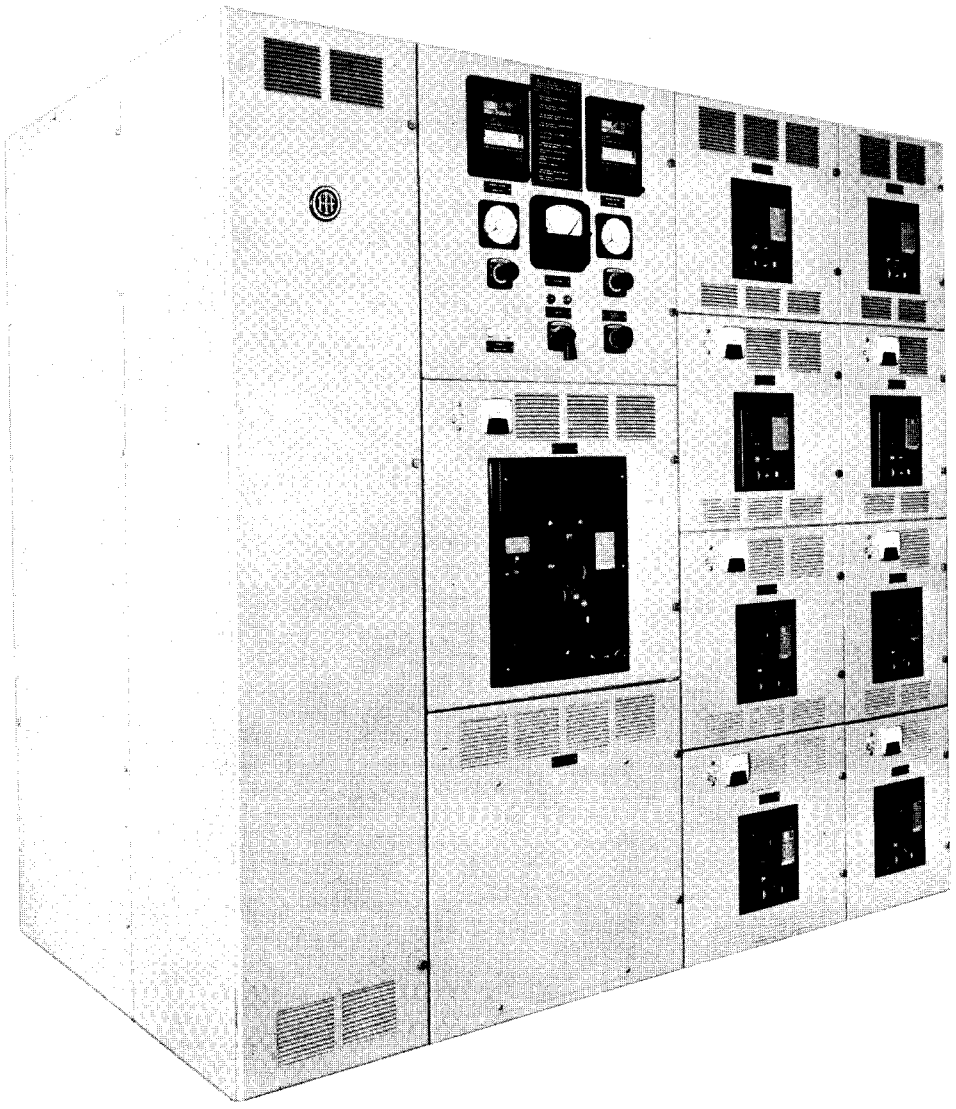
IB-7.2.7-1
ISSUE A

METAL-ENCLOSED LOW-VOLTAGE POWER SWITCHGEAR

INSTRUCTIONS

METAL-ENCLOSED LOW-VOLTAGE POWER-CIRCUIT-BREAKER SWITCHGEAR



I-T-E IMPERIAL CORPORATION

INSTRUCTIONS FOR METAL-ENCLOSED LOW-VOLTAGE POWER-CIRCUIT-BREAKER SWITCHGEAR

INTRODUCTION

Instructions for installation, operation and maintenance of Metal-enclosed Low-voltage Power-circuit-breaker Switchgear are furnished with each shipment.

These instructions should be read carefully and used as a guide during installation and initial operation.

File these instructions in a readily accessible place together with drawings and descriptive data of the switchgear. The use of these instructions will facilitate proper maintenance of the equipment and prolong its life and usefulness.

SCOPE OF INSTRUCTIONS

These instructions are general. They cover requirements for installation as applied to all Metal-enclosed Low-voltage Power-circuit-breaker Switchgear.

Specific information on particular installations is furnished in the form of Bills of Material and drawings as follows:

1. Bills of Material listing electrical devices and equipment.
2. Front view showing arrangement of relays, instruments and circuit breakers.
3. Single line diagram showing power connections.
4. Floor plan indicating available space for power and control conduits.
5. Special construction details.

The first sheet of the Bill of Material indicates the application of the drawings.

TRANSPORTATION

Prior to shipment, the switchgear undergoes careful factory inspection. Each section is plainly marked at convenient places with its number and position. When size or other reasons make it necessary to divide the equipment for shipment, the unit number of the particular equipment is also marked on the section, along with its weight. The circuit breakers are shipped in individual cartons or crates.

Immediately upon receipt of the switchgear, examine for any damage or loss sustained during transportation. Check the contents against the packing list before discarding any packing material.

If there is any shortage, notify the nearest I-T-E representative at once.

The I-T-E Imperial Corporation is not responsible for damage after delivery of shipment to the carrier. However, if the company is notified of such claims, it will furnish forms to facilitate securing any adjustments. If damage to the shipment indicates rough handling, claim for damage should be filed at once with the carrier and the I-T-E Imperial Corporation promptly notified.

