Installation and Maintenance Manual Advantage Motor Control Centers

Instruction Book
I.B. 8922-1
Model A

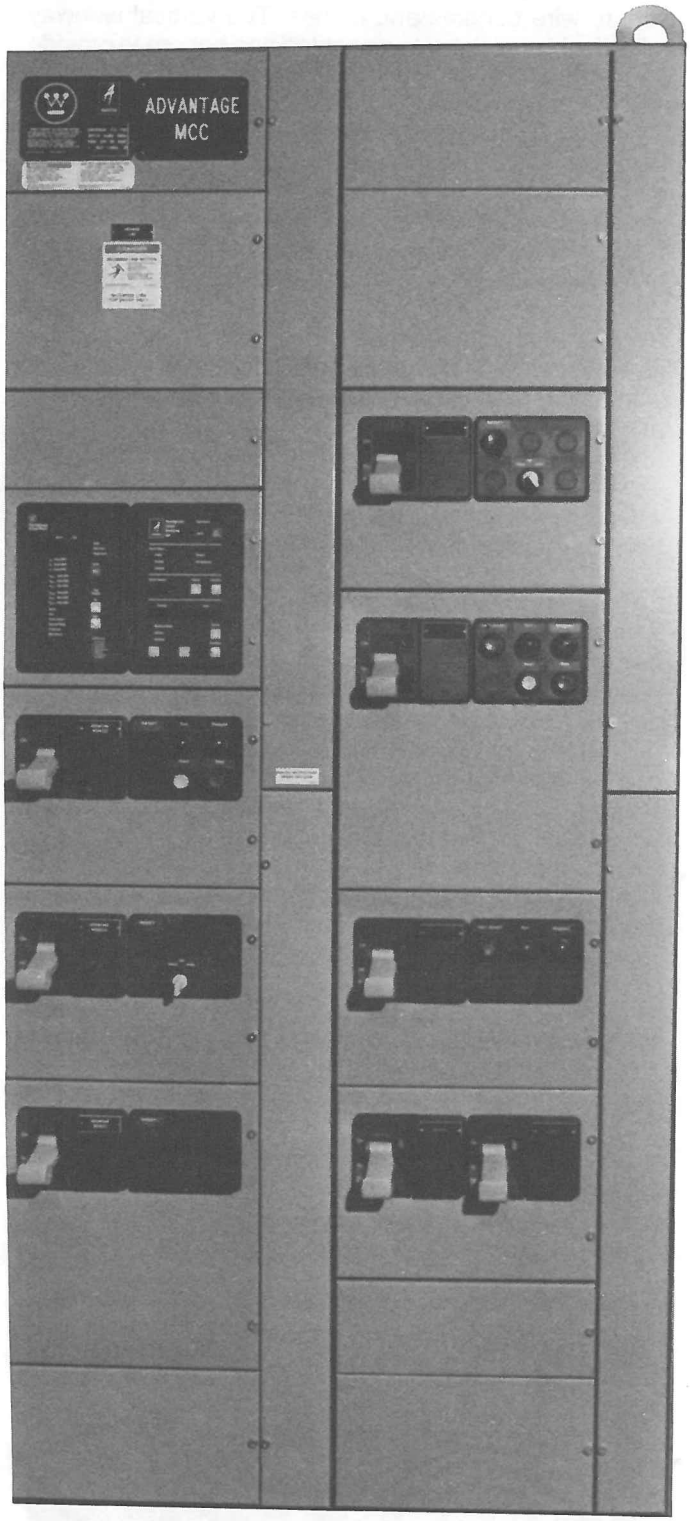


TABLE OF CONTENTS

This electrical control equipment 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. The maximum short circuit capability of the equipment should not be exceeded by connection to a source with higher capacity.

If maintenance or troubleshooting assistance is required, contact your nearest Westinghouse Engineering Service Division or Sales Office.

Westinghouse Electric Corporation
Construction Equipment Division
Fayetteville, N.C. U.S.A. 28306

Part 1
GENERAL INFORMATION

THE MOTOR CONTROL CENTER

The Westinghouse Advantage Motor Control Center may be joined to existing Five Star and Series 2100 installations using the same splice bar kits common to both. Units designed for the Advantage can be mounted in Five Star and Series 2100 sections, but the opposite is not recommended, because Five Star and Series 2100 units may lack terminal blocks and sufficient interrupting capacity.

CONTROL CENTER NOMENCLATURE

The numbers shown in parentheses in the following text refer to the balloon legends in Figure 2.

The Westinghouse Advantage Motor Control Center consists of one or more totally enclosed, dead front, free standing structural assemblies (16) 90 inches high which are compartmentalized to house individual control units. (2) With control units mounted in the front side only, the structure may be 16 or 21 inches deep. For mounting units back-to-back, the structure is 21 inches deep. Steel covers (6) enclose the structure at the top, sides and at the rear of front-mounted-only structures.

Each control center contains a main horizontal bus system (8) mounted at the top and extending across the length of the control center.

A vertical bus system (7) installed in each vertical section is connected to the horizontal bus to feed the individual control units. The vertical bus utilizes a labyrinth barrier which provides both isolation and insulation. (13) An automatic shutter is included with the labyrinth barrier system to cover the stab openings for each control unit.

At the top of each section, a door provides ready access to the top horizontal wireway (10) and ground bus (9). The horizontal wireway is isolated from the bus systems by steel barriers (11) which can be removed for installation and maintenance operations. Adequate space is provided for control wiring and top cable entry.

At the bottom of each section, a door (17) provides ready access to the bottom horizontal wireway (18), and neutral bus (if provided). The bottom of each section is completely open to provide unrestricted bottom entry of cable and conduit. Channel sills may be installed across the bottom of the control center if specified, and an optional bottom plate may also be specified.

A vertical wireway 8 inches deep, (15) extending the full 90 inch height of the control center is located to the right of each unit compartment. This wireway is covered by two hinged doors (14) and contains cable supports to secure wire bundles and cables. The vertical wireway joins the horizontal wireway at top and bottom to provide unobstructed space for interwiring.

Each vertical section provides space to mount up to six controller units (2) with a minimum height of 12 inches, in increments of six inches, for a total of 72 inches of usable space. Controllers through NEMA Size 5 are drawout type (except reduced-voltage starters). These drawout unit assemblies are a completely self-contained package consisting of a steel enclosure, operating handle and electrical components. The drawout assembly slides into its compartment on guide rails (12) to provide easy withdrawal and reinsertion and to ensure precise alignment of the unit stabs with the vertical bus. Each drawout unit is held in place by a single quarter-turn latch (3) which can only be engaged when the unit stabs are fully mated with the vertical bus. Each unit has a separate door, (1) held closed by a minimum of two quarter-turn fasteners.

The operating handle on the controller unit (4) moves vertically. In the ON or TRIPPED positions, the handle interlocks with the unit door to prevent its opening. In this position, authorized personnel can open the door by turning the defeater mechanism screw. (19) With the unit door open and the operating handle in the ON position, another interlock to the divider pan prevents removal of the unit. This same interlock prevents insertion of the unit unless the handle mechanism is in the OFF position. To ensure that units are not energized accidentally or by unauthorized personnel, the handle mechanism can be padlocked in the OFF position. Space for a minimum of three padlocks is provided on each handle.

The device panel (5) is mounted on the drawout unit. It will accommodate up to six pilot devices. The overload reset button is mounted on the unit device panel.

Fig. 1 Nameplate

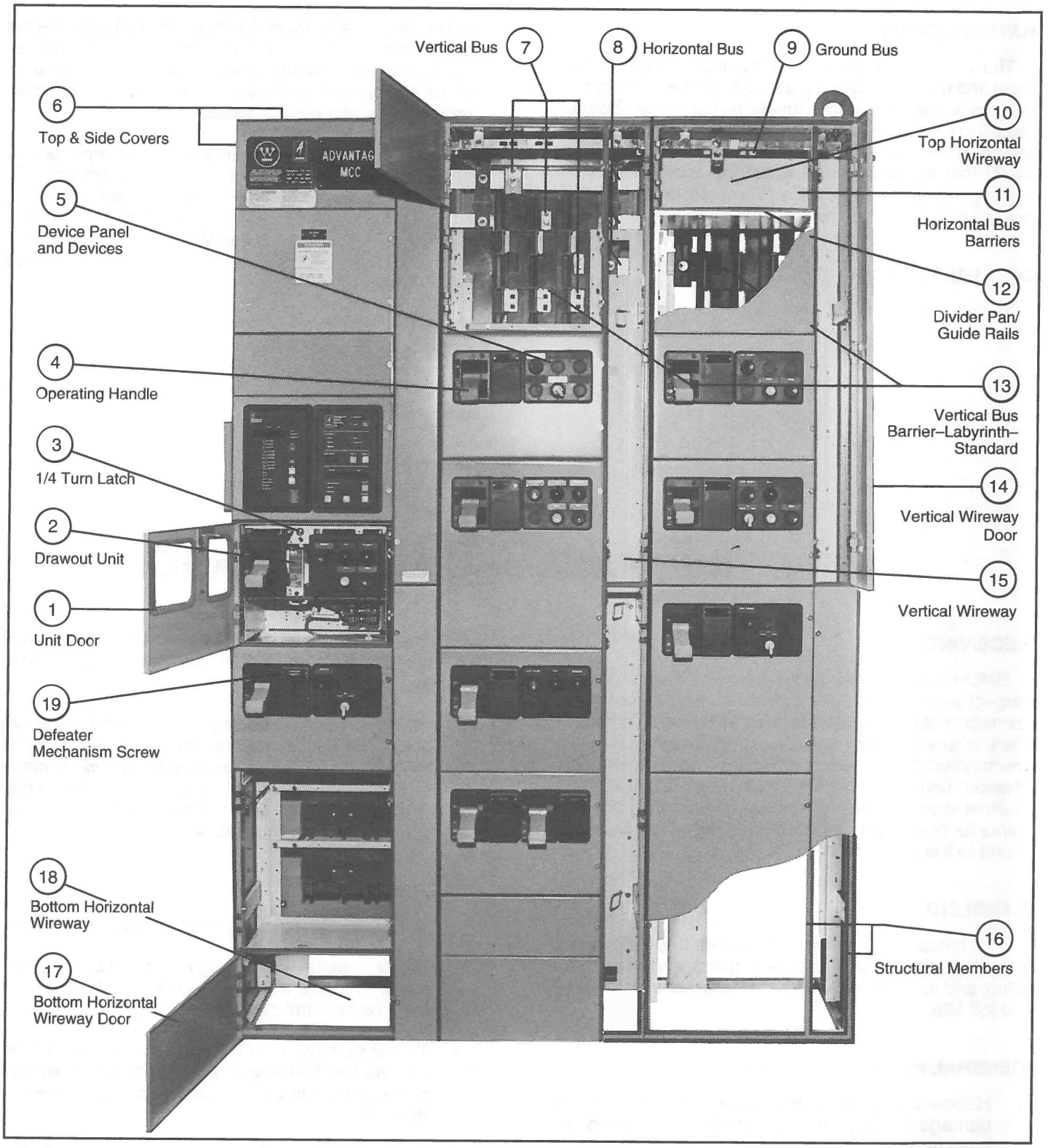


Fig. 2 Motor Control Center Nomenclature

RATINGS

Each Advantage Motor Control Center has a rating nameplate attached to the door of the top horizontal wireway of the primary section. See Figures 1 and 2. This nameplate shows the general/shop order number under which the motor control center was built and its continuous electrical ratings, in terms of incoming line voltage, phases, and frequency, and ampere ratings of the horizontal bus and the vertical bus for each section. In addition, this nameplate shows the passive short-circuit (withstand) rating of the horizontal and vertical bus system.

RATINGS (Cont.)

The active short-circuit (interrupting) ratings of the main and unit short-circuit protective devices are shown on labels attached to the inside of each unit. Before installing a motor control center, calculate and record the fault current available at the incoming line terminals. Verify that the short-circuit withstand and short-circuit interrupting ratings of the units in the motor control center are appropriate for the fault current available.

QUALIFIED PERSONNEL

Individuals who install, operate or maintain motor control centers must be trained and authorized to operate the equipment associated with the installation and maintenance of a motor control center, as well as the operation of the equipment that receives its power from controller units in the motor control center.

Such individuals must be trained in the proper procedures with respect to disconnecting and locking OFF power to the motor control center, wearing protective clothing and equipment, and following established safety procedures as outlined in the *National Electrical Safety Code (ANSI C2)* and *Electrical Equipment Maintenance (NFPA 70B).*

Part 2
RECEIVING, HANDLING AND STORAGE

RECEIVING

Before and after unloading the motor control center, inspect each section and unit exterior for evidence of damage that may have been incurred during shipment. If there is any indication that the control center has been mishandled or shipped on its back or side, remove the drawout units and make a complete inspection of the internal structure, bus bars, insulators and unit components for possible hidden damage. Report any damage found to the carrier at once.

HANDLING

The following guidelines are provided to help avoid personal injury and equipment damage during handling, and to facilitate moving the motor control center at the job site.

GENERAL HINTS

1. Handle the motor control center with care, to avoid damage to components and to the enclosure or its paint finish.
2. Keep the motor control center in an upright position.
3. Insure that the moving means has the capacity to handle the weight of the motor control center.
4. The control center should remain secured to the shipping skid until the motor control center is in its final location.
5. Exercise care during any movement and placement operations to prevent falling or unintentional rolling or tipping.
6. Lifting angles for handling by overhead crane are bolted to the top of each shipping section. Handling by overhead crane is preferable but when crane facilities are not available, the motor control center can be positioned with a fork-lift truck or by using rollers under the shipping skid.

OVERHEAD CRANE

1. See Figure 3 for recommended lifting configuration.
2. Select or adjust the rigging lengths to compensate for any unequal weight distribution, and to maintain the motor control center in an upright position.
3. To reduce tension on the rigging and the compressive load on the lifting angles, do not allow the angle between the lifting cables and vertical to exceed 45 degrees.
4. Use slings with safety hooks or shackles. **Do not pass ropes or cables through lifting angle holes.**
5. After removing the lifting angles, replace the mounting hardware to prevent the entrance of dirt, etc.

FORK-LIFT TRUCK

Motor control centers are normally top and front heavy. Balance the load carefully and steady, as necessary,

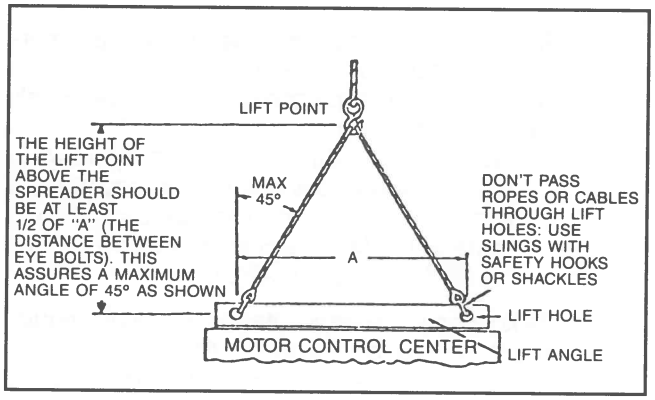


Fig. 3 Correct Use of Lifting Angle

while moving. **Always use a safety strap when handling with a fork-lift.**

ROLLERS

Rod or pipe rollers, with the aid of pinch bars, provide a simple method of moving the motor control center on one floor level, if there is no significant incline. Roll the motor control center slowly, and steady the load to prevent tipping.

STORAGE

When a motor control center cannot be installed and placed into operation immediately upon receipt, take steps to prevent damage by condensation or harsh environmental conditions. If the motor control center cannot be installed in its final location, store it in a clean, dry, ventilated building, heated to prevent condensation, and protected from dirt, dust, water, and mechanical damage. When storage conditions are less than ideal, install temporary electrical heating, typically in the form of light bulbs, totaling 150 watts per section, hung in the vertical wireway, or by applying power to self-contained space heaters that the motor control center may be equipped with. Remove all loose packing and flammable materials before energizing any of the heating elements.

Part 3
INSTALLING CONTROL CENTER SECTIONS

GENERAL

Advantage Motor Control Centers (MCC's) are designed for installation in accordance with both the *National Electrical Code (NEC), NFPA 70,* and the *National Electrical Safety Code (NESC), ANSI C2.*

Caution — If work is involved in connecting the control center with existing equipment, ensure that incoming power is disconnected before work is begun. Disconnecting means should be locked out and/or tagged out of service. Where it is not feasible to de-energize the system, the following precautions should be taken:

A) Persons working near exposed parts that are or may be energized should be instructed and should use practices (including appropriated apparel, equipment, and tools) in accordance with the NESC.

B) Persons working on exposed parts that are or may be energized should, in addition, be qualified persons who have been trained to work on energized circuits.

INSTALLATION

1. Before any installation work is begun, consult all drawings furnished by Westinghouse as well as all applicable contract drawings for the installation. Give particular attention to the physical location of units in the control center and their relation to existing or planned conduit, busways, etc. Provide for future conduit entrance prior to control center installation.

2. Locate the control center in the area shown on the building floor plans. If in a wet location or outside of the building, protect the control center from water entering or accumulating within the enclosure. Recommended clearances or working spaces are as follows:
   a) Clearance from walls (where not rear accessible) — a minimum of 1/2 inch for indoor and 6 inches for outdoor or wet locations.
   b) Clearance from front of MCC (working space) — minimum of 3 feet for control centers without exposed live parts. See NEC 110-16d. NOTE: This working space should not be used for storage and should have adequate lighting.

