# INSTRUCTIONS

# IC7160 LIMITAMP* CONTROLLERS WITH AIR-BREAK CONTACTOR AND 30-INCH-DEEP PANEL

**2300, 4000, and 4800 Volts, A-C**

## INTRODUCTION

IC7160 Limitamp control is a high-interrupting-capacity, magnetic control for squirrel-cage, wound-rotor, and synchronous motors; for transformer feeders; and for equipment used in special applications. It can include control for auxiliary and accessory equipment such as incoming-line panels, lighting panels, low-voltage a-c and d-c motor starters, and relaying and metering equipment. See Fig. 1 for a typical full-voltage Limitamp controller, and refer to Fig. 3.

Limitamp control makes use of the current-limiting characteristics of fast-acting fuses to protect connected equipment from the high, short-circuit currents available from modern industrial-power systems. It takes full complement of protective functions and a type of control adaptable to a variety of control requirements.

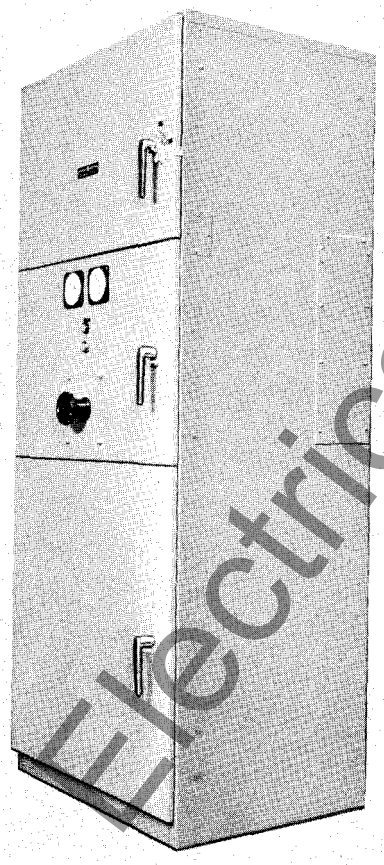

*Fig. 1. View showing typical full-voltage Limitamp controller.*

* Trade-mark of General Electric Company.

## DESCRIPTION

### PHYSICAL FEATURES

The physical enclosure of the IC7160 Limitamp controller is 30 inches deep. No rear aisle space is required, as the control is completely front accessible. Either back-to-back or back-to-wall mounting applications may be used. Height of the enclosure is 90 inches.

Mountable as a free-standing general-purpose NEMA 1 enclosure, the Limitamp is furnished in semi-dust-tight, dust-tight NEMA 5, and weather-resistant NEMA 3 enclosures.

For a view of the principal components of the Limitamp controller, refer to Fig. 3.

Giving full protection to both the motor and controller alike, Limitamp has co-ordinated components which fully protect connected equipment over the complete range of overload and fault conditions.

### CURRENT-LIMITING FUSES

Type EJ-2 current-limiting fuses, designed for use on motor circuits, provide full short-circuit protection. The current-limiting action of Type EJ-2 fuses is shown in Fig. 2.

In complete short circuit (when fault currents are at maximum rating of the fuse), melting of the fuse element occurs before the current of the first major loop can reach its peak; and the fault is cleared during the first half-cycle. Since the strength and duration of the fault current are limited, the amount of "let-through" energy is restrained to a non-damaging value.

*These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which ore not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.*

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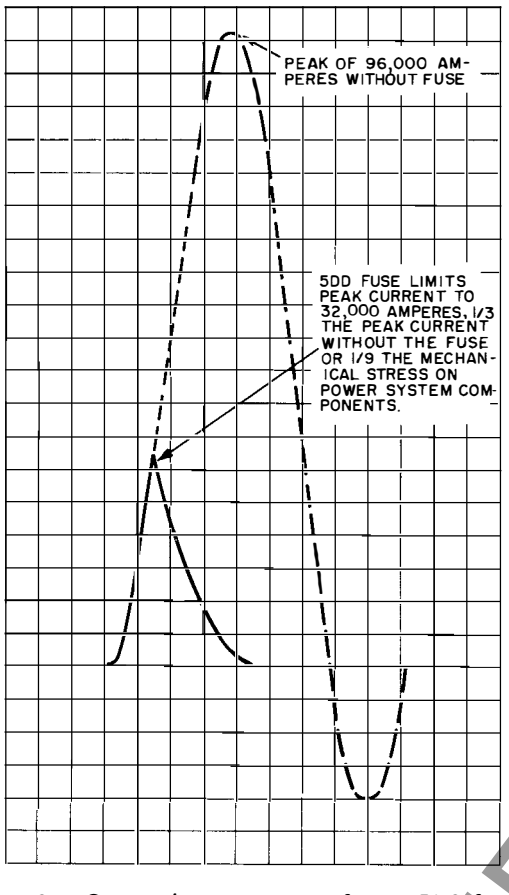