Indoor switchgear housings are shipped in groups. Each group is mounted on heavy timber shipping bases. Unloading and handling at the site is usually done by placing rollers under the shipping bases. To avoid distortion to the switchgear, any force to move the structures should be applied to the bases by means of crowbar, block and tackle, crane, etc.

STORAGE

Leave each switchgear group on its shipping base for subsequent moving. Remove circuit breakers and accessories from cartons or crates.

Observe the following precautions:

1. Check for missing or damaged parts.
2. Store in clean, dry place.
3. Cover parts susceptible to rust with heavy oil or grease.
4. Cover with heavy wrapping paper to keep dirt or dripping water from entering. Dirt or moisture may foul working parts or deteriorate contacts and insulation.
5. If the switchboard is to be stored for any length of time, or in any place where dampness may be present, then heaters should be used to keep the switchboard dry until it is placed in service. When outdoor switchboards equipped with heaters are stored, the power source for the heaters should be brought to the load terminals of the cutout device which controls the heater circuits.

UNLOADING AND HANDLING

The following is a recommended method for unloading and handling the switchgear housings.

INDOOR INSTALLATION

The switchgear should be unloaded as near to the installation site as possible. The operation may be com-

pleted by raising the switchgear with track jacks or overhead lifting device. The following is a general description of each method.

Raising by Jacks

In most locations the practical way of handling the switchgear is by jacks.

1. After switchgear housings have been moved near site, raise the units by placing jacks under the switchgear housing near the front and rear corners as shown in Fig. 1.

CAUTION: DO NOT APPLY JACKS TO THE HOUSINGS AT ANY OTHER POINTS.

Raise evenly and just enough to position rollers. Repeat operation at other end of assembly so that rollers are equally distributed under units as shown in Fig. 2.

2. While a crew pushes the switchgear longitudinally towards its final position, one man should insert an additional roller under the forward end of the units. He should continue this operation by moving each roller that is freed from the rear end to the forward end until the units are in the desired position.

3. For lateral moving, raise the units by jacks and remove the rollers. Place the rollers laterally with steel channels (not furnished) resting on the rollers as shown in Figs. 3 and 4. Move the units, using procedure described in paragraph 2, until they are in the desired position.

4. When the units are in their final position, raise the units enough to just clear the rollers and any channels resting on the rollers. Remove all rollers and channels and lower units to the floor. Remove all the lag bolts inside the units which hold them to the shipping bases. Place jacks under the front and rear corner posts of the units and raise just enough to clear bases.

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Remove the shipping bases and lower the units evenly so as not to distort any of the structure.

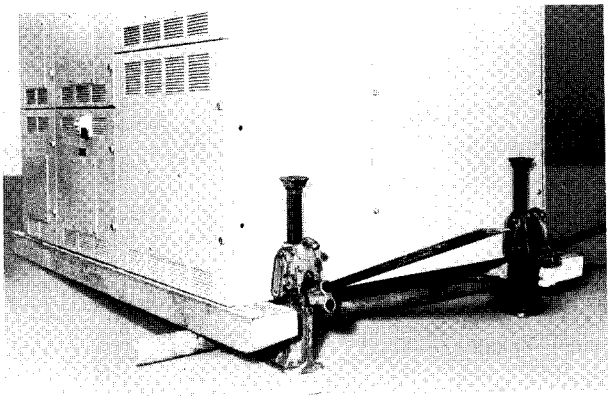

Fig. 1—Method of Raising Switchgear by Use of Jacks. Rollers in Place

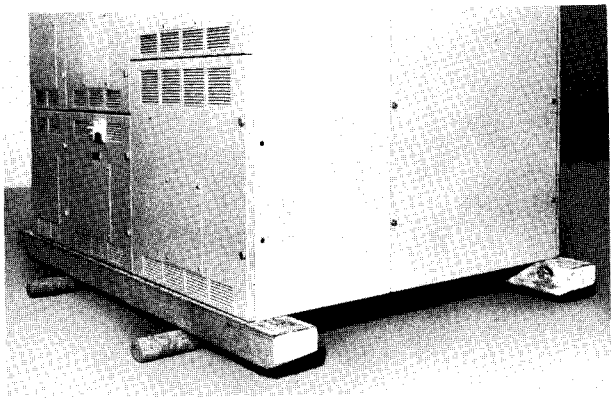

Fig. 2—Jacks Removed and Switchgear Ready for Longitudinal Moving

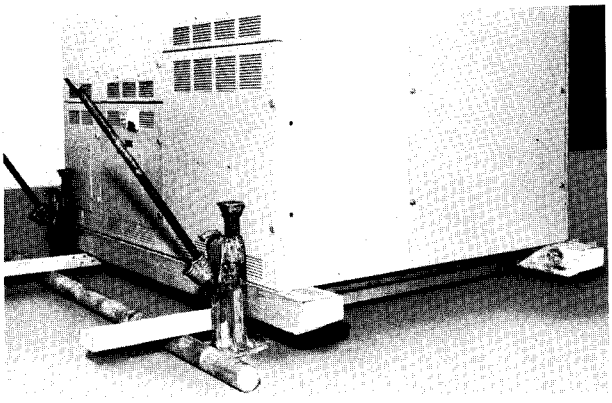

Fig. 3—Switchgear Raised, Rollers and Channels in Place Prior to Lateral Moving

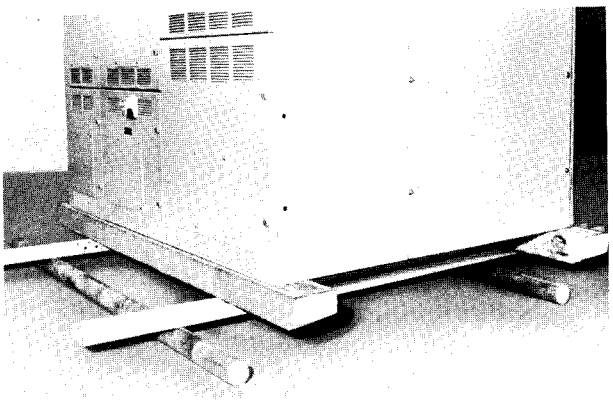

Fig. 4—Jacks Removed and Switchgear Ready for Lateral Moving

Raising by Slings

Where overhead lifting facilities are available, an alternate method of handling may be used for moving.

