

## Instructions for V201, V211 V251 NEMA Size 5 Vacuum Contactor Nonreversing or Reversing

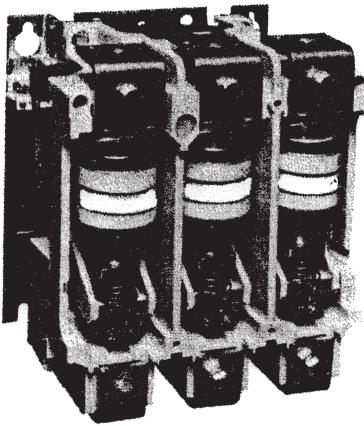

**RoHS**


Fig. 1 V201 Nonreversing Contactor

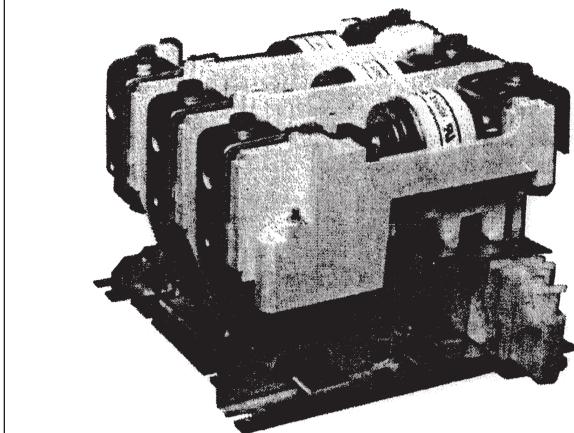


Fig. 2 Left portion of V211 Reversing Contactor

### THE CONTACTOR

Class V201 NEMA Size 5 contactors are designed for the control of inductive or non-inductive loads at voltages between 200 and 600, AC. The units are suitable for mounting on either steel or insulated panels. All parts are front removable. Contactors should be protected against short circuits by branch circuit protective devices selected in accordance with the National Electrical Code.

This industrial type control is designed to be installed, operated, and maintained by adequately trained workmen. These instructions do not cover all details, variations, or combinations of the equipment, its storage, delivery, installation, check out, safe operation, or maintenance. Care must be exercised to comply with local, state, and national regulations, as well as safety practices, for this class of equipment.

Mount each contactor with four 5/16" x 18 or 1/4" x 20 bolts. Flat washers should be used on bolts entering slotted holes or keyholes.

### CONTROLLER RATINGS - 3 POLE CONTACTORS

| 3 PHASE HORSEPOWER AT    |                              |   |      |      |
|--------------------------|------------------------------|---|------|------|
| 200V                     | 230V                         | 380V  | 460V | 575V |
| 75                       | 100                          | 150   | 200  | 200  |
| MAXIMUM CURRENT RATINGS  |                              |   |      |      |
| Continuous Carrying Open | Continuous Carrying Enclosed | Motor, Transformer or Capacitor Make or Break |      |      |
| 300A RMS                 | 270A RMS                     | 3163A Peak                                    |      |      |

Maximum Capacitor Switching - 3 Phase  
160 kvar at 460 volts: 200 kvar at 575 volts

Two-pole contactors have the same current ratings as 3 pole devices but are not suitable for controlling 3 phase motors.