3. Since control centers are assembled at the factory on smooth and level surfaces to assure correct alignment of all parts, control centers should be securely mounted on a level surface. The foundation furnished by the purchaser must be true and level, or the

INSTALLATION (Cont.)

bottom frames must be shimmed to support the entire base in a true plane. It is recommended that leveled channel sills under both the front and rear of the control center be used to provide this level base. Drill and tap the channel sills for mounting bolts in accordance with the applicable floor plan drawing and then either install the MCC level with, or on top of, the finished floor. If sills are grouted in concrete, the mounting bolts should be screwed in place and remain until the concrete has hardened.

4. For bottom entry, position the motor control center so that the conduit stubs or floor openings are located in the shaded areas shown on the MCC floor plan drawings (refer to pages 30 and 31 for floor plan dimensions). The shaded areas represent the open space available for conduit entry through the bottom of each section. A shaded area may be restricted if large controllers or autotransformers are mounted in the bottom of the sections. If optional bottom plates are supplied, the plates may be removed and drilled for conduit entry.

5. Install the MCC in its final position, progressively leveling each section and bolting the frames together if they are separated. If necessary, secure the MCC to walls or other supporting surfaces. Do not depend on wooden plugs driven into holes in masonry, concrete, plaster, or similar materials. See NEC 110-13.

6. If two or more shipping sections are to be joined into an integral assembly or a shipping section is to be joined to an existing section, refer to paragraphs below before proceeding with the installation.

7. Ground and bond the motor control center as follows:

   a) Motor control centers used as service equipment for a grounded system or as an incoming line section for a separately-derived previously grounded system:
      i) Run a grounding electrode conductor (ground wire) having a size in accordance with NEC 250-94 from the grounding electrode to the MCC ground bus or ground terminal provided. See also NEC 250-91(a) and 92(b).
      ii) If the system is grounded at any point ahead of the MCC, the grounded conductor must be run to the MCC in accordance with NEC 250-23(b), and connected to the ground bus terminal.
      iii) Do not make any connections to ground on the load side of any neutral disconnecting line or any sensor used for ground-fault protection. Do not connect outgoing grounding conductors to the neutral.

   b) Motor control centers used as service equipment for an ungrounded system or as an incoming line section for a separately-derived previously ungrounded system:
      i) Run a grounding electrode conductor (ground wire) having a size in accordance with NEC 250-94 from the grounding electrode to the MCC ground bus terminal. See NEC 250-91(a) and 92(b).

   c) Motor control centers not used as service equipment nor as an incoming line section for a separately-derived system, and used on either a grounded or ungrounded system:
      i) Ground the MCC ground bus by means of equipment grounding conductors having a size in accordance with NEC 250-95 or by bonding to the raceway enclosing the main supply conductors in accordance with NEC 250-91(b).

8. When all wiring and adjustments are complete, close all unit and wireway doors.

9. In damp indoor locations, shield the MCC to prevent moisture and water from entering and accumulating.

10. Unless the motor control center has been designed for unusual service conditions, it should not be located where it will be exposed to ambient temperatures above 40°C (104°F), corrosive or explosive fumes, dust, vapors, dripping or standing water, abnormal vibration, shock or tilting.

JOINING COMPATIBLE SECTIONS

If two or more shipping blocks are to be joined into an integral assembly, or a section added to an existing installation, splicing of horizontal bus, ground bus, neutral bus and joining of the adjacent vertical sections must be planned with the installation.

1. Remove the side sheets from adjacent vertical sections to be joined. (These sheets will have been removed from factory assembled sections.)

2. The horizontal bus splice plates and hardware will be shipped with the MCC attached to one end of shipping section. Refer to Figure 4. This method provides the most convenient access to the bolts, and eliminates the need to remove the horizontal bus barriers in that structure. Should the existing bus be oxidized, sand lightly with a fine aluminum oxide paper. CAUTION — Do not use emery cloth or any abrasive containing metal.

3. Remove the upper horizontal wireway door from the structure on the right side of the left hand (LH) section and remove the two-piece wireway barrier to provide access to the ends of the bus in that section.

4. Move the section in place, aligning the upright structural channels and bottom channels. Alignment of the section with floor sills and foundation provisions will be facilitated by removing the bottom horizontal wireway doors. Using the "U" type frame clamps provided, clamp adjacent front upright channels together at the top, bottom and approximate center of the vertical structure. This operation will be facilitated by removing the vertical wireway doors from the left hand structure and one or more drawout units from the right hand structure. See Part 9.

5. If rear access is available, "U" clamps should also be used to clamp the rear upright channels together. In front-mounted-only structures this will require removal of the adjacent back sheets. In a back-to-back mounted structure, remove the vertical wireway doors and one or more drawout units as above.

6. Secure the sections to the floor sills or mounting bolts as provided for the installation.

7. Bolt the horizontal bus splice plates to the bus in the left hand structure, torquing all bus splice bolts to 275 pound-inches. See Figure 5.

8. Replace all unit, bus barriers, and doors.

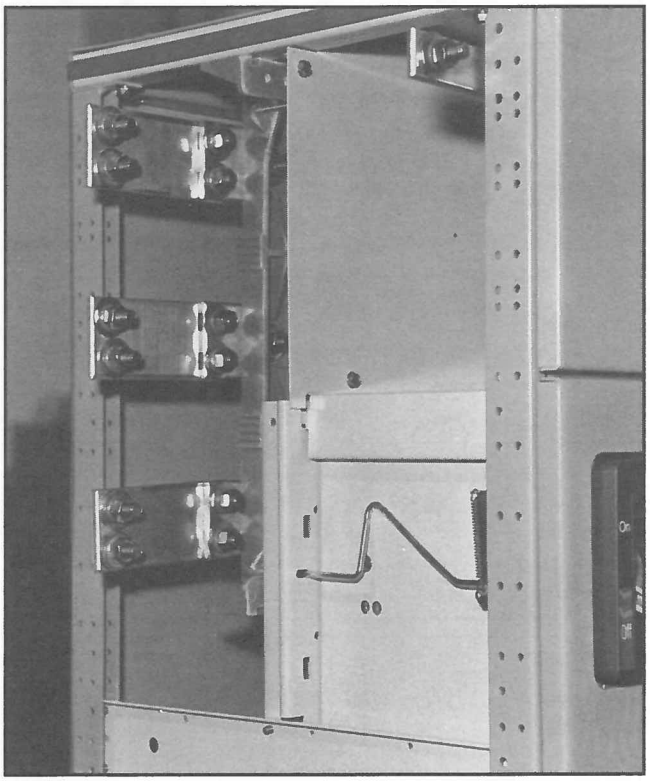


Fig. 4 Splice Plates Attached to RH Section

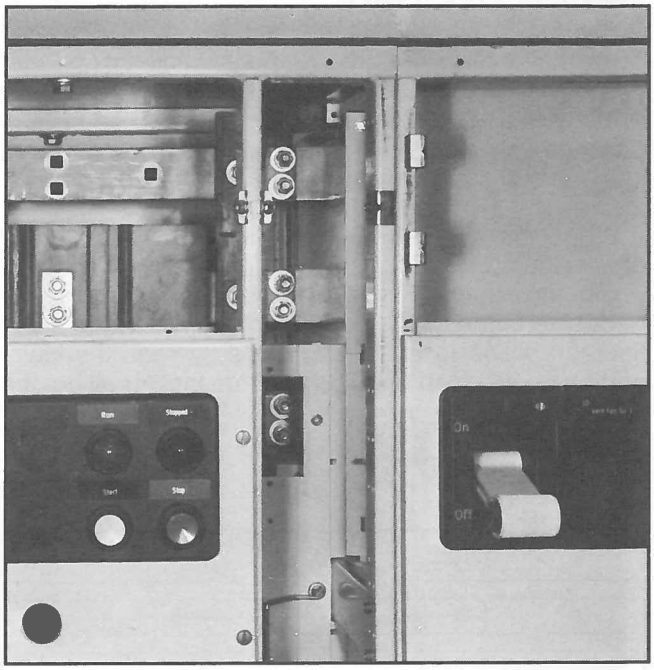


Fig. 5 Access to LH Splice Plate Connections

JOINING INCOMPATIBLE SECTIONS

Joining an Advantage Motor Control Center to other equipment such as Type W and 11-300 Control Centers will involve a transition section installed between the two varieties of equipment. This transition section will be detailed on drawings provided by Westinghouse and the applicable contract drawings. If provided separately, it should be installed first. Review the overall installation task to determine whether the transition section should be attached to the existing equipment or to the Advantage section, before it is moved into place, and select the sequence which will provide best access to bus splicing and joining of the structures.

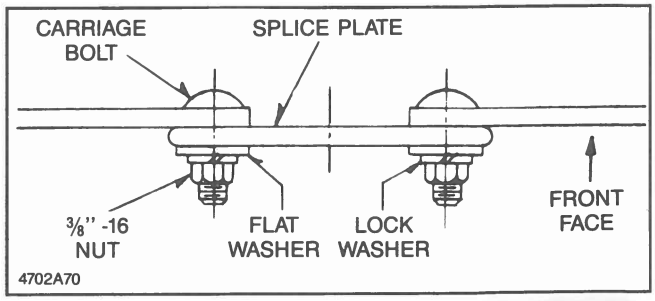


Fig. 6 Single Bar Splice Kit

SPLICE PLATES

Each splice plate kit consists of short pieces of bus bar the same width as the main horizontal bus of the MCC the kit is shipped with, four bolts per phase, and appropriate

SPLICE PLATES (Cont.)

quantities of related hardware. For a single bus bar per phase the hardware is used as shown in Figure 6 for either 16" or 20" deep enclosures. Each splice plate is punched with rectangular holes to accept a square shank carriage bolt that will not rotate as the nut is tightened.

Where the MCC is built with two horizontal bus bars per phase, the splice plates are installed as shown in Figure 7. The top edge of Figures 7 through 10 represents the back side of the MCC. The top portion of each of these figures applies to 20" deep enclosures and the lower portion to 16" deep enclosures. Note that for all but the single-bar per phase (Figure 6) installation, the 16" deep enclosures require the use of a nut plate that is mounted with the same carriage bolt used to attach the horizontal bus bars to the channel-shaped insulators. Install these nut plates before mounting the splice plates. Tighten the splice plate bolts with a driving torque of 275 pound-inches (23 pound-feet).

TYPE 3R ENCLOSURES

Where the MCC is supplied in a Type 3R enclosure for an outdoor application, apply roof splice caps at each shipping block junction to maintain the enclosure integrity.

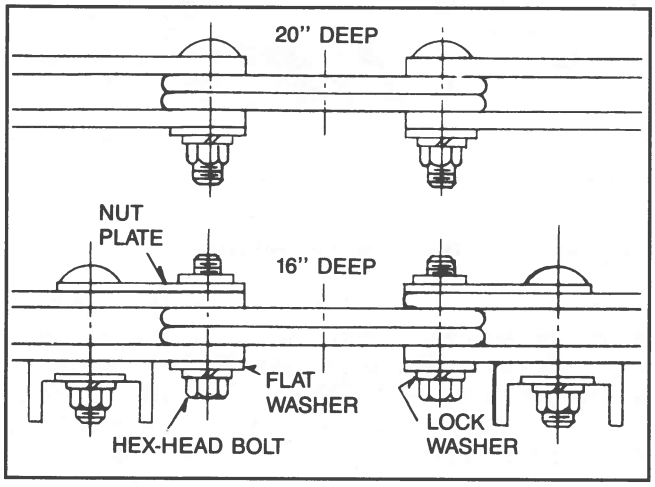


Fig. 7 Double Bar Splice Kit

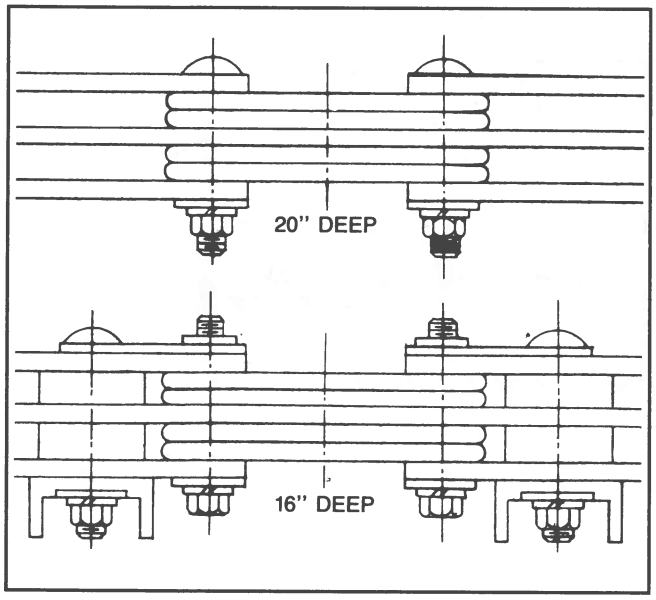


Fig. 8 Triple Bar Splice Kit

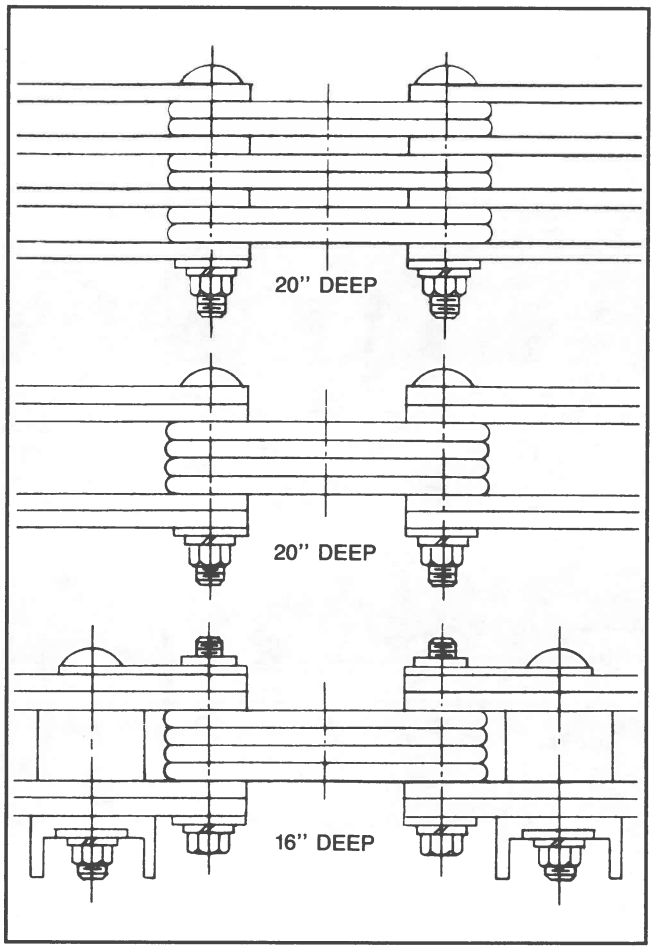


Fig. 9 Quadruple Bar Splice Kits

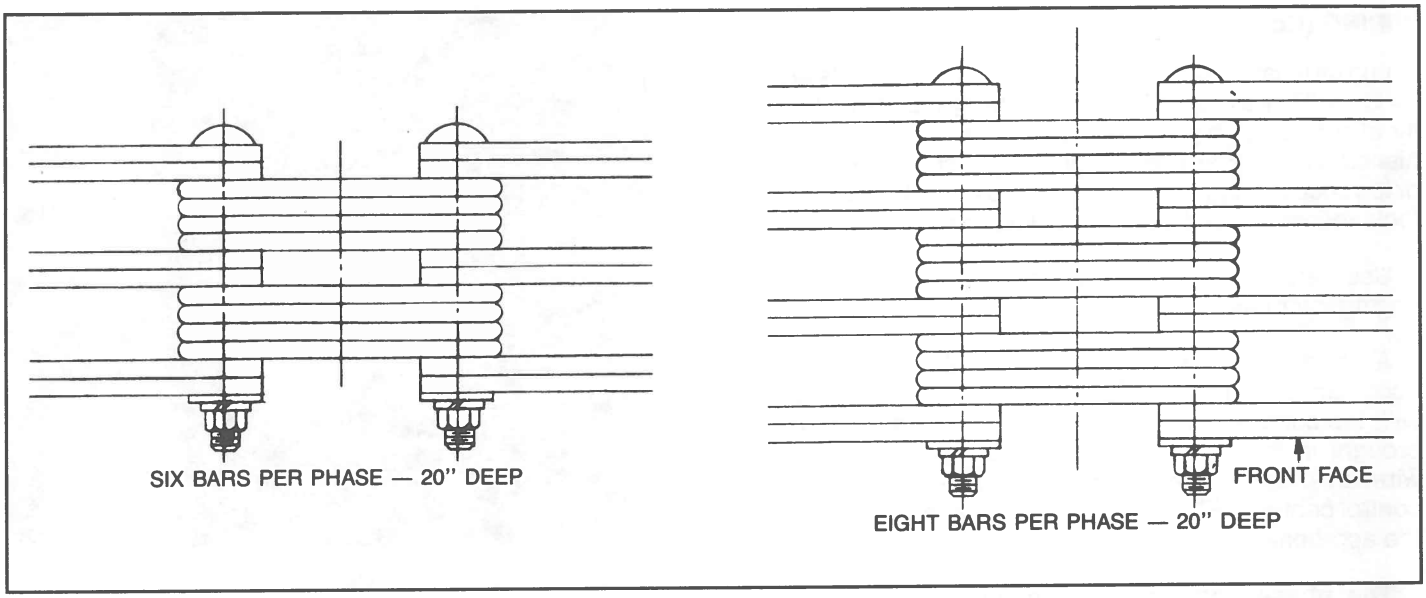


Fig. 10 Six and Eight Bar Splice Kits

Part 4
INSTALLING CONDUIT AND WIRING

CONDUIT

Install conduit in such a manner as to prevent water from entering and accumulating in the conduit or the enclosure. Eliminate sags in conduit. Have the conduit enter the motor control center (MCC) in the areas designated for conduit entry on the plan views. See pages 30 and 31 of this booklet and outline drawings shipped with the MCC. Keeping conduit within the shaded areas shown in the plan views will avoid cable interference with structural members and live bus. (See Part 11.)