*Fig. 2. Current-limiting action of Type EJ-2 fuse.*

## OVERLOAD PROTECTION

Motor overload protection is provided by temperature-compensated, thermal-overload relays whose tripping characteristics closely approximate the motor's heating curve.

The co-ordinating control effort of fuses and overload relays is shown graphically in Fig. 4. While the overload relays are selected to protect the motor from damaging overloads (both running overloads and stalled conditions)—opening the line contactor before damage occurs—the fuses are chosen so that they will not melt in locked-rotor condition, but will melt on all fault conditions.

Thermal and mechanical strength of all components subjected to fault currents—bus, cable, current transformers, isolating switch, and contactor—is great enough to withstand any "let-through" current of Type EJ-2 power fuses.

For synchronous motors, Limitamp controllers assure maximum motor utilization through the use of precision-angle field application and load-angle field removal, in addition to graduated squirrel-cage winding protection.

## UNDERVOLTAGE PROTECTION

Time-delay undervoltage protection is provided in all Limitamp control to prevent removal of machinery from the line on momentary loss of power. Relay drop-

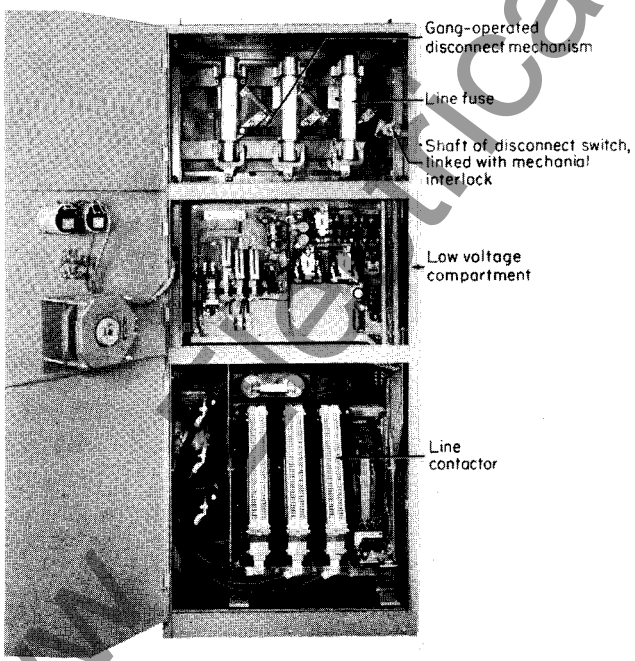


*Fig. 3. View of typical Limitamp controller showing location of principal components.*

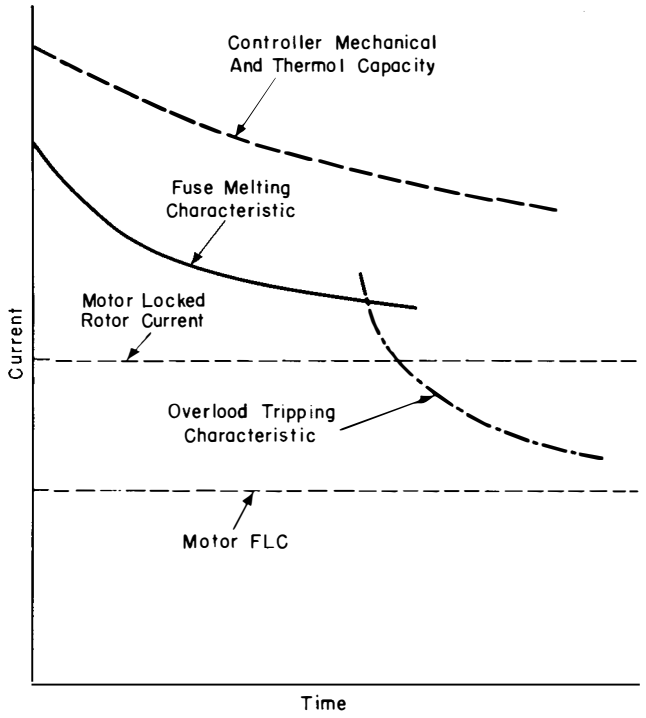


*Fig. 4. Co-ordination of line fuses and overload relay.*



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# IC7160 LIMITAMP* CONTROLLERS

## SUPPLEMENT TO GEH-1938

This supplement contains additional information for installing and using this Limitamp equipment.