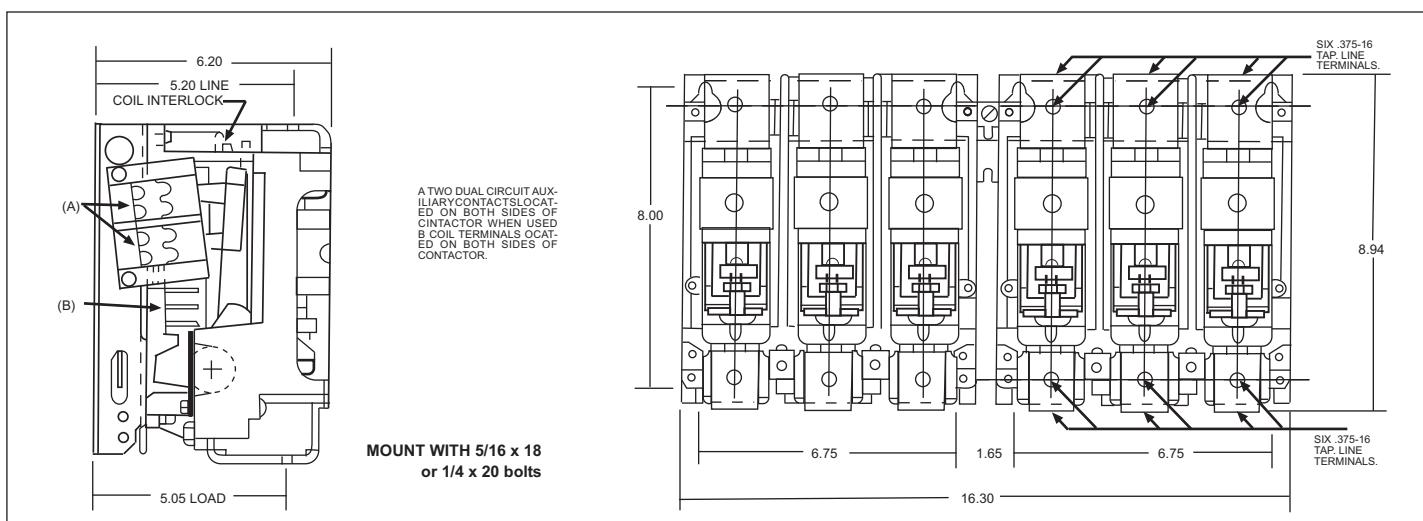


Fig. 3 Reversing and Nonreversing Contactor (V211, V201) Dimension Drawings (Dim. in inches)

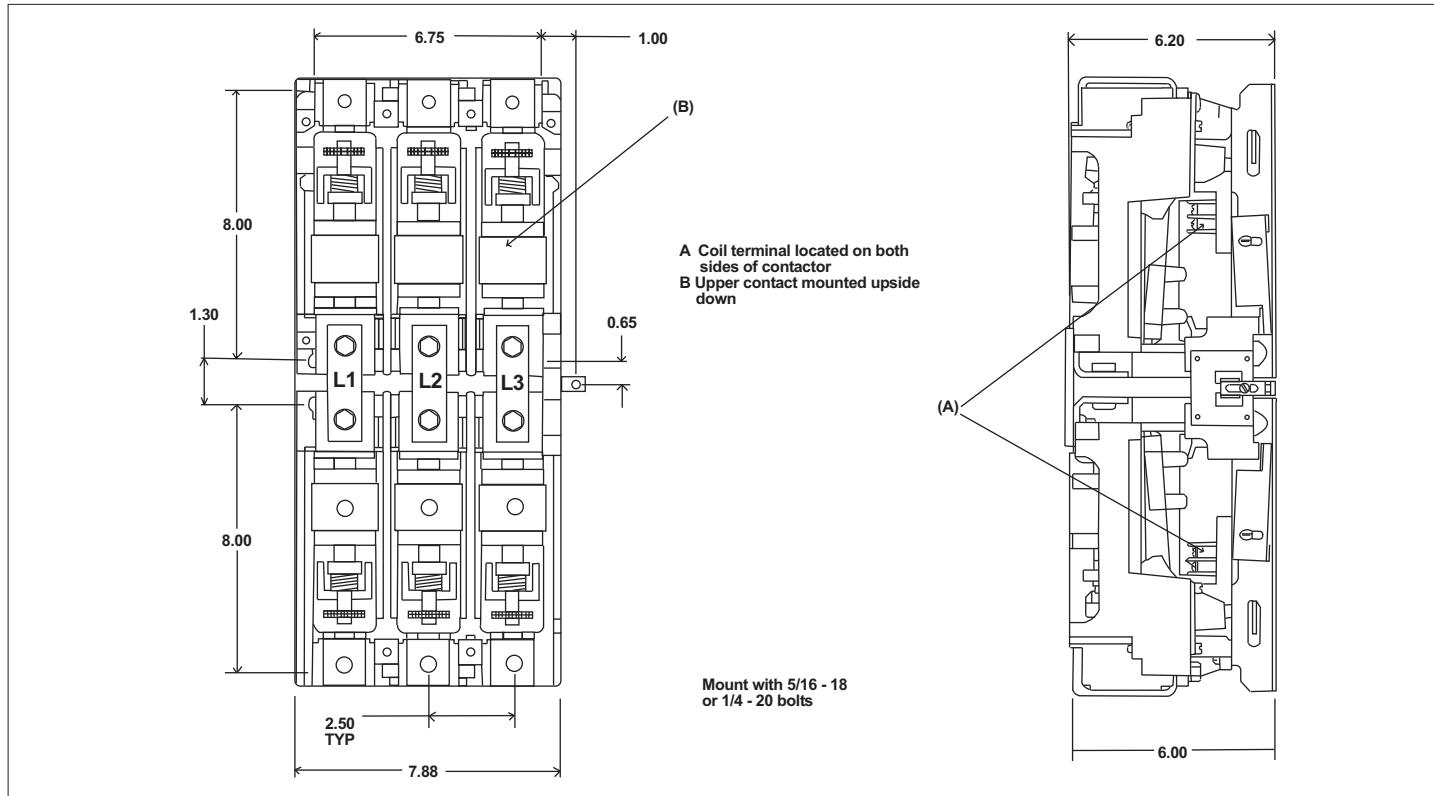


Fig. 4 Reversing Controller (V251) Dimension Drawing (Dimensions in inches)