WIRING

Install the line and load conductors sized in accordance with the NEC. **Use copper wire only for control terminations. Use copper wire only for power terminations unless they are marked "CU/AL."** Use conductors with a temperature rating of 75°C or higher, but regardless of the insulation temperature rating select the wire size on the basis of 75°C wire ampacity. Using a higher temperature wire ampacity table often results in a smaller cross-section of copper available for carrying heat away from terminals.

Install insulated wire and cable at a temperature sufficiently warm to prevent the insulation from cracking or splitting.

When more than one conduit is run from a common source or to a common load, be sure to have each conduit carry conductors from each phase and the same number of conductors per phase. If the phase conductors are not distributed uniformly, eddy currents will be generated in the steel between the conduits.

Locate conductors within the MCC to avoid physical damage and to avoid overheating. Secure incoming power lines in a manner adequate to withstand the forces which will act to separate the conductors under short-circuit conditions. Use the cable ties furnished in both horizontal and vertical wireways to support the load and interconnection wire. Use a shielded communications cable inside of flexible metal conduit to protect very low voltage signals transmitted to or from a computer or programmable controller.

WIRING (Cont.)

Lugs furnished with the MCC and its components are for Class B and Class C stranding. Verify the compatibility of wire size, type, and stranding with the lugs furnished. Where they are not compatible, change the wire or lugs accordingly. If crimp lugs are used, crimp with the tools recommended by the manufacturer.

Use care in stripping insulation to avoid nicking or ringing the metal.

All field wiring to control units should be made in accordance with the wiring drawings that are furnished with the control center. Load and control wiring can be brought in through the upper and/or lower horizontal wireways. Determine the type of wiring installed in the control center (NEMA Type B-D, or C) and proceed per the appropriate paragraph below.

The phase sequence of the power circuit load terminals (left-to-right: T3, T2, T1) in units mounted on the rear side of the MCC is opposite to that of the load terminals in units mounted on the front side of a back-to-back MCC. To obtain the same direction of rotation for a motor connected to a rear-mounted unit as for one connected to a front-mounted unit, relabel the terminals in the rear-mounted unit: T3, T2, T1, and wire accordingly. Refer to the warning sticker supplied with rear-side units.

When making connections to the load terminals be sure to leave sufficient slack in the wires so that the unit can be withdrawn to the detent position for maintenance. See page 20.

NEMA TYPE B-D WIRING

Each control unit is factory assembled with devices interwired within the unit. In addition, all control wiring is carried to unit terminal blocks mounted on the right hand side of the unit. See Figure 11. Bring the field wiring of control wires from a horizontal wireway into the vertical wireway on the right hand side of the applicable control unit and terminate them at the unit terminal blocks. Bring load wiring from the vertical wireway, under the bottom right hand side of the unit, to terminations within the unit. See below.

ENGAGING PULL-APART TERMINAL BLOCKS

The male portion of the pull-apart terminal block is located in a plastic bag tied to the pivot rod inside the unit. This terminal block can be wired outside of the vertical wireway. To engage the terminal block, align the fingers of the male connector with the slot at the back of the female portion of the terminal block. Then rotate the male portion forward and to the left into the female portion of the terminal block.

Each male portion of the pull-apart terminal block has two cavities adjacent to the center terminal screw to accept the blade of an electrician's screwdriver used to

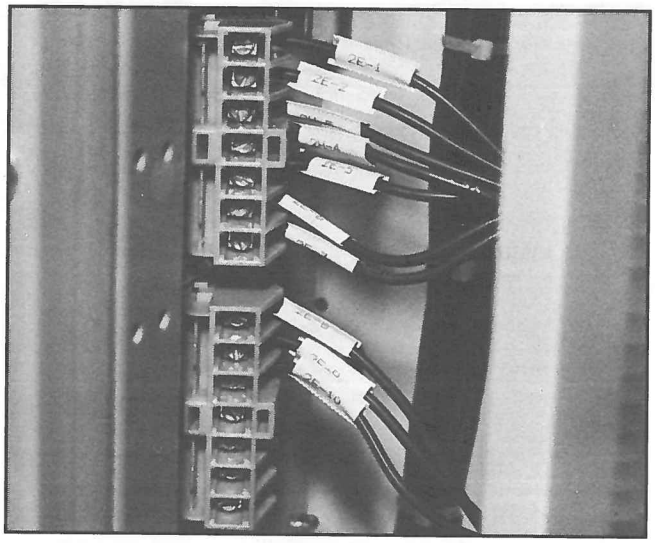


Fig. 11 Unit Terminal Blocks

cam the block into and out of engagement. Each male portion also has a rear slot that can engage the edge of the unit frame where it can be mounted for ease in trouble-shooting.

NEMA TYPE C WIRING

Each control unit is factory assembled with devices interwired within the unit. In addition, all control wiring is carried to unit terminal blocks on the side of the unit and from these unit blocks, along with load wiring through Size 3, to master terminal blocks located at the top or bottom of the structure. See Figure 12. Master terminal blocks can be either fixed or drawout mounted. In the drawout design the terminal blocks are rack mounted to permit withdrawal of the entire assembly for ease of wiring during installation and maintenance. Bring field wiring from the horizontal wireway to the master terminal blocks except for load wiring larger than Size 3. These latter load wires should be carried into the vertical wireway and under the bottom right hand side of the unit to terminations within the unit.

Fig. 12 Master Terminal Blocks

Part 5
INCOMING LINE CONNECTIONS

OVERCURRENT PROTECTION

All ungrounded conductors in a motor control center (MCC) installation require some form of overcurrent protection in order to comply with Section 240-20 of the NEC. Such overcurrent protection for the incoming lines to the MCC is in the form of fuses or a circuit breaker located at the transformer secondary that supplies the MCC. The conductors from the transformer secondary constitute the feeder to the MCC, and the "10-foot rule" and the "25-foot rule" of NEC 240-21 apply. These latter exceptions to the general rule allow the disconnect means and overcurrent protection to be located in the MCC, provided the feeder taps from the transformer are sufficiently short and other requirements are met.

MAIN DISCONNECTS

A circuit breaker or a circuit interrupter combined with fuses controlling the power to the entire MCC may provide the overcurrent protection required as described above or may be a supplementary disconnect (isolation) means. See Figures 13, 14 and 15.

When the MCC has a main disconnect, bring the incoming lines (the feeders) to the line terminals of the circuit breaker or circuit interrupter. The load side of the circuit breaker or the load side of the fuses associated

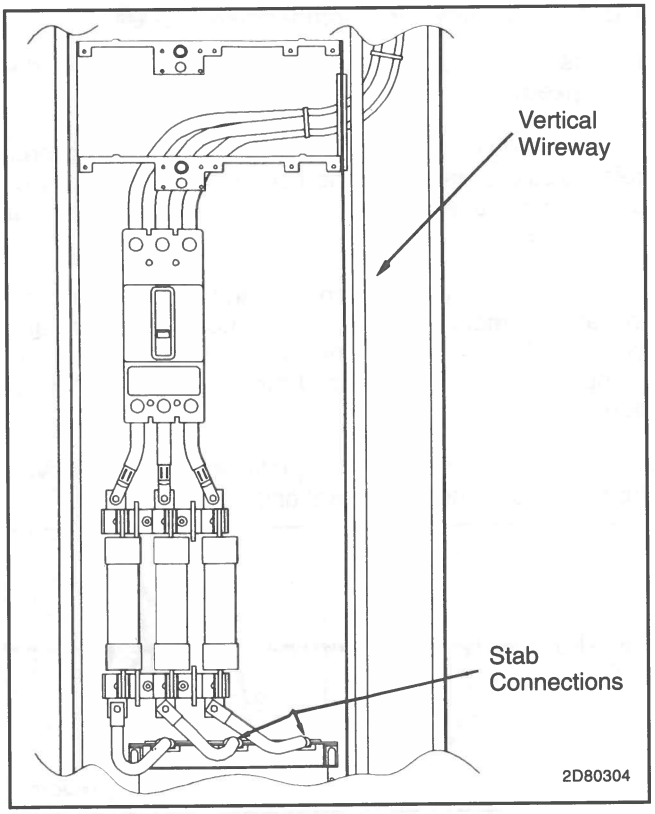


Fig. 13 Main Disconnect with Stab Load Connections

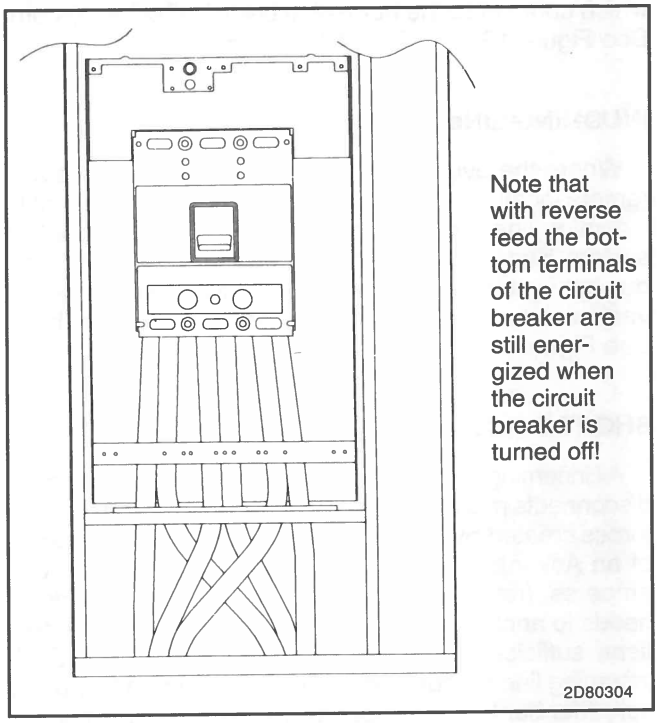


Fig. 14 Main Circuit Breaker with Reverse Feed

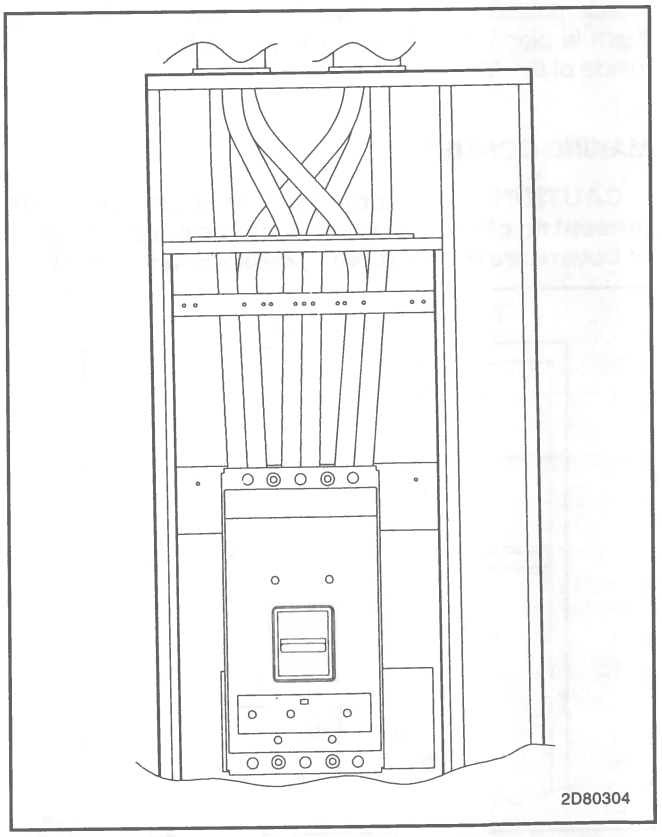


Fig. 15 Main Circuit Breaker

MAIN DISCONNECTS (Cont.)

with the circuit interrupter has already been connected to the MCC bus bar distribution system. In the case of main disconnects rated 400 amperes or less, this load connection is made by stab connections to vertical bus bars which connect to the horizontal bus distribution system. See Figure 13.

INCOMING LINE LUGS

Where the overcurrent protection for the MCC is at a remote location, the MCC feeder lines are connected to incoming line lugs attached to the bus bar distribution system. See Figure 16. For high-ampere rated horizontal bus bar systems, the incoming line lugs are mounted on vertical risers which connect to the horizontal bus bars. See Figure 17.

SHORT-CIRCUIT BRACING

All incoming lines to either incoming line lugs or to main disconnects must be braced to withstand the mechanical forces created by a high fault current. With the remainder of an Advantage MCC braced for not less than 65,000 amperes (rms symmetrical), the installing electrician needs to anchor the cables at the incoming line connections sufficiently and tighten the lugs correctly. Each incoming line compartment is equipped with a two-piece spreader bar located about nine inches from the conduit entry. Use this spreader bar and appropriate lacing material to tie cables together where they can be bundled and to hold them apart where they are separated. In other words, position the incoming line cables and then anchor them in place. See Figure 18 and the instruction sheet inside of the MCC.

MAKING CONNECTION

CAUTION: All incoming line compartments present an obvious hazard when the door is opened or covers are removed with power on. When working in this area, the incoming feeder should be de-energized.

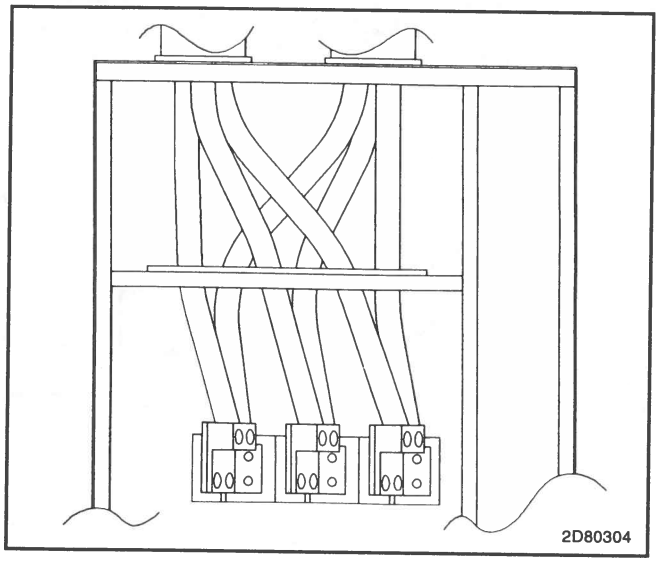


Fig. 16 Incoming Line Lug Connections

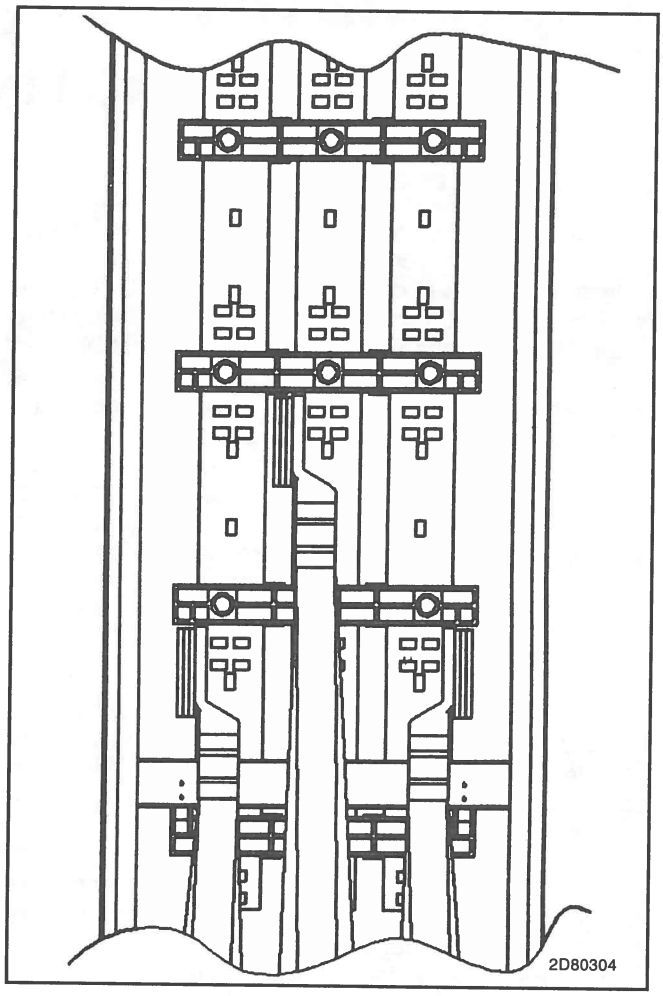


Fig. 17 Incoming Line Compartment, 2000A

Before beginning work on incoming line connections, refer to all drawings furnished by Westinghouse as well as all applicable contract drawings for the particular installation.

Depending on the location, size and type of the incoming arrangement, remove one or more horizontal and vertical wireway doors, and selected units to provide complete access. See Part 9 for unit removal instructions.

For top entry, the top cover plates are easily removed for drilling or punching operations.

