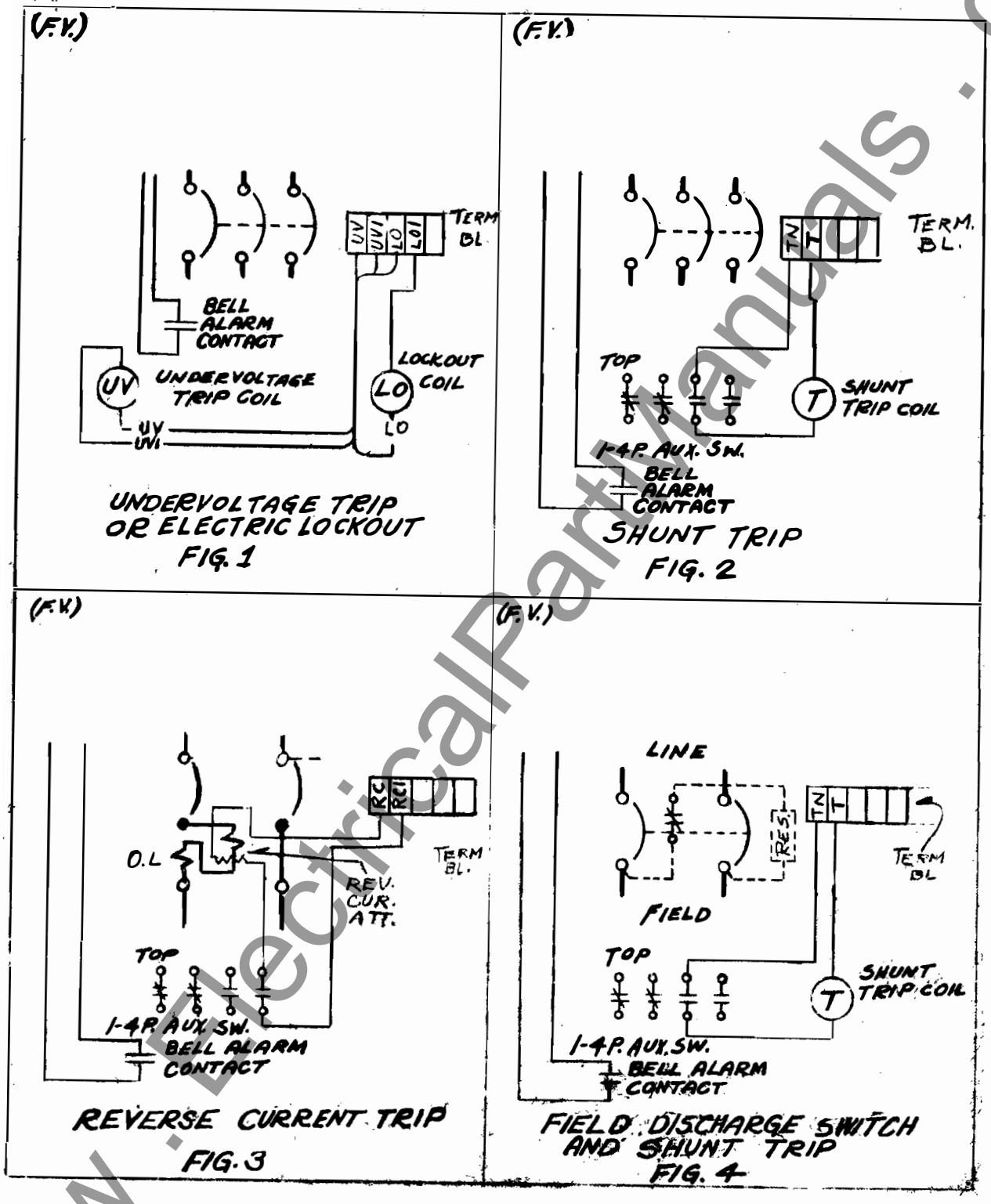
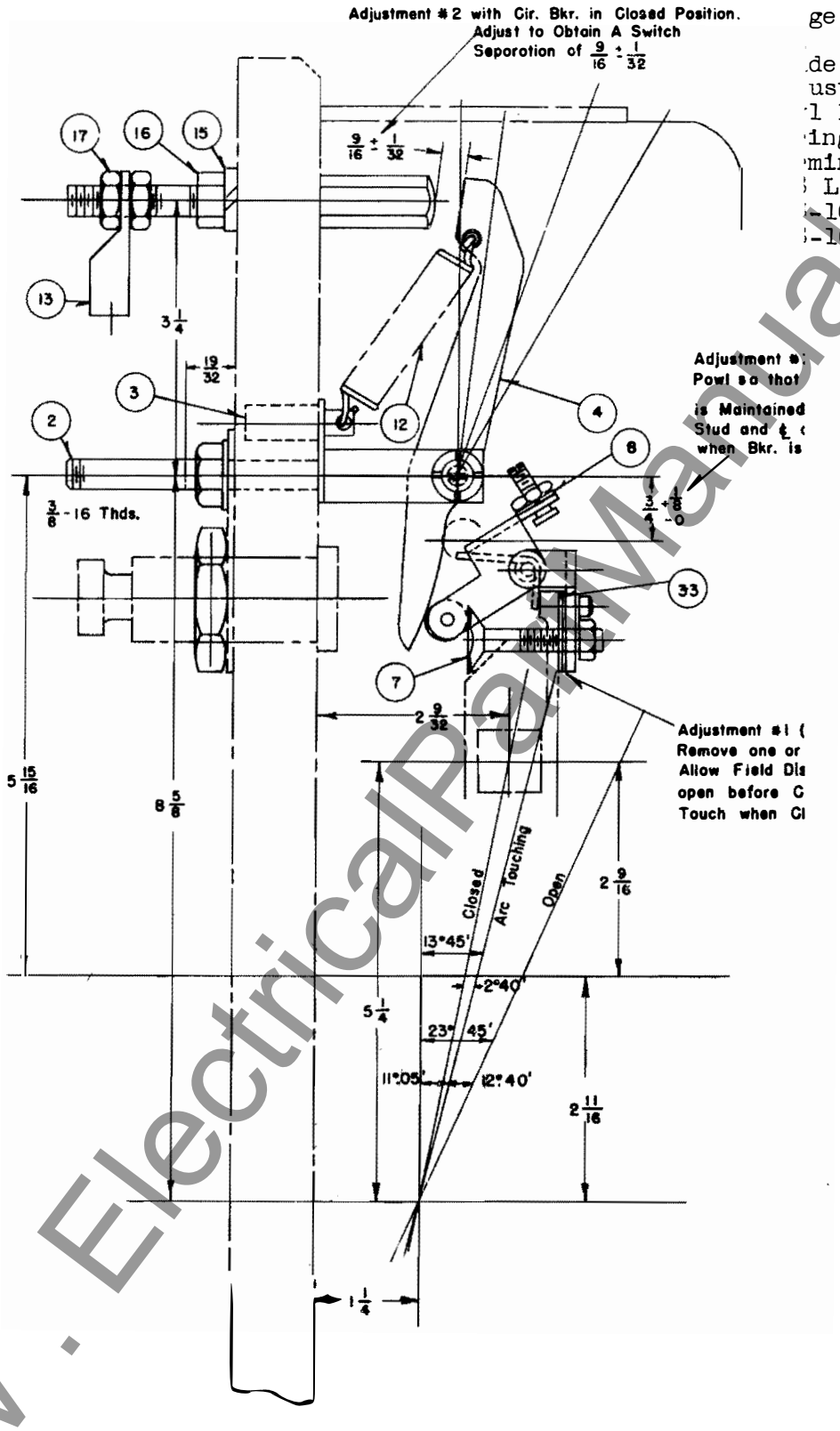


Fig. 13 - Wiring Diagrams
Drawing 5-D-8336



Description

ge Stud

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l Details
ing
minal
Lock Washer
-16 Hexagon Steel Nut
-16 Hexagon

ield Discharge Switch
ing 7-A-8945-15

TYPE DK-15 AND DK-25 AIR CIRCUIT BREAKER

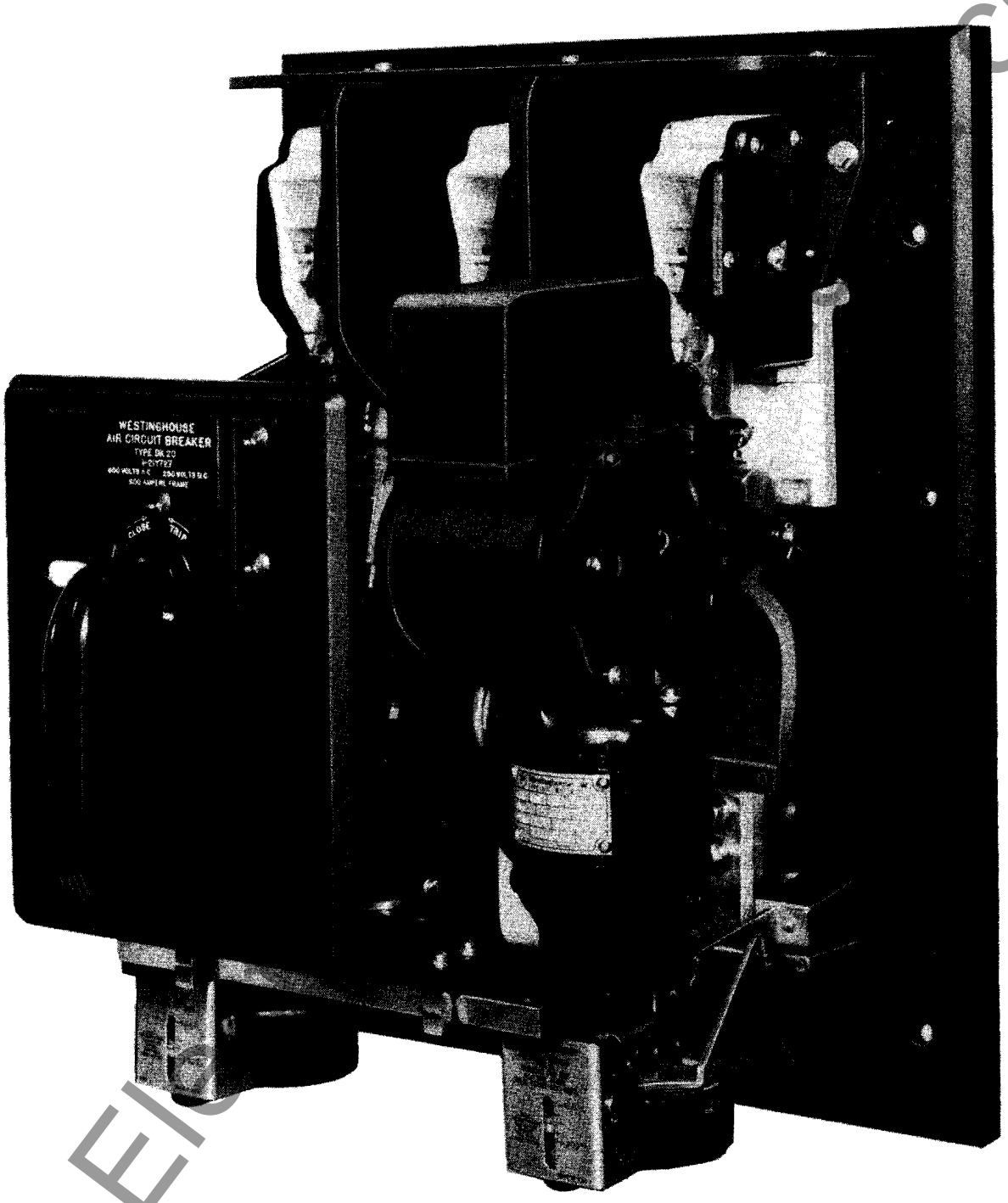

Fig. 1—3-Pole, 600-Ampere, 600-Volt A-C., 250-Volt D-C. Breaker

Instruction Book 5965-F
Filing No. 35-000

Westinghouse Electric Corporation
East Pittsburgh, Pa.

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Preface

It would be difficult to over-emphasize the importance of adequate care of all protective devices. To assure proper functioning, they should be the subject of periodical, systematic and intelligent inspection. Even the smallest details of required maintenance should not be neglected if costly failures of equipment and service are to be avoided. Maintenance must include occasional checks on calibration as well as on the coordination and freedom of all moving parts. The purpose of this Instruction Book on the DK circuit breakers is to provide a guide for those charged with these responsibilities. It is not possible to outline a procedure that will apply in all cases. The frequency and character of inspection will for the most part be a matter of experience. In general, light monthly inspection, with a thorough inspection semi-annually, should be a minimum. The Company will be glad to furnish such additional information as may be needed to amplify or clarify these instructions.

Type DK-15 and DK-25 Air Circuit Breaker

General

The DK air circuit breaker, complete with all attachments, is a self-contained unit, and has been mounted, adjusted and calibrated on its own permanent panel at the factory. It is designed only to be mounted in a vertical position, and all inspections for proper operation must be made with the breaker main panel held vertically.

Unpacking

Care must be exercised when unpacking to make sure that no parts are broken or damaged, and an inspection should be made immediately to check for any damage in transit. All dust and dirt should be carefully blown out of the complete assembly, especially in the closing toggle linkage overload attachments and such other attachments as are supplied.

It is not advisable to lubricate any parts of the breaker. The lubrication supplied during factory assembly, where necessary, is a special form of grease which is used sparingly. This will be found sufficient for years of service. Additional oil will only promote the accumulation of dust and dirt. In new installations, the breaker must be carefully protected from plaster, concrete and other foreign gritty particles that may add friction to the moving parts in the toggle linkage.

Inspection

Final inspection should preferably be made with the breaker in its permanent mounting, but if this is impossible, it can be set up rigidly in a vertical position while the inspection is made.

Rotate the manual operating handle slowly in a clockwise direction to move the contacts toward the closed position. Check the movement of each arc tip through the throat of the "De-ion" arc interrupting chamber to make sure that the tips do not rub against the ceramic side plates. Continue the closing motion until the moving arc tips just touch the stationary arc tips. Check the main contact separation at approximately 1/8 inch, as shown on Figs. 2 and 3. Continue the handle rotation to the fully closed position and watch the main contact overtravel as evidenced by rotary motion away from its stop, adjacent to the section where the shunt is attached.

Return the manually operated handle to the neutral position and rotate counterclockwise to trip the breaker. The toggle linkage should collapse and the moving contact assembly move freely to the full open position. This is followed immediately by complete resetting of the links in the toggle mechanism. This resetting operation is accomplished entirely by gravity. For this reason the links must always be free to move without friction or binding.

Adjustment of Contacts

The arc tip adjustment should be made as shown in Figs. 2 and 3. There is no adjustment provided for the main contacts, and under ordinary circumstances these main contacts will last the life of the breaker without repair other than occasional cleaning. Both main and arcing contacts are a high silver alloy.

Replacement of Contacts

The sub-panel, barrier and "De-ion" interrupting assembly may be removed as a unit by taking out two bolts at the outer ends of the sub-panel. This gives access to the contacts for easy inspection or replacement.

The moving arc tip can be removed by taking out the wire clip and nut on the threaded rod, removing two small screws that hold the secondary shunt to the main contact, and removing the arc tip pin. The stationary arc tip may be removed by taking out four flat head screws. The new items may be replaced in the reverse order. Take care to make proper adjustment as shown in Figs. 2 and 3, and set all poles of the breaker at one time and then securely lock each adjusting nut with a wire clip.

The moving main contact may be removed by taking out the bolts at the upper end of the trip unit, removing two bolts from the rear that hold this lower section to the panel, and taking out the pin in the contact arm. The contact and shunt can now be removed intact and replaced in the reverse order. The stationary main contact can be removed by taking out two bolts from the rear of the panel on the flat stud, or removing the finger cluster, large contact nut, and one bolt from the rear of the panel on the drawout type. Replacement is made with a complete new upper stud.

Adjustment of Toggle Linkage

The toggle linkage in the DK circuit breaker is a series of links so arranged that the closed breaker load is transmitted through successive toggles with a reduction at each step, to the final tripping toggle where a very low, but consistent, load is maintained with one simple adjustment. This adjusting screw will be found in the front of the main frame behind the face plate, as shown in Figs. 2 and 3. This adjustment is set slightly over toggle to produce a light tripping load. The factory adjustment should not vary in service, but can easily be checked or readjusted by reference to the sketches. For this operation, use a small spring balance applied to the left pole trip finger on the trip bar at a point in line with the plunger. This 2 pound tripping load must be maintained to insure proper tripping of the breaker by the overload trip units and other calibrated attachments.

Dual Overload Tripping Attachments

The DK circuit breaker is supplied with either of two distinct types of adjustable inverse time delay trip units:- (1) oil sucker-magnetic dual overload, and (2) thermal-magnetic dual overload. Both types are suitable for either a-c. or d-c. service. The oil sucker type of time delay is designed for all standard application where overcurrent tripping is desired with time delay that can be adjusted to a minimum, approaching zero time if required. The thermal type of time delay, on the other hand, is for applications which require unusually long tripping time at relatively large overloads, associated with motor starting conditions and protections. In both cases any current in excess of ten times normal rating produces instantaneous tripping.

Characteristics of Oil Sucker-Magnetic Dual Overload

Fig. 2 shows the arrangement of adjustments on this tripping attachment, and Fig. 6 represents the characteristic inverse time delay. The 100% calibration setting is the normal rating of the trip unit, and that value of current will just trip the breaker with no oil in the pot. Adjustment of the thumb screw toward the 200% calibration setting raises the minimum tripping current in minute steps as desired. Rotation of the molded pot, properly filled with oil as explained on the drawing, varies the time delay between 0 and 100%. Thus, any desired combination of minimum tripping current and time delay can be selected as desired.