### AUXILIARY CONTACTS - TYPE J

Two mounting brackets for auxiliary contacts are provided on each contactor. Auxiliary contacts themselves must be ordered separately. An auxiliary contact with one or more normally open poles may be used as the holding circuit auxiliary. A maximum of four auxiliary units can be installed in the brackets of each nonreversing contactor (three in each reversing contactor). They mount by means of a spring clip and retainer screw. To remove the auxiliary contacts, loosen the retainer screw several times (counterclockwise) and then slide the auxiliary contact unit out of the bracket.

| TYPE J AUXILIARY CONTACTS                  |             |
|--|-------------|
| Contact Type                               | Catalog No. |
| 2 Normally Closed                          | J02         |
| 2 Normally Open                            | J20         |
| 1 Normally Open and 1 Normally Closed      | J11         |
| 1 Normally Open and 1 Normally Closed, DB* | J1C         |

\*DB = Delayed Break

### TYPE J CONTACT RATINGS (A600, R300)

| Voltage     | Continuous | Make   | Break |
|-------------|------------|--------|-------|
| 120-600 VAC | 10A        | 7200VA | 720VA |
| 72-120 VAC  | 10A        | 60A    | 720VA |
| 28-72 VAC   | 10A        | 60A    | 10A   |
| 28-300 VDC  | 1.0A       | 28VA   | 28VA  |

### TABLE I - ACCESSORIES

Fuse Block Kits - Meet requirements of National Electric Code (NEC) concerning common control fusing.

| Order | Qty. | Description   |
|-------|------|---|
| F56   | 2    | Contactor mounted Fuse Holder for one 600 volt Bussmann KTK Fuse  |
| FKR   | 1    | Panel mounted Fuse Holder for two Class CC (Bussmann KTKR) Fuses* |

\* Use when available fault current exceeds 10,000 amperes.

## COIL

The operating coil has a "figure-eight" shape and is really two coils in series, with a connection to their common point. Both coils are encapsulated in one environment-immune coil shell, which also contains a full-wave bridge. When AC is connected directly to terminals A and B on the coil shell, the magnet excitation is unfiltered DC. The magnet will not chatter as AC magnet sometimes do, but at less than rated volts it may hum slightly. A normally-closed Type L63 auxiliary contact, set to open slightly before the armature fully closes, is connected to terminals C and D on the coil shell. When adjusted correctly, this contact allows a relatively high current through the pick-up winding, and as the contactor closes, the contact inserts the holding winding, which reduces the coil current to a low value sufficient to hold the magnet closed without overheating. No external resistors are required.

| COIL DATA (TYPICAL VALUES) |       |           |                 |             |
|----------------------------|-------|-----------|-----------------|-------------|
| Coil Voltage               | Freq. | Inrush VA | Sealed VA/Watts | Part Number |
| 110-120                    | Any   | 600       | 20              | 7874A09G01  |
| 220-240                    | Any   | 600       | 20              | 7874A09G04  |
| 440-480                    | Any   | 600       | 20              | 7874A09G05  |
| 550-600                    | Any   | 600       | 20              | 7874A09G06  |
| 24                         | DC    | -         | 15              | 7874A09G07  |
| 48                         | DC    | -         | 15              | 7874A09G08  |

## MAGNET OPERATING RANGE

When properly adjusted as described in previous sections, the contactor should operate within the ranges shown in Table II.

| TABLE II - OPERATING RANGES |                         |       |                               |       |
|-----------------------------|-------------------------|-------|-------------------------------|-------|
| Rated Coil Voltage          | Pick-Up-To-Seal Voltage |       | Drop-Out-To-Full Open Voltage |       |
|                             | Above                   | Below | Above                         | Below |
| 110-120 VAC                 | 60                      | 77    | 10                            | 50    |
| 220-240 VAC                 | 120                     | 152   | 20                            | 100   |
| 440-480 VAC                 | 240                     | 304   | 40                            | 200   |
| 550-600 VAC                 | 300                     | 385   | 50                            | 250   |
| 24 VDC                      | 12                      | 15    | 2                             | 10    |
| 48 VDC                      | 24                      | 30    | 4                             | 20    |