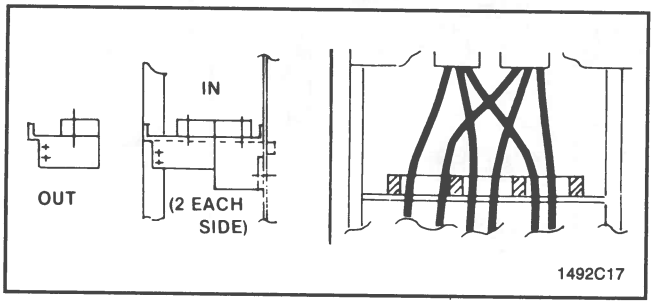


Fig. 18 Spreader Bar For Top Entry

Part 6
OVERCURRENT PROTECTION DEVICES

DEVICE SELECTION

Articles 240 and 430 of the NEC contain the rules for selecting fuses, circuit breakers and overload relays by type and by voltage and ampere rating. Follow these rules for feeder circuits, and the instructions attached to the inside of the left-most vertical wireway door, for motor branch circuits. Select the correct overload relay setting based on the motor service factor and full-load current. The Advantage starter includes solid-state overload protection which is ambient insensitive.

Overload protection is factory preset at Class 10 Overload Protection Class and lowest current setting with manual reset required. Thus the proper setting must be set for the motor to start and be properly protected.

For overload current settings see instructions in Part 7.

OVERLOAD PROTECTION

A Class W200 motor starter offers overload protection as a Class 10, Class 20, or Class 30 overload relay without the need for heater elements and the resulting heat losses of a thermal overload relay.

Accuracy is obtained by three closely-coupled current sensors in combination with a microprocessor that counts units of the line current-squared (I^2), the heating effect within the motor. The sensors are coils wound in the form of toroidal helixes around a customized iron core with a controlled air gap. This combination of coil, core and air gap results in greater accuracy than thermal overload relays, without the fuss of heater elements. The stored count decreases whenever the line current is less than the maximum motor full-load current specified for the overload setting selected. This decrease represents the natural motor winding cooling that occurs as the motor runs at full-load current or less. The counter never decreases to zero while the motor is running. It remembers that the motor is hot.

When an Advantage starter is equipped with an optional illuminated alarm and trip reset pushbutton, the LED in the indicator blinks whenever the motor is in an overcurrent condition and turns full ON, to indicate a tripped condition that requires a reset before the motor can be restarted.

OVERLOAD SETTINGS

The cutout in the arc box cover that provides access to the DIP switch is designed to accept a snap-in clear plastic window. Insert the window after initial DIP switch settings have been made, by engaging the hooks of one corner and pushing on the opposite corner. To change a DIP switch setting after the window has been installed, remove the arc box cover by loosening the two captive cover screws (four for size 5 and 6) accessible through the nameplate.

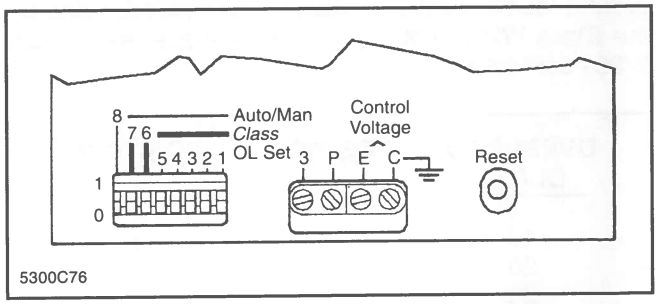


Fig. 19 DIP Switch, Terminals and Reset

Use the eight-position (8-pole) DIP switch to select the method of reset (MANUAL or AUTOMATIC), the overload protection Class (10, 20, or 30 or NONE) and the trip current rating appropriate for the motor full-load current in amperes (FLA). When a DIP switch handle is moved towards the position number (marked 8 through 1, left to right) that switch is closed (represented by "1"). When a switch handle is away from the position number, the switch is open (represented by "0"). See Figure 19. **Be sure that each DIP switch handle is moved to the full ON (1) or full OFF (0) position.**

RESET METHOD	POSITION 8
MANUAL (Nonautomatic. Wait 5 minutes)*	0
AUTOMATIC (Reset time is based on protection Class.)	1

*When set for manual, overload relay will reset after 5 minutes and loss of power.

OVERLOAD CLASS

Use the Class 10 (fast-trip) setting for hermetic refrigerant motor-compressors, submersible pumps and similar applications as well as for protecting general-purpose motors where the load permits the motor to reach rated speed without the overload protection circuit tripping.

Use the Class 30 (slow-trip) setting for special motors driving high inertia loads such as ball mills, reciprocating pumps, loaded conveyors and the like.

Use the Class 20 (standard-trip) setting for all other applications. Most NEMA-rated general-purpose motors will be protected by a Class 20 setting.

IF A PROPERLY SELECTED TRIP CURRENT SETTING RESULTS IN AN OVERLOAD TRIP, MOVE TO A HIGHER CLASS SETTING RATHER THAN TO A HIGHER TRIP-CURRENT SETTING.

Select Class NONE when no overload, phase-loss nor ground-fault protection is wanted. With NONE selected, the Class W200 motor starter will behave like a Class W201 contactor.

OVERLOAD CLASS	POSITION 7	POSITION 6
10	0	0
20	0	1
30	1	0
NONE	1	1

TRIP CURRENT SETTING

The overload trip current of an Advantage starter is determined by the DIP switch positions 5 through 1 as shown in Part 7. Use only the table appropriate for each starter size.

TRIPPED CONDITIONS

Both phase-loss (or extreme phase unbalance) and ground-fault protection are provided in a Class W200 motor starter except when the catalog number includes "Y4" and/or "Y7", respectively. Check the Test Verification label on the side of the motor controller to determine which features are included.

An Advantage starter trips (turns itself OFF) when it recognizes that a phase-loss, ground-fault or significant overload condition exists. The starter must be RESET after tripping before it can be turned ON again. These protection functions can be nullified by a DIP switch setting. See **OVERLOAD SETTINGS.**

The standard reset pushbutton or optional overload alarm and trip indication may be provided by an illuminated reset pushbutton, both mounted on the MCC starter device panel. The trip indicator requires that control power be supplied to the starter to light. All ground-fault and phase-loss trips must be manually reset with the control power ON. "Manual" resetting consists of completing an electrical circuit between internal terminals, with either the reset button provided on the starter or a remote reset kit. A trip caused by an overload condition can also be reset by turning the control power OFF and waiting five minutes.

THIS CONTROLLER WILL TRIP IN RESPONSE TO AN OVERLOAD, A PHASE LOSS OR A GROUND-FAULT CURRENT IN EXCESS OF THE VALUES SHOWN IN TABLE 6-1. WAIT FIVE MINUTES AND RESET WITH CONTROL POWER "ON." IF THE CONTROLLER CONTINUES TO TRIP, THE CAUSE OF TRIP HAS NOT BEEN CORRECTED.

TABLE 6-1: GROUND-FAULT PROTECTION

Size	Minimum Ground-Fault Current To Trip*	Start Delay	Run Delay
1 Low Range	1A	17 sec.	1 sec.
1 & 2	10A	17 sec.	1 sec.
3 & 4	30A	17 sec.	1 sec.
5 & 6	120A	17 sec.	1 sec.

* Ground fault currents greater than the interrupting capability of the starter are cleared by the short circuit protective device in the branch circuit.

MOTOR CIRCUIT PROTECTOR (MCP)

AFTER INSTALLATION OF THE CONTROL CENTER, EACH MCP MUST BE ADJUSTED TO ACTUAL MOTOR FULL-LOAD AMPERES (FLA) SO THAT IT WILL TRIP AT ANY CURRENT WHICH EXCEEDS STARTING INRUSH. This setting provides low-level fault protection. The first half-cycle inrush will vary with the motor characteristics. Motors with locked-rotor currents of six times motor full-load amperes will usually require an instantaneous magnetic setting of 7 to 11 times motor full-load amperes to prevent tripping when starting.

A cam to accept a small narrow-blade electrician's screwdriver is near the lower left corner and around which are eight lettered adjustment points, calibrated in trip amperes. See Figure 20. Adjustment should never exceed 13 times FLA which is in accordance with NEC requirements for magnetic-trip-only breakers. **Adjustment should be made as follows:**

1. Obtain FLA from motor nameplate.
2. Multiply FLA by 13.
3. Set the cam to the highest trip setting which does not exceed the calculated figure of Item 2. This is the maximum setting that should be used.
4. Depress and turn the screwdriver adjustment counter-clockwise one setting at a time, until the breaker trips in starting and then adjust upward one setting position. This will insure that the circuit will open instantly on any current above the motor inrush, usually 7 to 11 times FLA.

The PUSH-TO-TRIP button checks the tripping function and is used to periodically exercise the operating mechanism. The button is designed to be operated by using a small screwdriver.

Advantage MCC's are supplied with Type HMCP motor circuit protectors having an interrupting rating to match the short-circuit withstand rating of the bus bar system. For MCP's in 225 and 400 ampere frame sizes, the magnetic-trip adjustment is set for each pole. A three-pole MCP has three trip settings to adjust. Place all three poles at the same setting.

CURRENT LIMITERS FOR USE WITH TYPE HMCP AND HFD BREAKERS

The addition of the current limiter provides interrupting capacity above the range handled by the HMCP in motor starters or by HFD thermal-magnetic feeder breakers.

Each HMCP or HFD breaker rated up to 150 amps has its own current limiter to provide co-ordinated protection against faults up to 100,000 amperes, rms symmetrical.

Built-in trip indicators in each phase immediately show when a fault has blown the current limiter and tripped the circuit breaker. This provides protection against single phasing. **After interrupting a fault, the current limiter will require replacement.** After the fault has been cleared, the current limiter is replaced by the removal of three screws. The breaker can then be reset to provide for subsequent high overcurrent protection.

TYPE HMCP AND HFD CIRCUIT BREAKERS WITH TERMINAL END COVERS

Circuit breakers installed in units connected to 600 volt distribution systems require a terminal end cap to be installed on the line side. Replace the terminal end cap when replacing circuit breakers in such units.

Fig. 20 Motor Circuit Protector

Part 7
OVERLOAD PROTECTION SELECTION

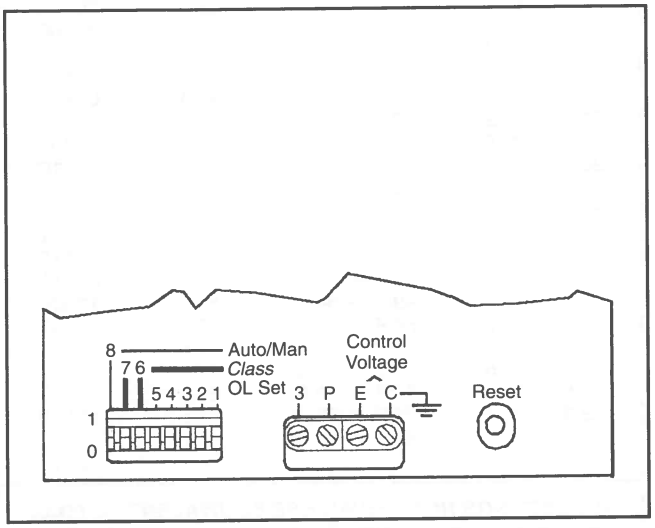


Fig. 21 Dip Switch, Terminals and Reset

TRIP CURRENT SETTING

The overload trip current of an Advantage starter is determined by its program and the DIP switch settings in positions 5 through 1 as shown in Tables 7-1 thru 7-7. Use only the table appropriate for the starter involved and disregard the others.

For motors with a marked temperature rise of not over 40° C, or with a service factor of not less than 1.15, find in Column A the range of motor FLA that includes the FLA of the motor to be protected and use the setting shown for DIP switch positions 5 through 1. For all other motors, select a range in Column B.

Settings based on Column A give a trip rating of not more than 125% of motor FLA. Settings based on Column B give a trip rating of not more than 115% of motor FLA.

TABLE 7-1 – SIZE 1 LOWER CURRENT RANGE

Column A SERVICE FACTOR 1.15 to 1.25 MIN.	Column A SERVICE FACTOR 1.15 to 1.25 MAX.	Column B SERVICE FACTOR 1.0 MIN.	Column B SERVICE FACTOR 1.0 MAX.	TRIP RATING (AMPERES)	DIP SWITCH SETTING (POSITIONS) (54321)
0.47	0.51	0.51	0.56	0.59	00000
0.52	0.56	0.57	0.61	0.65	00001
0.57	0.61	0.62	0.67	0.71	00010
0.62	0.68	0.68	0.74	0.78	00011
0.69	0.75	0.75	0.82	0.86	00100
0.76	0.82	0.83	0.89	0.95	00101
0.83	0.90	0.90	0.98	1.04	00110
0.91	1.00	0.99	1.09	1.14	00111
1.01	1.09	1.10	1.19	1.26	01000
1.10	1.21	1.20	1.31	1.38	01001
1.22	1.33	1.32	1.44	1.52	01010
1.34	1.46	1.45	1.59	1.67	01011
1.47	1.61	1.60	1.75	1.84	01100
1.62	1.77	1.76	1.93	2.02	01101
1.78	1.95	1.94	2.12	2.23	01110
1.96	2.14	2.13	2.33	2.45	01111
2.15	2.36	2.34	2.56	2.69	10000
2.37	2.60	2.57	2.82	2.96	10001
2.61	2.85	2.83	3.10	3.26	10010
2.86	3.14	3.11	3.42	3.58	10011
3.15	3.46	3.43	3.76	3.94	10100
3.47	3.81	3.77	4.14	4.34	10101

*** ALL SETTINGS NOT SHOWN ARE EQUIVALENT TO 00000.**

Replace the arc box cover securely after making selections.

TABLE 7-2 – SIZE 1 UPPER CURRENT RANGE

Column A SERVICE FACTOR 1.15 to 1.25 MIN.	Column A SERVICE FACTOR 1.15 to 1.25 MAX.	Column B SERVICE FACTOR 1.0 MIN.	Column B SERVICE FACTOR 1.0 MAX.	TRIP RATING (AMPERES)	DIP SWITCH SETTING * (POSITIONS) (54321)
3.15	3.46	3.43	3.75	3.93	00000
3.47	3.81	3.76	4.13	4.33	00001
3.82	4.19	4.14	4.55	4.77	00010
4.20	4.61	4.56	4.99	5.25	00011
4.62	5.0	5.0	5.4	5.77	00100
5.1	5.5	5.5	6.0	6.35	00101
5.6	6.0	6.1	6.5	6.9	00110
6.1	6.6	6.6	7.2	7.7	00111
6.7	7.3	7.3	8.0	8.5	01000
7.4	8.1	8.1	8.8	9.3	01001
8.2	8.9	8.9	9.6	10.2	01010
9.0	9.8	9.7	10.6	11.2	01011
9.9	10.8	10.7	11.7	12.4	01100
10.9	11.9	11.8	12.9	13.6	01101
12.0	13.1	13.0	14.2	15.0	01110
13.2	14.4	14.3	15.7	16.5	01111
14.5	15.8	15.8	17.2	18.1	10000
15.9	17.4	17.3	18.9	19.9	10001
17.5	19.2	19.0	20.9	21.9	10010
19.3	21.1	21.0	22.9	24.1	10011
21.2	23.2	23.0	25.2	26.5	10100
23.3	25.6	25.3	27.0	29.1	10101
25.7	27.0	—		32.1	10110

***ALL SETTINGS NOT SHOWN ARE EQUIVALENT TO 00000.**

Replace the arc box cover securely after making selections.

TABLE 7-3 – SIZE 2 CURRENT RANGE

Column A SERVICE FACTOR 1.15 to 1.25 MIN.	Column A SERVICE FACTOR 1.15 to 1.25 MAX.	Column B SERVICE FACTOR 1.0 MIN.	Column B SERVICE FACTOR 1.0 MAX.	TRIP RATING (AMPERES)	DIP SWITCH SETTING * (POSITIONS) (54321)
3.15	3.46	3.43	3.75	3.93	00000
3.47	3.81	3.76	4.13	4.33	00001
3.82	4.19	4.14	4.55	4.77	00010
4.20	4.61	4.56	4.99	5.25	00011
4.62	5.0	5.0	5.4	5.77	00100
5.1	5.5	5.5	6.0	6.35	00101
5.6	6.0	6.1	6.5	6.9	00110
6.1	6.6	6.6	7.2	7.7	00111
6.7	7.3	7.3	8.0	8.5	01000
7.4	8.1	8.1	8.8	9.3	01001
8.2	8.9	8.9	9.6	10.2	01010
9.0	9.8	9.7	10.6	11.2	01011
9.9	10.8	10.7	11.7	12.4	01100
10.9	11.9	11.8	12.9	13.6	01101
12.0	13.1	13.0	14.2	15.0	01110
13.2	14.4	14.3	15.7	16.5	01111
14.5	15.8	15.8	17.2	18.1	10000
15.9	17.4	17.3	18.9	19.9	10001
17.5	19.2	19.0	20.9	21.9	10010
19.3	21.1	21.0	22.9	24.1	10011
21.2	23.2	23.0	25.2	26.5	10100
23.3	25.6	25.3	27.8	29.1	10101
25.7	28.1	27.9	30.5	32.1	10110
28.2	31.0	30.6	33.7	35.3	10111
31.1	34.1	33.8	37.0	38.9	11000
34.2	37.5	37.1	40.7	42.8	11001
37.6	41.2	40.8	44.8	47.0	11010
41.3	45.0	44.9	45.0	51.6	11011

*** ALL SETTINGS NOT SHOWN ARE EQUIVALENT TO 00000.**

Replace the arc box cover securely after making selections.