Characteristics of Thermal-Magnetic Dual Overload

The general arrangement of this attachment is shown in Fig. 3 with inverse time delay characteristics in Fig. 7. The 100% calibration setting of the pointer on the scale plate is the normal rating of the trip unit. Adjustment of the thumb screw toward the maximum calibration setting raises the minimum tripping current in minute steps as desired.

Ambient correction is explained in Fig. 3 as 1% increase in calibration for each 2°C. rise in temperature. The attachment is calibrated for 24°C. ambient, but if it is desired to meet the calibration characteristics of Fig. 5 at 40°C., for instance, the calibration adjustment should be set at approximately 108% for minimum tripping at normal current rating.

The calibration adjustment can therefore be set as close to the normal running current of the motor as is desired, depending on ambient temperature, frequency of starting, etc. Complete protection is thus afforded under all conditions of operation.

Full details for adjustment and maintenance of the thermal-magnetic trip attachment are explained in Fig. 3.

Replacement of Overload Attachments

Both types of overload trip units may be easily removed. From the rear, take out two screws that fasten the magnet assembly to the main panel and disconnect the trip unit upper terminal where it is bolted to the main pole unit shunt section. In the case of drawout studs the finger cluster and large nut must also be removed. The trip unit may now be removed. Replacement is simply the reverse of this procedure.

After the unit is securely mounted to the panel, only one adjustment is necessary for correct operation with the breaker. This adjustment consists of setting the screw in the outer end of the trip armature lever to properly trip the breaker with a thin spacer between the armature and magnet, as explained in Figs. 2 and 3.

Electric Closing Mechanism

Electrically operated DK circuit breakers are equipped with an entirely self-contained motor mechanism (fig. 11) mounted on the right side of the breaker frame. Two of the toggle linkage pins serve as dowels to accurately locate the mechanism insulating base. By removing three bolts this complete assembly can be taken off the breaker without disengaging any parts except the wiring.

The closing motor is a single phase commutator type, vertical shaft motor with ball bearings sealed with lubricant that will normally last the life of the apparatus. A single reduction of speed between the motor shaft and the mechanism crank is accomplished with a worm mounted on the upper end of the motor shaft engaging a worm gear on the crank shaft. This gear assembly is lubricated on assembly sufficient for several years of normal service. An oil seal on the motor shaft prevents any oil or grease from running down into the motor windings.

The motor is designed to develop an exceptionally high torque for its size, and is therefore rated for intermittent service. If the breaker is closed more frequently than once every 3 minutes for long periods, the motor may overheat. A centrifugal speed limiting device is built into the lower end-bell of the motor to prevent excessive speed at normal and overvoltage, and to prevent coasting of the mechanism after the limit switch has cut off the motor current.

The mechanism crank engages a hardened steel cam on the roller lever. The relative motion of the crank roller with respect to this cam surface is to produce the maximum mechanical advantage when the closing load is greatest. A limit switch segment on the mechanism crank shaft positively carries the crank roller past the cam after a closing operation, so that the breaker can be closed either manually or electrically without interference or mechanical disengagement. The only requirement is that the limit switch must be allowed to cut off the motor closing current.

One adjustment between the motor mechanism and the breaker roller lever should be checked for proper operation. Close the breaker manually and rotate the motor by hand. This is done by removing the plate at the lower end and rotating the armature in the direction of the arrow, until the crank roller is just passing over the heel of the cam. There should be from 1/64 to 1/32 inch clearance between the roller surface and the cam surface at this point. If binding occurs, the minimum closing voltage will be unduly high, and if too much clearance is present, the mechanism may fail to move the breaker toggle linkage to the completely closed position. This adjustment is maintained by adding or taking out a spacer between the molded tiebar and the cast roller lever on the right side.

The motor closing current is given in the following table for standard control voltage ratings:

Voltage Rating	Closing Current at Normal Voltage
110 Volt, A-c.	30 Amperes
220 Volt, A-c.	15 Amperes
125 Volt, D-c.	30 Amperes
250 Volt, D-c.	15 Amperes

Shunt Trip Attachment

The shunt trip attachment, when supplied, is mounted rigidly to the breaker frame behind the face plate. The trip bar bracket is attached to its lower end. When the shunt trip is not supplied, its place is taken by a long trip rod held by a case identical in outside appearance with the shunt trip case. Both types are interchangeable and can be readily removed and replaced. In replacing the shunt trip assembly, make sure the moving core and trip rod assembly is free to move without binding against the guide holes or coil.

The shunt trip is designed for intermittent duty. The tripping current must always be cut off by an auxiliary switch on the breaker. The normal tripping currents for standard control voltages are:

Voltage Rating	Tripping Current
110 Volt, A-c.	7 Amperes
220 Volt, A-c.	4 Amperes
125 Volt, D-c.	2.5 Amperes
250 Volt, D-c.	1.5 Amperes

Wiring Diagram

The standard wiring diagram for the motor mechanism and shunt trip attachments are given in Fig. 10. The motor control circuit can be supplied with a special relay as an integral part of the electrically operated breaker that prevents reclosure until after the external control switch has been opened. See Fig. 8. This prevents the breaker from pumping if closed against a high overload or short circuit. A further feature of the control wiring is the prevention of electrically inching the breaker closed after the moving contact assembly has started to close.

Undervoltage Tripping Attachment

The undervoltage attachment is normally mounted on the main panel to the left of the breaker. It operates to trip the breaker through the trip bar if the control voltage drops to a value of 35% to 60% of rated voltage. To check the adjustment of this attachment, remove the voltage from the holding coils, hold the armature against the magnet by hand, and close the breaker. Now allow the armature to move slowly away from the magnet under action of the spring in the flexible link. The breaker should trip by this dead push. Adjustment to provide this operation is made by shortening or lengthening the flexible link detail.

When the undervoltage attachment is furnished with a time delay tripping feature, the oil dash pot should be removed by unscrewing the pot when the above adjustment is checked. Always connect the undervoltage coils to the line side of the breaker.

Reverse Current Attachment

The reverse current attachment (Fig. 12-13) is used to trip the breaker when the direction of current flow in that pole is reversed. The attachment consists of a magnet energized by a voltage coil and an armature energized by a current coil in series with one pole of the breaker. When the series coil current is flowing in the proper direction the armature tends to rotate but is restrained by a stop. When the series current is reversed the armature is rotated in the opposite direction against a spring to trip the breaker. This adjustment is calibrated and marked on the scale plate at 10%, 15%, 20% and 25% reverse current, based on normal current rating.

The reverse current armature is reset after a tripping operation by opening the voltage coil circuit. This can be accomplished by wiring the voltage coil through an auxiliary switch on the breaker.

Field Discharge Switch

The field discharge contact (Fig. 13-14) is normally mounted on a two pole breaker in the space left vacant above the breaker toggle linkage. Correct adjustment in one direction is evidenced by opening of the switch contact just prior to the arc tips touching during the breaker closing motion. Similarly, the switch must make contact before the breaker contacts part more than 1/8" during the opening motion of the breaker.

Auxiliary Switch

The DK auxiliary switch shown in Fig. 9 is a compact molded assembly supplied in either 4 to 8 poles and is rigidly mounted on the side of the main breaker frame. Each pole consists of two silver posts in the sections which carry the terminal screws on the reverse side. The moving contact is a silver bridging member, spring mounted on the sliding bar, and with an eccentric rolling motion such that adequate wiping action takes place when the switch contact is made.

The terminal screws are readily accessible on the completely assembled breaker and adequate wiring space is provided from the switch assembly through wiring holes to the rear of the main panel.

Each four point switch is normally assembled with two "make" and two "break" contacts, but any pole may be reversed by removing the sliding bar and inverting the bridging member, thus making possible any desired arrangement.

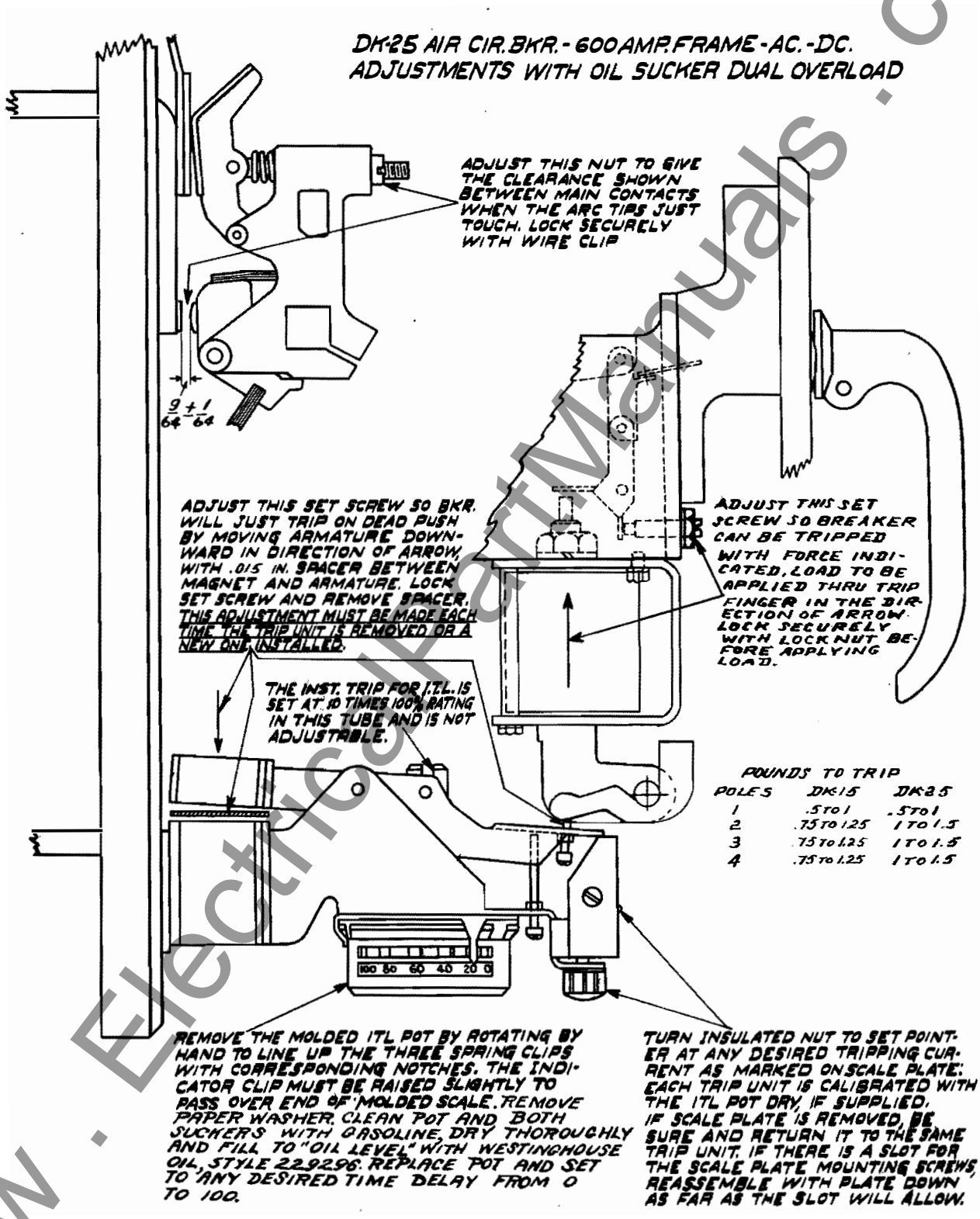


Fig. 2 - Adjustments with Oil Sucker Magnetic Dual Overload
Drawing 4-D-2515-5

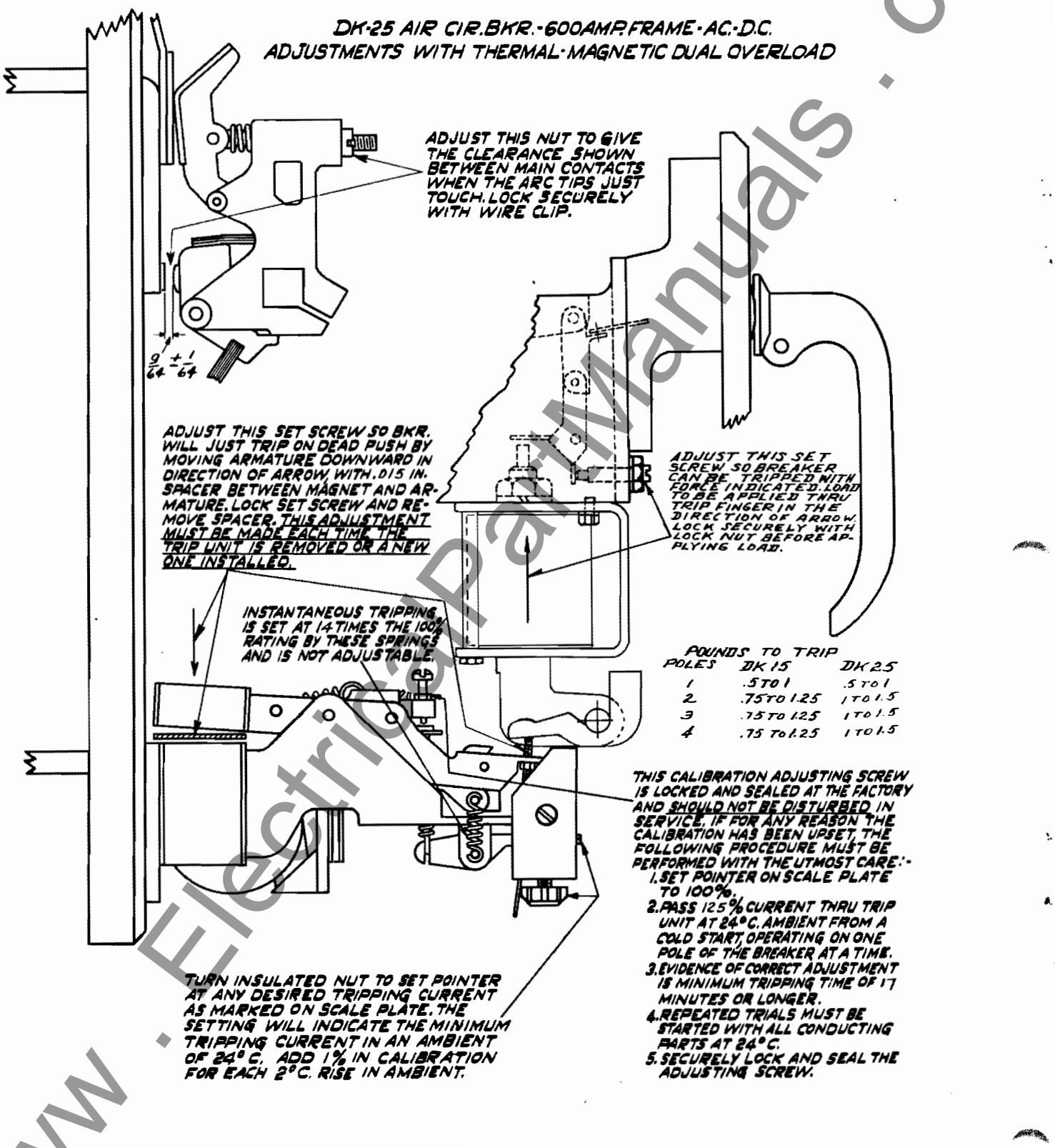
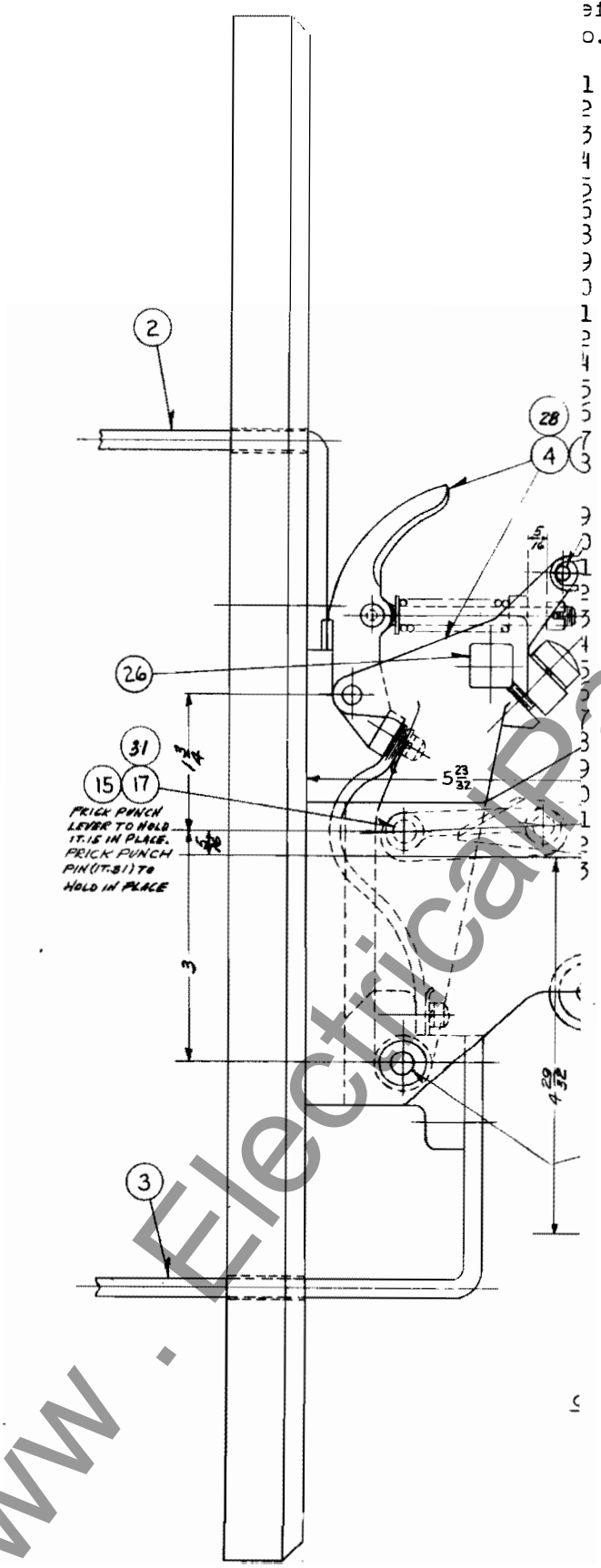