If the magnet chatters, look for mechanical interference that prevents the magnet from sealing. If there is no interference, then the magnet itself may be misaligned. The magnet gap can be seen from the left and right sides with the help of a flashlight. A screwdriver inserted into one of the long slots (Y-Figure 9) can be used as a lever to put a corrective set into the mounting plate around the magnet. It should not be necessary to do this unless the contactor has been damaged and it can be seen that the armature does not fit against the magnet. A poor magnet to armature fit usually produces a high dropout voltage and/or chatter. Mechanical interference can be produced by various incorrect adjustments. Two specific points to check are:

- A. Armature travel incorrect, causing the contact springs to be compressed into a solid, non-resilient "tube" that stops the crossbar rigidly. Refer to Eaton Service for assistance.
- B. The auxiliary contact mounting brackets are misadjusted, so that a contact plunger bottoms solidly before the magnet seals. When the contactor is fully sealed closed, there should still be a small amount of travel remaining for the plungers. See AUXILIARY CONTACT ADJUSTMENT.

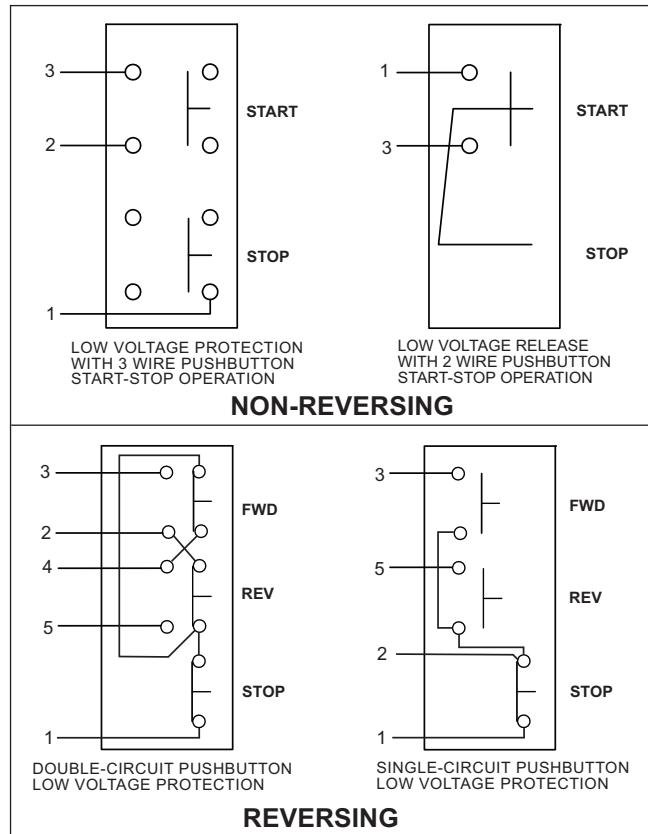


Fig. 5 Control Circuit Diagrams

## SHORT-CIRCUITS RATINGS

This motor controller is suitable for use on a circuit capable of delivering not more than the current (rms symmetrical amperes) shown below in circuits rated not more than the voltage shown in Table III.

**TABLE III - SHORT-CIRCUIT PROTECTION**

| Short-Circuit Protective Device (SCPD)          | Max. size SCPD | Current Breaker Interrupting Rating | Short-Circuit Rating          |                      | Typical Disconnect Device Cat No. Prefix     |
|---|----------------|-------------------------------------|-------------------------------|----------------------|--|
|   |                |                                     | Current                       | Voltage              |  |
| Class J Fuse                                    | 600A           | -                                   | 65,000A<br>100,000A           | 600V<br>480V         | MCS (High Mag Trip)                          |
| Class K Fuse                                    | 600A           | -                                   | 65,000A<br>100,000A           | 600V<br>480V         | MCS (High Mag Trip)                          |
| Class L Fuse                                    | 600A           | -                                   | 22,000A                       | 600V                 | MCS (High Mag Trip)                          |
| Class R Fuse                                    | 600A           | -                                   | 65,000A<br>100,000A           | 600V<br>480V         | MCS (High Mag Trip)                          |
| Class T Fuse                                    | 600A           | -                                   | 65,000A<br>100,000A           | 600V<br>480V         | MCS (High Mag Trip)                          |
| Magnetic Only <sup>1</sup> Type CB <sup>2</sup> | 400A*          | Marked HMCP                         | 35,000A                       | 600V                 | HMCP   |
| Thermal/Mag <sup>3</sup> Type CB <sup>2</sup>   | 600A           | 25,000A<br>30,000A<br>35,000A       | 25,000A<br>30,000A<br>42,000A | 600A<br>480V<br>480V | HLA, HLB, HLC<br>LA, LB, LC<br>HLA, HLB, HLC |
| ThermalMag <sup>3</sup> Type CB <sup>2</sup>    | 600A           | 14,000A<br>22,000A                  | 14,000A<br>22,000A            | 1,000V<br>1,000V     | HNAM<br>HPBM                                 |
|   | 800A           | 14,000A<br>24,000A                  | 14,000A<br>22,000A            | 1,000V<br>1,000V     | HNAM<br>HPBM                                 |