TABLE 7-4 – SIZE 3 CURRENT RANGE

Column A SERVICE FACTOR 1.15 to 1.25 MIN.	Column A SERVICE FACTOR 1.15 to 1.25 MAX.	Column B SERVICE FACTOR 1.0 MIN.	Column B SERVICE FACTOR 1.0 MAX.	TRIP RATING (AMPERES)	DIP SWITCH SETTING* (POSITIONS) (54321)
9.9	10.8	10.8	11.7	12.4	00000
10.9	11.9	11.8	12.9	13.6	00001
12.0	13.1	13.0	14.2	15.0	00010
13.2	14.4	14.3	15.6	16.5	00011
14.5	15.8	15.7	17.2	18.1	00100
15.9	17.4	17.3	18.9	19.9	00101
17.5	19.2	19.0	20.9	21.9	00110
19.3	21.1	21.0	22.9	24.1	00111
21.2	23.2	23.0	25.2	26.5	01000
23.3	25.6	25.3	27.8	29.1	01001
25.7	28.1	27.9	30.6	32.1	01010
28.2	30.9	30.7	33.6	35.3	01011
31.0	34.1	33.7	37.0	38.8	01100
34.2	37.5	37.1	40.8	42.7	01101
37.6	41.3	40.9	44.9	47.0	01110
41.4	45.4	45.0	49.4	51.7	01111
45.5	50.0	49.5	54.3	56.9	10000
50.1	54.9	54.4	59.7	62.6	10001
55.0	60.5	59.8	65.7	68.8	10010
60.6	66.5	65.8	72.3	75.7	10011
66.6	73.2	72.4	79.6	83.3	10100
73.3	80.7	79.7	87.7	91.6	10101
80.8	88.7	87.8	90.0	101	10110
88.8	90.0	—		111	10111

***ALL SETTINGS NOT SHOWN ARE EQUIVALENT TO 00000.**

Replace the arc box cover securely after making selections.

TABLE 7-5 – SIZE 4 CURRENT RANGE

Column A SERVICE FACTOR 1.15 to 1.25 MIN.	Column A SERVICE FACTOR 1.15 to 1.25 MAX.	Column B SERVICE FACTOR 1.0 MIN.	Column B SERVICE FACTOR 1.0 MAX.	TRIP RATING (AMPERES)	DIP SWITCH SETTING* (POSITIONS) (54321)
9.9	10.8	10.8	11.7	12.4	00000
10.9	11.9	11.8	12.9	13.6	00001
12.0	13.1	13.0	14.2	15.0	00010
13.2	14.4	14.3	15.6	16.5	00011
14.5	15.8	15.7	17.2	18.1	00100
15.9	17.4	17.3	18.9	19.9	00101
17.5	19.2	19.0	20.9	21.9	00110
19.3	21.1	21.0	22.9	24.1	00111
21.2	23.2	23.0	25.2	26.5	01000
23.3	25.6	25.3	27.8	29.1	01001
25.7	28.1	27.9	30.6	32.1	01010
28.2	30.9	30.7	33.6	35.3	01011
31.0	34.1	33.7	37.0	38.8	01100
34.2	37.5	37.1	40.8	42.7	01101
37.6	41.3	40.9	44.9	47.0	01110
41.4	45.4	45.0	49.4	51.7	01111
45.5	50.0	49.5	54.3	56.9	10000
50.1	54.9	54.4	59.7	62.6	10001
55.0	60.5	59.8	65.7	68.8	10010
60.6	66.5	65.8	72.3	75.7	10011
66.6	73.2	72.4	79.6	83.3	10100
73.3	80.7	79.7	87.7	91.6	10101
80.8	88.7	87.8	96.4	101	10110
88.8	97.5	96.5	105	111	10111
97.6	106	106	116	122	11000
107	117	117	127	134	11001
118	129	128	133	147	11010
130	135	—		162	11011

***ALL SETTINGS NOT SHOWN ARE EQUIVALENT TO 00000.**

Replace the arc box cover securely after making selections.

TABLE 7-6 – SIZE 5 CURRENT RANGE

Column A SERVICE FACTOR 1.15 to 1.25 MIN.	Column A SERVICE FACTOR 1.15 to 1.25 MAX.	Column B SERVICE FACTOR 1.0 MIN.	Column B SERVICE FACTOR 1.0 MAX.	TRIP RATING (AMPERES)	DIP SWITCH SETTING* (POSITIONS) (54321)
38.3	41.9	41.7	45.6	47.9	00000
42.0	46.1	45.7	50.1	52.5	00001
46.2	51.0	50.2	55.5	57.7	00010
51.1	55.9	55.6	60.8	63.9	00011
56.0	61.7	60.9	67.1	70.0	00100
61.8	67.5	67.2	73.4	77.3	00101
67.6	74.9	73.5	81.4	84.5	00110
75.0	82.3	81.5	89.5	93.7	00111
82.4	90.3	89.6	98.2	103	01000
90.4	99.9	98.3	108	113	01001
100	109	109	118	125	01010
110	120	119	130	137	01011
121	132	131	143	151	01100
133	145	144	157	166	01101
146	159	158	173	182	01110
160	175	174	190	200	01111
176	193	191	209	220	10000
194	213	210	231	242	10001
214	233	232	254	267	10010
234	257	255	270	293	10011
258	270	—		322	10100

***ALL SETTINGS NOT SHOWN ARE EQUIVALENT TO 00000.**

Replace the arc box cover securely after making selections.

TABLE 7-7 – SIZE 6 CURRENT RANGE

Column A SERVICE FACTOR 1.15 to 1.25 MIN.	Column A SERVICE FACTOR 1.15 to 1.25 MAX.	Column B SERVICE FACTOR 1.0 MIN.	Column B SERVICE FACTOR 1.0 MAX.	TRIP RATING (AMPERES)	DIP SWITCH SETTING* (POSITIONS) (54321)
38.3	41.9	41.7	45.6	47.9	00000
42.0	46.1	45.7	50.1	52.5	00001
46.2	51.0	50.2	55.5	57.7	00010
51.1	55.9	55.6	60.8	63.9	00011
56.0	61.7	60.9	67.1	70.0	00100
61.8	67.5	67.2	73.4	77.3	00101
67.6	74.9	73.5	81.4	84.5	00110
75.0	82.3	81.5	89.5	93.7	00111
82.4	90.3	89.6	98.2	103	01000
90.4	99.9	98.3	108	113	01001
100	109	109	118	125	01010
110	120	119	130	137	01011
121	132	131	143	151	01100
133	145	144	157	166	01101
146	159	158	173	182	01110
160	175	174	190	200	01111
176	193	191	209	220	10000
194	213	210	231	242	10001
214	233	232	254	267	10010
234	257	255	279	293	10011
258	282	280	307	322	10100
283	311	308	338	354	10101
312	342	339	372	390	10110
343	376	373	409	429	10111
377	414	410	450	471	11000
415	456	451	496	519	11001
457	501	497	540	571	11010
502	540	—		628	11011

***ALL SETTINGS NOT SHOWN ARE EQUIVALENT TO 00000.**

Replace the arc box cover securely after making selections.

NOTE: Select overload protection setting for Part Winding and Wye-Delta starters after applying the correction factors shown below:

1 - Part Winding (PW) – FLA X 0.5
2 - Wye-Delta (Y-D) – FLA X 0.57

Part 8
INSPECTION PRIOR TO ENERGIZING

1. Before energizing the motor control center (MCC), conduct a thorough inspection to make certain that all foreign materials such as tools, scraps of wire and other debris are removed from all units and the structure. Remove any accumulation of dust and dirt with a vacuum cleaner.

2. All circuit connections are tightened at time of assembly by power driven tools with controlled torque. However, the vibrations experienced in transit may loosen some of these connections. Check at least 10% of the total connections for a tight connection. **Should this spot check reveal some loose connections, it will be necessary to check all connection points.** The connections to be checked include bus hardware, circuit breaker and switch terminals, contactor and relay terminals and terminal blocks. Always check the incoming line connections. Tighten to the torque values shown in Table 8-1.

3. Remove all blocks or other temporary holding means used for shipment from all component devices in the MCC interior.

4. Check the enclosure to see that it has not been damaged so as to reduce electrical spacings.

5. Compare all circuits for agreement with the wiring diagrams which accompany the MCC. Be sure that each motor is connected to its intended starter.

6. Make certain that field wiring is clear of live busses and physically secured to withstand the effects of fault current.

7. Check to determine that all grounding connections are made properly.

8. Check all devices for damage. Make all necessary repairs or replacements, prior to energizing.

9. Manually exercise all switches, circuit breakers, and other operating mechanisms to make certain that they are properly aligned and operate freely.

10. Test any ground-fault protection systems that were furnished.

11. Set any adjustable current and voltage trip mechanisms to the proper values. See Part 7.

12. Install power circuit fuses in the fusible switches in accordance with NEC application requirements. Make sure that fuses are completely inserted in the clips provided. Do not attempt to defeat the rejection feature on the fuse clip, when provided.

13. Do not operate a current transformer with its secondary circuit open. Insure current transformer is connected to a load, or a secondary shorting bar is installed.

14. To prevent possible damage to equipment or injury to personnel, check to insure that all parts and barriers that may have been removed during wiring and installation have been properly reinstalled.

15. Conduct an electrical insulation resistance test to make sure that the MCC and field wiring are free from short circuits and grounds. Do this test phase-to-phase, phase-to-ground, and phase-to-neutral, with the switches or circuit breakers opened.

16. The MCC contains a labyrinth vertical bus barrier system, verify the operation of the automatic shutters. See Part 9 for adjustments of this mechanism.

17. Install covers, close doors, and make certain that no wires are pinched and that all enclosure parts are properly aligned and tightened.

18. Turn all circuit breakers and fusible switches to the OFF position before energizing the bus.

TABLE 8-1 DRIVING TORQUE

Control Wiring:	
Coil Leads	6 lb.-in.
Relays	8 lb.-in.
Push Buttons	8 lb.-in.
Control Fuse Blocks	8 lb.-in.
Auxiliary Contacts	7 lb.-in.
Terminal Blocks	12 lb.-in.
Power Wiring:	
Size 1 Starter	18-20 lb.-in.
Size 2 Starter	45-50 lb.-in.
Size 3 Starter	90-100 lb.-in.
Size 4 Starter	90-100 lb.-in.
Size 5 Starter	300 lb.-in.
Size 6 Starter	300 lb.-in.
30 Amp Fuse Assy	25 lb.-in.
60 Amp Fuse Assy	50 lb.-in.
100 Amp Fuse Assy	50 lb.-in.
200 Amp Fuse Assy	300 lb.-in.
400 Amp Fuse Assy	300 lb.-in.
600 Amp Fuse Assy	300 lb.-in.
150 Amp Frame Bkr 250 Amp Frame Bkr 400 Amp Frame Bkr 600 Amp Frame Bkr 800 Amp Frame Bkr 1200 Amp Frame Bkr	Refer to Torque Values on Circuit Breaker Case
Incoming Line Lugs:	
#2/0- 350 MCM	360 lb.-in.
#2/0- 650 MCM	360 lb.-in.
#2/0- 750 MCM	500 lb.-in.
500-1000 MCM	600 lb.-in.
Bus Bolts:	
All	275 lb.-in (23 lb.-ft.)

Part 9
UNIT INSTALLATION AND ADJUSTMENT

DOOR REMOVAL AND INSTALLATION

All doors on the control center are mounted on pin hinges to facilitate removal for installation and maintenance operations. With the operating handle in the OFF position, rotate the quarter-turn latches, open the door, remove the hinge pins as shown in Figure 22, partially close the door and lift it from the structure. Reverse this procedure for installation.

UNIT REMOVAL AND INSTALLATION

After opening and/or removing the unit door, the control unit is exposed. With a screwdriver, push in on the latch at the top center of the unit and rotate 1/4 turn counterclockwise. **CAUTION**—Units 18" or more high have a retaining brace at the lower edge of each side of the unit frame to add stability in shipping. The shipping braces may be retained or removed after installation, unscrew prior to unit withdrawal. Pull-apart terminal blocks in the vertical wireway must be disengaged (see Figure 23 and page 10) and wiring from the unit to other units, to master terminal blocks or to load devices must be disconnected before the unit is removed. Grasp the unit as shown in Figure 24 and pull it outward. The first inch of travel pulls the stabs free from the vertical bus, and the grounding clip on the side of the unit frame is also disengaged.

To replace a control unit, position the mounting points on the unit frame with the mating guide rails. Slide the unit inward until all four mounting points are engaged, then move it inward with a quick push. This movement easily overcomes the compression of the stabs as they engage the vertical bus. With the unit in its correct position, the quarter-turn latch is easily engaged by pushing inward and rotating 1/4 turn clockwise.

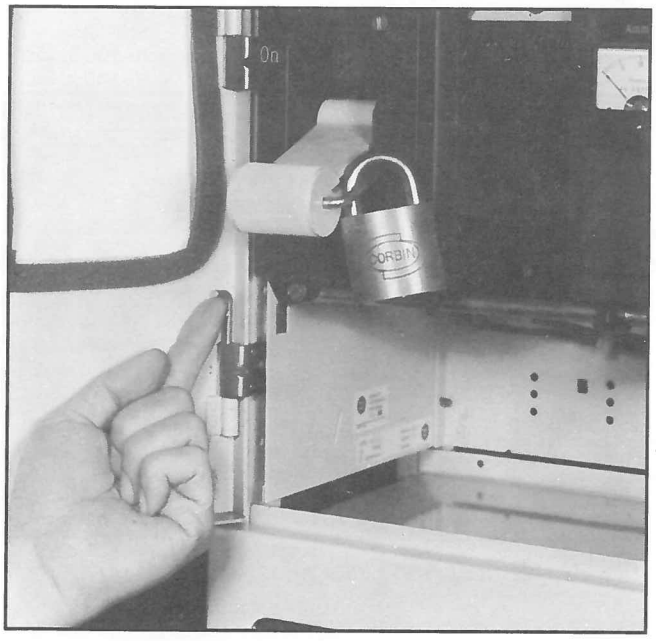


Fig. 22 Hinge Pin Removal

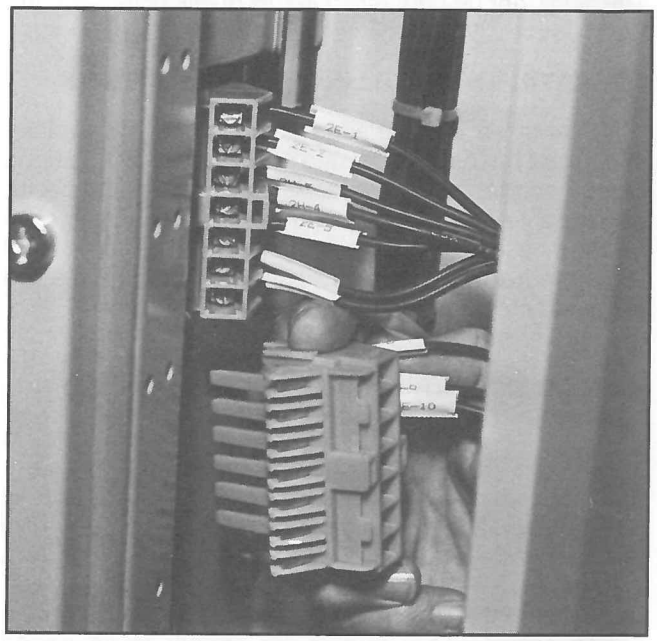


Fig. 23 Disengaging Pull-Apart Terminal Blocks

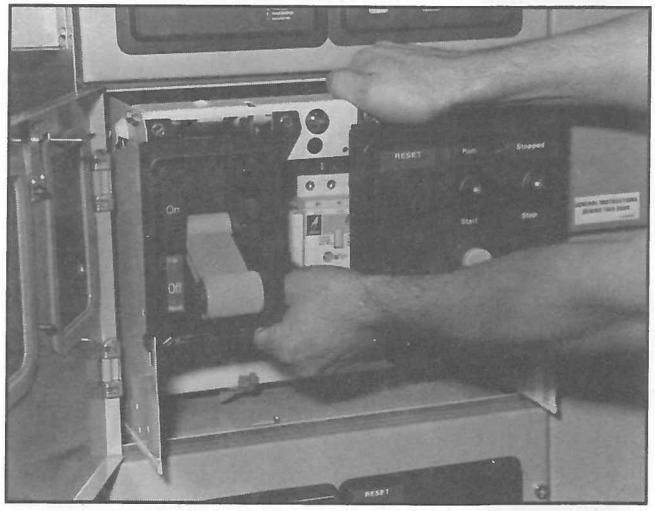


Fig. 24 Withdrawing a Unit

DETENT POSITION

For maintenance and test purposes, the unit can be partially withdrawn (approximately 1 1/2 inches) until the stabs are free of the bus. In this position, the quarter-turn latch can be rotated clockwise to engage the detent position slot, this will secure the unit to ensure the stabs remain disengaged during maintenance. See Figure 25. The latch can be padlocked in this position.

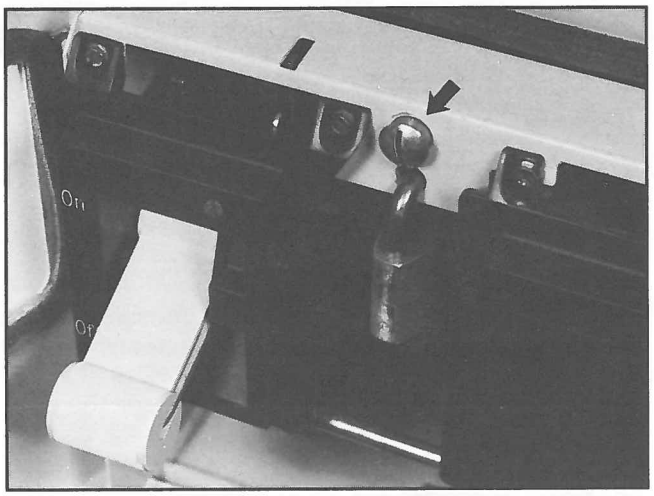


Fig. 25 Unit Locked in Detent Position

OPERATING HANDLE LINKAGE ADJUSTMENT

Movement of the operating handle in the vertical plane should not be restricted by the handle cavity at either the top or bottom of its travel. Should restriction occur, eliminate it adjusting the length of the operating linkage as shown in Figure 26. Depending on the type of primary disconnect device contained in the control unit, it may be necessary to lengthen or shorten the linkage.