**Refer to page 3—Isolating switch and control power interlock operation: the isolating switch is for isolating purposes only. It should not be opened or closed with any load connected to the switch.**

Positions of the switch handle are designated "SWITCH OPEN" and "SWITCH CLOSED" rather than "ON" and "OFF."

A control power interlock (Fig. A) mounted in the control compartment prevents opening the isolating switch until all control load has been disconnected by contacts of this control power interlock. If it is desired to connect additional devices to the control circuit, care must be taken that these devices are added to the load side of the control circuit fuse so that the control power interlock, connected ahead of the fuse, will also interrupt the added load.

The instructions for operating the control power and door interlocking system are as follows:

1. To open the isolating switch and all compartment doors:

a. Press the "STOP" button.

b. Open the center door to the control compartment.

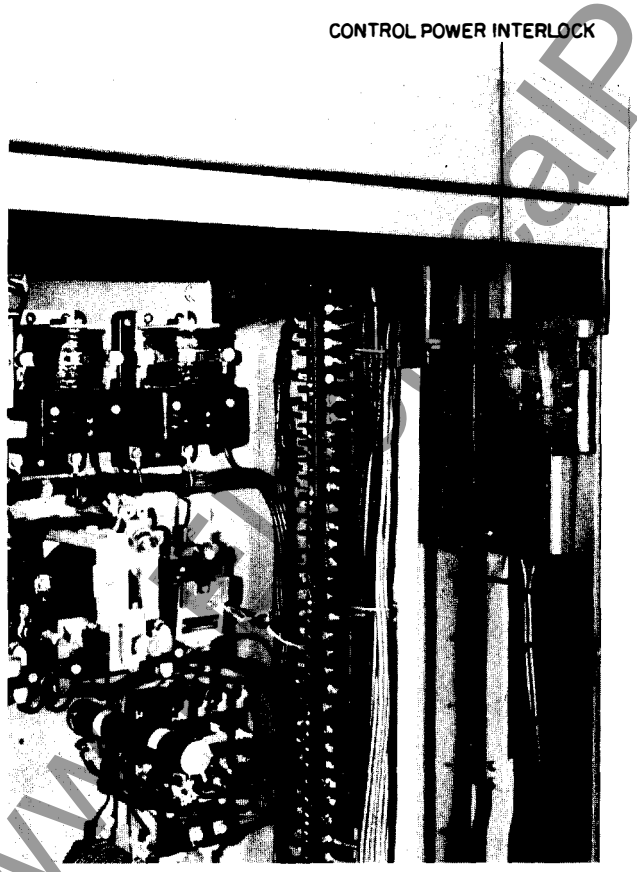


*Fig. A. Control power interlock.*

*Trade-mark of General Electric Company

c. Throw the control power interlock to the "OPEN" position.

d. Close the center door.

e. Throw the isolating switch to the "SWITCH OPEN" position.

f. Any or all doors may now be opened.

2. To close the isolating switch and all the compartment doors:

a. Close the center and bottom doors.

b. Close the top door and throw the isolating switch to the "SWITCH CLOSED" position.

c. Open the center door and throw the control power interlock to the "CLOSED" position.

d. Close the center door.

### PREPARING THE PANEL FOR OPERATION

*(Ref. Page 6)*

The following procedure supersedes steps 1 through 3 on page 6 of GEH-1938. Note that the contactor need only be removed if it is necessary to make cable connections to that panel.

1. Remove the door lintel which separates the center (low-voltage) compartment from the roll-out contactor compartment by loosening the two nuts and sliding out. To remove the base lintel, remove the five screws on front and the two screws on the roll-out contactor assembly.

2. The hinged control panel may be swung out by removing the two nuts on the left-hand side of this panel.

3. Release all wires and cable connected to the roll-out contactor assembly as follows:

a. Remove wires on panel side of terminal board on top right-hand side of roll-out contactor assembly.

b. Unbolt the cables connected to the front side of the current transformers.

c. Unbolt the cables from the bottom of the fuse supports.

4. The contactor may now be rolled out. (Check first to make sure shipping supports bolting the contactor assembly to the roll-out tracks have been removed. These supports are located a few inches in front of the rear wheels of the contactor.)