<sup>1</sup> Instance Adjustable Trip

<sup>2</sup> Circuit Breaker

<sup>3</sup> Inverse Time

\* To comply with the NEC, thermal overload relays must be included in the branch circuit.

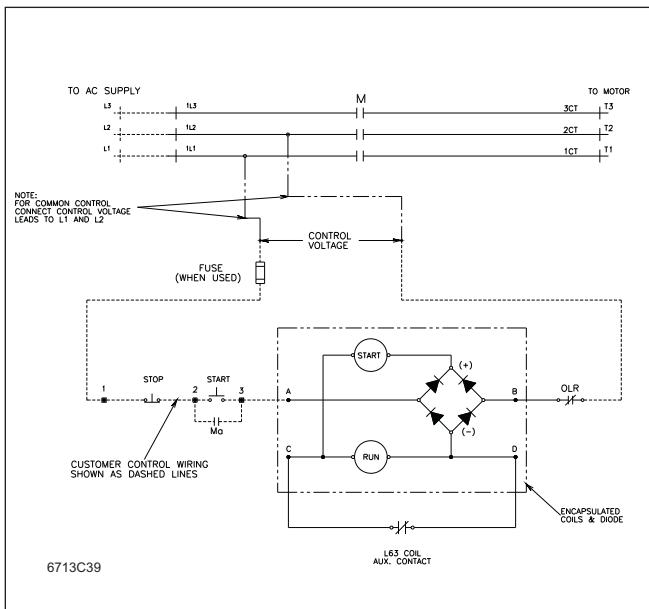


Fig. 6 Connection Diagram, V201

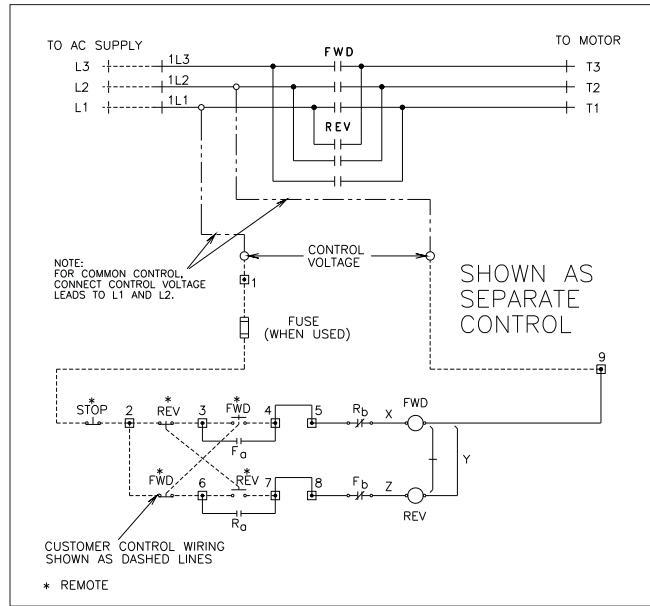


Fig. 7 Reversing Control Circuit

## TERMINATION MEANS

Lugs for power circuit conductors are not supplied with V201 contactors. Regardless of the termination means used, maintain the minimum clearance shown in Table IV for the application involved. Use adequate insulating material as needed. One recommended terminal for conductor size #0 through 500 MCM is Typical part Number 2119A76G01 (set of 6).

**TABLE IV - MINIMUM CLEARANCE**

Maintain minimum clearance between live parts and grounded parts and between live parts of opposite polarity.

### System Voltage

Not greater than 600 volts

### Minimum Clearance

.375 inches

## MECHANICAL INTERLOCKS

Mechanical interlocks are used when a pair of contactors must be mechanically protected against the closing of one when the other is already closed. For the horizontal configuration, the Type M33-5 is used. For the vertical configuration, the M36-2 is used. Both mechanical interlocks occupy one recess in each contactor.