AUTOMATIC SHUTTER TRAVEL ADJUSTMENT

When the optional labyrinth vertical bus barrier is installed in the control center, a shutter is provided to automatically cover the stab openings when a control unit is withdrawn. The shutter is opened by engagement of the left hand side of the control unit with the shutter arm linkage attached to the left hand vertical structural members. When the unit is withdrawn free of the linkage, a spring automatically moves the shutter to its closed position. See Figure 27 and Figure 4.

With the control unit removed, the shutter should completely cover the stab openings. If it does not cover the openings, use an adjustable wrench to bend the link arm to the right until the shutter covers the stab openings.

If, on re-insertion of the control unit, interference is felt between the stab assembly at the rear of the unit and the shutter, the engagement of the control unit with the shutter arm linkage is insufficient to fully open the shutter. Use an adjustable wrench to bend the linkage arm inward toward the unit to increase its engagement with the unit. An inward bend of approximately 1/4 inch will provide sufficient additional shutter travel.

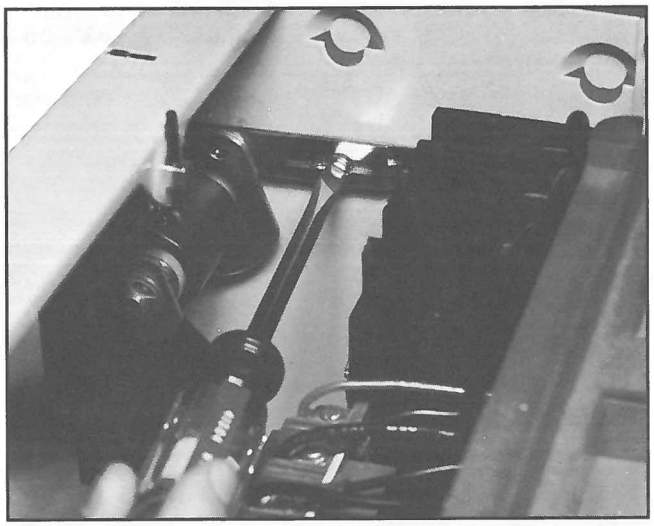


Fig. 26 Operating Handle Linkage Adjustment

INSTALLING PILOT DEVICES

The device panel can accommodate up to six pilot devices such as oil-tight push-buttons, indicating lights, selector switches and miniature meters. If unused space is available and the addition of other devices is desired, observe the following procedure.

After opening the unit door, loosen the two screws at the top of the device panel. Slide the panel 1/2 inch left to permit it to swing down for access. See Figure 28. With the peen end of a ball-peen hammer or with a drift or chisel, remove the desired knockout.

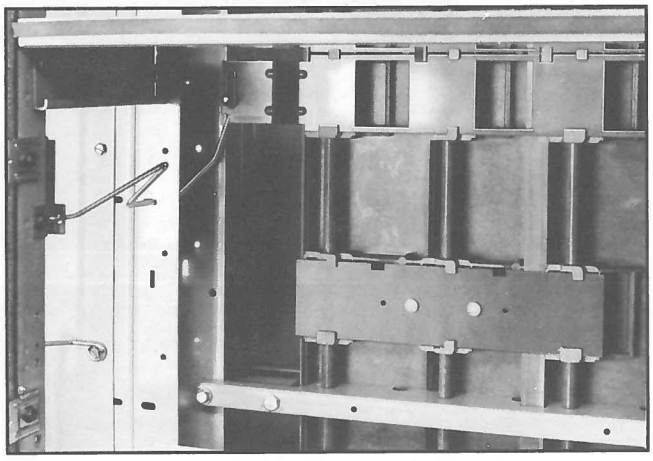


Fig. 27 Shutter Arm Linkage

CAUTION — Brace the panel solidly to avoid breaking the hinge points. Use a knife or small file to remove remaining plastic burrs. Install and wire the new device and re-attach the top of the device panel to the unit.

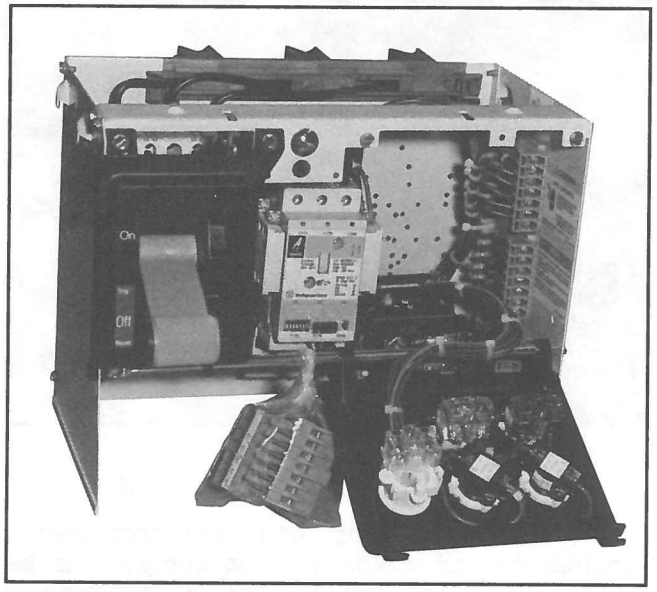


Fig. 28 Unit Device Panel

INSTALLING A NEW UNIT

It is recommended that a new unit be installed in a unit space at the top of a vertical compartment or directly below an existing unit. Material provided with the new unit by the factory includes: a divider pan with integral guide rails, a unit door, hinges, catches and hardware. Observe the following sequence of operations for installation.

1. Remove the existing blank door.

2. Position the new unit door over the open space to ensure the hinges and latches are aligned. If the spaces differ, the hinges and latches on the structure must be re-located to match the unit door hinges and latches. Mount the door, using the hinge pins provided.

3. Install the new divider pan in the notches provided in the rear barrier so that it is aligned with the bottom of the new door. Attach the pan to the vertical structure channels with one thread-forming screw on each side.

4. Install an automatic shutter over the stab cutouts. Follow the instruction sheet provided with the shutter kit.

Part 10
MAINTENANCE

PREVENTIVE MAINTENANCE

Preventive maintenance should be a program, a scheduled periodic action that begins with the installation of the equipment. At that time, specific manufacturer's instruction literature should be consulted, then stored for future reference. Follow-up maintenance should be at regular intervals, as frequently as the severity of duty justifies. Time intervals of one week, or one month, or one year may be appropriate, depending on the duty. It is also desirable to establish specific check lists for each control, as well as a logbook to record the history of incidents. A supply of renewal parts should be obtained and stored.

This control equipment 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.

Authorized personnel may open a unit door of a motor control center (MCC) while the starter unit is energized. This is accomplished by defeating the mechanical interlock between the operating mechanism and the unit door. A clockwise quarter-turn of the slotted head screw located above operating handle will allow the door to open. See Figure 29.

When servicing and adjusting the electrical equipment, refer to the applicable drawings covering the specific motor control center (MCC) and any other related interconnection drawings. Follow any instructions which may be given for each device. A list of instruction leaflets covering standard components is shown on the back page of this manual. Any of these leaflets may be obtained by contacting your nearest Westinghouse Representative.

General guidelines. The whole purpose of maintaining electrical equipment can be summarized in two rules:

a. Keep those portions conducting that are intended to be conducting.

b. Keep those portions insulated that are intended to be insulated.

Good conduction requires clean tight joints free of contaminants such as dirt and oxides.

Good insulation requires the absence of carbon tracking and the absence of contaminants such as salt and dust that become hydroscopic and provide an unintended circuit between points of opposite polarity.

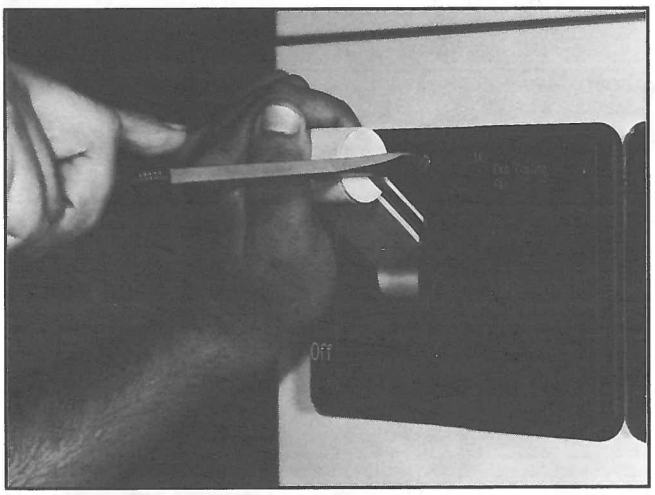


Fig. 29 Defeater Mechanism

CAUTION: Maintenance of control components requires that all power to these components be turned OFF by opening the branch circuit disconnect means and withdrawing the unit to the detent position (see Figure 25) or removing the unit entirely from the MCC. **When units are fully inserted into the MCC, the line side of each disconnect is energized. Do not work on fixed units unless the main disconnect for the MCC is OFF.**

When working on portions of a branch circuit remote from the MCC, lock the disconnect means for that circuit in the OFF position. To positively lock the operating mechanism in the OFF position, a metal locking bar recessed in the handle may be extended and padlocked with from one to three padlocks. See Figure 30.

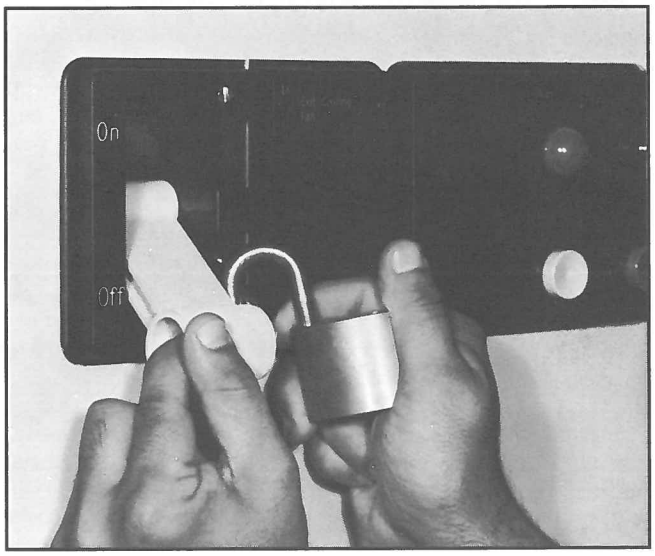


Fig. 30 Locking Out a Disconnect

With the door open and the disconnect device OFF, the operating handle is mechanically interlocked to prevent inadvertently being pushed ON. To defeat this interlock, the bar on the top of the mechanism should be pushed in slightly, allowing the handle to move upward to the ON position. WARNING: If fully inserted, the power and control circuits will be energized. Padlocking to prevent this handle movement may be accomplished by the same method as described above.

Separate control sources of power must also be disconnected. If control power is used during maintenance, take steps to prevent feedback of a hazardous voltage through a control transformer. Be alert to power factor correction capacitors that may be charged. Discharge them before working on any part of the associated power circuit.

Cleaning. Soot, smoke, or stained areas (other than inside arc chutes), or other unusual deposits, should be investigated and the source determined before cleaning is undertaken. Vacuum or wipe clean all exposed surfaces of the control component and the inside of its enclosure. Equipment may be blown clean with compressed air that is dry and free from oil. (Be alert to built-in oilers in factory compressed air lines!) If air blowing techniques are used, remove arc covers from contactors and seal openings to control circuit contacts that are present. It is essential that the foreign debris be removed from the control center, not merely rearranged. Control equipment should be clean and dry. Remove dust and dirt inside and outside the cabinet without using liquid cleaner. Remove foreign material from the outside top and inside bottom of the enclosure, including hardware and debris, so that future examination will reveal any parts that have fallen off or dropped onto the equipment. If there are liquids spread inside, determine the source and correct by sealing conduit, adding space heaters, or other action as applicable.

Mechanical checks. Tighten all electrical connections. Look for signs of overheated joints, charred insulation, discolored terminals, etc. Mechanically clean to a bright finish (don't use emery paper) or replace those terminations that have become discolored. Determine the cause of the loose joint and correct. Be particularly careful with aluminum wire connections. Aluminum wire is best terminated with a crimp type lug that is attached to the control component. When screw type lugs (marked CU/AL) are used with aluminum wire, joints should be checked for tightness every 200 operations of the device.

Wires and cables should be examined to eliminate any chafing against metal edges caused by vibration, that could progress to an insulation failure. Any temporary wiring should be removed, or permanently secured and diagrams marked accordingly.

The intended movement of mechanical parts, such as the armature and contacts of electromechanical contactors, and mechanical interlocks should be checked for freedom of motion and functional operation.

Wrap-up. Check all indicating lamps, mechanical flags, doors, latches, and similar auxiliaries and repair, if required.

Log changes and observations into record book before returning equipment into service. Do not remove any labels or nameplates. Restore any that are damaged.

CONTACT WEAR AND REPLACEMENT

Contactors are subject to both mechanical and electrical wear during their operation. In most cases mechanical wear is insignificant. The erosion of the contacts is due to electrical wear. During arcing, material from each contact is vaporized and blown away from the useful contacting surface.

A critical examination of the appearance of the contact surfaces and a measurement of the remaining contact overtravel will give the user the information required to get the maximum contact life.

OVERTRAVEL MEASUREMENT

Contact life has ended when the overtravel of the contacts has been reduced to .020 inch.

Overtravel of the contact assembly is that part of the stroke which the moving contacts would travel after touching the fixed contacts, if they were not blocked from movement by the fixed contacts.

A method of measuring overtravel is as follows:

A. Place a .020 inch feeler gauge between the armature and magnet, with the armature held tightly against the magnet.

B. Check continuity in each phase, i.e., determine if circuit from terminal-to-terminal for each pole is open under these conditions.

C. If there is continuity through all phases, the remaining overtravel is sufficient. If there is not continuity through all phases, replace all stationary and moving contacts plus moving contact overtravel springs. After replacing parts, manually operate contactor to be sure binding does not occur.

CONTACTOR TROUBLESHOOTING CHART

Defect	Cause	Remedy
Short contact life	Low contact force	Adjust overtravel, replace contacts, and replace contact springs as required to correct contact force.
	Contact bounce on opening or closing	Correct improper voltage applied to coil. Correct any mechanical defects or misalignment.
	Abrasive dust on contacts	Do not use emery cloth to dress contacts.

CONTACT EVALUATION

Time of Service	Contact Appearance
New	The new contact has a uniform silver color.
Start of Service	The contact surface will have a blue coloring. The geometric form of the contact is unchanged. The sharp outer corners will be rounded with small silver beads. (See Figure 31.)
Intermediate Service to End of Service Life	The coloring changes to brown or black with distributed small silvery white areas. The surface has a finely chiselled appearance. Material transfer causes small peaks and valleys in the contact button surface. (See Figure 32.)

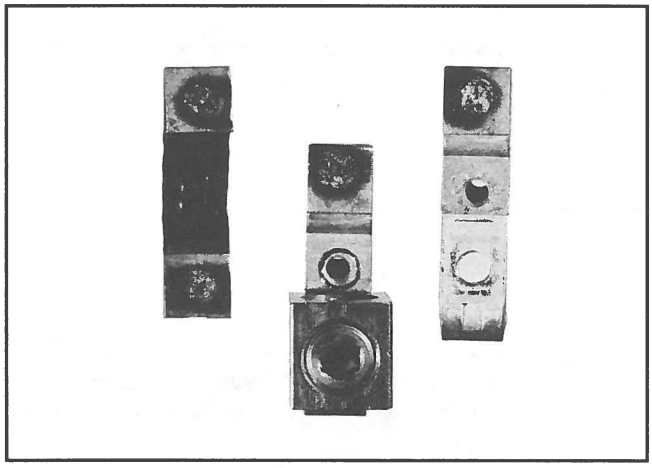


Fig. 31 Normal Service Wear

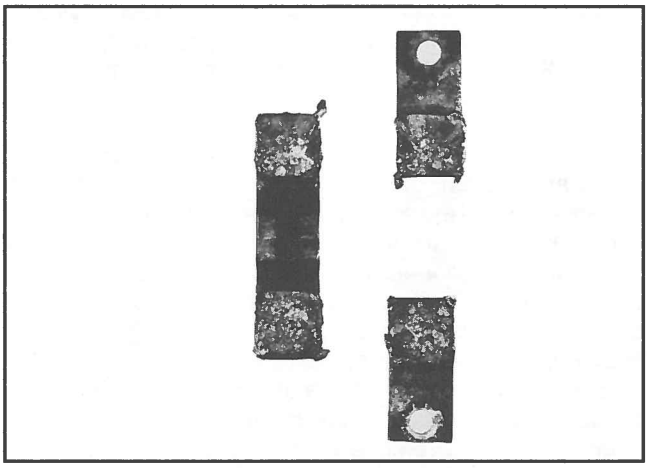


Fig. 32 End of Service Life

ABNORMAL WEAR CONDITIONS

Contact Appearance	Cause
Curling and Separation of Corner of Contact	Curling is usually a result of service that produces very high heat, as under jogging or inching duty.
Irregular Contour or Slantwise Wear	One corner of a contact may wear more quickly than the other three corners. This wear is normally due to misalignment of the moving and stationary contacts. Contacts should be replaced if it is apparent that one contact is nearly making direct contact with the contact carrier.
Large Beads of Silver on Edges of Contacts	Breaking an excessive current.
Welded Spot (Core of Smooth, Shining Silver Surrounded by a Roughened Halo)	Making an excessive current. High frequency of operation, i.e., jogging.