5. Remove the steel bus barrier by removing the nuts on the right-hand side and the bottom of the barrier.

6. Remove the perforated metal barrier beneath the switch compartment by removing the two nuts on each side. This will allow standing room for the operator to pull in cable.

7. Follow steps 4 through 19 on page 6 of GEH-1938.

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out is delayed 1.5 to 2 seconds; and restarting of a group of motors within this time will not ordinarily place undue burden on the line.

## DISCONNECT SWITCH AND INTERLOCK PROTECTION

An externally operated, disconnect switch, with all blades connected to a common shaft, isolates the accessible high-voltage components from the line. The "ON" and "OFF" positions are clearly marked on the switch handle.

A system of mechanical interlocks between the disconnect switch, lower compartment door, and contactor, prevents opening the line by the disconnect switch while the contactor is closed.

This system also prevents opening the doors to the high-voltage compartments until the isolating switch is in the "OFF" position. The switch is visible so that the blade position can be seen.

The isolating switch can be locked in either "ON" or "OFF" position by as many as three padlocks entering locking holes in the switch handle.

## HIGH-VOLTAGE CONTACTOR

### General

Wheel-mounted in the lower compartment of the controller, the IC2812 high-voltage, a-c, air-break contactor is readily accessible, and may be simply rolled out for maintenance of the Limitamp. See Fig. 5.

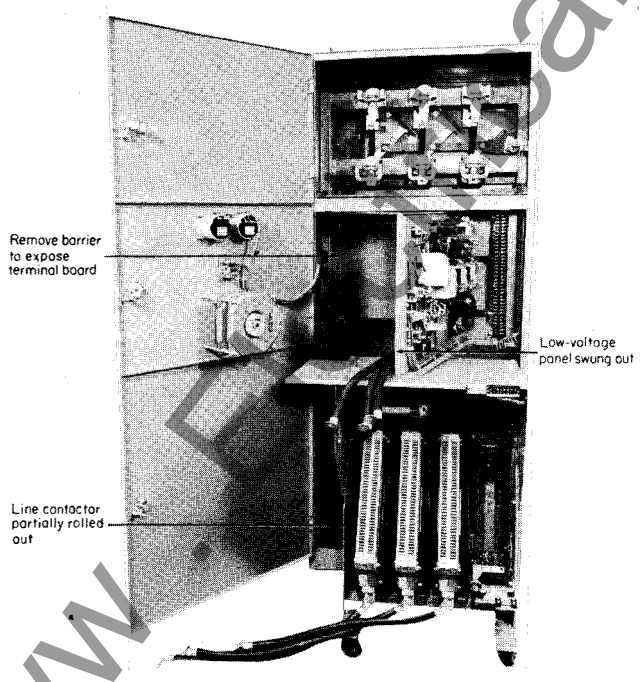


*Fig. 5. Free entrance to controller gained by rolling out IC2812 contactor.*

These contactors are designed for equipment that is used in starting a-c motors on 2300-, 4000-, and 4800-volt lines.

Contactors in the line are made with continuous ratings of 400 amperes, and are suitable for use with induction motors to a maximum 2500 hp, and on synchronous motors up to 3000 hp.

With high-voltage equipment, it is not sufficient to block one contactor open until the other has completed its stroke—but it is necessary to assure that the arc on the one contactor has been completely interrupted before the other contactor can close in (as in the case of a reversing starter).

Therefore, current and potential interlocking are provided when required.

In many cases, no interlocking need be provided because the necessary time delay is introduced by the type of pilot devices. An example of this is the use of a selector switch. In the operation of the selector switch, both sets of contactors are opened; and before the complete reversal can be made, restarting from the "START" push button must be made (and no mechanical interlock is required, since the operating time for a person to manipulate these pilot devices is far in excess of normal arcing time).

Magnetic blowouts, suitable for continuous currents of 400 amperes, are available on the contactors for wide range current interruption, made possible by two-section blowout coils.

### Maintenance of Contactor

Contact life, of course, depends on the severity of service required for the device.

The contactor should have a complete inspection after every 50,000 operations. All power should be disconnected from the contactor before any inspection is made. Check for loosened screws, nuts, bolts, cable clamps, and electrical interlocks. Contact wear and contact force should be checked.

Refer to the instruction book on the IC2812 contactor for instructions on replacing contacts, normally open and normally closed contacts, a-c coils, contact springs and d-c coils; and for further information on the air-break contactor.