## GENERAL

The V201 contactor has its main contacts sealed inside ceramic tubes from which all air has been evacuated, i.e., the contacts are in vacuum. No arboboxes are required, because any arc formed between opening contacts in a vacuum has no ionized air to sustain it. The arc simply stops when the current goes through zero as it alternates at line frequency. The arc usually does not survive beyond the first half cycle after the contacts begin to separate. The ceramic tube with the moving and stationary contacts enclosed is called a **vacuum interrupter** or a **bottle**, and there is one such bottle for each pole of the contactor. A two-pole contactor has two vacuum bottles, and a three-pole contactor has three vacuum bottles. A metal bellows (like a small, circular accordion) allows the moving contact to be closed and pulled open from the outside without letting air into the vacuum chamber of the bottle. Both the bellows and the metal-to-ceramic seals of modern bottles have been improved to the point that loss of vacuum is no longer cause for undue concern.

The moving contacts are driven by a molded plastic crossbar supported by two pre-lubricated ball bearings that are clamped in alignment for long life and free motion.

The contacts in an unmounted bottle (vacuum interrupter) are normally-closed, because the outside air pressure pushes against the flexible bellows. For contactor duty, the contact must be "normally-open" when the operating magnet is not energized. Therefore, the contacts of the vacuum bottles must be held apart mechanically against the air pressure when used in a contactor. In the contactor, all of the bottles are held open by a single kickout spring in the rear of the contactor. The kickout spring pulls against the moving armature and crossbar and thereby forces the bottles into the open position. In the open position, the crossbar is pulling the moving contacts to hold them open.

The contactor is intended to be mounted with its mounting plate vertical and the moving stem of the vacuum bottles aimed down. However, mounting position is not critical. If an unusual position is required, it is wise to check the pick-up voltage on a bench before installation, with the contactor oriented as it will ultimately be installed. The kickout spring can be adjusted as described under **Kickout Spring Adjustment**, if required to obtain the correct pick-up voltage.

## CONTACT FORCE AND ALTITUDE

A vacuum contactor is affected by atmospheric pressure on the bellows of the vacuum bottle. Up to an altitude of 3300 feet, the contactor is designed to tolerate normal variations in barometric pressure. If the contactor is to be operated over 3300 feet above sea level, consult the factory.

## CONTACT WEAR ALLOWANCE

Contact material vaporizes from the contact faces during every interruption and condenses inside the bottle. This is normal, and is provided for by **overtravel**, or wear allowance. When the contactor is fully closed, there is a gap between the pivot plate and the bottle nuts. See Figure 9. As the contacts wear, this gap decreases. When any gap goes **below .020 in.**, the unit should be replaced. Use the .020 in. thick fork-shaped overtravel gauge supplied for this measurement. Part No. 7874A59H01.

**CAUTION:** The easiest way to close the contactor is to energize the coil. If the coil is energized for this or other maintenance, use adequate care to guard against electrical shock.

**Do not re-adjust the bottle nuts to reset overtravel as the bottles wear.** Once placed in service, overtravel should be checked but not adjusted. A star-wheel lock is included for locking the bottle nuts of each bottle to prevent tampering.

## CHECK-OUT, VACUUM INTERRUPTERS

The dielectric strength of the interrupters should be checked before the contactor is energized for the first time and regularly thereafter to detect any deterioration in the dielectric strength of the contact gap. A good interrupter will withstand a 5.5KV, 50 or 60 hertz test voltage for one minute across a 0.090 inch contact gap, which is the normal new gap.

When a vacuum bottle is tested with voltage over 5000 volts across its open gap, there is some possibility of generating X-rays. Test time should be minimized and personnel should not be closer than 10 feet. This is a precaution until such time as the possible hazard is better understood and standards are published.

Periodic dielectric tests across open contacts are desirable since under certain operating conditions the contactor may perform satisfactorily even though one vacuum interrupter becomes defective. Dielectric tests should be made with the contactor in the same position it has when operating.

The interval between periodic tests depends on the number of operations per day, environmental factors, and experience. It is a matter of operator judgment, and philosophy of preventative maintenance.

## CHECK-OUT, MECHANICAL

Make sure all power circuits are de-energized and isolated. The controller can be checked in its cabinet or outside. A mechanical interlock **must** be checked installed, to make certain that it functions properly.

If the contactor is checked in its cabinet, make certain that the contactor coil is electrically isolated, to prevent feedback into a control transformer that could be hazardous.

Connect a separate power source of correct AC voltage to the coil of the contactor. Operate appropriate pushbuttons to close and open the contactor. If the contactor does not close fully or does not drop out fully refer to **Magnet Operating Range**.

While the contactor is closed, observe the overtravel gap between the pivot plates on the crossbar and the bottle nut on each pole. This overtravel gap should be not less than .045 inch when the contactor is new. If less refer to **Contact Wear Allowance**. Disconnect separate power source before proceeding.