1. Holes are provided in the top of the units for attaching lifting angles (not furnished) along the front and rear of the units. These angles should be continuous the entire length of the assembled units and be securely bolted to each unit using all the holes provided for this purpose. Provide a large hole in the outstanding leg, near each end of the lifting angles, to permit the attaching of steel cable slings.

2. Spreaders should be placed where necessary on the slings so that the cables rise vertically from the top of the units. This will avoid the transfer of lateral stresses to the top of the units and prevent damage during lifting.

3. The switchgear should be raised high enough to clear projections above floor level, moved over the installation site and lowered into place. Then slings and lifting angles should be removed.

OUTDOOR INSTALLATION

Outdoor installation is handled similarly to the indoor type. Outdoor switchgear is constructed with a steel base that serves as a shipping convenience as well as a permanent support for the internal and external housings. Jacks may be placed under the base to raise the whole structure for positioning rollers.

Where overhead lifting facilities are available, lifting holes are provided at each end of the steel bases. Cable slings attached to these lifting holes should be equipped with spreaders placed above the assembly to prevent damage to the top of the switchgear.

CAUTION: DO NOT ATTACH SLINGS TO THE HOUSING AT ANY OTHER POINTS.

Before assembling a Walk-In structure read the drawing "Erection Procedure", listed on the front sheet of the Bill of Material, carefully and follow procedure indicated thereon.

For proper assembly of Outdoor Non-Walk-In switchgear, consult the drawing entitled "Gasket Application" which is listed on the front sheet of the Bill of Material.

INSTALLATION

GENERAL

Before attempting any installation operations consult all drawings furnished by the I-T-E Imperial Corporation for the particular order. These drawings are in the form of floor plans, front views, primary and secondary connection diagrams and Bills of Material of the equipment furnished. These drawings and the following recommendations should be studied carefully previous to planning the work.

LOCATION

The switchboard should be located with ample clearance from walls, columns, etc. Clearances at the front should be sufficient to permit removing the circuit breakers. Clearance at the back should be sufficient to permit opening the hinged rear doors and provide access to the interior of the compartments. This access will be required for making connections to the switchboard previous to putting it in operation and for periodic inspections thereafter. The minimum required clearances are shown on the drawings or may be obtained on request.

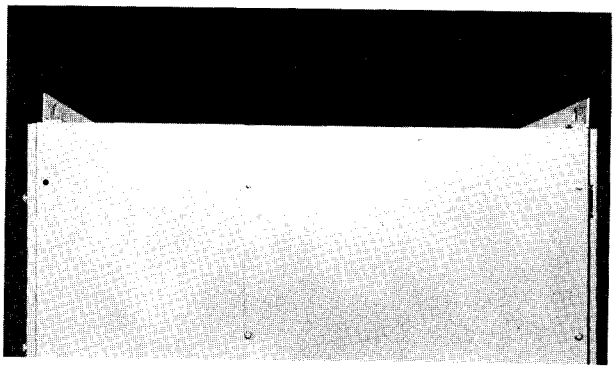

Fig. 5—Lifting Angles Bolted to Top of Switchgear (When Specified)

PREPARATION OF FLOOR

Floor plan drawings are supplied for each installation. Typical floor plan drawings are not enclosed since they usually vary with each installation due to length and arrangement of housings.

The design of the floor may include channel iron sills embedded in the concrete. It is important that these sills be straight and level their full length, and correctly spaced. To insure this condition, it is recommended that ties be bolted between the sills at various intervals after which the lower flange of the sill be shimmed to proper height.

Where necessary, power and secondary (control) conduits should be installed before the installation of the housings. Available space for the conduits is given on the floor plan accompanying each order. These conduits should not extend more than one inch above the station floor level. Take precautions to plug conduit openings before pouring cement.

The cement should be prepared in accordance with instructions issued by the Portland Cement Association, available at their offices in the large cities.

ASSEMBLING THE HOUSINGS

When the floor has been properly prepared, assembly of the switchgear may be started. Sections of the housings may be moved on their bases adjacent to final positions.

If the switchgear consists of a number of sections, the center sections should be installed first, and the remaining sections added at each end. When the first section is in position, it should be checked for distortion in shipment. This may be done by dropping a plumb bob from the center of the front and rear doors. If the structures are not

true, they should be straightened before proceeding. As each section is added, it should be checked for distortion, otherwise considerable pressure may be required to bring the sections into alignment.

Holes are provided in the floor for plug welding the housings to the channel sills.

When shipment is made in sections, the main bus, control wiring, and inter connections are dismantled at the point where the switchgear is separated. These should now be reassembled and all bolts and screws tightened. Incoming and outgoing connections should be made for both the main power circuit and all control circuits.

UNIT SUBSTATIONS

On unit substations one or more power transformers and a switchboard constitute a coordinated assembly. The transformers and their primary disconnect switches, when provided, are shipped separately. At the time of installation, primary disconnect switch, transformer and switchgear are to be mounted adjacent to each other.

When several unit substations are ordered at the same time, care must be exercised in pairing the primary disconnect switch, transformer and switchgear sections properly. The different transformers may be identical in rating, dimensions and arrangement, and it may seem therefore that it is not important to install any particular transformer alongside each switchboard. However, proper selection is important when the transformers have disconnect switches key interlocked with the secondary breakers, since the successful operation of the key interlock scheme depends on having locks on the switch and the breaker operated by the same key. To avoid unnecessary work, the key numbers should be checked before each piece of equipment is moved to its final location.