## LOW-VOLTAGE AND BUS COMPARTMENTS

The low-voltage (center-front) compartment mounts the relays and low-voltage contactors in the IC7160 Limitamp controller.

The compartment has terminal boards for external low-voltage purchaser's connections; and on its door is mounted metering equipment. The compartment has a hinged base which can be moved to one side—thus providing accessibility to the isolated a-c bus



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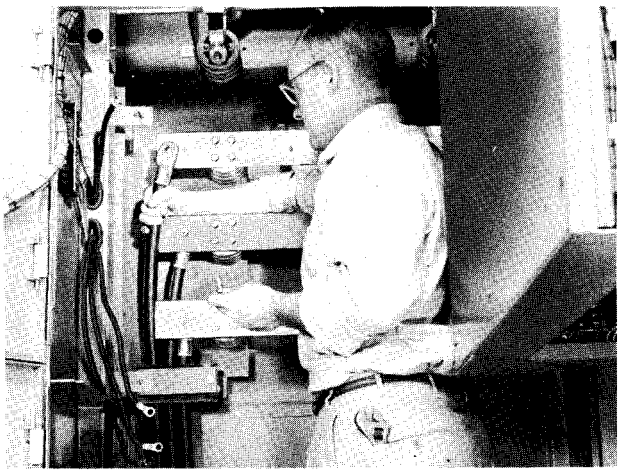

*Fig. 6. Connection of incoming power leads to bus.*

compartment. In the panel is a wiring trough, provided for neat and convenient wiring to the clamp-type control terminal board.

If power bus is furnished it is located in the center-rear compartment—behind the isolating steel barrier in the rear of the low-voltage compartment. If bus is not furnished, however, purchaser's power connections are still made in the center-rear compartment. See Fig. 6

### BASIC PANELS

Limitamp controllers include basically the same components within the four major compartments. The compartments are all separated by steel barriers. Refer to Fig. 3.

In the full-voltage and reduced-voltage squirrel-cage controllers, and in the synchronous motor controllers, the same general components are included in standard panels (except in the low-voltage compartment). The low-voltage compartment houses such devices as low-voltage control-circuit fuses, temperature-compensated thermal overload (hand-reset) relays, time-delay undervoltage relays, motor-driven definite-time delay relay, field control, etc.

## INSTALLATION

### RECEIVING AND HANDLING

Limitamp equipment is mounted in a rigid, floor-mounted enclosure. Panels are crated and shipped in an upright position. When a panel is received, it should be handled from the top and kept upright. If the panel is not to be installed immediately, it should be stored in a clean, dry location. When the panel is installed, the control should be unpacked carefully, making certain that no small parts are thrown away with the packing material.

Components of full-voltage non-reversing controllers boxed separately or shipped separately include the roll-out contactor assembly, the EJ-2 power fuses, and the contactor arc chutes. All other additional high-voltage contactors when required for other type starting functions are also shipped separately.

Check the nameplate rating of the machine to be sure that it agrees with that given on the panel nameplate. The starter is designed for use with a specific machine and must not be applied to any other unless first approved by the General Electric Company. It is also important that the roll-out assemblies be inserted in their respective control panels. Corresponding nameplates are provided on both the roll-out contactor and the control panel for matching at installation.

After the panel is unpacked, it should be handled from the removable lifting angle on top provided for that purpose. To avoid undue strains on the panel, sling the lifting rope through the holes near the ends of the lifting angle. Clean the inside of the control panel with a brush, soft cloth, or dry, compressed air. Make certain that any dirt, dust, or bits of packing material, which may interfere with successful operation of the panel devices, are removed from the panel. Care should be taken during the cleaning operation to prevent any dirt from being blown into the inaccessible spaces of the devices.

### INSTALLING THE PANEL

#### General

When the panel is to be installed, it is essential that it be securely fastened in a true upright position on a level surface to permit proper operation of the devices mounted on the panel.

The enclosing case is mounted on two floor sills, one each across the back and front of the enclosing case. Floor sills consist of channel irons which are four inches wide and two inches high. On all enclosures, the four-inch dimension is horizontal. On single-case installations (except NEMA Type 3) the floor sills may be removed and the enclosing case bolted to the floor. On lineups of more than one case, it is recommended that the one-half-inch mounting bolts be grouted in the floor in the proper location for fastening the panel.