While the contactor is open, attempt to pull the armature forward. The armature should not move because it should already be firmly against the plastic main frame. If it does move refer to **Kickout Spring Adjustment**.

## CHECK-OUT, INSULATION LEVEL

After installation, and before energizing the contactor for the first time, measure and record the insulation resistance between poles and from each pole to ground. It is not practical to specify an absolute value for this reading since it is dependent on other connected apparatus, and conditions of service. However, any unusually low reading or sudden reduction in this reading after the contactor has been in service indicates a possible source of trouble, and the cause should be determined and corrected before restoring power.

## MAINTENANCE

Establish a maintenance program as soon as the contactor is installed and put into operation. After the contactor has been inspected a number of times at monthly intervals, and the condition noted, the frequency of inspections can be increased or decreased to suit the conditions found, depending upon the severity of the contactor duty. It is a matter of operator judgment.

This industrial type control is designed to be installed, operated, and maintained by adequately trained workers. These instructions do not cover all details, variations, or combinations of the equipment, its storage, delivery, installation, check-out, safe operation, or maintenance. Care must be exercised to comply with local, state, and national regulations, as well as safety practices, for this class of equipment.

All work on this controller should be done with the main circuit disconnect device open. Also, disconnect power from any other external circuits. Discharge any hazardous capacitors.

### Kickout Spring Adjustment

The kickout spring is not disturbed by any maintenance described in this leaflet, and it should not need to be adjusted. However, when the contactor is in the de-energized, open position, the crossbar should be solidly against the frame, so that it cannot move any further open even when pulled. It can be moved, the kickout spring must be stretched to hold the crossbar firmly against the frame. Refer to figure 8. Loosen the lock nuts and tighten the adjusting screws alternately (to keep the spring on centerline) until the force from the spring holds the crossbar properly open. Lock the two lock nuts again.

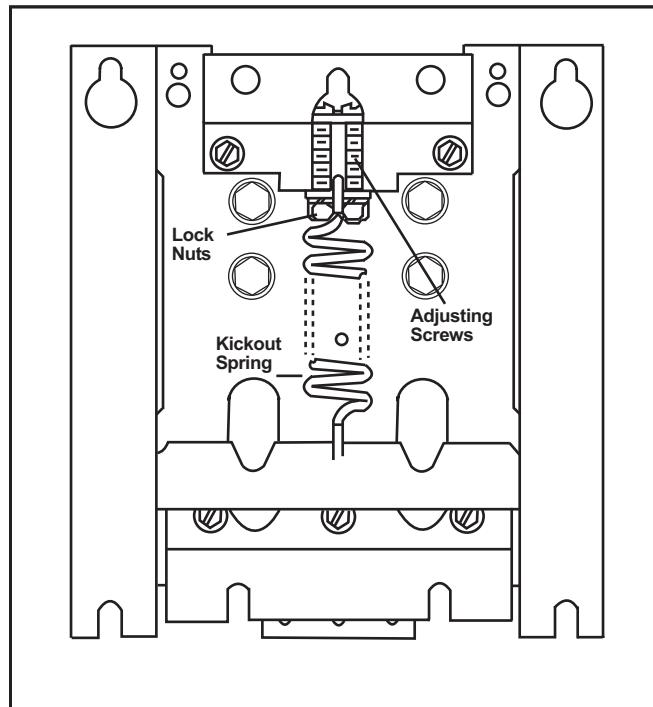


Fig. 8 Kickout Spring

## LOSS OF VACUUM

Gross loss of vacuum is highly unlikely, but it can be checked easily. With the contactor open, pull downward

on the bottle nuts, one pole at a time, using an effort of about 20 pounds. If the bottle nuts (see Figure 9) move easily away from their pivot, the vacuum has probably failed and the unit must be replaced.

It is also unlikely, but possible, to have a very slight leak that does not change the bottle force appreciably, but which might seriously damage the ability of the bottle to interrupt. In this regard, it must be remembered that in a three-phase ungrounded circuit, it is possible for any two good interrupters to successfully interrupt the circuit even if the third interrupter is weak. But this condition should not be allowed to continue. It can be detected only by an electrical test. See **Check-out Vacuum Interrupters**.

**WARNING:** All work on this contactor should be done with the main disconnect device open. As with any contactor, there is danger of electrocution and/or severe burns. Make certain that the power is off.

### Changing Operating Coil

The operating coil has a pickup winding which is intermittently rated. It may burn out in only minutes if continuously energized at rated voltage because the L63 auxiliary contact does not open correctly.