CONTACTOR TROUBLESHOOTING CHART (Cont.)

Defect	Cause	Remedy
Short contact life (cont.)	Load current is too high	Reduce load. Use larger contactor.
	Jogging cycle is too severe	Reduce jogging cycle. Check factory for more durable contact material. Use larger contactor.
Overheating	Load current too high	Reduce load. Use larger contactor.
	Loose connections	Clean discolored or dirty connections and retighten. Replace poorly crimped lugs.
	Overtravel and/or contact force too low	Adjust overtravel, replace contacts, and replace contact springs as required to correct defect.

CONTACTOR TROUBLESHOOTING CHART

Defect	Cause	Remedy
Overheating (cont.)	Ambient temperature is too high.	Reduce load. Provide better ventilation. Relocate starter. Use larger contactor.
	Line and/or load cables are too small	Install terminal block and run larger conductors between contactor and terminal block.
Poor arc interruption	Arc box not in place	Install arc box.
	Arc box damaged	Replace broken or eroded insulating parts, arc horns, and grid plates. Clean or replace insulating parts having a heavy coating of foreign conducting material.
	Dirt or paint on arc horns or steel-grid plates	Remove contaminating materials which may have accumulated on arc horns and steel-grid plates.
Welding of contacts	Overtravel and/or contact force is too low	Adjust overtravel, replace contacts, and replace contact springs as required to correct defect.
	Magnet armature stalls or hesitates at contact touch point	Correct low voltage at coil terminals as coil draws inrush current.
	Contactor drops open to contact-touch position because of voltage dip	Maintain voltage at coil terminals. Install low voltage protective device, sometimes called "Brownout Protector."

CONTACTOR TROUBLESHOOTING HINTS

If the controller does not operate as expected, check the following:

(a) All control power to terminals 3-P-E-C must be supplied from the same phase.

(b) Terminal P must be energized to permit the contactor to pickup.

(c) Terminals E and C must be energized to obtain a tripped indication.

(d) A starter in a tripped condition caused by a phase-loss or a ground-fault must be reset with control power ON.

(e) Each DIP switch handle must be in the full ON or full OFF position.

A Type WCMU central monitoring unit can be of great assistance in troubleshooting.

CONTACTOR TROUBLESHOOTING CHART

Defect	Cause	Remedy
Welding of contacts (cont.)	Excessive contact bounce on closing	Correct coil overvoltage condition.
	Contacts rebound to contact-touch position when opening	Correct mechanical defect in stop assembly. Correct mechanical defect in latch if one is used.
	Poor contact alignment	Adjust contacts to touch simultaneously within 1/32 inch.
	Jogging duty is too severe	Reduce jogging cycle. Check factory for more weld-resistant contact material. Use larger contactor.
	Excessive inrush current	Motor has locked rotor code letter greater than G. Most contactors are designed for motors with code letters A through G. Therefore, use larger contactor. Check factory for more weld-resistant contact material.
	Vibration in starter mounting	Move starter to location having less shock and vibration. Insulate starter from shock and vibration. Provide more rigid support for starter.

CONTROL POWER AND TERMINALS

Advantage motor controllers require a constant source of control power to operate and indicate a tripped condition. Loss of control power or a severe drop in control voltage will cause an Advantage motor controller to open.

The location and function of each control terminal are shown below:

3 = Terminal to which the START signal must be delivered
P = Terminal which must be energized to permit operation
E = Ungrounded side of control power source
C = Grounded (common) side of control power source

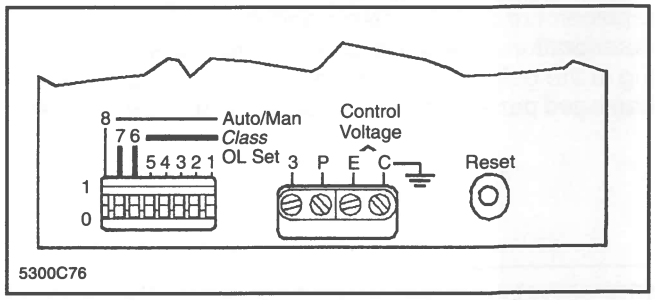


Fig. 33 DIP Switch, Terminals and Reset

MAINTENANCE OF MOTOR CONTROLLERS AFTER A FAULT†

In a motor branch circuit which has been properly installed, coordinated and in service prior to the fault, opening of the branch-circuit short-circuit protective device (fuse, circuit breaker, motor short-circuit protector, etc.) indicates a fault condition in excess of operating overload. This fault condition must be corrected and the necessary repairs or replacements made before reenergizing the branch circuit.

It is recommended that the following general procedures be observed by qualified personnel in the inspection and repair of the motor controller involved in the fault.

Procedure: Caution: All inspections and tests are to be made on controllers and equipment which are deenergized, disconnected and isolated so that accidental contact cannot be made with live parts and so that all plant safety procedures will be observed.

Enclosure. Substantial damage to the unit door or frame such as deformation, displacement of parts or burning, requires replacement of the entire unit.

Circuit breaker. Examine the unit interior and the circuit breaker for evidence of possible damage. If evidence of damage is not apparent, the breaker may be reset and turned ON. If it is suspected that the circuit breaker has opened several short-circuit faults or if signs of circuit breaker deterioration appear within the enclosure, the circuit breaker should be replaced.

Disconnect switch. The external operating handle of the disconnect switch must be capable of opening the switch. If the handle fails to open the switch or if visual inspection after opening indicates deterioration beyond normal wear and tear, such as overheating, contact blade or jaw pitting, insulation breakage or charring, the switch must be replaced.

Fuse holders. Deterioration of fuse holders or their insulating mounts requires their replacement of damaged parts.

Terminals and internal conductors. Indications of arcing damage and/or overheating such as discoloration and melting of insulation require the replacement of damaged parts.

Contactor. Contacts showing heat damage, displacement of metal, or loss of adequate wear allowance require replacement of the contacts and the contact springs. If deterioration extends beyond the contacts, such as binding in the guides or evidence of insulation damage, the damaged parts or the entire contactor must be replaced.

TABLE 10-1— RENEWAL PARTS

Description	Order
Replacement Contacts, Size 1*	WCK13
Replacement Contacts, Size 2*	WCK23
Replacement Coil, 110-120V, Size 1-2	1A96633G01
Replacement Contacts, Size 3*	WCK33
Replacement Contacts, Size 4*	WCK43
Replacement Coil, 110-120V, Size 3-4	1A48101G01
Replacement Contacts, Size 5*	WCK53
Replacement Contacts, Size 6*	WCK63
Replacement Coil, 110-120V, Size 5-6	1A96712G01
DIP Switch Windows (Pkg. of 10)	WDIPSW10

Replacement Printed Circuit Board Assemblies are ordered by description: Size, Class, Control Volts/Freq., Protection Features.

*These kits include contacts, screws, and crossbar assembly with armature attached.

TABLE 10-2 — AUXILIARY CONTACTS AND TIE POINTS

Contacts	Tie Points	Cat. No.
1 NO & 1 NC	2	W11T
1 NO & 3 NC	0	W13
2 NO & 2 NC	0	W22
3 NO & 1 NC	0	W31
4 NO	0	W40
4 NO	0	W04

NO = Normally-Open, NC = Normally-Closed

TABLE 10-3 — ACCESSORIES

Description	Catalog Number
External (remote) Reset for W200, 24-in. Leads*	WRSK24
External (remote) Reset for W200, 72 -in. Leads*	WRSK72
External (remote) Reset/Trip Indicator for W200, 24-in. Leads	WRSKL24
External (remote) Reset/Trip Indicator for W200, 72-in. Leads	WRSKL72
Communications Module — Data, Status and Control	WPONI
Communications Module – Status and Control	WCTLPONI
Central Monitoring Unit to Receive WPONI output	WCMU
Alarm Module with one NO Contact	WBNOC

*There is no trip indication available when this accessory is used, other than via a communications network.

†Reproduced by permission of the National Electrical Manufacturers Association from NEMA Standards Publication No. ICS 2-1978 (R1983), Industrial Control Devices, Controllers and Assemblies, copyright 1978 by NEMA.

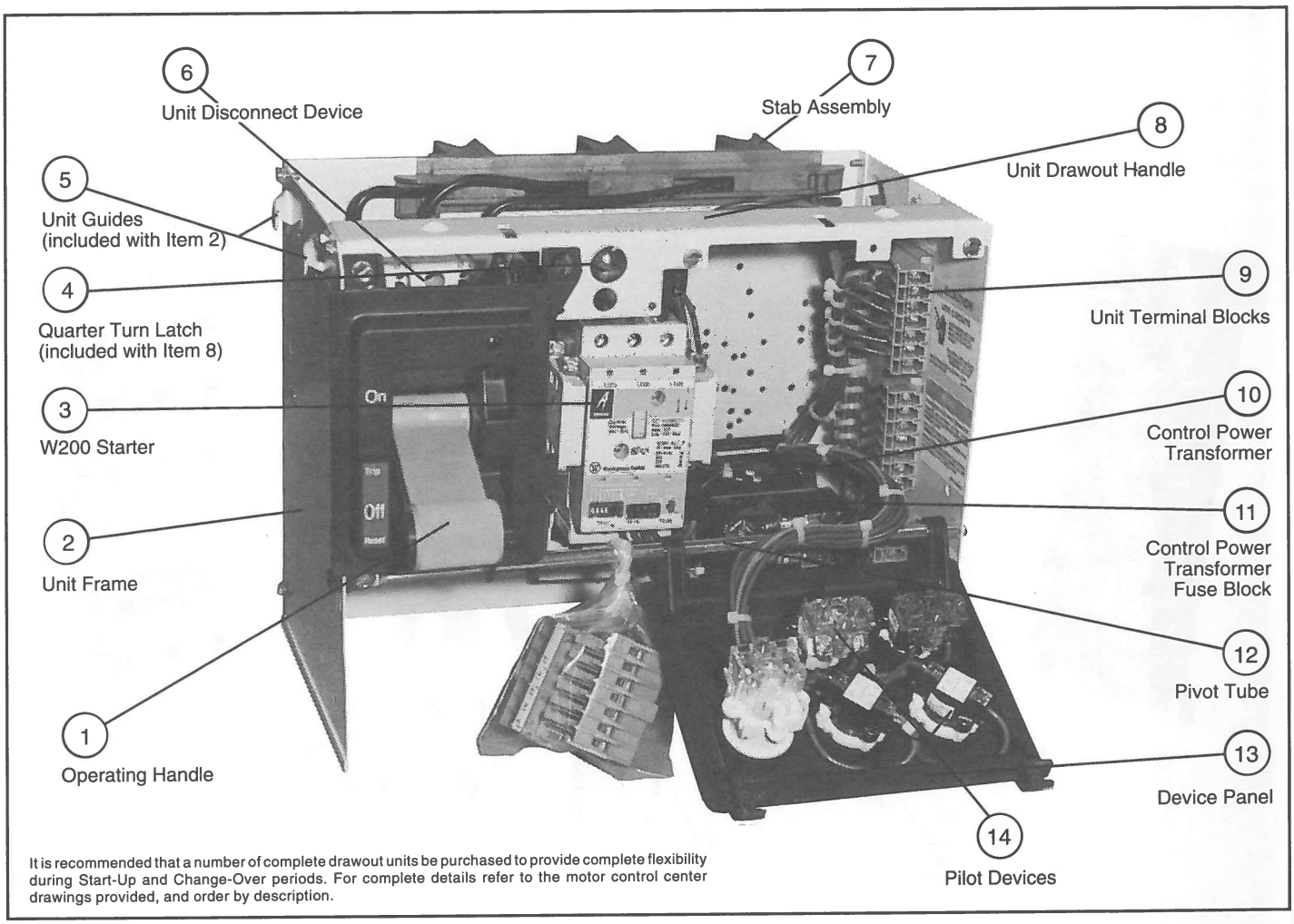


Fig. 34 Control Center Unit Nomenclature

Return to service. Before returning the controller to service, checks must be made for the tightness of electrical connections and for the absence of short circuits, grounds and leakage.

All equipment enclosures must be closed and secured before the branch circuit is energized.

RENEWAL PARTS

When ordering renewal control center parts, give the complete nameplate reading. Always give the name of the part wanted, the part, catalog or style number of the individual apparatus on which it is to be used, and the order number of the complete motor control center.

STARTER TYPE	Unit Catalog Number Designation (Class)		
Disconnect Means:	Fusible	Circuit Breaker	Circuit Breaker With Current Limiter
Description			
Full Voltage, Non-Reversing	W204	W206	W207
Full Voltage, Reversing	W214	W216	W217
Reduced Voltage, Autotransformer Type	W604	W606	W607
Reduced Voltage, Part Winding Type	W704	W706	W707
Full Voltage, Non-Reversing, 2-Speed, 2 Windings	W964	W966	W967
Full Voltage, Non-Reversing, 2-Speed, 1-Winding, Constant HP	W974	W976	W977
1-Winding, Constant or Variable Torque	W984	W986	W987
Reduced Voltage, Closed Transition Star-Delta	W894	W896	W897

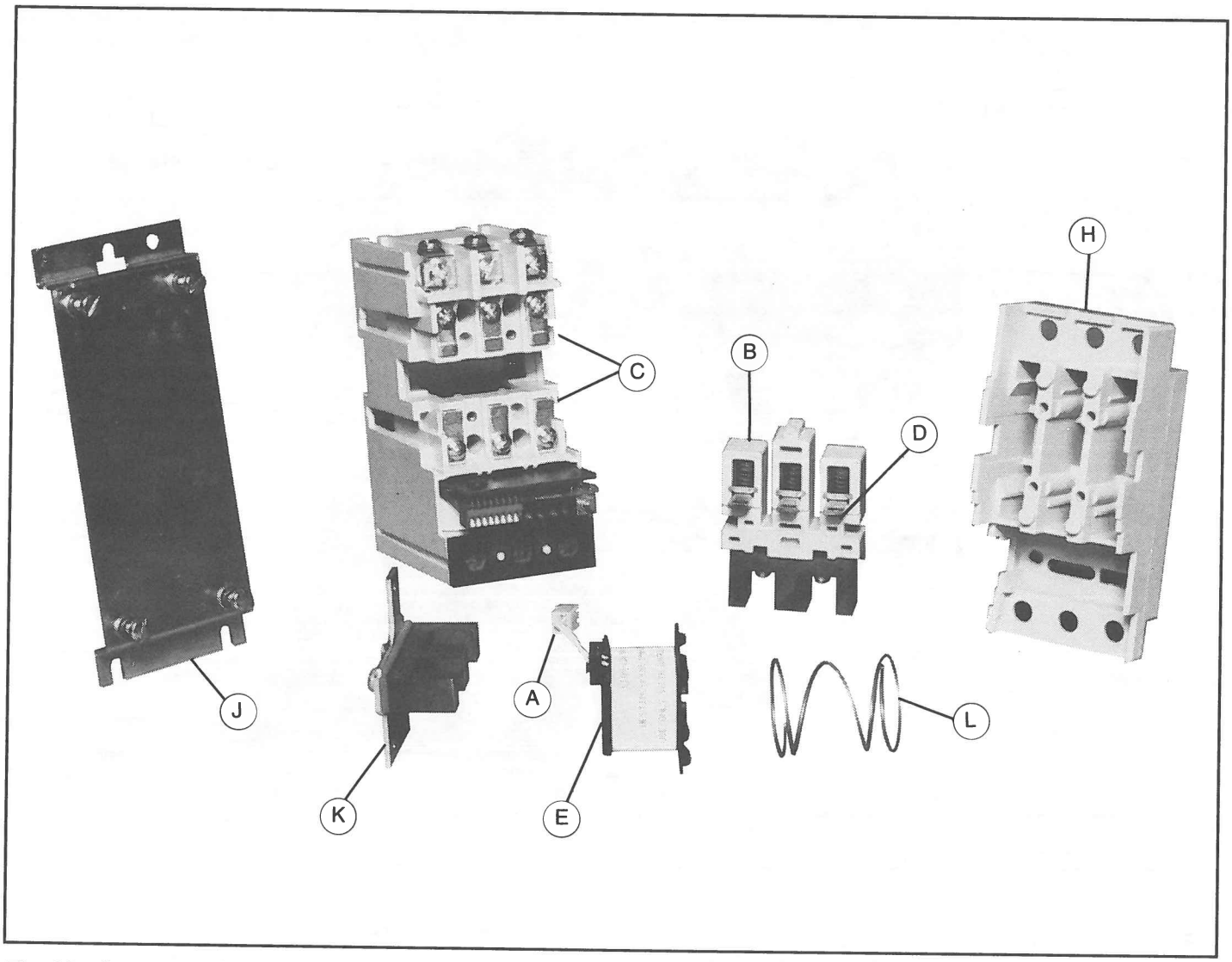


Fig. 35 Size 1 W200 Starter (Exploded View)

RENEWAL PARTS (Cont.)

Control center renewal parts identified by part or style number are detailed in Westinghouse Publication 8991, Renewal Parts Data. The nomenclature to identify these parts is shown in Figures 2 and 34. The most common renewal parts for components are shown in Figure 35 and on page 26. Structure parts are the same as Series 2100.