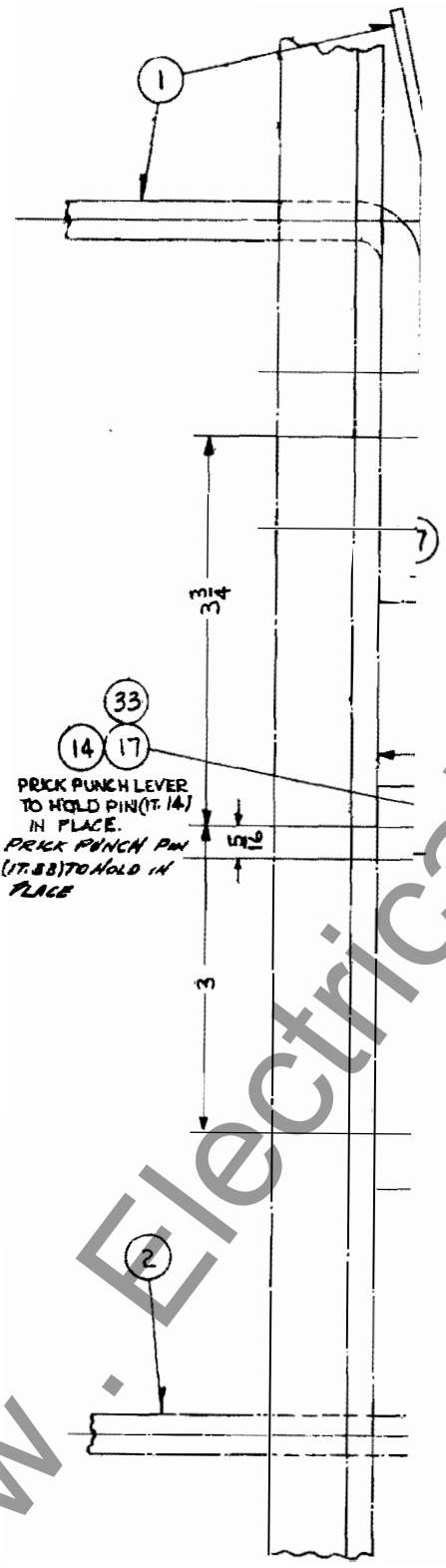
Fig. 3 - Adjustments with Thermal-Magnetic Dual Overload
Drawing 4-D-8316-3



Ref No.	Description
1	Shunt Trip
2	Upper Stud
3	Lower Stud
4	Moving Contact Assembly
5	Moving Contact Assembly
6	Cross Bar Lever
8	Linkage Assembly
9	Roller Lever
10	Spring (Accelerating)
11	Spring (Closing Lever Reset)
12	Spring (Trigger)
14	Pin
15	Pin
16	1/16 x 1/2 Steel Cotter Pin
17	Grease #4739
18	3/8-16 x 7/8 Fillister Head Steel Machine Screw
19	3/8 Steel Lock Washer
20	.164 Wide Brass Washer
21	Headless Set Screw
23	1/4-20 Steel Lock Nut
24	1/4 Steel Lock Washer
25	Pin
26	1/16 x 3/8 Steel Cotter Pin
27	Cross Bar
28	Pin
29	Moving Contact Assembly
30	Frame
31	Linkage Assembly
32	Pin (5/16 Nickel Steel)
33	Pin (5/16 Stainless Steel)
34	Pin (5/32 Nickel Steel)

1 Assembly (With or Without Current Parts)
Drawing 14-A-5153-5

Type



Ref No.	Description
1	Upper Stud
2	Lower Stud
3	Cross Bar
4	Shunt Trip
5	Moving Contact Assembly
6	Moving Contact Assembly
7	Cross Bar Lever
9	Linkage Assembly
10	Roller Lever
11	Spring (Accelerating)
12	Spring (Roller Lever Reset)
13	Spring (Trigger)
14	Pin (5/16 x 2 17/32 Nickel Steel)
15	Pin (Copper Alloy) (5/16 x 3 21/32)
17	Grease #4739
18	1/16 x 1/2 Steel Cotter Pin
19	.164 Wide Brass Washer
20	Pin
22	1/16 x 3/8 Steel Cotter Pin
23	Headless Set Screw
24	1/4 Steel Lock Washer
25	1/4-20 Steel Lock Nut
26	3/8-16 x 1-1/4 Hexagon Head Steel Bolt
27	3/8 Steel Lock Washer
28	Linkage Assembly
29	Time Delay and Shunt Trip Unit
30	Moving Contact Assembly
31	Main Frame
32	Linkage Assembly
33	Pin (5/16 x 2 9/16 Nickel Steel)
34	Pin (5/16 x 3 21/32 Stainless Steel)
35	Pin (5/32 x 2 Nickel Steel)

- Mechanism Assembly (With or Without Current Parts)
Drawing 14-A-5857-10)

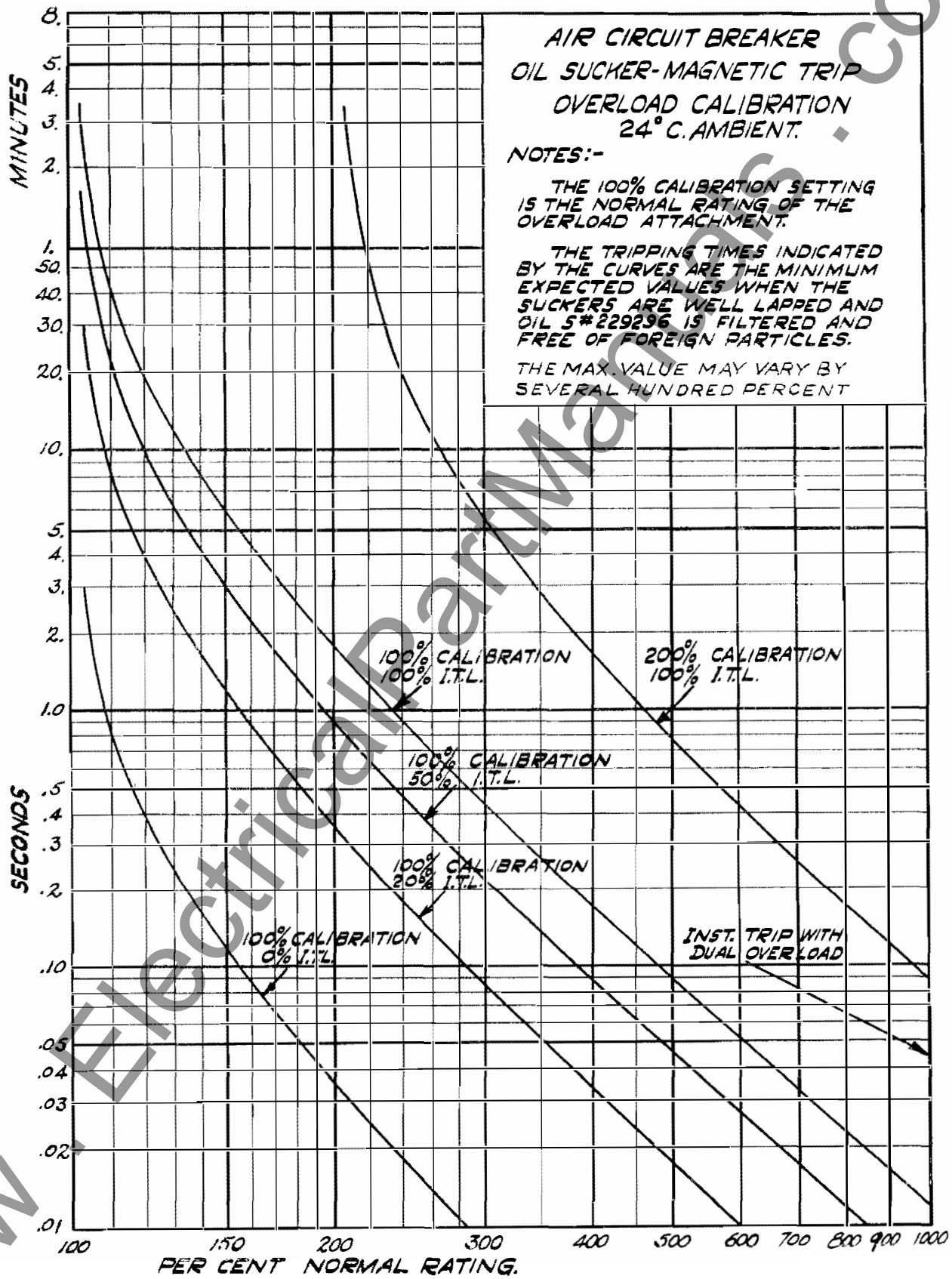


Fig. 6 Oil Sucker Magnetic Trip Overload Calibration Curve 261560

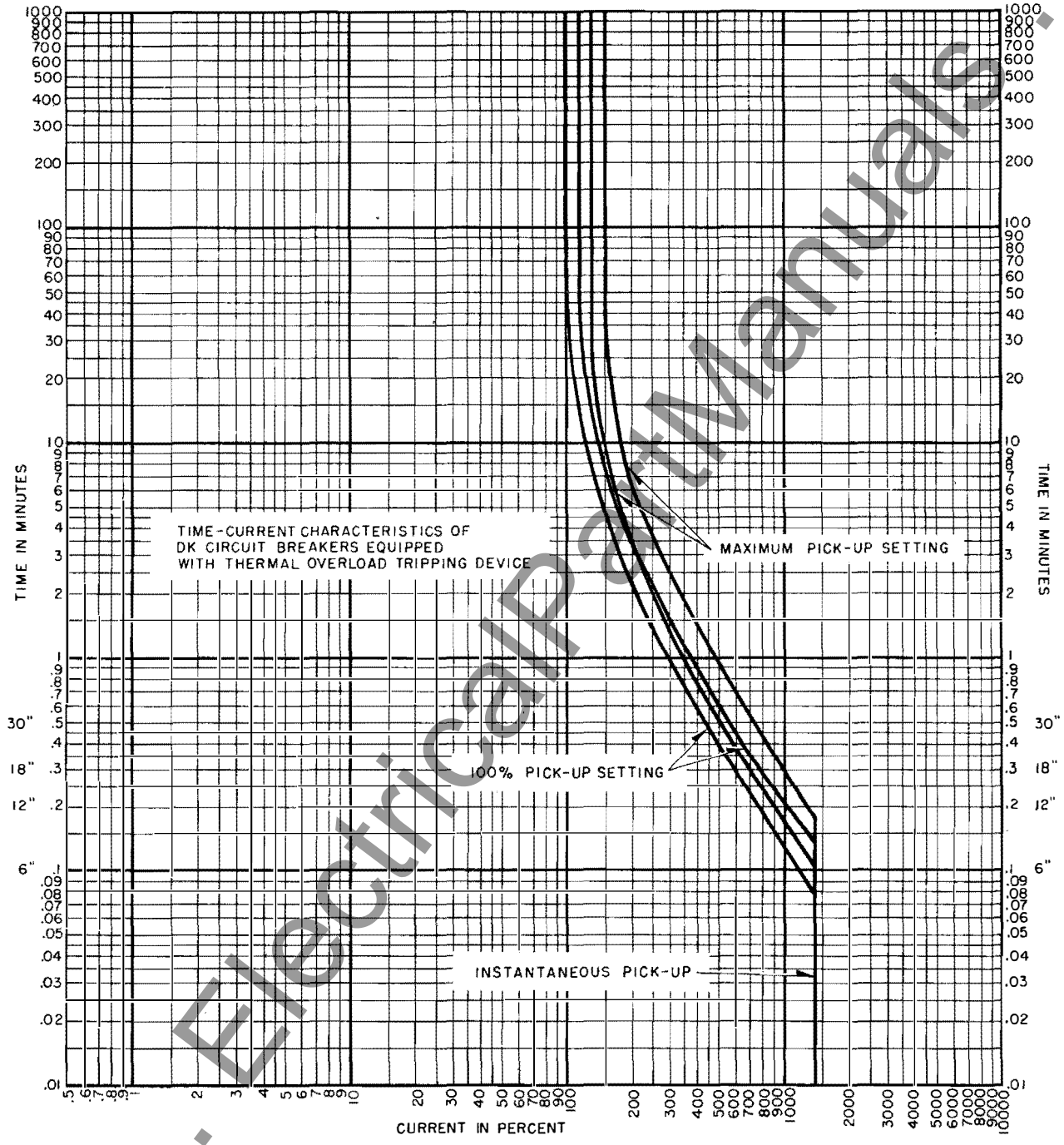


Fig. 7 Thermal Overload Trip Calibration
Curve 351052

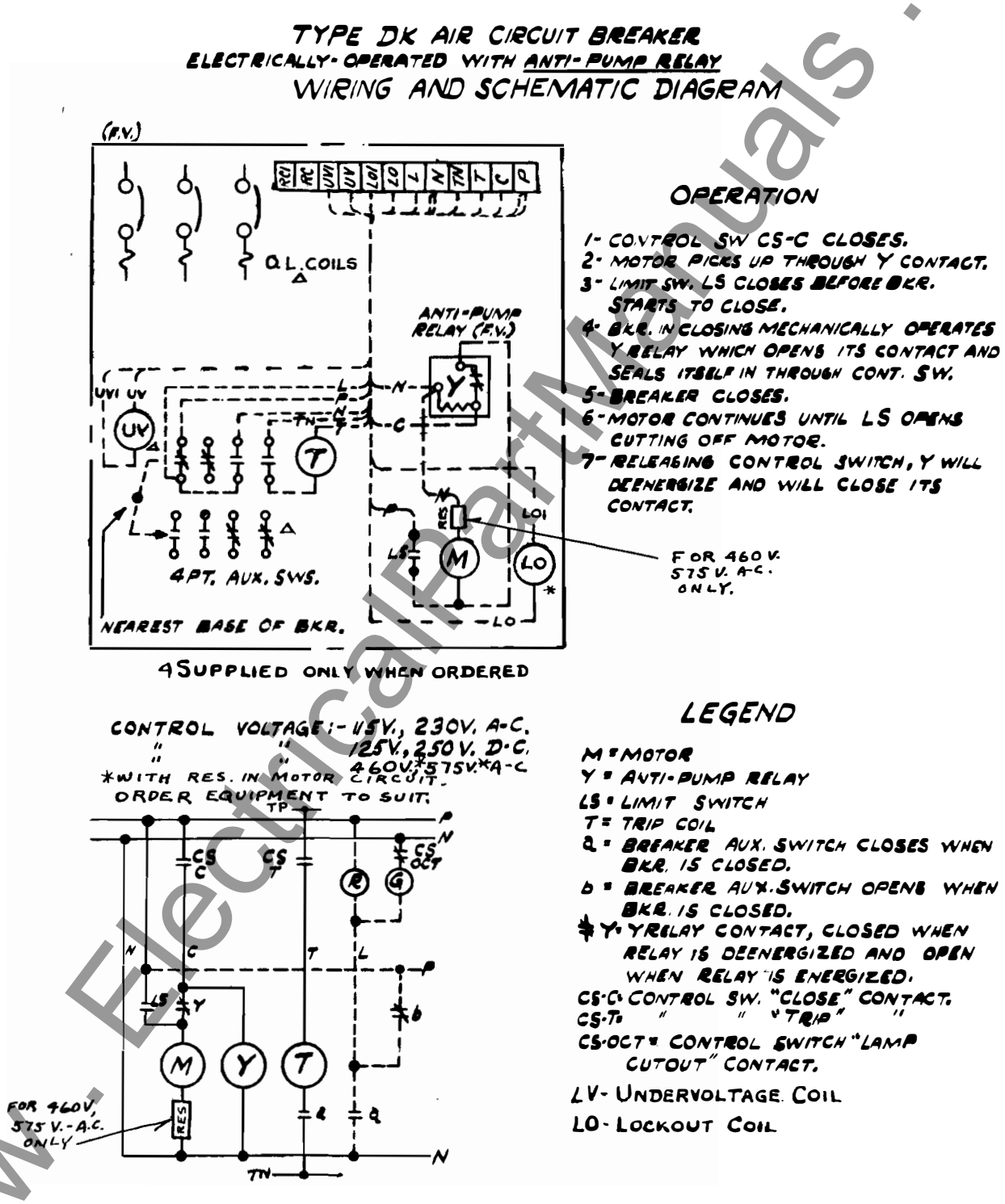


Fig. 8 - Wiring and Schematic Diagram With Anti-Pump Relay
Drawing 5-D-8339-6

Typ.	Description
1	Auxiliary Switch
2	Auxiliary Switch
3	Lever
4	Link
5	Link
6	Bracket
7	Link
8	Breaker Center Pole
9	Indicator Assembly
10	Spacer S# 898 756 + Fin
11	1/4-20 x 3/4 Hexagon Head Steel Bolt
12	1/4 Standard Lock Washer
13	1/4-20 x 1/2 Hexagon Head Steel Bolt
14	1/4-20 Hexagon Steel Machine Screw Nut
15	Shakeproof Lockwasher
16	.190-32 x 1/2 Fillister Head Steel Machine Screw
17	Washer S# 779354 + Fin
18	3/32 x 3/8 Steel Cotter Pin
19	Pin
20	Lock Washer
21	Washer S# 779355 + Fin
25	Link
26	Switch Assembly