CONNECTIONS

Unit substations are generally shipped in separate sections, each transformer constituting a separate section. Switchboards are shipped in sections when their dimensions or weights exceed the maximum values specified by the purchaser or by the carriers. The buses are arranged to permit splitting for shipment. Terminal blocks are inserted in the secondary and control wiring running between units at the points where shipping splits occur. The individual wires are marked to correspond with marks on the terminal block and then they are disconnected and coiled up.

After the separate units have been erected and bolted together, the bus work and the secondary and control wiring must be reconnected at the points where it was split for shipment. It is important to make sure that all bolted joints are tight.

In replacing secondary and control wiring connections, the connection diagram must be followed to insure that no connection is missed.

After completing all internal connections, make the external connections to control power sources and circuits, to secondary current and potential circuits, to feeders and to power sources and to ground. AFTER COMPLETING ALL CONNECTIONS TO SECONDARY CURRENT CIRCUITS, FOLLOW THESE CIRCUITS AND REMOVE ANY TEMPORARY JUMPERS ACROSS CURRENT TRANSFORMER SECONDARIES. These jumpers are installed to protect against abnormal high voltages that may occur if the current transformer primaries carry currents while the secondary circuits are still not completed. After the secondary circuits are closed, the jumpers are no longer necessary, and failure to remove them will interfere with the operation of meters, relays or other devices connected in these circuits.

Outgoing power connections are made to the feeder circuit breakers by means of lugs furnished with the switchboard.

Incoming power connections should be made after all other connections have been completed. If the switchboard contains any device affected by phase sequence, the connection diagram includes a note indicating the proper phase sequence to use to obtain correct operation of these devices. The phase sequence of the incoming power source should be checked before making connections.

ROOF BUSHINGS

Roof bushings, for cable entrance, are shipped detached from the housing, and must be mounted in place when the switchgear is installed. Each bushing is furnished with a gasket that must be properly inserted between the roof and the bushing flange, using the adhesive as a binder between each of the parts. Cement the gasket to the roof using one layer of adhesive, then spread cement on the remaining flat surface of the gasket. Now put the bushing in place and bolt to the structure. Apply a bead of sealer to the exposed edge of the gasket to provide a weathertight seal.

CONNECTION TO GROUND BUS

Ground bus bars are bolted to the frames of the housings at the factory before shipment. When housings are shipped separately, it is necessary to bolt the ground bus to the framing. Ground bus bars should be solidly and permanently connected to the station ground by means of a cable or bus of cross section not less than that of the housing ground bus.

Cable or bus should not be in conduit, and should take the most direct path to station ground.

CONNECTION TO CONTROL SOURCE

The control source wiring to the switchgear should be of larger cross section than the balance of the control wiring in order to reduce the voltage drop, particularly when this source is some distance from the switchgear. Provision is made in the switchgear, in the form of heavy duty terminal blocks, for the connection of these control source leads. The leads should first be checked for proper electrical sequence before the connection is made.

Secondary and Control Connections

All secondary and control connections on the switchgear are factory wired in accordance with the connection diagrams applying to the installation. The secondary and control connections for all outgoing connections are wired to terminal blocks accessible to the conduit connections.

Control connections between housings are provided through openings in the side sheets of the switchgear. When shipment is made in groups of several units each, the cross connections between groups are installed at the factory, one end of each of the group connectors is then disconnected and tagged. Care should be taken to insure that all these connections between groups are securely remade when the groups are placed together again.

INSTALLATION OF BUS BAR CONNECTION BETWEEN GROUPS

The main bus in each group is assembled in the factory complete. It is spliced at the shipping splits located at either end of the group and is unbolted for shipment.

All contact surfaces at all bolted joints in the bus are silver plated. These contact surfaces should be cleaned and then bolted together. Conductivity of a bolted or clamped joint depends upon the pressure applied. The contact surfaces may be cleaned by first rubbing lightly with fine steel wool, then wiping with cloth saturated with carbon tetrachloride. Take care not to remove silver plating.

After bolting the sections of the main bus at junction point of shipment groups, torque ½ inch diameter hardware 30 to 45 foot-pounds to insure adequate electrical connection.

TESTING AND INSPECTION

With the housings erected, assembled, and connected, observe the following precautions:

1. Remove all extraneous matter and see that all internal parts are free of dirt, grease, and moisture. If moisture has penetrated, dry out with air or heat.

2. Remove all blocks in relays used for protection in shipment.

3. Apply potential tests to check for any damaged insulation.

60 CYCLE, RMS, WITHSTAND VOLTAGES (1 MINUTE)		
Rated	**Factory Test**	**Field Test**
60 volts	500 volts	375 volts
61 to 220 volts	1500 volts	1100 volts
221 to 600 volts	2200 volts	1650 volts
4800 volts	19,000 volts	14,600 volts
7200 volts	36,000 volts	27,000 volts
13,800 volts	36,000 volts	27,000 volts

CAUTION: IF PHASE TO PHASE TESTS ARE MADE IN ADDITION TO PHASE TO GROUND TEST, CARE MUST BE TAKEN THAT NO SHUNT CONNECTED COILS SUCH AS POTENTIAL TRANSFORMERS ARE CONNECTED DURING THE TESTS.

4. Check continuity of all circuits. A great deal of this work can be done after the circuit breakers are installed by energizing the control source and operating the equipment with the main circuit dead. Indicating instruments check the continuity of current transformer and potential transformer circuits after the main circuit is energized.