CONTACTS AND COILS

The contactors which serve as the magnetically operated switches in each of the motor control units are designed for convenient maintenance, with direct access to contacts and coils for easy inspection and replacement. Figure 35 shows an exploded view of a Size 1 contactor, representative of Sizes 1 through 4. The same principles of disassembly apply to Sizes 5 and 6. Devices larger than Size 1 have larger terminals and larger contacts. See the instruction leaflet for each controller for more information. (See back page).

FOR ALL MAINTENANCE – First Turn Off Power

Failure to completely disconnect the motor controller from all communications networks and power sources, including control circuit power, prior to inspection may result in severe injury or death.

This industrial controller 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.

TABLE 10-5 — WIRING DATA

Controller Size	Circuit Conductor	Wire Range (AWG)	Tightening Torque (lb.-in.)
1	Power	#14–8	18–20
2	Power	#14–4	45–50
1 & 2	Aux. Contact	#22–12	7
1 & 2	Control	#18–14*	6
3 & 4	Power	#14–250 kcmil	90-100
3 & 4	Auxiliary Contact	#22–12	7
3 & 4	Control	#18–14*	6
5	Power	1 – #00–500 kcmil	300-375
6	Power	2 – #00–500 kcmil	225-300
5 & 6	Auxiliary Control	#22–12	7
5 & 6	Control	#18–14*	6

Wire with copper conductors only. Use wire rated 75°C or higher, based on the ampacity of 75°C wire.

* Strip control wires for terminals 3-P-E-C not more than 1/4 inch.

To Inspect Contacts:

Refer to Figure 35: Loosen the two captive arc box cover screws accessible through holes in the nameplate and remove the arc box cover (H). Remove the crossbar (B) assembly containing the movable contacts. Stationary contacts (C) and movable contacts (D) are visible. The silver-cadmium-oxide contacts need NO dressing or lubricant throughout their life. **Important** — Replace all contacts, springs and crossbar as a group to avoid misalignment.

To Replace Contacts:

With the crossbar assembly removed, remove the two stationary contacts per pole. Discard all old parts, including the magnet armature attached to the old crossbar. Reverse the procedure to reassemble, tightening the new stationary contact screws that hold the new stationary contacts in place to a torque of 12-18 lb.-in. Replace the crossbar (B) assembly and arc box. Tighten the arc box cover screws to 7-10 lb.-in.

To Replace the Coil:

Refer to Figure 35. Loosen the two captive arc box cover screws and remove the arc box cover (H). Remove the baseplate (J). Note the small molded connector (A) containing the two coil leads attached to a plug on the circuit board. With a small screwdriver, lift the latch that holds this connector and slide it off the plug. Loosen the three screws that are accessible via the deep holes between the stationary contacts and free the plate (K) that holds the E-shaped magnet. Do **not** remove the magnet from its supporting plate (K). Replace the coil (E). Reassemble with the new coil positioned so that the arc projections on the coil bobbin engage the armature return spring (L) and the coil leads are pointed towards the circuit board. Attach the coil lead connector (A) to its plug. Tighten the three screws that hold the magnet supporting plate to 7-10 lb.-in.

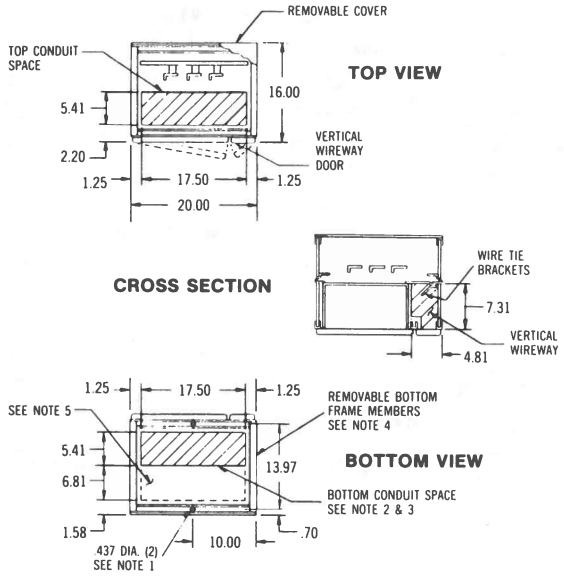
Magnet — Armature Assembly

Self alignment and permanent air gap features of the magnet armature make replacement unnecessary. Mating pole face surfaces should be kept clean.

Arc box must be in place when the controller interrupts a circuit.

Part 11
PLAN VIEWS

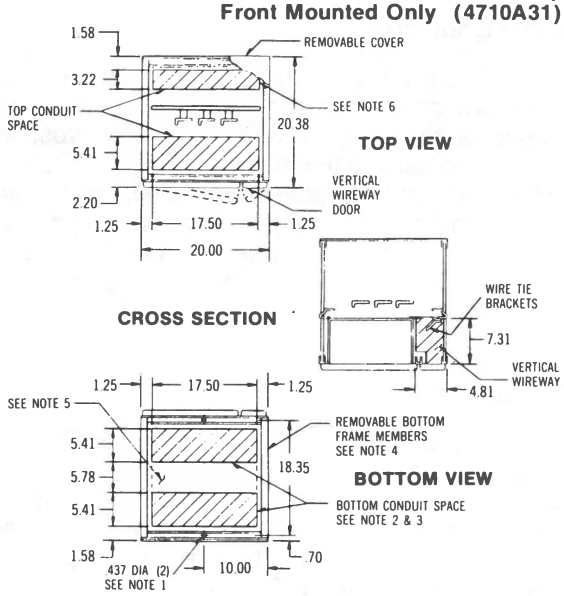
20 Inches Wide, 16 Inches Deep Front Mounted Only (4710A30)



1. Minimum length of anchor bolt 2 inches (.36-16 recommended.)
2. Recommended maximum conduit height above floor line 3.50 inches.
3. Maximum conduit space with channel sills 17.5 x 9.73 inches.
4. For multiple structure assemblies either one or both of these members are removed to provide maximum un-restricted conduit space at bottom.
5. This conduit space not recommended when neutral bus required. Otherwise available.

See side View A, far right for vertical dimensions.

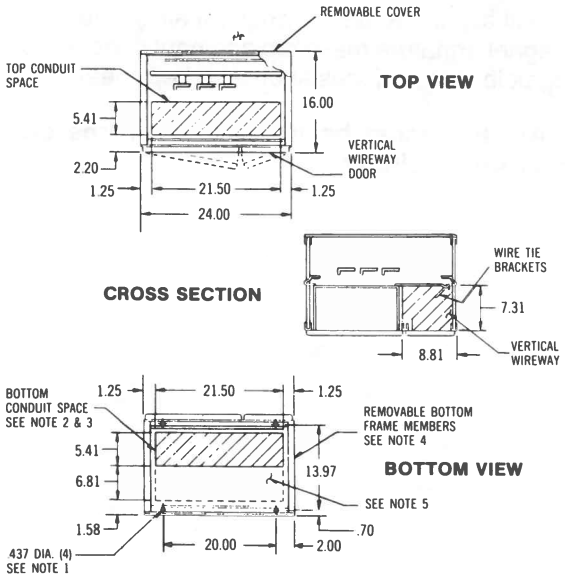
20 Inches Wide, 21 Inches Deep Front Mounted Only (4710A31)



1. Minimum length of anchor bolt 2 inches (.36-16 recommended.)
2. Recommended maximum conduit height above floor line 3.50 inches.
3. Maximum conduit space with channel sills 17.5 x 14.11 inches.
4. For multiple structure assemblies either one or both of these members are removed to provide maximum un-restricted conduit space at bottom.
5. This conduit space not recommended when neutral bus required. Otherwise available.
6. Top rear conduit space not recommended for conduit entry in FMO structure.

See side View A, far right for vertical dimensions.

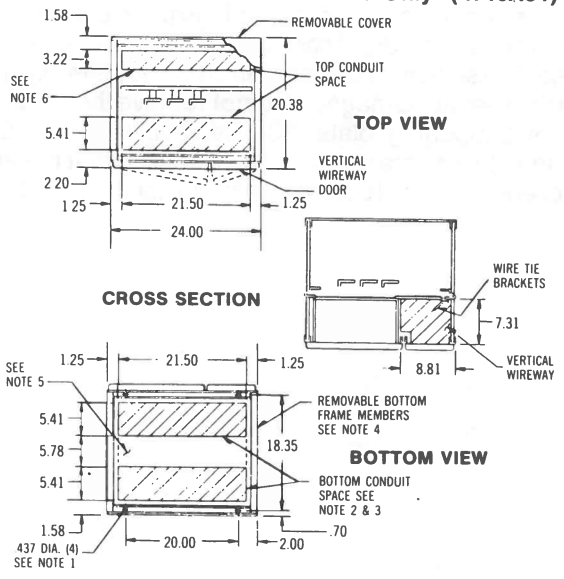
24 Inches Wide, 16 Inches Deep Front Mounted Only (4710A33)



1. Minimum length of anchor bolt 2 inches (.36-16 recommended.)
2. Recommended maximum conduit height above floor line 3.50 inches.
3. Maximum conduit space with channel sills 21.5 x 9.73 inches.
4. For multiple structure assemblies either one or both of these members are removed to provide maximum un-restricted conduit space at bottom.
5. This conduit space not recommended when neutral bus required. Otherwise available.

See side View A, far right for vertical dimensions.

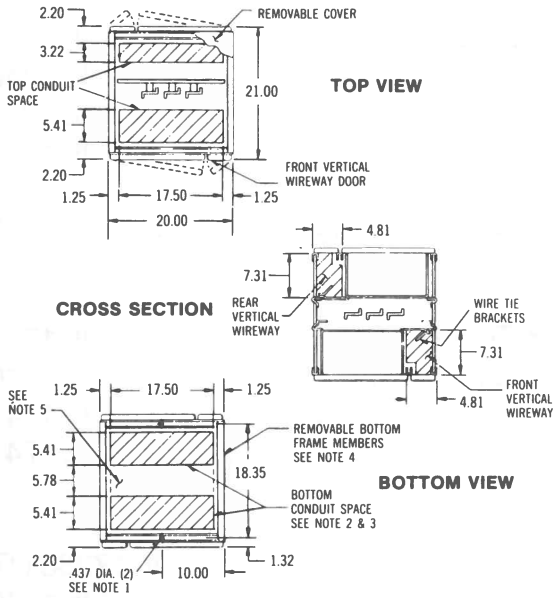
24 Inches Wide, 21 Inches Deep Front Mounted Only (4710A34)



1. Minimum length of anchor bolt 2 inches (.36-16 recommended.)
2. Recommended maximum conduit height above floor line 3.50 inches.
3. Maximum conduit space with channel sills 21.5 x 14.11 inches.
4. For multiple structure assemblies either one or both of these members are removed to provide maximum un-restricted conduit space at bottom.
5. This conduit space not recommended when neutral bus required. Otherwise available.
6. Top rear conduit space not recommended for conduit entry in FMO structure.

See side View A, far right for vertical dimensions.

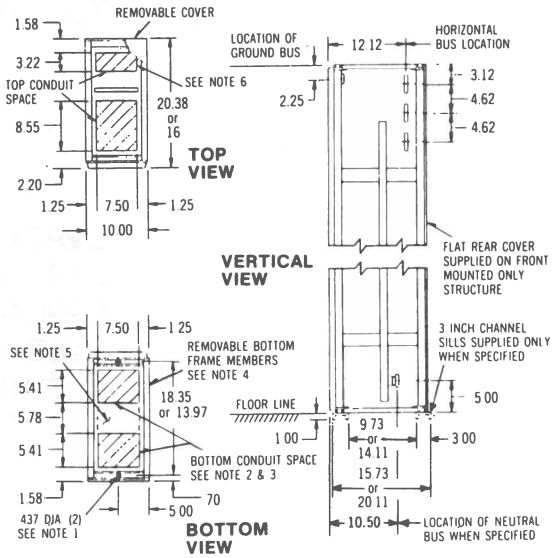
20 Inches Wide, 21 Inches Deep Front and Rear Mounted (4710A32)



1. Minimum length of anchor bolt 2 inches (.36-16 recommended.)
2. Recommended maximum conduit height above floor line 3.50 inches.
3. Maximum conduit space with channel sills 17.5 x 14.11 inches.
4. For multiple structure assemblies either one or both of these members are removed to provide maximum un-restricted conduit space at bottom.
5. This conduit space not recommended when neutral bus required. Otherwise available.

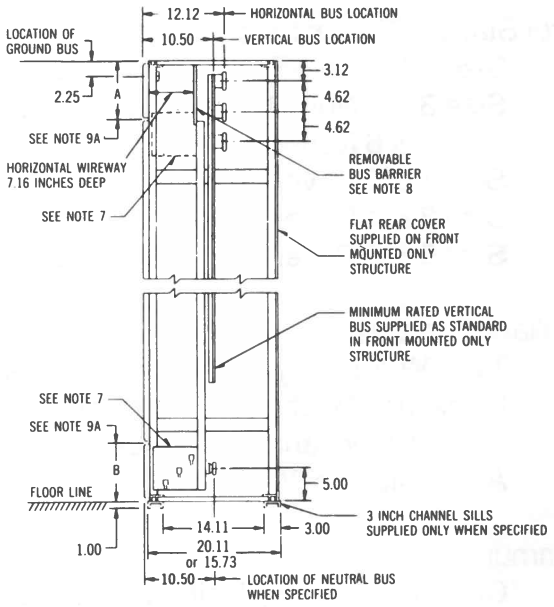
See side View B, far right for vertical dimensions.

10 Inches Wide, 16 or 21 Inches Deep Transition Structures (4710A35/6)



1. Minimum length of anchor bolt 2 inches (.36-16 recommended)
2. Recommended maximum conduit height above floor line 3.50 inches.
3. Maximum conduit space with channel sills 7.5 x 14.11 inches in 21" deep structure, 7.5 x 9.73 inches in 16" deep structure.
4. For multiple structure assemblies either one or both of these members are removed to provide maximum un-restricted conduit space at bottom.
5. This conduit space not recommended when neutral bus required. Otherwise available.
6. Top rear conduit space not recommended for conduit entry in 21" deep FMO structure. Space not available in 16" deep structure.

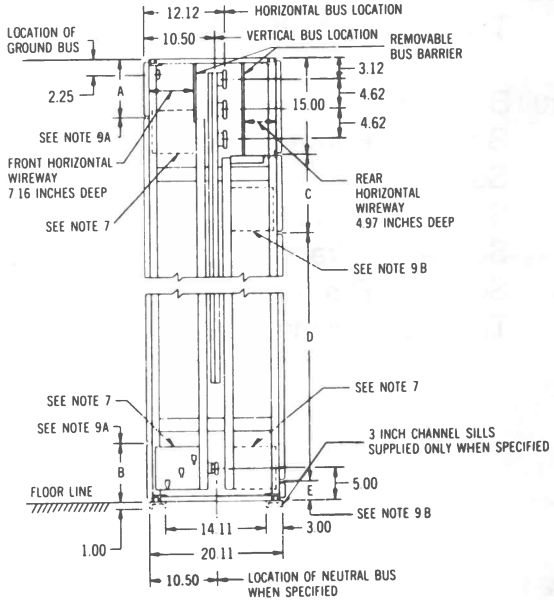
SIDE VIEWS



SIDE VIEW A

Common Notes

7. Master terminal block assembly furnished for Type C wiring only. When location not specified, MTB supplied at the bottom.
8. Rear horizontal bus barrier not supplied with front mounted only structure.
9. Standard structure arrangement
   (a) In Front
   Without MTB; A & B = 9"
   With MTB at bottom; A & B = 9"
   With MTB at top; A = 15", B = 3"
   (b) In Rear
   Without MTB; C = 0, D = 72", E = 3"
   With MTB at bottom; C = 0, D = 66", E = 9"
   With MTB at top; C = 12", D = 60", E = 3"



SIDE VIEW B

RELATED INSTRUCTION LEAFLETS

Motor Starters/Contactors:
- Size 1 & 2 Non-Reversing . . . . . IL 17401
- Size 3 & 4 Non-Reversing . . . . . IL 17403
- Size 5 & 6 Non-Reversing . . . . . IL 17405
- Size 1 & 2 Reversing . . . . . IL 17402
- Size 3 & 4 Reversing . . . . . IL 17404
- Size 5 & 6 Reversing . . . . . IL 17406

Auxiliary Contacts:
- Type W Auxiliary Contacts (Electrical Interlocks) & Terminal Blocks . . . . . IL 17420
- Horizontal Mechanical Interlock . . . . . IL 17407
- Vertical Mechanical Interlocks . . . . . IL 17417
- Alarm Module (WBNOC) . . . . . IL 17419

Communications:
- Central Monitoring Unit . . . . . IL 17383 (TD)
- Advantage PONI (WPONI) . . . . . IL 17408
- Advantage Control PONI (WCTLPONI) . . . . . IL 17409

Reset/Trip Indicators . . . . . IL 17415

Accutrol 120 . . . . . IB 8920-2
Accutrol 200 . . . . . IM 8741 / IM 8742
Accutrol 300 . . . . . IM 8720
IQ Data Plus . . . . . TD 17195

Disconnect Switches:
- Type DS, 30A, 60A, 100A . . . . . IL 14441

Circuit Breakers:
- Series C, F-frame . . . . . IL 29C101
- Series C, J-frame . . . . . IL 29C103
- Series C, K-frame . . . . . IL 29C104
- Series C, L-frame . . . . . IL 29C105
- Series C, R-frame . . . . . IL 29C107
- Transfer Switches . . . . . IL 14477

Westinghouse Electric Corporation
Construction Equipment Division
Fayetteville, N.C. U.S.A. 28306

Printed in USA