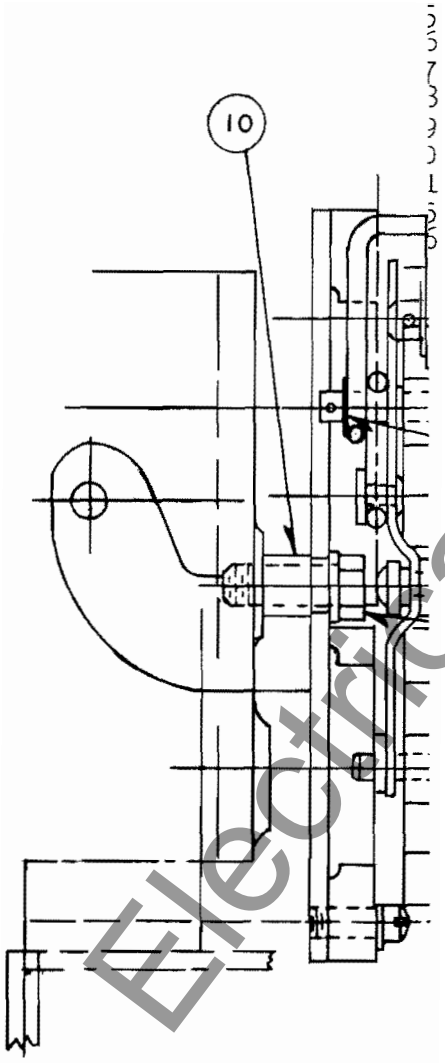
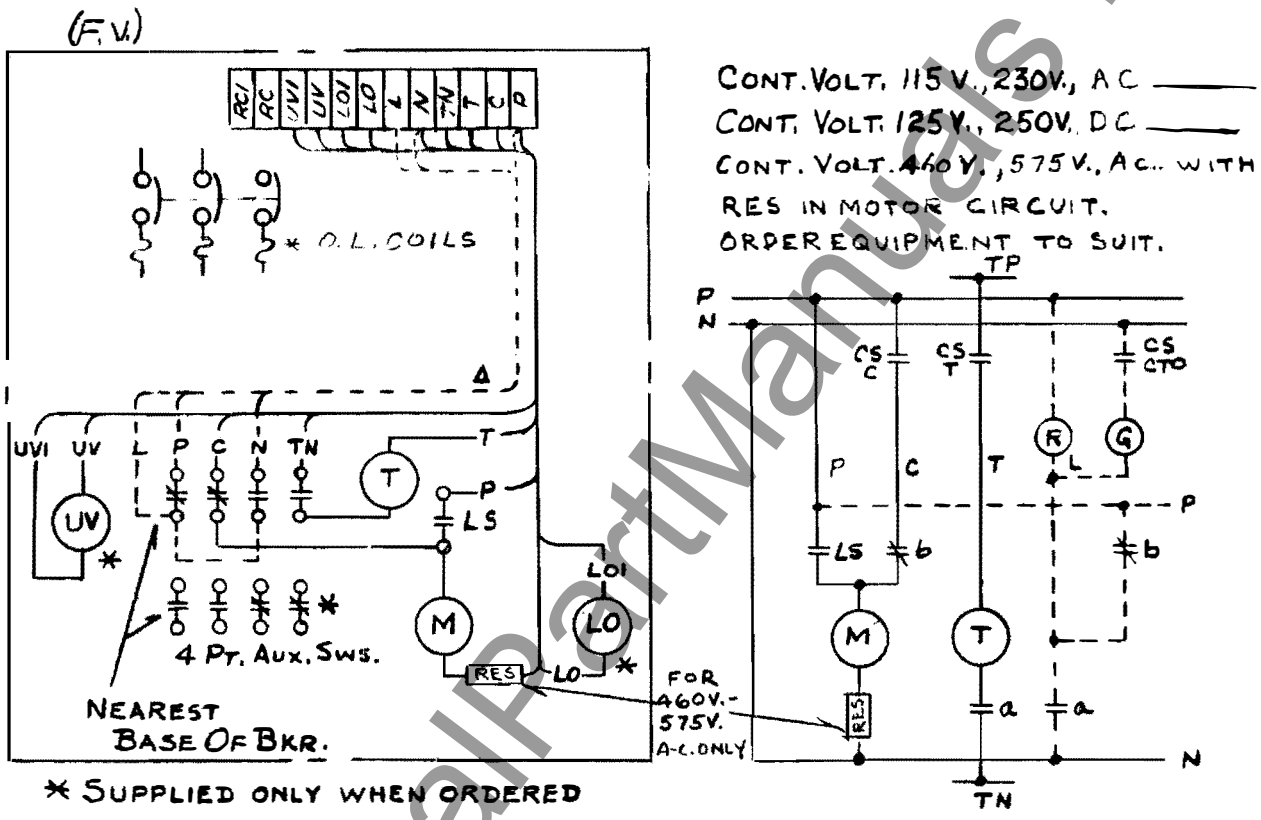


Fig. 9 - Auxiliary Switch and Mounting Assembly
Drawing 7-B-9438-10

TYPE "DK" AIR CIRCUIT BREAKER
ELECTRICALLY OPERATED
WIRING AND SCHEMATIC DIAGRAM



* SUPPLIED ONLY WHEN ORDERED

Δ DOTTED CONN. SUPPLIED ONLY WHEN ORDERED.

OPERATION

1. CONTROL SW. CS-C CLOSES.
2. MOTOR STARTS THROUGH BKR. AUX. SW. b.
3. LIMIT SW. CLOSES BEFORE BKR. STARTS TO CLOSE.
4. BKR. IN CLOSING OPENS AUX. SW. b.
5. RELEASE CONTROL SW. CS AFTER BKR. STARTS TO CLOSE.
6. BKR. CLOSES.
7. MOTOR RUNS UNTIL LS OPENS.

LEGEND

M - MOTOR
LS - LIMIT SW.
T - TRIP COIL
a - BKR. AUX. SW. CLOSED WHEN BKR. IS CLOSED.
b - BKR. AUX. SW. OPEN WHEN BKR. IS CLOSED.
CS - CONTROL SW. (C-CLOSE, T-TRIP, CTO-LAMP CUTOUT)
UV - UNDERVOLTAGE COIL
LO - LOCKOUT COIL

Fig. 10 - Wiring and Schematic Diagram Without Anti-Pump Relay
Drawing 5-D-8338-6

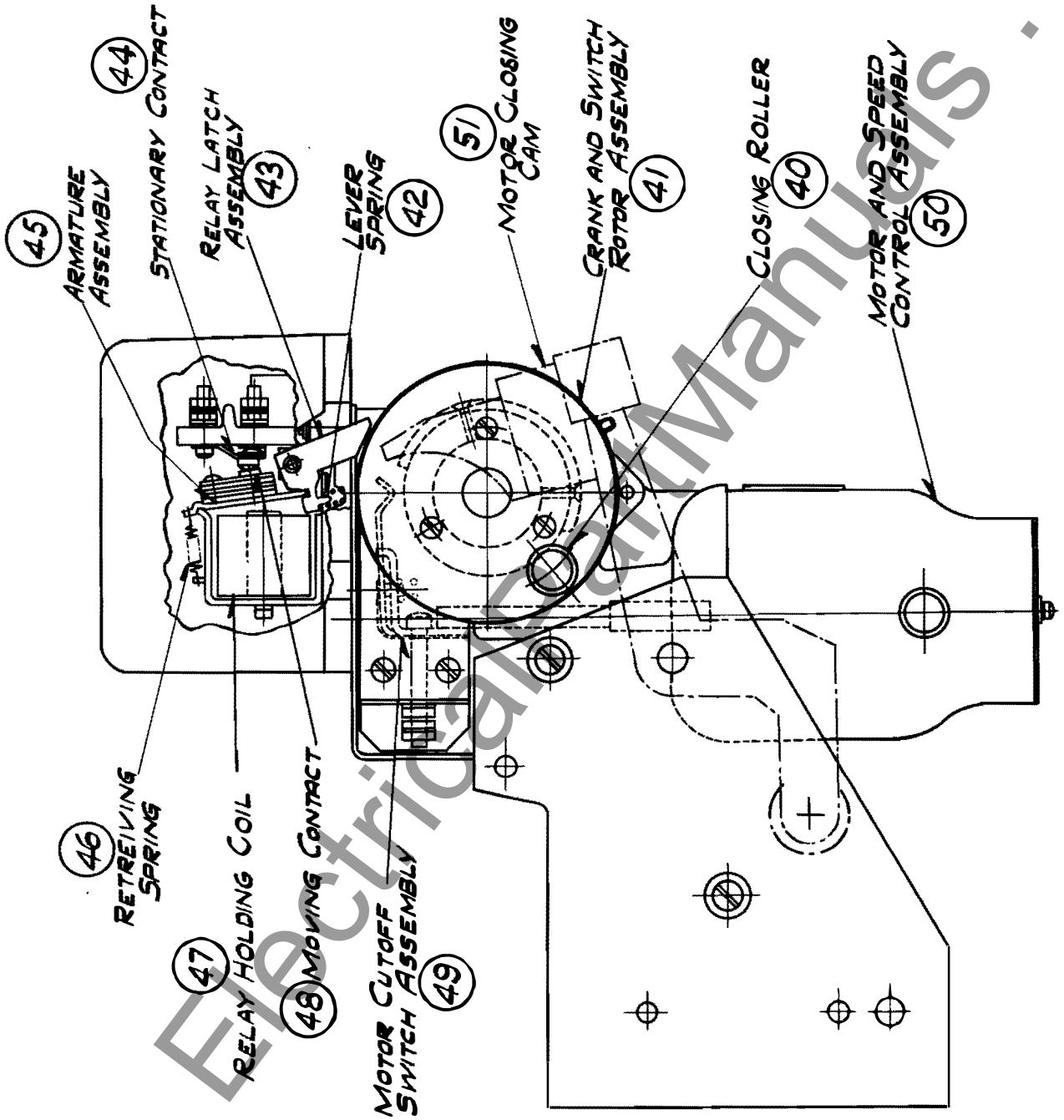


Fig. 11 - Motor Mechanism and Anti-Pump Assembly
Drawing 4-D-8494-3

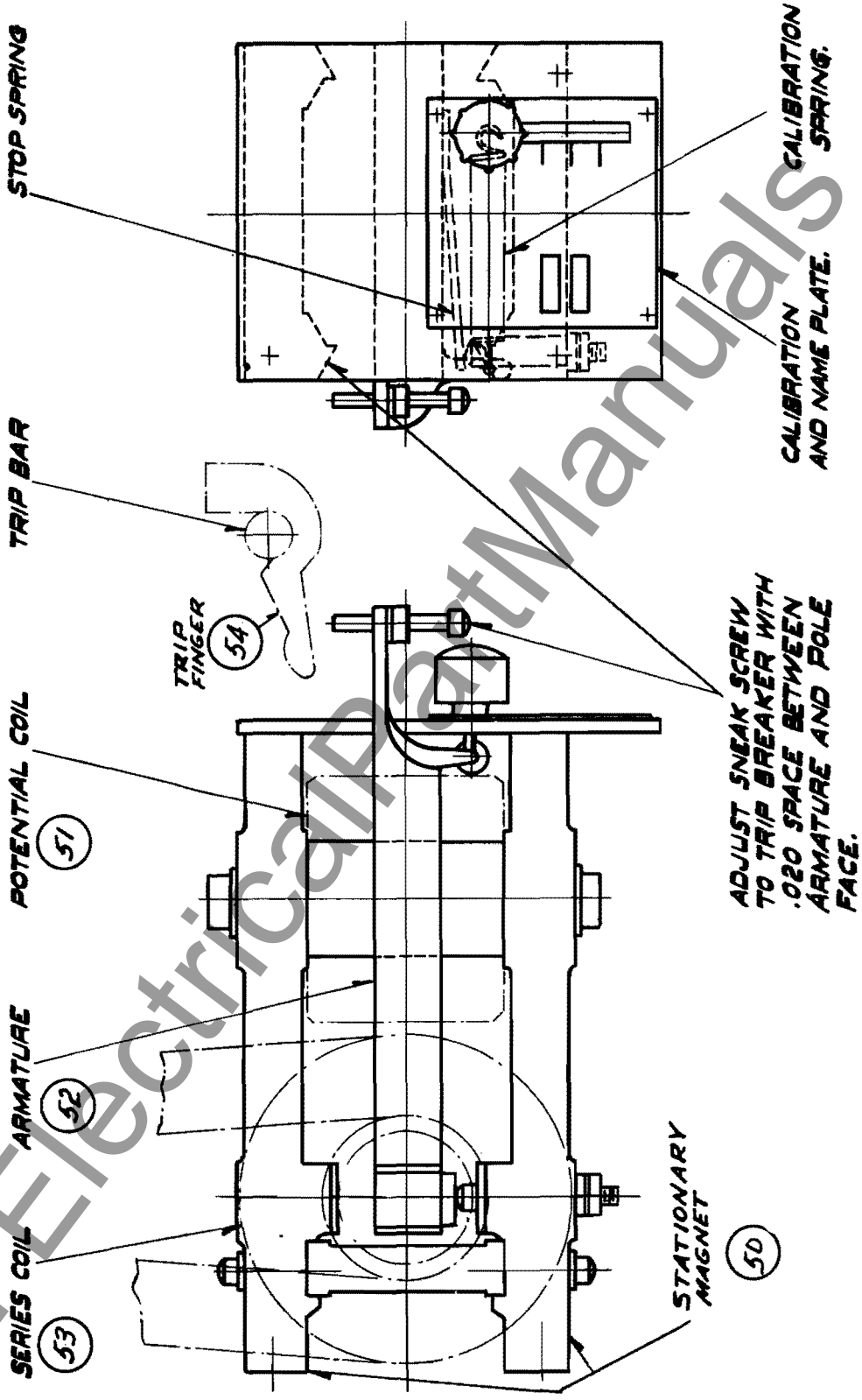


Fig. 12 - Reverse Current Trip
Drawing 8-D-2969

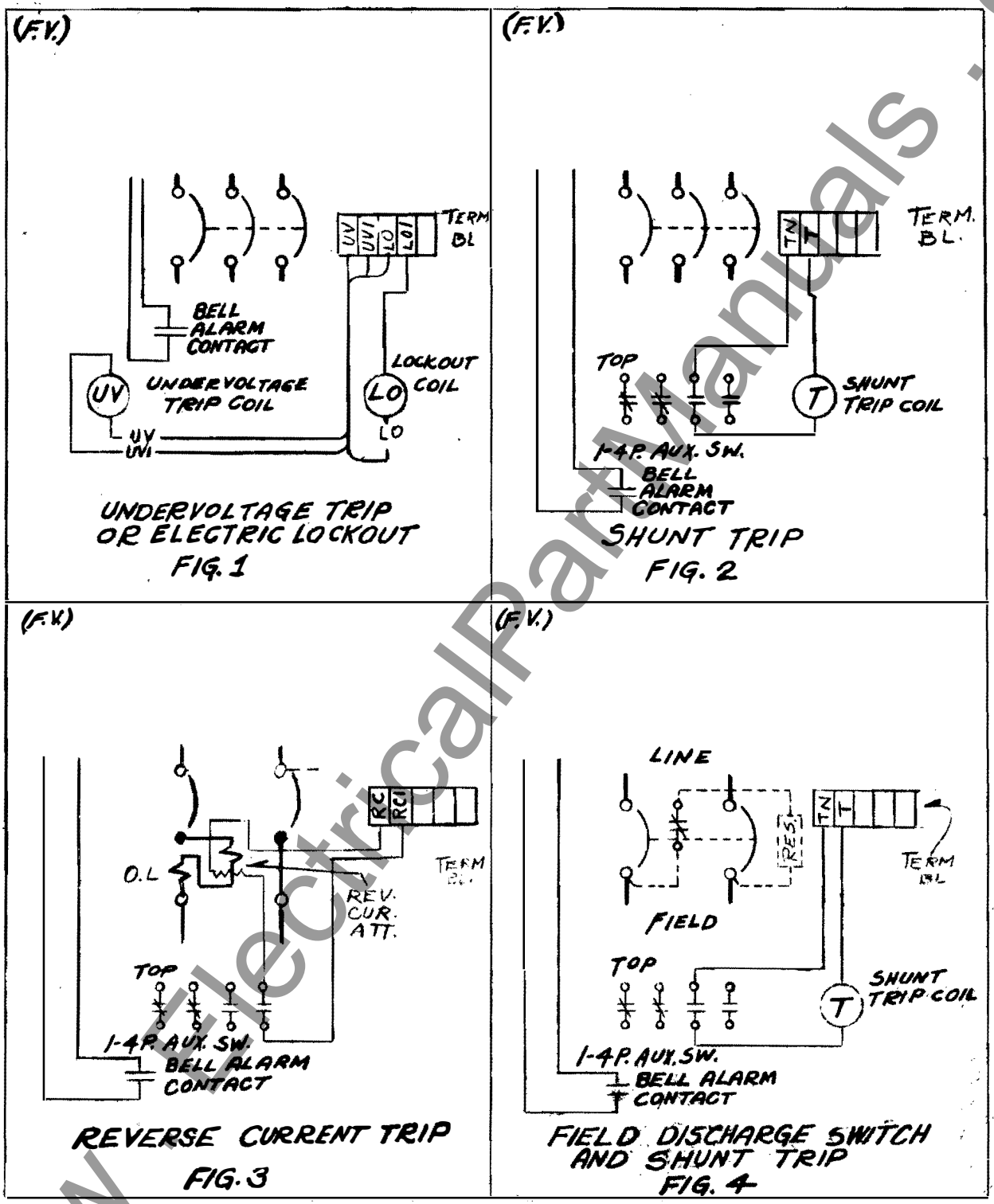
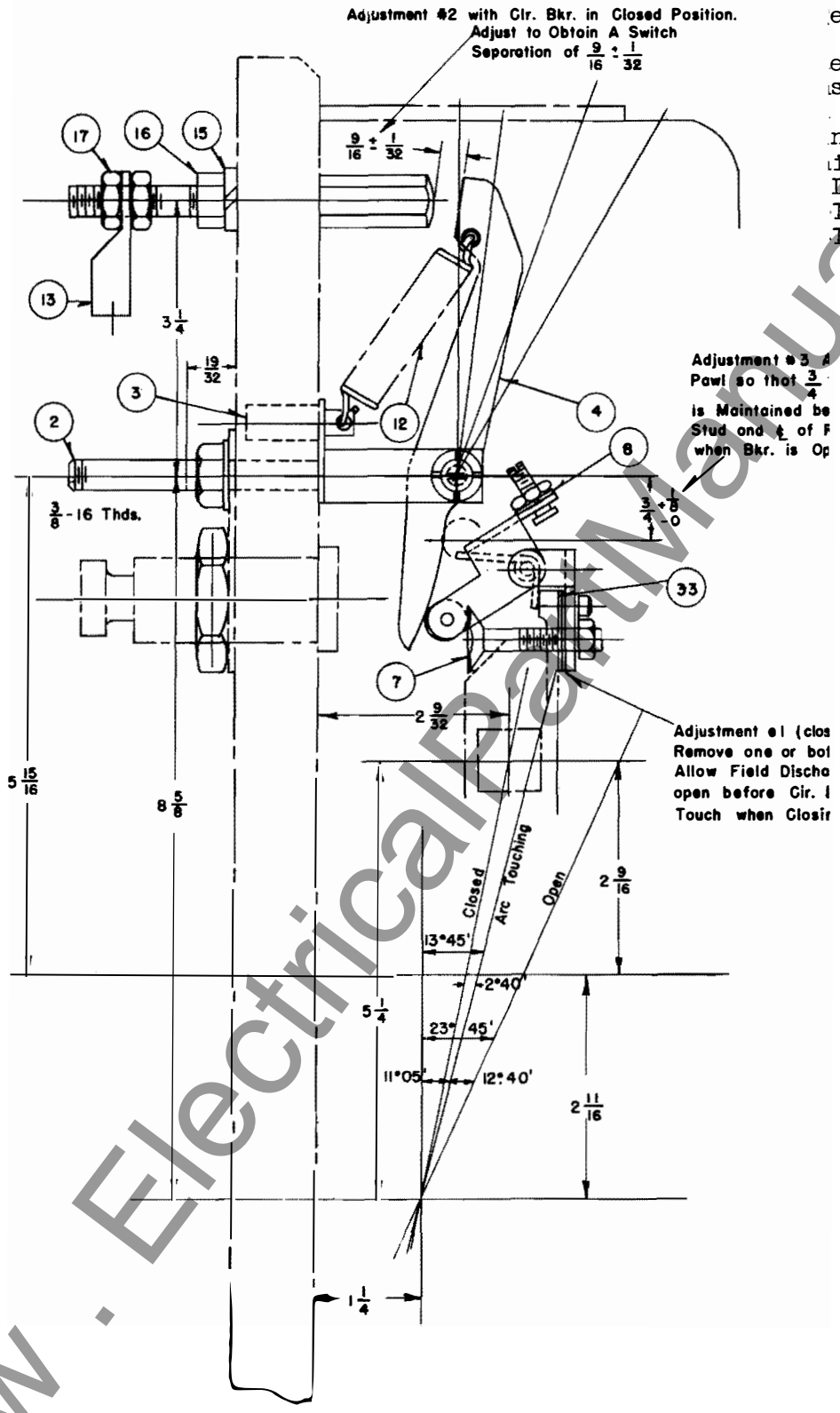