#### Installing Floor Sills

There are several possible methods of installing the floor sills; the most frequently used are described below. (The first two methods are recommended because the roll-out contactor tracks are at floor level and require no special inclined plane for inserting the contactor into the panel.)



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1. If the concrete floor is to be poured before the panel is installed, a dummy set of floor sills can be used. These dummy sills can be made of wood of the proper size and length. The dummies should be set in place, together with the one-half-inch anchor bolts, before the concrete is poured, and then replaced with the actual sills after the panel is received.

2. If the concrete floor is to be poured at the time the panel is installed, grout the one-half-inch anchor bolts in the subfloor and slip the panel over them. Check alignment of the floor sills with a level and make sure that the panel supports are plumb. Then pour concrete around the floor sills. This should be done carefully so as not to splash concrete on the panel devices. Care should be taken to finish the surface of the concrete so that it will not interfere with the operation of the door of the enclosing case, and also to obtain a tight joint between the floor and the enclosure side to prevent entrance of dirt at the bottom of the panel.

3. If the panel is to be installed on an existing floor, grout the one-half-inch anchor bolts in the floor and slip the panel over them. Check level position of the sills with a machinist's level, and shim the sills if necessary. Check that the surfaces of the front and back sills are in a plane, so that the angle iron supports of the panel are plumb. If the panel is installed in this manner, there will be a two-inch gap between the floor and sides of the panel enclosure. This gap should be closed to prevent accumulation of dirt under the panel, which in due time may interfere with the proper operation of the panel devices.

Provision should be made, before the panel is in place, for incoming and outgoing cable and control wires. In all cases, the outline for the panel in installation should be used to determine the space available, and the panel wiring diagram should be checked for the number of wires and cables to be installed. Space is provided for top or bottom entrance.

On outdoor enclosures it is recommended that all cables enter the bottom of the panel. On these panels, the bottoms are closed.

Sufficient clamps are provided in the panel to support the cables regardless of whether entrances are made from top or bottom.

## PREPARING THE PANEL FOR OPERATION

Before the panel can be operated, even for a tryout without power, all devices must be placed in fully operative condition. The armatures of many of the relays and contactors, including the high-voltage contactor, have been tied or blocked to prevent damage during shipment. Remove all of these ties and blocks before operating devices.

Sealing surfaces of unplated and laminated a-c contactor and relay magnets, as well as the ends of shafts, are coated with a heavy grease rust preventative.

Before operating the panel, the rust preventative should be wiped off. Magnet sealing surfaces may then be coated with a thin film of light machine oil.

Operate each device by hand to see that the moving parts operate freely without binding. Make sure that all electrical interlocks are clean and make good contact when closed. Relays and contactors are carefully adjusted and tested at the factory. Should adjustments of the devices be necessary, however, these are explained in the individual instructions for each device.

CAUTION: Power should not be applied until the following steps have been completed.

In reviewing the following steps for preparing the panel for operation, refer to Fig. 3 and 5 for general components of the high-voltage controller; Fig. 6, for a view of connecting the incoming power leads to bus; and to Fig. 7 for a close-up view of the mechanical interlock arrangement.

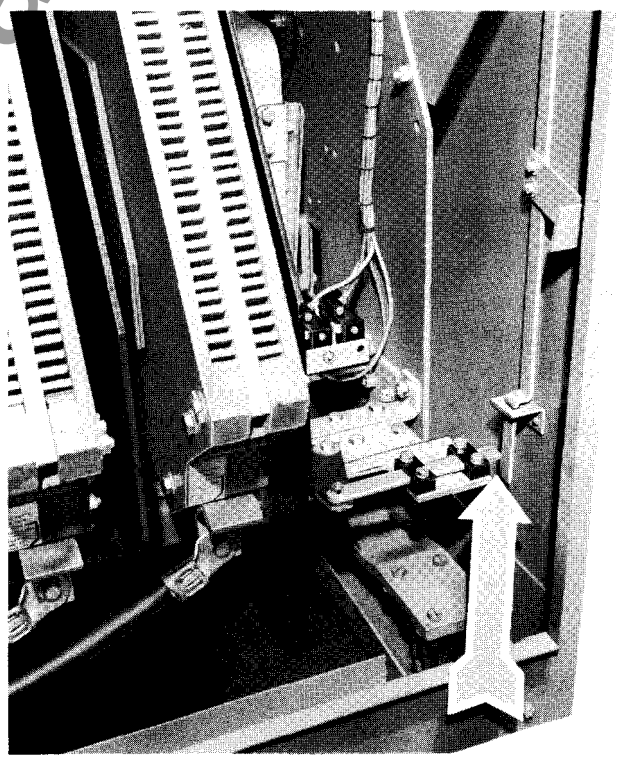

*Fig. 7. View shows vertical connecting rod, on right, mechanically connected to gang-operated isolating switch; interference interlock (left to arrow) prevents vertical rod from being lowered when contactor is energized.*



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1. Remove the door lintel which separates the low-voltage compartment from the roll-out assembly compartment, simply by loosening two nuts and sliding out. Also, remove the base lintel.