5. Set all relays, regulators, and other devices for proper operation of loads. No relays are set at the factory. Remove screws from short circuiting strip on terminal blocks in current transformer circuits. Screws should be stored in tapped holes in corners of the blocks.

6. If finish has been marred during shipment or installation, apply touch-up paint (which may be secured from the factory).

IMPORTANT: PROPER PHASING OF ALL MAIN CIRCUITS SHOULD BE CHECKED ACCORDING TO DIAGRAM.

FINAL INSPECTION

After the switchgear together with the apparatus which it is to control has been installed and all interconnections made, it should be given a final check and test before being put into service. This is necessary to insure that the equipment has been correctly installed and that all connections are completed. Extreme care must be exercised to prevent the equipment to be controlled from being connected to the system while the preliminary tests are being conducted.

If disconnecting switches are not part of the apparatus or switchgear, the line leads should be disconnected to accomplish this. The testing equipment required will depend entirely on the type of installation. Portable voltmeters both a-c and d-c with a wide range of scales will usually be required.

Some simple portable device for ringing or lighting out circuits should be included in the testing equipment.

STANDARD CONSTRUCTION

BUS INSULATION

All bus work in the switchgear with the exception of the ground bus is supported with I-T-E standard insulation, "Polyester Laminate." The insulation is designed to assure safe operating clearances of all bus work, phase to phase and phase to ground, when bus is subjected to the stresses of the short circuit current available.

PRIMARY DISCONNECT DEVICE

Each primary terminal of a drawout circuit breaker is equipped with a disconnect device consisting of a circle of fingers compressed by a garter spring or a set of in-line fingers compressed with compression springs. The mounting of these fingers on the circuit breaker permits inspection of them when the circuit breaker is withdrawn. This is a high pressure, self-aligning device, whose parts are silver plated to reduce the resistance to a minimum. The springs are outside the current path.

The tubular or flat stationary element is rigidly mounted in an insulating molding located in the housing.

SECONDARY DISCONNECTING DEVICES

All electrically operated circuit breakers are provided with separable disconnecting devices of the self-aligning pressure-type. These devices are amply proportioned for

carrying the required amount of current. The flexible member of the device is mounted on the breaker frame to facilitate inspection and maintenance. These devices make contact in the fully connected and test position, and no test jumper is needed.

GROUND BUS AND CONTACTS

The extension of the ground projecting toward the front on the lower left of breaker compartment rear barrier. The ground bus contacts are located on the rear structure of the circuit breaker and engage the ground bus extension when the breaker is in the connected, test, and any intermediate position.

CONTROL WIRES

The main control leads are mounted in the rear of the bus compartment. All electrically operated equipment is connected to these control wires through a suitable control circuit protective device.

CIRCUIT BREAKERS

GENERAL

Circuit breakers are boxed and shipped separately. Movable parts of the breakers are not blocked for protection in shipping.

On each switchboard all circuit breakers of like rating are interchangeable unless the secondary (control) circuit requires otherwise. In these cases interlocking will be used to prevent interchangeability.

Circuit breakers and housing are each set in a jig at the factory.

Circuit breakers have three positions in the housing. In the "DISCONNECT" position the main and control disconnecting devices on the breaker are disengaged and separated a safe distance from the stationary part of the devices located on the housings. In the "TEST" position, also, the main disconnecting devices are disengaged, but certain of the control contacts are connected so that the circuit breaker may be operated.

In the third or "CONNECTED" position, the main disconnecting devices are engaged. All control contacts, except those connected to the push buttons on the breaker, are connected.

Interlocks prevent moving a circuit breaker from one position to another unless the breaker is open, and prevent closing the breaker between positions.

For handling of circuit breakers, for the procedure of inserting them into the switchgear compartment and removing them, refer to the separate bulletin covering the breakers.

PLACING SWITCHBOARD IN SERVICE

GENERAL

Before energizing any part of the switchboard, make a complete check of mechanical operation of all devices. Remove any blocking wedges that may have been inserted in relays, circuit breakers, meters, etc. to prevent movement during shipment. Operate all circuit breakers and relays by hand and make sure that there is no binding of moving parts.

Make sure that no foreign matter, tools, etc. have fallen into or been mislaid in the rear of the switchboard.

PROCEDURE

The following procedure is recommended when putting the switchboard into service for the first time:

1. Open compartment doors on all drawout type circuit breakers and move these breakers to the "TEST" position. (See "Circuit Breaker Instruction Bulletins".)

2. Trip all stationary type breakers.

3. Check each control switch, making sure that it is in "TRIP" position.

4. Apply control voltage to the switchboard and test all electrically operated breakers for electrical closing and tripping, while they are in the test position. Test all manually operated breakers for closing and tripping while in the test position.

5. Move all drawout type breakers to the full connected position and close compartment doors.

6. Energize the main bus to the main circuit breaker and note if operation of instruments and relays is correct

7. Close the main circuit breaker and note operation of instruments and relays.

8. Close the desired feeder breakers.

MAINTENANCE

GENERAL

All switchgear installations should be given a general inspection at frequent intervals. Perform a visual inspection, front and rear, to see that there is no evidence of loose parts, warping or undue vibration. Take steps to remedy any deficiencies of this nature that may appear. Keep the assembly dry at all times. If leaks from overhead pipes and dripping from condensation or other sources cannot be eliminated, prevent the moisture from falling on the gear.

SEMI-ANNUAL INSPECTION

At least twice yearly, a thorough inspection of the board must be performed. Prior to this inspection, deenergize all circuits. The following checks in particular are emphasized:

1. Inspect all bolted connections, nuts and screws for tightness.

2. Inspect all cables for tight connections and ample support.

3. Inspect control wiring for signs of wear and damage. Replace wires wherever doubtful.

4. Examine resistors and other devices prone to overheating.

5. Open all hinged panels and remove all bolted panels.

6. Clean all insulation thoroughly.

7. Withdraw all drawout components and clean. (Refer to Circuit Breaker Instruction Bulletin before cleaning circuit breakers.)