Fig. 13 - Wiring Diagrams
Drawing 5-D-8336

Type DK-15 and DK-25 Air Circuit Breaker



Description

e Stud

e
stment Bolt
Details
ng
inal
Lock Washer
16 Hexagon Steel Nut
16 Hexagon

eld Discharge Switch
ng 7-A-8945-15

TYPE DK-15 AND DK-25 AIR CIRCUIT BREAKER

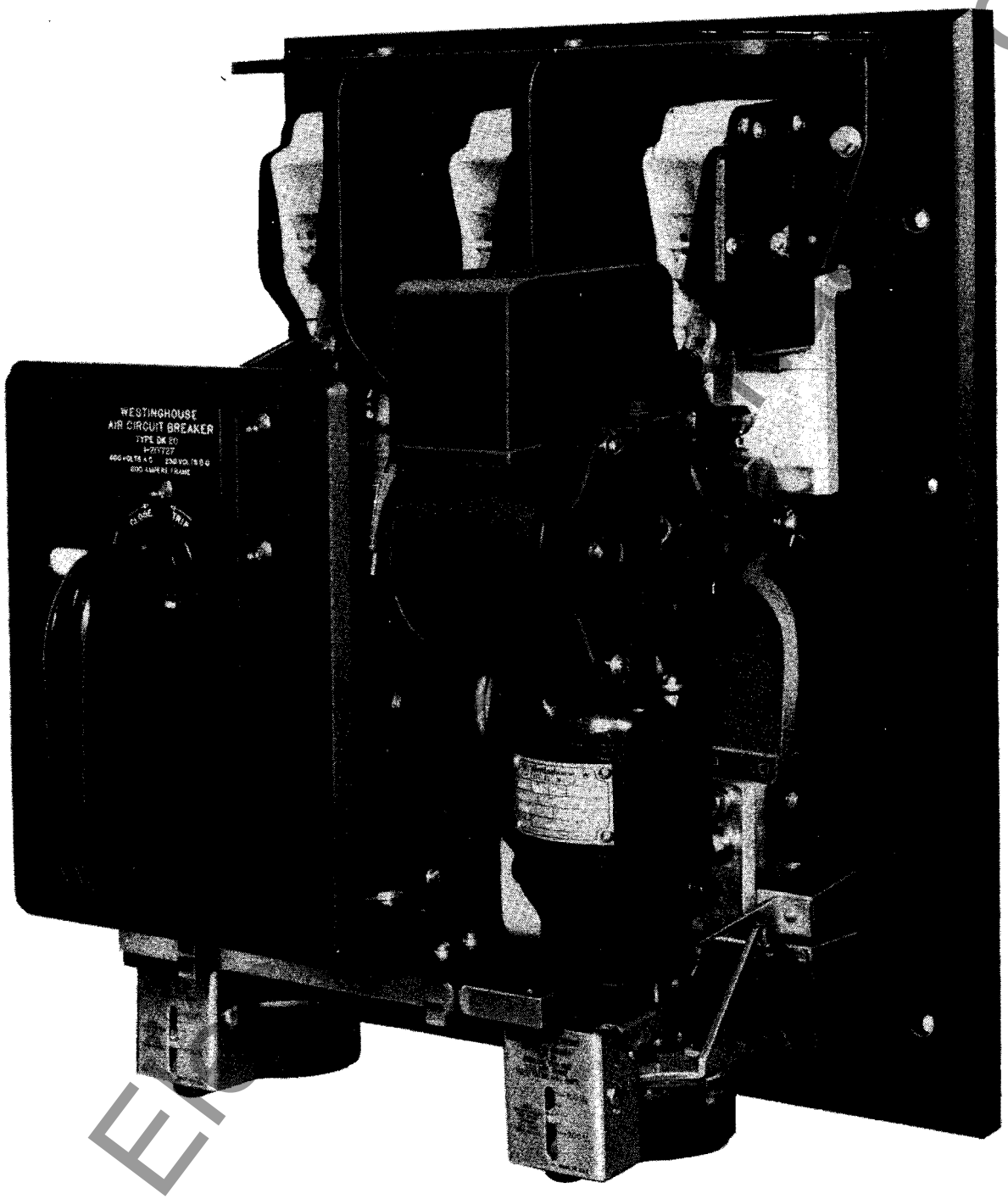


Fig. 1—3-Pole, 600-Ampere, 600-Volt A-C., 250-Volt D-C. Breaker

Instruction Book 5965-E

Westinghouse Electric Corporation
East Pittsburgh, Pa.

Preface

It would be difficult to over-emphasize the importance of adequate care of all protective devices. To assure proper functioning, they should be the subject of periodical, systematic and intelligent inspection. Even the smallest details of required maintenance should not be neglected if costly failures of equipment and service are to be avoided. Maintenance must include occasional checks on calibration as well as on the coordination and freedom of all moving parts. The purpose of this Instruction Book on the DK circuit breakers is to provide a guide for those charged with these responsibilities. It is not possible to outline a procedure that will apply in all cases. The frequency and character of inspection will for the most part be a matter of experience. In general, light monthly inspection, with a thorough inspection semi-annually, should be a minimum. The Company will be glad to furnish such additional information as may be needed to amplify or clarify these instructions.

General

The DK air circuit breaker, complete with all attachments, is a self-contained unit, and has been mounted, adjusted and calibrated on its own permanent panel at the factory. It is designed only to be mounted in a vertical position, and all inspections for proper operation must be made with the breaker main panel held vertically.

Unpacking

Care must be exercised when unpacking to make sure that no parts are broken or damaged, and an inspection should be made immediately to check for any damage in transit. All dust and dirt should be carefully blown out of the complete assembly, especially in the closing toggle linkage overload attachments and such other attachments as are supplied.

It is not advisable to lubricate any parts of the breaker. The lubrication supplied during factory assembly, where necessary, is a special form of grease which is used sparingly. This will be found sufficient for years of service. Additional oil will only promote the accumulation of dust and dirt. In new installations, the breaker must be carefully protected from plaster, concrete and other foreign gritty particles that may add friction to the moving parts in the toggle linkage.

Inspection

Final inspection should preferably be made with the breaker in its permanent mounting, but if this is impossible, it can be set up rigidly in a vertical position while the inspection is made.

Rotate the manual operating handle slowly in a clockwise direction to move the contacts toward the closed position. Check the movement of each arc tip through the throat of the "De-ion" arc interrupting chamber to make sure that the tips do not rub against the ceramic side plates. Continue the closing motion until the moving arc tips just touch the stationary arc tips. Check the main contact separation at approximately 1/8 inch, as shown on Figs. 2 and 3. Continue the handle rotation to the fully closed position and watch the main contact overtravel as evidenced by rotary motion away from its stop, adjacent to the section where the shunt is attached.

Return the manually operated handle to the neutral position and rotate counterclockwise to trip the breaker. The toggle linkage should collapse and the moving contact assembly move freely to the full open position. This is followed immediately by complete resetting of the links in the toggle mechanism. This resetting operation is accomplished entirely by gravity. For this reason the links must always be free to move without friction or binding.

Adjustment of Contacts

The arc tip adjustment should be made as shown in Figs. 2 and 3. There is no adjustment provided for the main contacts, and under ordinary circumstances these main contacts will last the life of the breaker without repair other than occasional cleaning. Both main and arcing contacts are a high silver alloy.

Replacement of Contacts

The sub-panel, barrier and "De-ion" interrupting assembly may be removed as a unit by taking out two bolts at the outer ends of the sub-panel. This gives access to the contacts for easy inspection or replacement.

The moving arc tip can be removed by taking out the wire clip and nut on the threaded rod, removing two small screws that hold the secondary shunt to the main contact, and removing the arc tip pin. The stationary arc tip may be removed by taking out four flat head screws. The new items may be replaced in the reverse order. Take care to make proper adjustment as shown in Figs. 2 and 3, and set all poles of the breaker at one time and then securely lock each adjusting nut with a wire clip.

The moving main contact may be removed by taking out the bolts at the upper end of the trip unit, removing two bolts from the rear that hold this lower section to the panel, and taking out the pin in the contact arm. The contact and shunt can now be removed intact and replaced in the reverse order. The stationary main contact can be removed by taking out two bolts from the rear of the panel on the flat stud, or removing the finger cluster, large contact nut, and one bolt from the rear of the panel on the drawout type. Replacement is made with a complete new upper stud.

Adjustment of Toggle Linkage

The toggle linkage in the DK circuit breaker is a series of links so arranged that the closed breaker load is transmitted through successive toggles with a reduction at each step, to the final tripping toggle where a very low, but consistent, load is maintained with one simple adjustment. This adjusting screw will be found in the front of the main frame behind the face plate, as shown in Figs. 2 and 3. This adjustment is set slightly over toggle to produce a light tripping load. The factory adjustment should not vary in service, but can easily be checked or readjusted by reference to the sketches. For this operation, use a small spring balance applied to the left pole trip finger on the trip bar at a point in line with the plunger. This 2 pound tripping load must be maintained to insure proper tripping of the breaker by the overload trip units and other calibrated attachments.

Dual Overload Tripping Attachments

The DK circuit breaker is supplied with either of two distinct types of adjustable inverse time delay trip units:- (1) oil sucker-magnetic dual overload, and (2) thermal-magnetic dual overload. Both types are suitable for either a-c. or d-c. service. The oil sucker type of time delay is designed for all standard application where overcurrent tripping is desired with time delay that can be adjusted to a minimum, approaching zero time if required. The thermal type of time delay, on the other hand, is for applications which require unusually long tripping time at relatively large overloads, associated with motor starting conditions and protections. In both cases any current in excess of ten times normal rating produces instantaneous tripping.

Characteristics of Oil Sucker-Magnetic Dual Overload

Fig. 2 shows the arrangement of adjustments on this tripping attachment, and Fig. 6 represents the characteristic inverse time delay. The 100% calibration setting is the normal rating of the trip unit, and that value of current will just trip the breaker with no oil in the pot. Adjustment of the thumb screw toward the 200% calibration setting raises the minimum tripping current in minute steps as desired. Rotation of the molded pot, properly filled with oil as explained on the drawing, varies the time delay between 0 and 100%. Thus, any desired combination of minimum tripping current and time delay can be selected as desired.

Characteristics of Thermal-Magnetic Dual Overload

The general arrangement of this attachment is shown in Fig. 3 with inverse time delay characteristics in Fig. 7. The 100% calibration setting of the pointer on the scale plate is the normal rating of the trip unit and that value of current will just trip the breaker in approximately 30 minutes or longer in a normal ambient temperature. Adjustment of the thumb screw toward the 150% calibration setting raises the minimum tripping current in minute steps as desired.

Ambient correction is explained in Fig. 3 as 1% increase in calibration for each 2°C. rise in temperature. The attachment is calibrated for 24°C. ambient, but if it is desired to meet the calibration characteristics of Fig. 5 at 40°C., for instance, the calibration adjustment should be set at approximately 108% for minimum tripping at normal current rating.

The calibration adjustment can therefore be set as close to the normal running current of the motor as is desired, depending on ambient temperature, frequency of starting, etc. Complete protection is thus afforded under all conditions of operation.

Full details for adjustment and maintenance of the thermal-magnetic trip attachment are explained in Fig. 3.

Replacement of Overload Attachments

Both types of overload trip units may be easily removed. From the rear, take out two screws that fasten the magnet assembly to the main panel and disconnect the trip unit upper terminal where it is bolted to the main pole unit shunt section. In the case of drawout studs the finger cluster and large nut must also be removed. The trip unit may now be removed. Replacement is simply the reverse of this procedure.

After the unit is securely mounted to the panel, only one adjustment is necessary for correct operation with the breaker. This adjustment consists of setting the screw in the outer end of the trip armature lever to properly trip the breaker with a thin spacer between the armature and magnet, as explained in Figs. 2 and 3.

Electric Closing Mechanism

Electrically operated DK circuit breakers are equipped with an entirely self-contained motor mechanism (fig. 11) mounted on the right side of the breaker frame. Two of the toggle linkage pins serve as dowels to accurately locate the mechanism insulating base. By removing three bolts this complete assembly can be taken off the breaker without disengaging any parts except the wiring.

The closing motor is a single phase commutator type, vertical shaft motor with ball bearings sealed with lubricant that will normally last the life of the apparatus. A single reduction of speed between the motor shaft and the mechanism crank is accomplished with a worm mounted on the upper end of the motor shaft engaging a worm gear on the crank shaft. This gear assembly is lubricated on assembly sufficient for several years of normal service. An oil seal on the motor shaft prevents any oil or grease from running down into the motor windings.

The motor is designed to develop an exceptionally high torque for its size, and is therefore rated for intermittent service. If the breaker is closed more frequently than once every 3 minutes for long periods, the motor may overheat. A centrifugal speed limiting device is built into the lower end-bell of the motor to prevent excessive speed at normal and overvoltage, and to prevent coasting of the mechanism after the limit switch has cut off the motor current.

The mechanism crank engages a hardened steel cam on the roller lever. The relative motion of the crank roller with respect to this cam surface is to produce the maximum mechanical advantage when the closing load is greatest. A limit switch segment on the mechanism crank shaft positively carries the crank roller past the cam after a closing operation, so that the breaker can be closed either manually or electrically without interference or mechanical disengagement. The only requirement is that the limit switch must be allowed to cut off the motor closing current.

One adjustment between the motor mechanism and the breaker roller lever should be checked for proper operation. Close the breaker manually and rotate the motor by hand. This is done by removing the plate at the lower end and rotating the armature in the direction of the arrow, until the crank roller is just passing over the heel of the cam. There should be from 1/64 to 1/32 inch clearance between the roller surface and the cam surface at this point. If binding occurs, the minimum closing voltage will be unduly high, and if too much clearance is present, the mechanism may fail to move the breaker toggle linkage to the completely closed position. This adjustment is maintained by adding or taking out a spacer between the molded tiebar and the cast roller lever on the right side.