The coil contains its own rectifier to convert the applied AC into unfiltered full-wave rectified DC. DC coils do not contain a rectifier. When the coil is at rated voltage, the magnet will be silent. At reduced AC voltage, some slight hum may be heard. However the magnet must not chatter.

If for some reason a coil must be changed, proceed as outlined below, referring to Figure 9.

1. De-energize **all** circuits as previously specified.
2. Disconnect the leads to the coil terminals, noting their position for later reconnecting.
3. Disconnect the line and the load leads from the contactor terminals.
4. Remove four  $\frac{1}{4}$ " x 20 screws (S) holding the frame subassembly to the mounting base.
5. Lift the line side of the frame subassembly away from the mounting base until two dowels (D) are clear of their holes. The frame subassembly will automatically move under pressure from the kickout system until the kickout bar reaches the end of its slots in the mounting base. The frame subassembly is then free to be moved outward away from the coil and put elsewhere.
6. The coil is then accessible. Remove the two mounting screws (M) to free the coil.
7. Install replacement coil and replace mounting screws.
8. Place the frame subassembly onto the mounting base so that the two posts extending from the crossbar go through the oblong slots in the base and into the notches in the kickout bar. Push the frame subassembly a short distance along the sur-

face of the mounting plate toward the kickout bar until the dowels (D) slip into the dowel holes. Replace the mounting screws (S). **Make sure that the coil leads to the L63 auxiliary contact are not pinched under the frame feet.**

9. Reconnect coil and recheck contactor for correct adjustment per this leaflet. By hand jiggle the ends of the kickout bar (K) to make sure it is seated onto the posts of the crossbar.
10. Reconnect line and load cables.

### Auxiliary Contact Adjustment

The nominal .34" pretravel gap shown for the L63 auxiliary contact (normally-closed) in the left upper portion of Figure 9 is important. If the gap is too big, the "hold" winding of the operator coil will not be inserted as the contactor closes, and the pick-up winding will burn out, because the pickup winding is only intermittently rated. If the gap is too small, the hold winding will be inserted too soon, reducing the force to "hold" before the contactor is closed, and producing an oscillation like a doorbell. In a particular contactor, the .34" gap may need slight adjustment to avoid these problems. The key is not the measurement, but the performance of the magnet. Replacement L63 auxiliary contacts are available as Part No. 578D461G03.

The Type J auxiliary contacts are not as critical. In the open position, their plungers may rest lightly against the operating arm, or may have a small clearance.

However, neither of the auxiliary contact plungers should bottom solidly in the closed contactor position, as discussed under **Magnet Operating Range**. If required, the auxiliaries can be adjusted by resetting their mounting brackets in their slotted holes. Adjust the L63 by loosening the two slotted hexagonal washer head screws that hold the L63 mounting bracket, repositioning and tightening. These bracket mounting screws are accessible from the top side of the contactor and are recognized by the slotted holes under their heads.

### Inspection After Short Circuit

The V201 contactor is intended to be protected by power fuses and/or a circuit breaker in accordance with the National Electrical Code (NEC). However, the magnitude of a short circuit may exceed the damage threshold of the vacuum bottles. After a short circuit, the unit should be examined for any apparent physical damage, or deformation of conductor bars and cables. If there is any evidence of severe stress, it is recommended that the unit be replaced. If the overtravel has changed significantly (from the last inspection) on one or more bottles, the unit should be replaced.

A dielectric test would not by itself confirm that the unit should be returned to service after a fault. However, if there is no physical evidence of stress, and if the overtravel exceeds the .020 in. minimum, the bot-

tles can then be dielectrically tested as outlined previously. If physical stress, overtravel, and dielectric are O.K., it is reasonable to return the unit to service after a fault.

### Insulation Level

Refer to the insulation resistance measurements between poles and from each pole to ground that were recorded at start-up and subsequent intervals. Measure the same points in the same manner and record. Investigate any sudden reduction in resistance or any unusually low reading.

Dust and moisture are detrimental to electrical equipment. Industrial equipment is designed to tolerate a less-than-perfect environment. However, excessive dust can cause trouble, and should be wiped or blown off

at appropriate intervals. If the contactor is wet for any reason, it must be dried until insulation resistance between poles and from each pole to ground has returned to normal.

**TABLE V - RECOMMENDED DRIVING TORQUE**

| Location (Qty.)          | Driving Torque (lb.-in.) | Fig. 9 Item Refer. |
|--------------------------|--------------------------|--------------------|
| Coil Terminals (4)       | 7-9                      | -                  |
| Base Mounting Screws (4) | 60-65                    | S                  |
| Coil Mounting Screws (2) | 10-15                    | M                  |