2. The hinged control panel should be swung out and the isolating steel bus barrier removed. This can be easily done by removing two nuts on the left-hand side of the hinged base, and two nuts on each side of the steel barrier.

3. Next, loosen the two top bolts and remove the perforated metal switch-compartment barrier. This allows standing room for the operator to pull in the cable.

4. After pulling in the cable from either the top or bottom of the enclosure, the incoming power lines should be fastened either to the bus or to the incoming power terminals, stamped L1, L2, L3, as required.

5. Next, the motor leads should be connected to the side of the current transformers, stamped T1, T2, T3.

6. A vertical wire trough has been provided for running low-voltage control wires from the conduit to the control terminal boards.

7. Reinsert the bus barrier in place.

8. Examine the roll-out contactor assembly (as outlined below) and roll it into the controller. If floor sills have not been grouted, a wooden inclined plane, two inches high by six inches, will be required to elevate the contactor to the contactor track level.

   a. Remove shipping supports, blocks, or ties used for protecting the contactor during shipment.
   b. Carefully inspect all parts of the contactor.
   c. Remove protective grease or oil which may be on the magnet face.
   d. Make sure that all parts of the contactor are clean.
   e. Do not apply power to the contactor until after the arc chutes have been mounted. The chutes are essential to confine and extinguish the arcs; without the chutes, the arcs may do serious damage.

9. Replace the base lintel and fasten the contactor to it, using bolts supplied with the contactor for this purpose.

10. With the contactor in place, insert the cable block into the weld studs on the bus barrier, and fasten. This will support and position the cables for connecting to the lower power fuse terminals.

11. Connect the contactor's three lower cables to the front terminals of the current transformers.

12. Swing the hinged base of the low-voltage compartment back into place and fasten.

13. Connect the control wires from the hinged base to the roll-out contactor assembly terminal board. These wires are fanned out and tied to avoid cross connections.

14. Replace the perforated fuse compartment barrier.

15. Insert the EJ-2 power fuses in the top compartment, and install the contactor arc chutes.

16. It is vitally important that the contactor switch and mechanical door interlock function properly. These have been carefully checked at the factory, but should be re-examined to make sure that no damage has occurred during shipment. With the high-voltage disconnect switch in the "ON" position, hand operate the contactor to make sure that the mechanical interlock lever is free to operate without binding, with the vertical link on the panel side wall. The clearance between the contactor lever and the vertical link should be no greater than $\frac{1}{16}$-inch.

17. The contactor should then be blocked in this closed position and an attempt made to open the gang-operated disconnect switch. It should be impossible to turn the operating handle more than approximately ten degrees. If this is true, the switch cannot be opened with the contactor tips closed.

18. With the power leads disconnected at motor terminals, but with all devices properly readied for operation, apply power and operate the panel to make certain that its operation is in agreement with the elementary diagram.

19. The leads may then be connected and the equipment placed in operation.

CAUTION: Since the back cover on many Limitamp controllers is used to support miscellaneous high-voltage components, this cover should, under no circumstances, be removed during or after installation.

## MAINTENANCE

### GENERAL

All electrical apparatus should provide maximum trouble-free service if given the benefit of preventative maintenance inspections and periodic cleanings. It is important that a definite inspection schedule be maintained. Of course, the frequency of the inspection periods will be dependent upon the operating conditions.

The publication, HOW TO MAINTAIN INDUSTRIAL CONTROL, GET-1195, will be helpful in establishing a maintenance schedule, and in finding the trouble when faulty operation is encountered. Also helpful are the data on contact gap and "wipe," and maintenance instructions contained in the individual device publications.



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### CORRECTING CONTACTOR WELDING

As previously described in the "Description" section, the isolating switch and the high-voltage compartment doors cannot be opened until the main contactor tips are open. In the event that the contactor tips weld in the fully-closed or "kiss" position, access must be gained to the contactor compartment to free the tips.