The motor closing current is given in the following table for standard control voltage ratings:

Voltage Rating	Closing Current at Normal Voltage
110 Volt, A-c.	30 Amperes
220 Volt, A-c.	15 Amperes
125 Volt, D-c.	30 Amperes
250 Volt, D-c.	15 Amperes

Shunt Trip Attachment

The shunt trip attachment, when supplied, is mounted rigidly to the breaker frame behind the face plate. The trip bar bracket is attached to its lower end. When the shunt trip is not supplied, its place is taken by a long trip rod held by a case identical in outside appearance with the shunt trip case. Both types are interchangeable and can be readily removed and replaced. In replacing the shunt trip assembly, make sure the moving core and trip rod assembly is free to move without binding against the guide holes or coil.

The shunt trip is designed for intermittent duty. The tripping current must always be cut off by an auxiliary switch on the breaker. The normal tripping currents for standard control voltages are:

Voltage Rating	Tripping Current
110 Volt, A-c.	7 Amperes
220 Volt, A-c.	4 Amperes
125 Volt, D-c.	2.5 Amperes
250 Volt, D-c.	1.5 Amperes

Wiring Diagram

The standard wiring diagram for the motor mechanism and shunt trip attachments are given in Fig. 10. The motor control circuit can be supplied with a special relay as an integral part of the electrically operated breaker that prevents reclosure until after the external control switch has been opened. See Fig. 8. This prevents the breaker from pumping if closed against a high overload or short circuit. A further feature of the control wiring is the prevention of electrically inching the breaker closed after the moving contact assembly has started to close.

Undervoltage Tripping Attachment

The undervoltage attachment is normally mounted on the main panel to the left of the breaker. It operates to trip the breaker through the trip bar if the control voltage drops to a value of 35% to 60% of rated voltage. To check the adjustment of this attachment, remove the voltage from the holding coils, hold the armature against the magnet by hand, and close the breaker. Now allow the armature to move slowly away from the magnet under action of the spring in the flexible link. The breaker should trip by this dead push. Adjustment to provide this operation is made by shortening or lengthening the flexible link detail.

When the undervoltage attachment is furnished with a time delay tripping feature, the oil dash pot should be removed by unscrewing the pot when the above adjustment is checked. Always connect the undervoltage coils to the line side of the breaker.

Reverse Current Attachment

The reverse current attachment (Fig. 12-13) is used to trip the breaker when the direction of current flow in that pole is reversed. The attachment consists of a magnet energized by a voltage coil and an armature energized by a current coil in series with one pole of the breaker. When the series coil current is flowing in the proper direction the armature tends to rotate but is restrained by a stop. When the series current is reversed the armature is rotated in the opposite direction against a spring to trip the breaker. This adjustment is calibrated and marked on the scale plate at 10%, 15%, 20% and 25% reverse current, based on normal current rating.

The reverse current armature is reset after a tripping operation by opening the voltage coil circuit. This can be accomplished by wiring the voltage coil through an auxiliary switch on the breaker.

Field Discharge Switch

The field discharge contact (Fig. 13-14) is normally mounted on a two pole breaker in the space left vacant above the breaker toggle linkage. Correct adjustment in one direction is evidenced by opening of the switch contact just prior to the arc tips touching during the breaker closing motion. Similarly, the switch must make contact before the breaker contacts part more than 1/8" during the opening motion of the breaker.

Auxiliary Switch

The DK auxiliary switch shown in Fig. 9 is a compact molded assembly supplied in either 4 to 8 poles and is rigidly mounted on the side of the main breaker frame. Each pole consists of two silver posts in the sections which carry the terminal screws on the reverse side. The moving contact is a silver bridging member, spring mounted on the sliding bar, and with an eccentric rolling motion such that adequate wiping action takes place when the switch contact is made.

The terminal screws are readily accessible on the completely assembled breaker and adequate wiring space is provided from the switch assembly through wiring holes to the rear of the main panel.

Each four point switch is normally assembled with two "make" and two "break" contacts, but any pole may be reversed by removing the sliding bar and inverting the bridging member, thus making possible any desired arrangement.

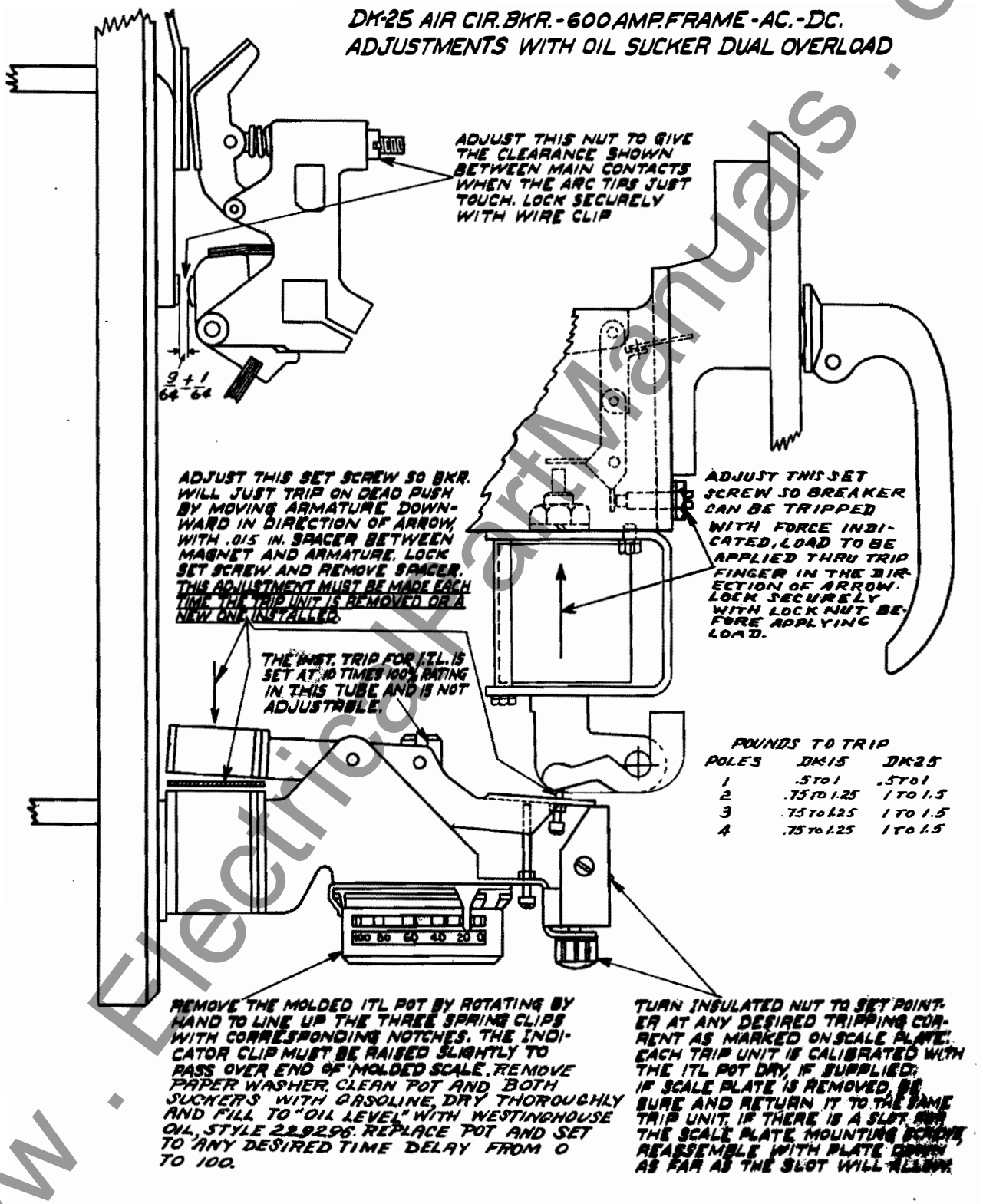


Fig. 2 - Adjustments with Oil Sucker Magnetic Dual Overload
Drawing 4-D-2515-5

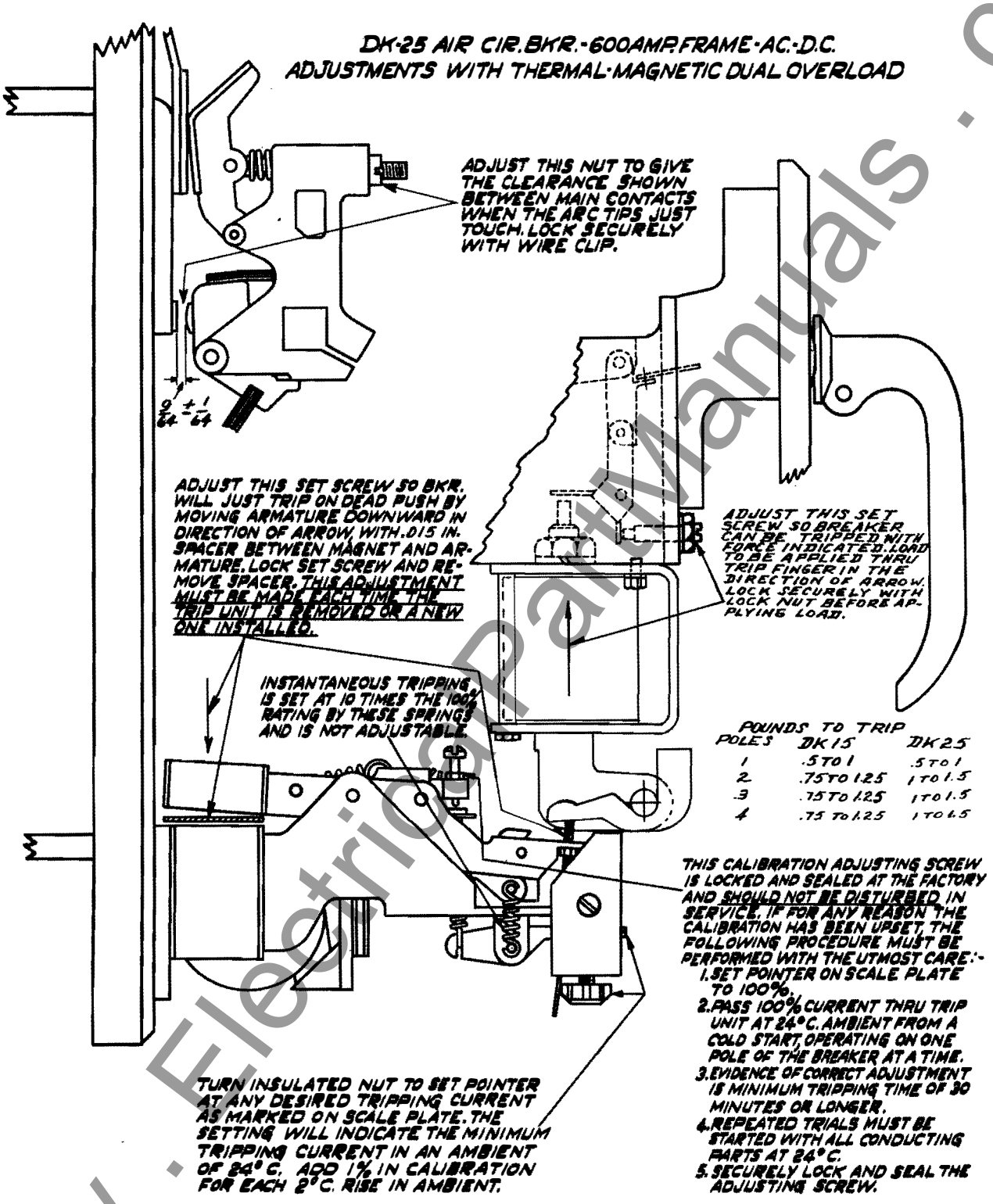
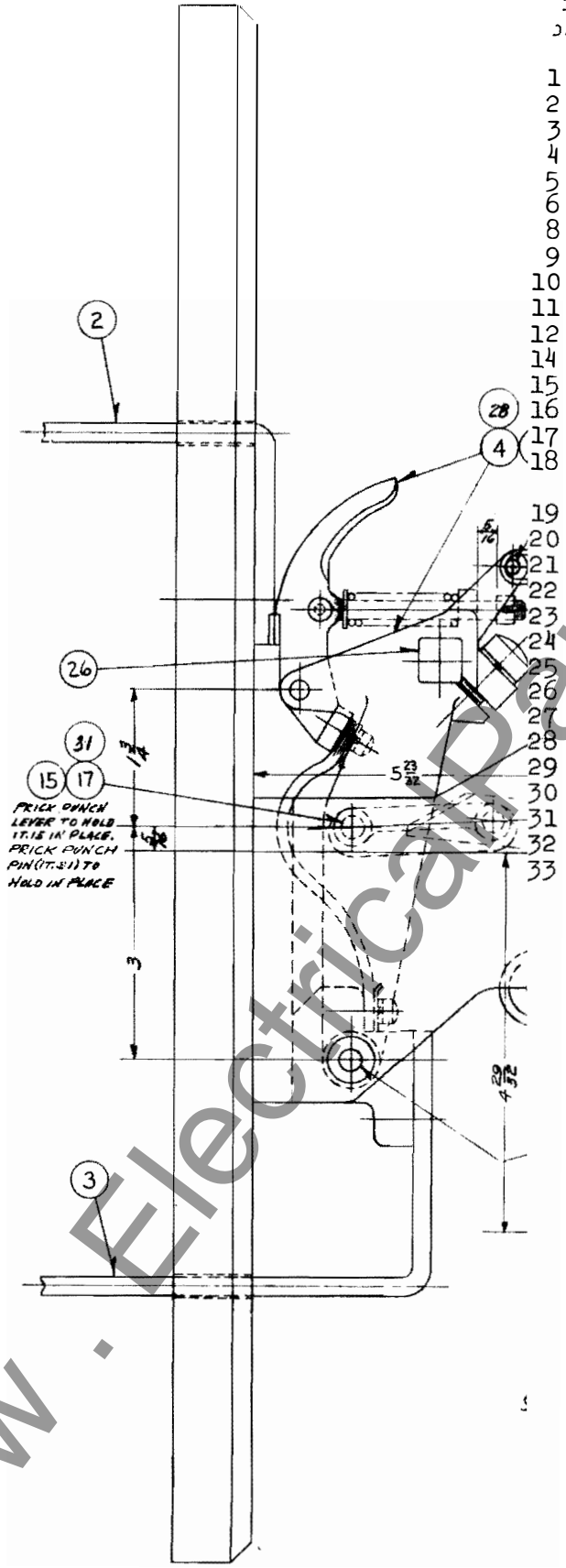


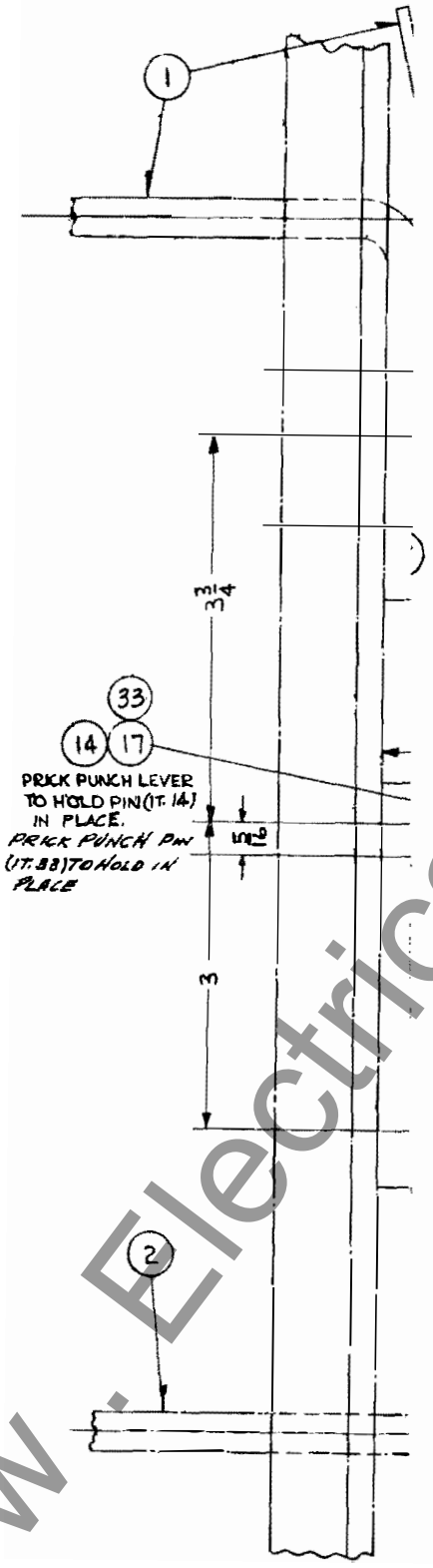
Fig. 3 - Adjustments with Thermal-Magnetic Dual Overload
Drawing 4-D-8316-3



f o.	Description
1	Shunt Trip
2	Upper Stud
3	Lower Stud
4	Moving Contact Assembly
5	Moving Contact Assembly
6	Cross Bar Lever
8	Linkage Assembly
9	Roller Lever
10	Spring (Accelerating)
11	Spring (Closing Lever Reset)
12	Spring (Trigger)
14	Pin
15	Pin
16	1/16 x 1/2 Steel Cotter Pin
17	Grease #4739
18	3/8-16 x 7/8 Fillister Head Steel Machine Screw
19	3/8 Steel Lock Washer
20	.164 Wide Brass Washer
21	Headless Set Screw
22	1/4-20 Steel Lock Nut
23	1/4 Steel Lock Washer
24	Pin
25	1/16 x 3/8 Steel Cotter Pin
26	Cross Bar
27	Pin
28	Moving Contact Assembly
29	Frame
30	Linkage Assembly
31	Pin (5/16 Nickel Steel)
32	Pin (5/16 Stainless Steel)
33	Pin (5/32 Nickel Steel)

sm Assembly (With or Without Current Parts)
Drawing 14-A-5153-5

Typ



Ref No.	Description
1	Upper Stud
2	Lower Stud
3	Cross Bar
4	Shunt Trip
5	Moving Contact Assembly
6	Moving Contact Assembly
7	Cross Bar Lever
9	Linkage Assembly
10	Roller Lever
11	Spring (Accelerating)
12	Spring (Roller Lever Reset)
13	Spring (Trigger)
14	Pin (5/16 x 2 17/32 Nickel Steel)
15	Pin (Copper Alloy) (5/16 x 3 21/32)
17	Grease #4739
18	1/16 x 1/2 Steel Cotter Pin
19	.164 Wide Brass Washer
20	Pin
22	1/16 x 3/8 Steel Cotter Pin
23	Headless Set Screw
24	1/4 Steel Lock Washer
25	1/4-20 Steel Lock Nut
26	3/8-16 x 1-1/4 Hexagon Head Steel Bolt
27	3/8 Steel Lock Washer
28	Linkage Assembly
29	Time Delay and Shunt Trip Unit
30	Moving Contact Assembly
31	Main Frame
32	Linkage Assembly
33	Pin (5/16 x 2 9/16 Nickel Steel)
34	Pin (5/16 x 3 21/32 Stainless Steel)
35	Pin (5/32 x 2 Nickel Steel)