8. Clean the stationary portion of the switchgear by wiping with a clean cloth. A compressed air hose will be useful in the relatively inaccessible areas.

9. Remove covers of all panel devices where practicable. Check wiring for secure connections. Clean contacts on relays and switches wherever necessary. Replace covers.

10. Replace all panels and components.

CARE OF FINISH

The exterior finish used on I-T-E Switchgear is of the highest grade baked synthetic enamel. The interior frame work is also bonderized and finished with oven baked enamel. The switchgear should be kept clean at all times. Wiping with a clean dry cloth will usually suffice. To remove oil and grease marks, use warm water and soap, wiping dry with a soft cloth.

To touch up the interior finish after final erection, use DuPont Air Dry Gray Enamel. The color finish furnished on the exterior varies, and this information is stated on the front sheet of the Switchgear Bill of Material. To touch up the exterior, use DuPont Duco of the corresponding color.

RENEWAL PARTS

The quantity of renewal parts to be stocked varies with the installation. Previous experience and the number of units in service are the best guides available. To order replacement parts, contact the nearest Sales Office of the I-T-E Imperial Corporation. Give a complete description of the parts and the nameplate data of the device requiring these parts. Specify the quantity required.

Issue A, 10-66 (Reprinted with company name change only)
2M-BPC-1268 Printed in U.S.A.

I-T-E METAL - ENCLOSED SWITCHGEAR

INSTRUCTIONS

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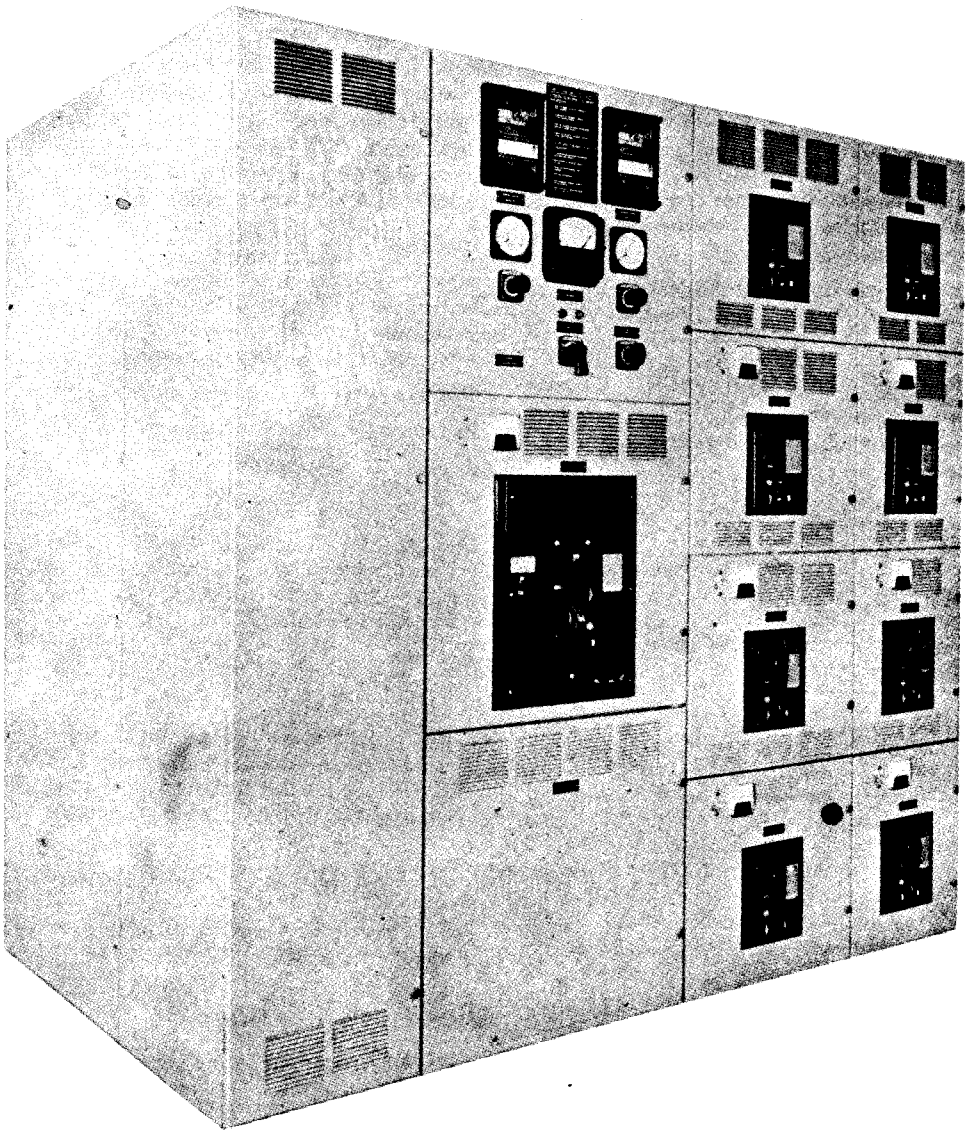

GOULD-BROWN BOVERI

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2. While a crew pushes the switchgear longitudinally towards its final position, one man should insert an additional roller under the forward end of the units. He should continue this operation by moving each roller that is freed from the rear end to the forward end until the units are in the desired position.

3. For lateral moving, raise the units by jacks and remove the rollers. Place the rollers laterally with steel channels (not furnished) resting on the rollers as shown in Figs. 3 and 4. Move the units, using procedure described in paragraph 2, until they are in the desired position.

4. When the units are in their final position, raise the units enough to just clear the rollers and any channels resting on the rollers. Remove all rollers and channels and lower units to the floor. Remove all the lag bolts inside the units which hold them to the shipping bases. Place jacks under the front and rear corner posts of the units and raise just enough to clear bases.