CAUTION: Only authorized personnel with complete instructions should be allowed to tamper with the mechanical interlock.

To free the mechanical interlock, in the event of contactor welding, the maintenance man must remove the two screws fastening the upper and lower portions of the vertical mechanical interlock rod. These screws are located in the control compartment.

CAUTION: Remove incoming power before tampering with the mechanical interlock.

The disconnect switch should then be opened and the lower portion of the mechanical interlock rod picked up sufficiently to allow the contactor compartment door to be opened. This operation allows access to free the contactor tips.

## INSTRUCTIONS ON INDIVIDUAL PANELS

Individual Limitamp panels are designed for a specific application—the components and function being dictated by the purchaser's specifications and needs.

Complete instructions covering individual units are furnished with each panel lineup, and the instruction book is identified on the equipment nameplate.

These instructions (GEH-1938) form a portion of the over-all instructions on individual panels.

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Binghamton, N. Y. . . . . 19 Chenango St.
Birmingham 3, Ala. . . . 1804 Seventh Ave., N.
Bismarck, N. Dak. . . . . 418 Rosser Ave.
Bluefield, W. Va. . . . . 704 Bland St. Appalachian Bldg.
Boise, Idaho . . . . . 1524 Idaho St.
Boston 1, Mass. . . . . 140 Federal St.
Buffalo 3, N. Y. . . . . 535 Washington St.
Butte, Mont. . P.O. Box 836, 103 N. Wyoming St.
Canton 2, Ohio . . . . . 700 Tuscarawas St., W.
Cedar Rapids, Iowa . . . . 210 Second St., S.E.
Charleston 28, W.Va. . 306 MacCorkle Ave., S.E.
Charlotte 1, N. C. . . . . 112 S. Tryon St.
Chattanooga 2, Tenn. . . . . 832 Georgia Ave.
Chicago 80, Ill. . P.O. Box 5970A, 840 S. Canal St.
Cincinnati 2, Ohio . . . . . 215 W. Third St.
Cleveland 4, Ohio . . . . 4966 Woodland Ave.
Columbia 1, S.C., P.O. Box 1434, 1420 Lady St.
Columbus 15, Ohio . . . . . 40 S. Third St.
Corpus Christi, Texas . . . . . 205 N. Chaparral
Dallas 2, Texas . . . . . 1801 N. Lamar St.
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Fort Wayne 6, Ind. . . . . 3606 So. Calhoun St.
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Fresno 1, Calif. . . . . 407 Patterson Bldg. Tulare and Fulton St
Grand Rapids 2, Mich. . . . 425 Cherry St., SE
Greensboro, N. C. . . . . 301 S. Elm St.
Greenville, S. C. . . . . 108 W. Washington St.
Gulfport, Miss. . . . . 207 Jo-Fran Bldg.
Hagerstown, Md. . . . . Professional Arts Bldg.
Hartford 5, Conn. . . . . 764 Asylum Ave.
Houston 1, Texas . . . . . 1312 Live Oak St.
Indianapolis 4, Ind. . . . . 110 N. Illinois St.
Jackson, Mich. . . . . 120 W. Michigan Ave.
Jackson 1, Miss. . . . . 203 W. Capitol St.
Jacksonville 2, Fla. . . . . 700 E. Union St.
Jamestown, N. Y. . P.O. Box 548, 2 Second St.
Johnstown, Pa. . . . . 841 Oak St.
Joplin, Mo. . P.O. Box 948, 220½ W. Fourth St.
Kalamazoo 3, Mich. . . . . 112 Parkway Ave.
Kansas City 6, Mo. . . . . 106 W. Fourteenth St.
Knoxville 16, Tenn. . . . . 1301 Hannah Ave.
Lake Charles, La. . . . . 422 Seventh St.
Lansing 8, Mich. . 306 Michigan National Tower
Lexington, Ky. . . . . First National Bank Bldg.
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Washington 5, D. C. . . . . 777–14th St., N.W.
Waterloo, Iowa . . . . . 206 W. 4th St.
Wenatchee, Wash. . 328 N. Wenatchee Ave.
Wheeling, W. Va. . . . . 40 Fourteenth St.
Wichita 2, Kan. . . . . 200 E. First St.
Williamston, N. C. . . . . 115 E. Main St.
Worcester 5, Mass. . . . . 288 Grove St.
York, Pa. . . . . 56 N. Harrison St.
Youngstown 5, Ohio . . . . 272 E. Indianola Ave.

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