- Mechanism Assembly (With or Without Current Parts)
Drawing 14-A-5857-10)

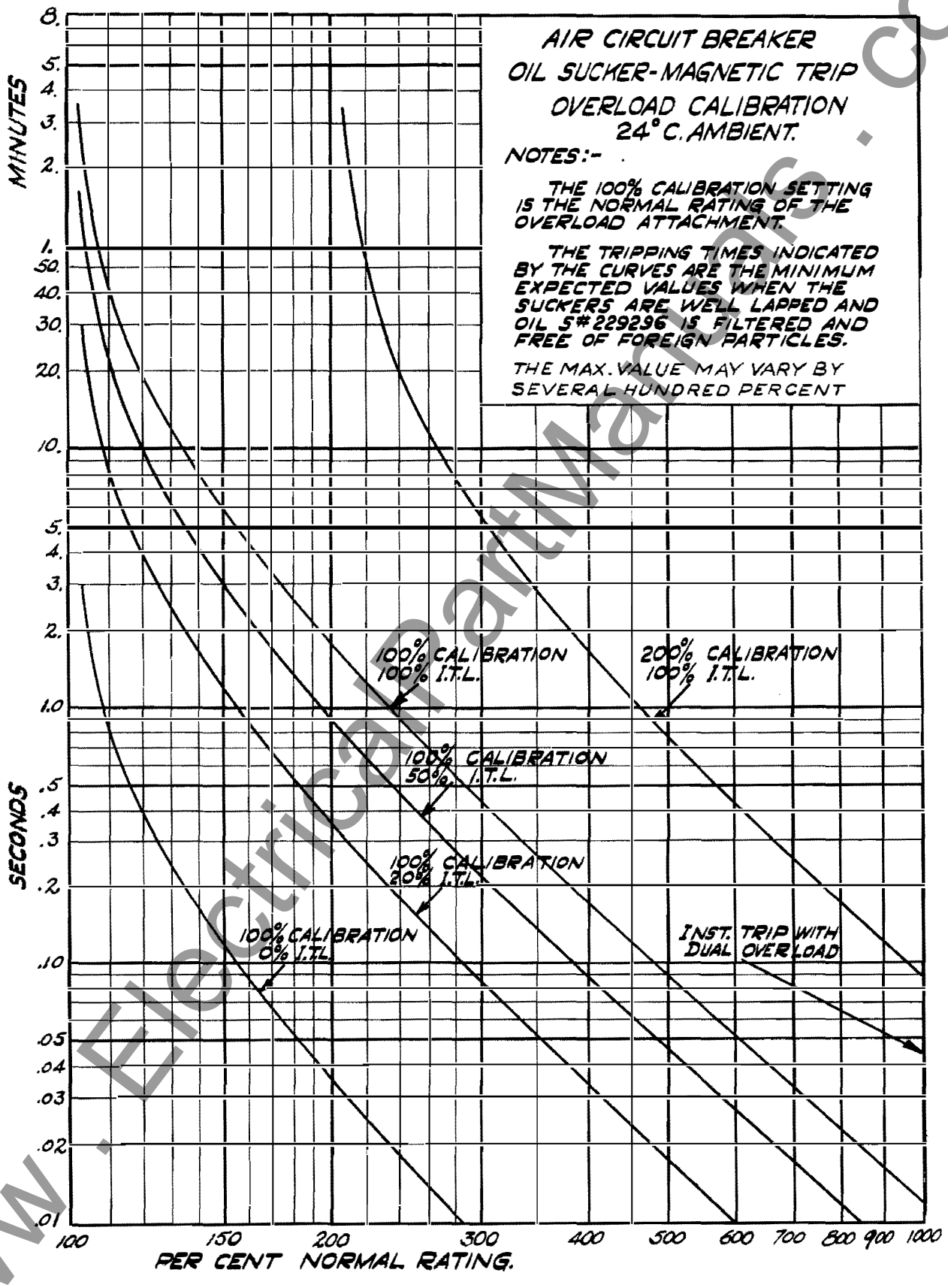


Fig. 6 Oil Sucker Magnetic Trip Overload Calibration
Curve 261560

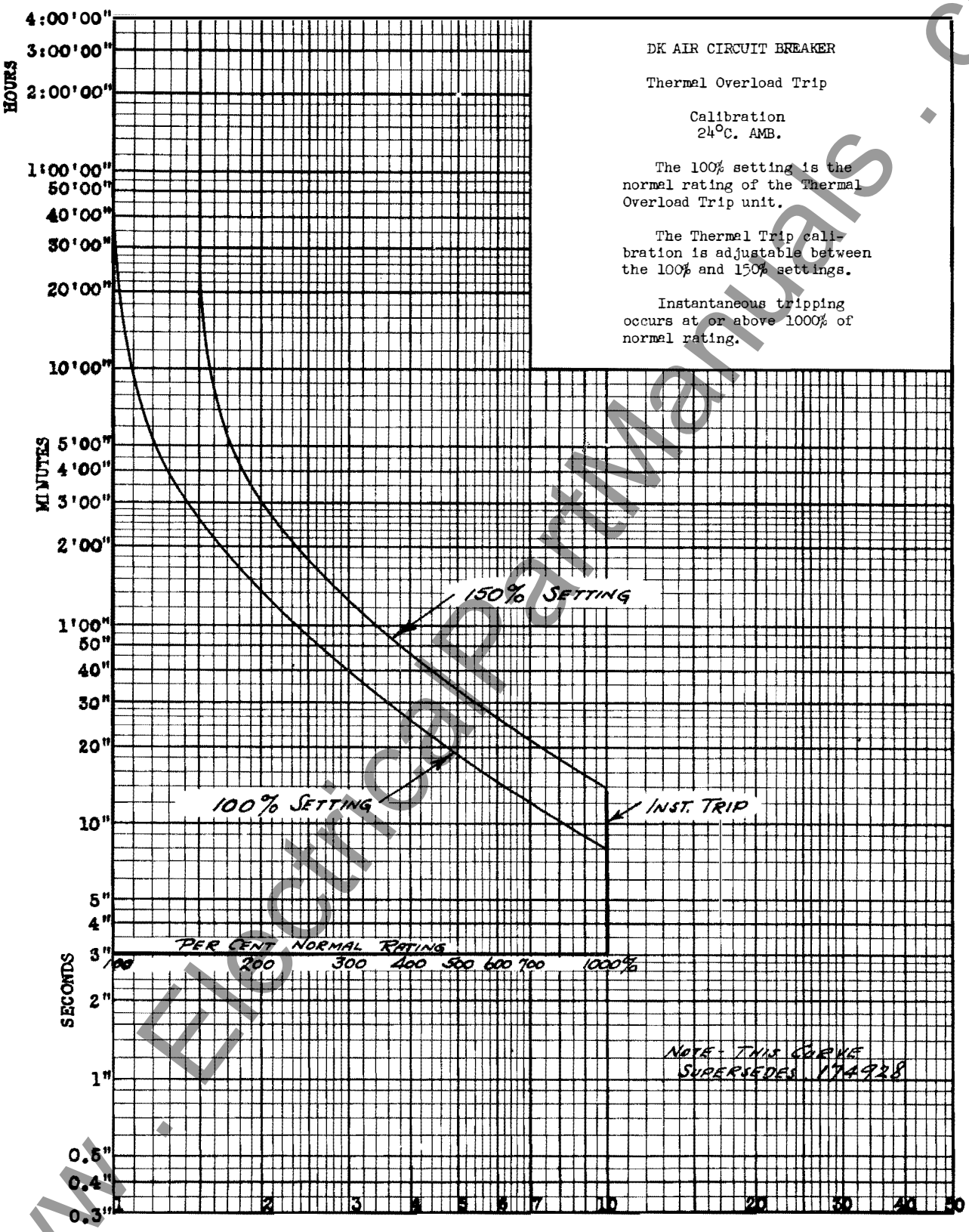


Fig. 7 Thermal Overload Trip Calibration
Curve 258872

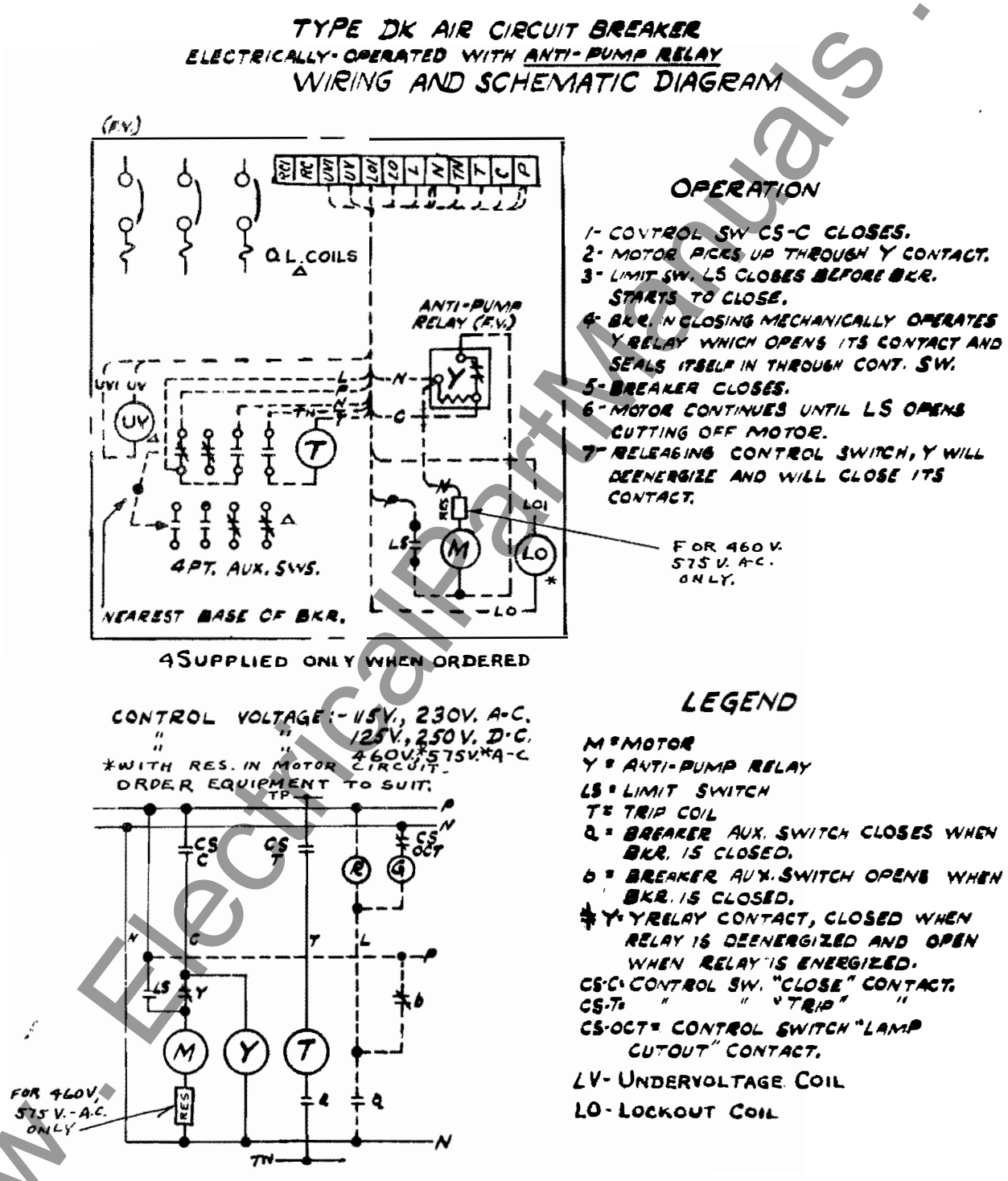


Fig. 8 - Wiring and Schematic Diagram With Anti-Pump Relay
Drawing 5-D-8339-6

Ref. No.	Description
1	Auxiliary Switch
2	Auxiliary Switch
3	Lever
4	Link
5	Link
6	Bracket
7	Link
8	Breaker Center Pole
9	Indicator Assembly
10	Spacer S# 898 756 + Fin
11	1/4-20 x 3/4 Hexagon Head Steel Bolt
12	1/4 Standard Lock Washer
13	1/4-20 x 1/2 Hexagon Head Steel Bolt
14	1/4-20 Hexagon Steel Machine Screw Nut
15	Shakeproof Lockwasher
16	.190-32 x 1/2 Fillister Head Steel Machine Screw
17	Washer S# 779354 + Fin
18	3/32 x 3/8 Steel Cotter Pin
19	Pin
20	Lock Washer
21	Washer S# 779355 + Fin
25	Link
26	Switch Assembly

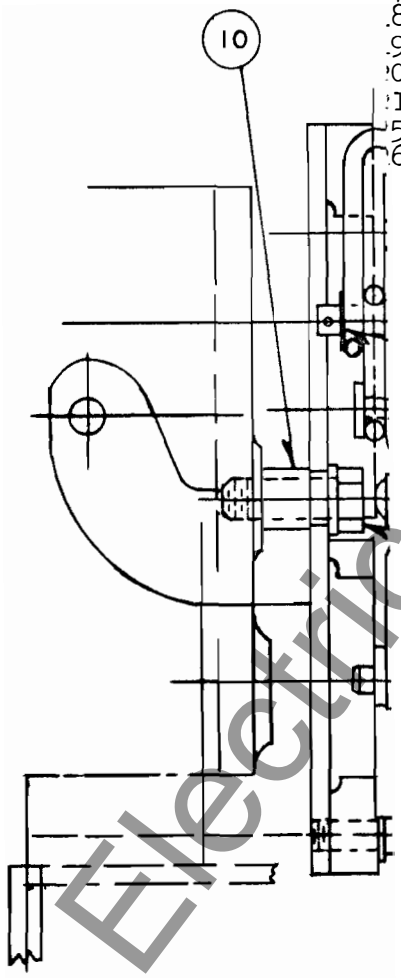
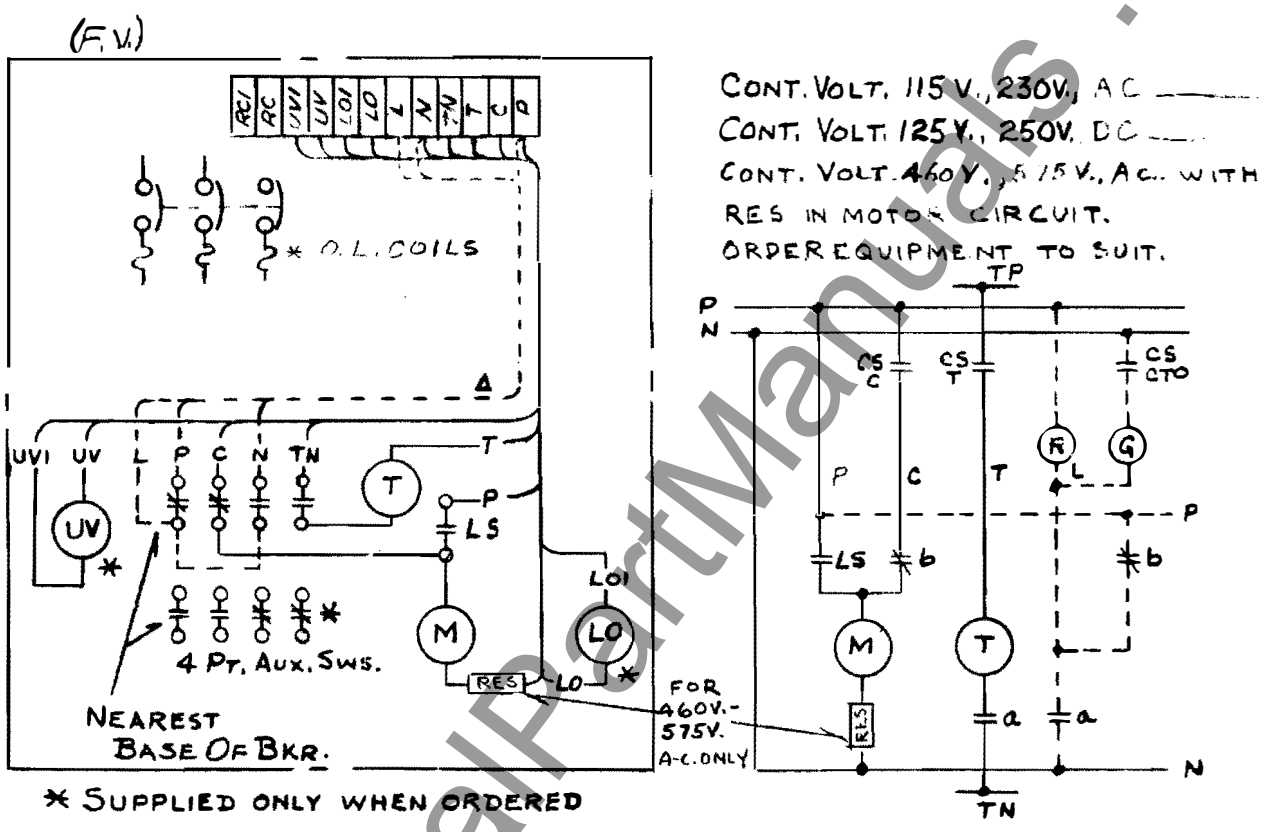


Fig. 9 - Auxiliary Switch and Mounting Assembly
Drawing 7-B-9438-10

TYPE "DK" AIR CIRCUIT BREAKER
ELECTRICALLY OPERATED
WIRING AND SCHEMATIC DIAGRAM



* SUPPLIED ONLY WHEN ORDERED

Δ DOTTED CONN. SUPPLIED ONLY WHEN ORDERED.