CAUTION: DO NOT APPLY JACKS TO THE HOUSING AT ANY OTHER POINTS.

Remove the shipping bases and lower the units evenly so as not to distort any of the structure.

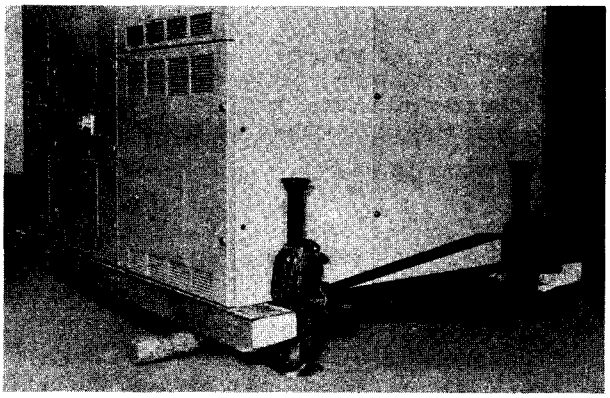


Fig. 1—Method of Raising Switchgear by Use of Jacks. Rollers in Place

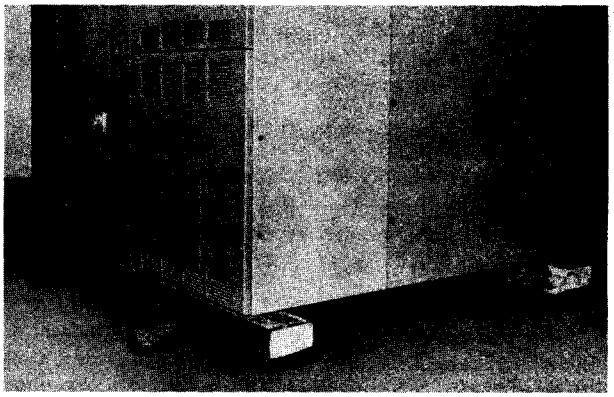


Fig. 2—Jacks Removed and Switchgear Ready for Longitudinal Moving

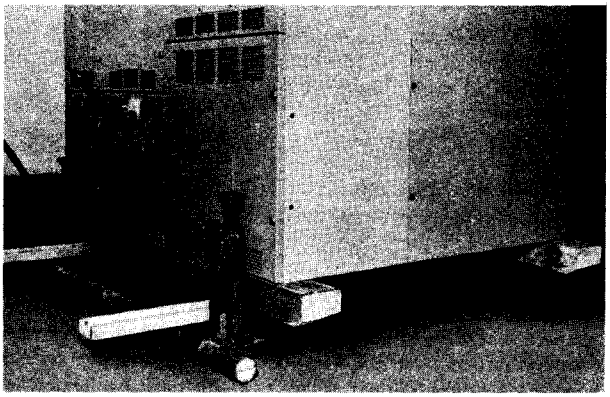


Fig. 3—Switchgear Raised, Rollers and Channels in Place Prior to Lateral Moving

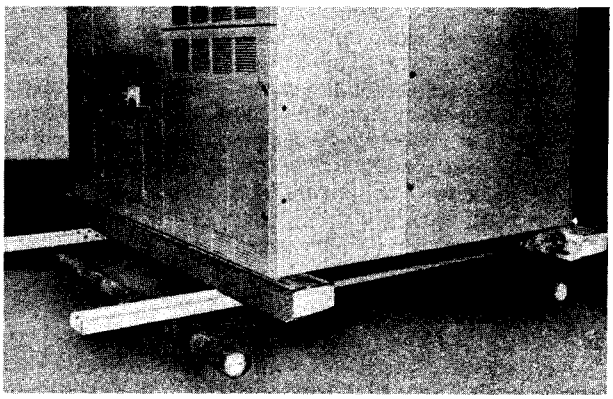


Fig. 4—Jacks Removed and Switchgear Ready for Lateral Moving

Raising by Slings

Where overhead lifting facilities are available, an alternate method of handling may be used for moving.

1. Holes are provided in the top of the units for attaching lifting angles (not furnished) along the front and rear of the units. These angles should be continuous the entire length of the assembled units and be securely bolted to each unit using all the holes provided for this purpose. Provide a large hole in the outstanding leg, near each end of the lifting angles, to permit the attaching of steel cable slings.

2. Spreaders should be placed where necessary on the slings so that the cables rise vertically from the top of the units. This will avoid the transfer of lateral stresses to the top of the units and prevent damage during lifting.

3. The switchgear should be raised high enough to clear projections above floor level, moved over the installation site and lowered into place. Then slings and lifting angles should be removed.

OUTDOOR INSTALLATION

Outdoor installation is handled similarly to the indoor type. Outdoor switchgear is constructed with a steel base that serves as a shipping convenience as well as a permanent support for the internal and external housings. Jacks may be placed under the base to raise the whole structure for positioning rollers.

Where overhead lifting facilities are available, lifting holes are provided at each end of the steel bases. Cable slings attached to these lifting holes should be equipped with spreaders placed above the assembly to prevent damage to the top of the switchgear.

CAUTION: DO NOT ATTACH SLINGS TO THE HOUSING AT ANY OTHER POINTS.

Before assembling a Walk-In structure read the drawing "Erection Procedure", listed on the front sheet of the Bill of Material, carefully and follow procedure indicated thereon.

For proper assembly of Outdoor Non-Walk-In switchgear, consult the drawing entitled "Gasket Application" which is listed on the front sheet of the Bill of Material.

INSTALLATION

GENERAL

Before attempting any installation operations consult all drawings furnished by Gould-Brown Boveri for the particular order. These drawings are in the form of floor plans, front views, primary and secondary connection diagrams and Bills of Material of the equipment furnished. These drawings and the following recommendations should be studied carefully previous to planning the work.