OPERATION

1. CONTROL SW. CS-C CLOSES.
2. MOTOR STARTS THROUGH BKR. AUX. SW. b.
3. LIMIT SW. CLOSES BEFORE BKR. STARTS TO CLOSE.
4. BKR. IN CLOSING OPENS AUX. SW. b.
5. RELEASE CONTROL SW. CS AFTER BKR. STARTS TO CLOSE.
6. BKR. CLOSES.
7. MOTOR RUNS UNTIL LS OPENS.

LEGEND

M - MOTOR
LS - LIMIT SW.
T - TRIP COIL
a - BKR. AUX. SW. CLOSED WHEN BKR. IS CLOSED.
b - BKR. AUX. SW. OPEN WHEN BKR. IS CLOSED.
CS - CONTROL SW. (C-CLOSE, T-TRIP, CTO-LAMP CUTOUT)
UV - UNDERVOLTAGE COIL
LO - LOCKOUT COIL

Fig. 10 - Wiring and Schematic Diagram Without Anti-Pump Relay
Drawing 5-D-8338-6

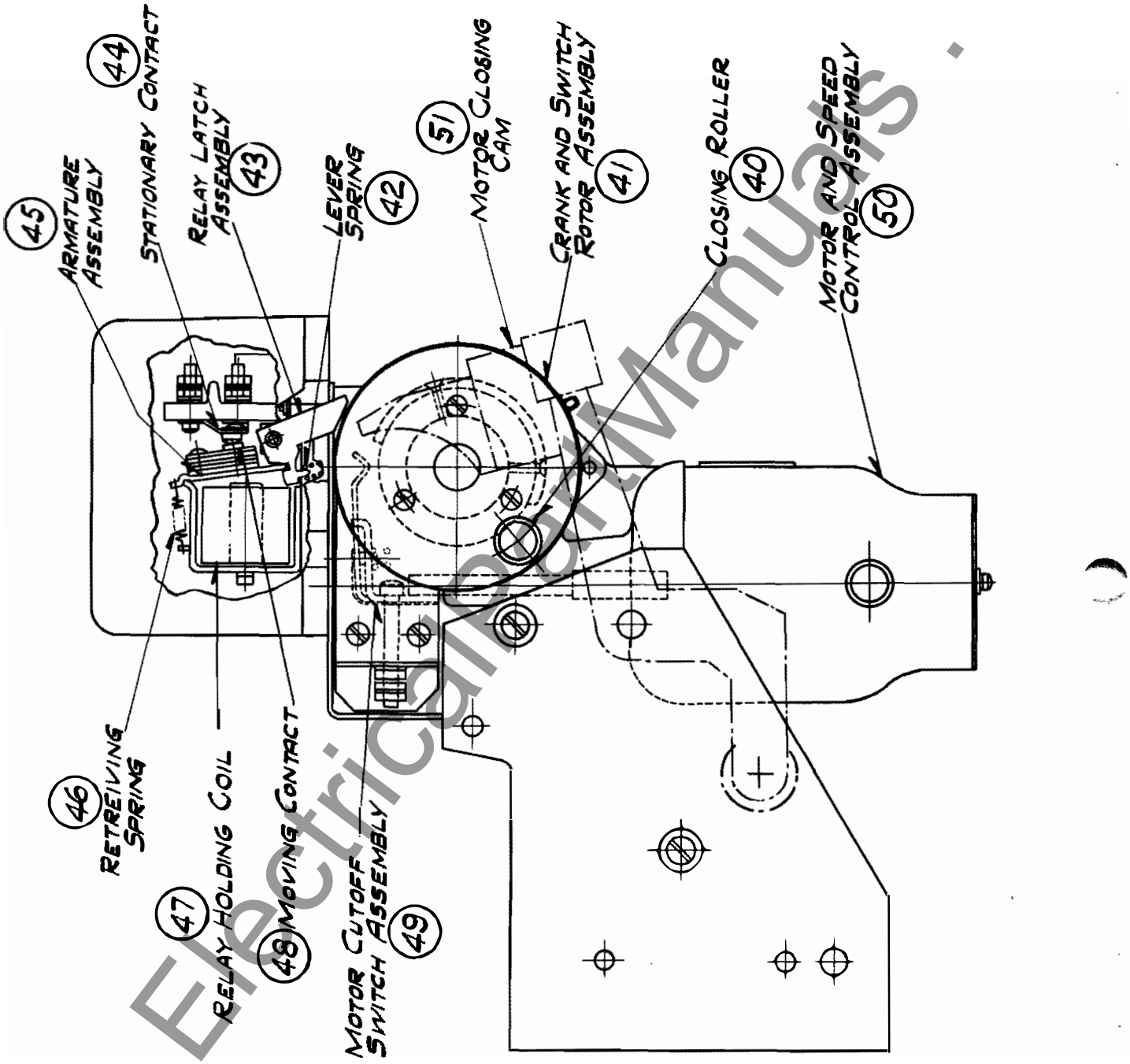


Fig. 11 - Motor Mechanism and Anti-Pump Assembly
Drawing 4-D-8494-3

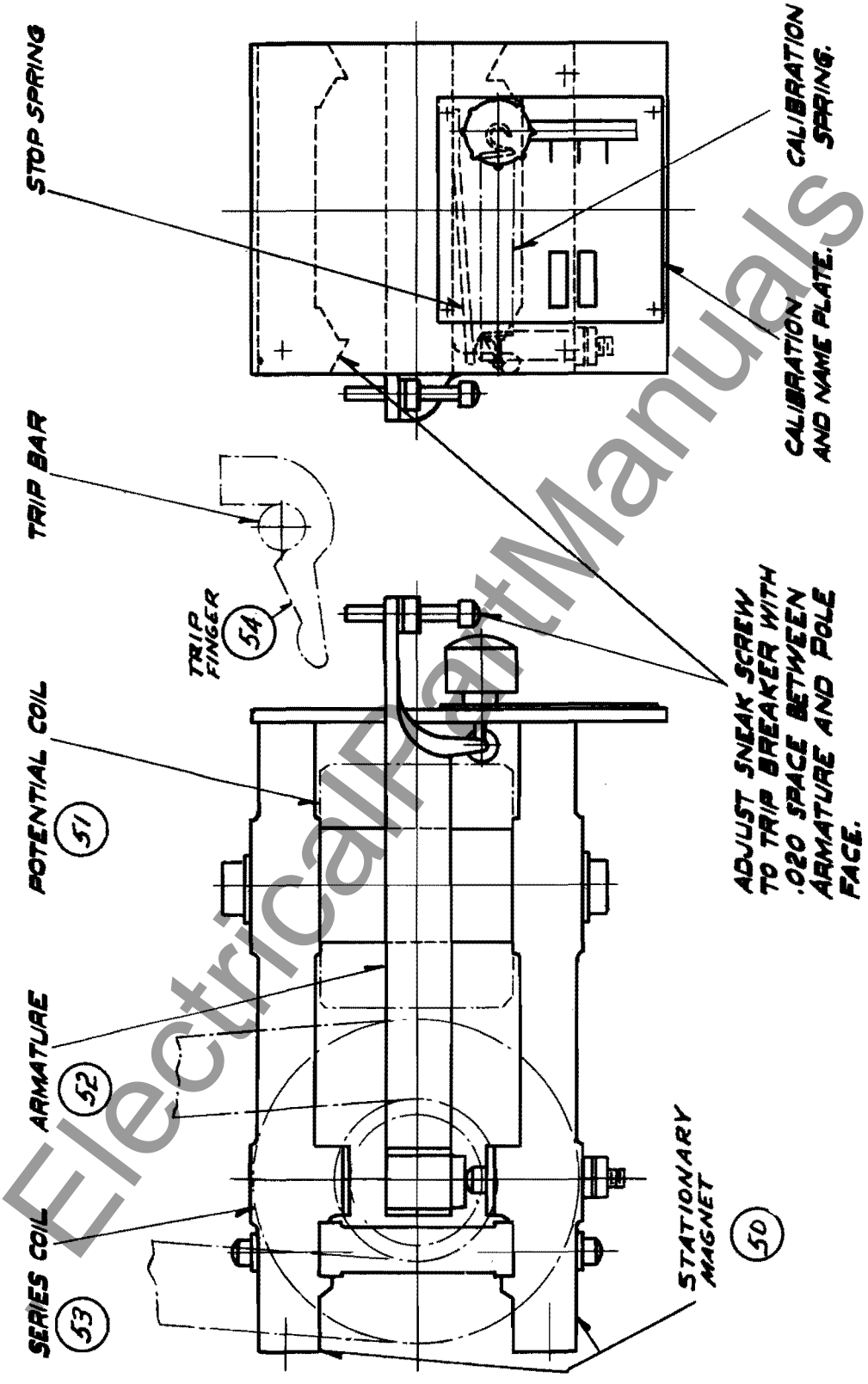


Fig. 12 - Reverse Current Trip
Drawing 8-D-2969

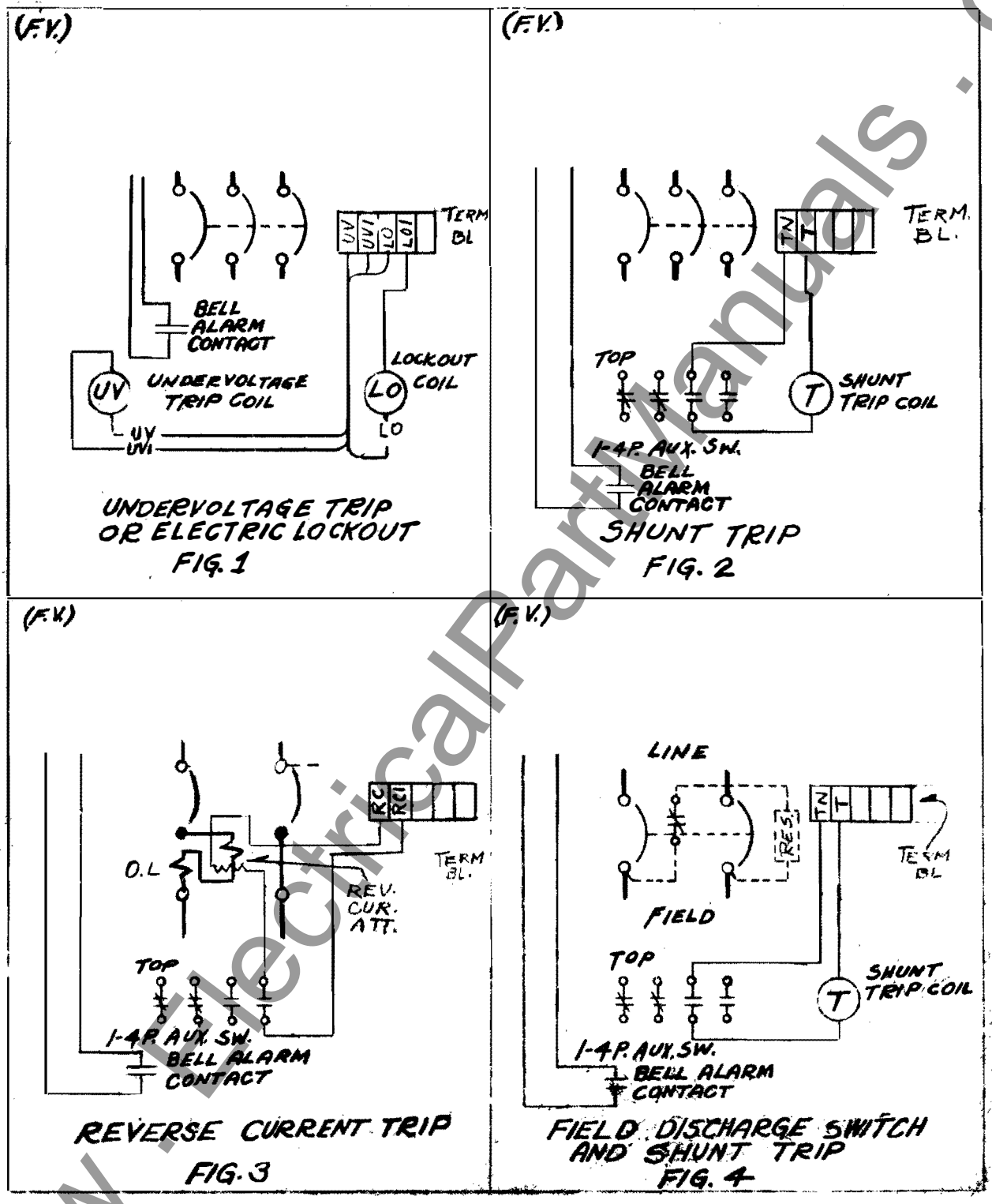
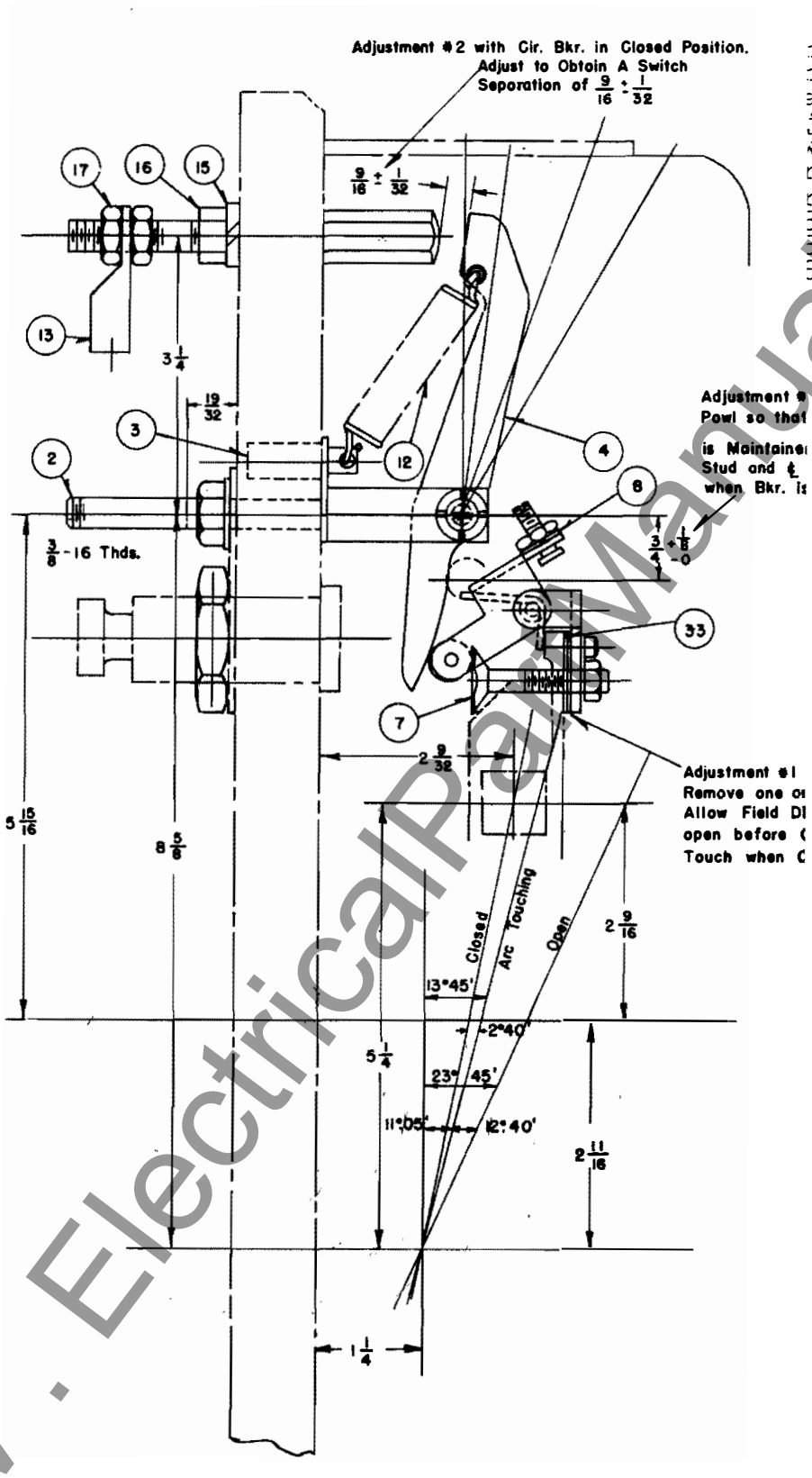


Fig. 13 - Wiring Diagrams
Drawing 5-D-8336

Description

ıge Stud
ı
ade
justment Bolt
ıl Details
ring
rminal
3 Lock Washer
3-16 Hexagon Steel Nut
3-16 Hexagon



Field Discharge Switch
ing 7-A-8945-15