LOCATION

The switchboard should be located with ample clearance from walls, columns, etc. Clearances at the front should be sufficient to permit removing the circuit breakers. Clearance at the back should be sufficient to permit opening the hinged rear doors and provide access to the interior of the compartments. This access will be required for making connections to the switchboard previous to putting it in operation and for periodic inspections thereafter. The minimum required clearances are shown on the drawings or may be obtained on request.

Fig. 5—Lifting Angles Bolted to Top of Switchgear (When Specified)

PREPARATION OF FLOOR

Floor plan drawings are supplied for each installation. Typical floor plan drawings are not enclosed since they usually vary with each installation due to length and arrangement of housings.

The design of the floor may include channel iron sills embedded in the concrete. It is important that these sills be straight and level their full length, and correctly spaced. To insure this condition, it is recommended that ties be bolted between the sills at various intervals after which the lower flange of the sill be shimmed to proper height.

Where necessary, power and secondary (control) conduits should be installed before the installation of the housings. Available space for the conduits is given on the floor plan accompanying each order. These conduits should not extend more than one inch above the station floor level. Take precautions to plug conduit openings before pouring cement.

The cement should be prepared in accordance with instructions issued by the Portland Cement Association, available at their offices in the large cities.

ASSEMBLING THE HOUSINGS

When the floor has been properly prepared, assembly of the switchgear may be started. Sections of the housings may be moved on their bases adjacent to final positions.

If the switchgear consists of a number of sections, the center sections should be installed first, and the remaining sections added at each end. When the first section is in position, it should be checked for distortion in shipment. This may be done by dropping a plumb bob from the center of the front and rear doors. If the structures are not

true, they should be straightened before proceeding. As each section is added, it should be checked for distortion, otherwise considerable pressure may be required to bring the sections into alignment.

Holes are provided in the floor for plug welding the housings to the channel sills.

When shipment is made in sections, the main bus, control wiring, and inter connections are dismantled at the point where the switchgear is separated. These should now be reassembled and all bolts and screws tightened. Incoming and outgoing connections should be made for both the main power circuit and all control circuits.

UNIT SUBSTATIONS

On unit substations one or more power transformers and a switchboard constitute a coordinated assembly. The transformers and their primary disconnect switches, when provided, are shipped separately. At the time of installation, primary disconnect switch, transformer and switchgear are to be mounted adjacent to each other.

When several unit substations are ordered at the same time, care must be exercised in pairing the primary disconnect switch, transformer and switchgear sections properly. The different transformers may be identical in rating, dimensions and arrangement, and it may seem therefore that it is not important to install any particular transformer alongside each switchboard. However, proper selection is important when the transformers have disconnect switches key interlocked with the secondary breakers, since the successful operation of the key interlock scheme depends on having locks on the switch and the breaker operated by the same key. To avoid unnecessary work, the key numbers should be checked before each piece of equipment is moved to its final location.

CONNECTIONS

Unit substations are generally shipped in separate sections, each transformer constituting a separate section. Switchboards are shipped in sections when their dimensions or weights exceed the maximum values specified by the purchaser or by the carriers. The buses are arranged to permit splitting for shipment. Terminal blocks are inserted in the secondary and control wiring running between units at the points where shipping splits occur. The individual wires are marked to correspond with marks on the terminal block and then they are disconnected and coiled up.

After the separate units have been erected and bolted together, the bus work and the secondary and control wiring must be reconnected at the points where it was split for shipment. It is important to make sure that all bolted joints are tight.

In replacing secondary and control wiring connections, the connection diagram must be followed to insure that no connection is missed.

After completing all internal connections, make the external connections to control power sources and circuits, to secondary current and potential circuits, to feeders and to power sources and to ground. AFTER COMPLETING ALL CONNECTIONS TO SECONDARY CURRENT CIRCUITS, FOLLOW THESE CIRCUITS AND REMOVE ANY TEMPORARY JUMPERS ACROSS CURRENT TRANSFORMER SECONDARIES. These jumpers are installed to protect against abnormal high voltages that may occur if the current transformer primaries carry currents while the secondary circuits are still not completed. After the secondary circuits are closed, the jumpers are no longer necessary, and failure to remove them will interfere with the operation of meters, relays or other devices connected in these circuits.

Outgoing power connections are made to the feeder circuit breakers by means of lugs furnished with the switchboard.

Incoming power connections should be made after all other connections have been completed. If the switchboard contains any device affected by phase sequence, the connection diagram includes a note indicating the proper phase sequence to use to obtain correct operation of these devices. The phase sequence of the incoming power source should be checked before making connections.

ROOF BUSHINGS

Roof bushings, for cable entrance, are shipped detached from the housing, and must be mounted in place when the switchgear is installed. Each bushing is furnished with a gasket that must be properly inserted between the roof and the bushing flange, using the adhesive as a binder between each of the parts. Cement the gasket to the roof using one layer of adhesive, then spread cement on the remaining flat surface of the gasket. Now put the bushing in place and bolt to the structure. Apply a bead of sealer to the exposed edge of the gasket to provide a weathertight seal.

CONNECTION TO GROUND BUS

Ground bus bars are bolted to the frames of the housings at the factory before shipment. When housings are shipped separately, it is necessary to bolt the ground bus to the framing. Ground bus bars should be solidly and permanently connected to the station ground by means of a cable or bus of cross section not less than that of the housing ground bus.

Cable or bus should not be in conduit, and should take the most direct path to station ground.

CONNECTION TO CONTROL SOURCE

The control source wiring to the switchgear should be of larger cross section than the balance of the control wiring in order to reduce the voltage drop, particularly when this source is some distance from the switchgear. Provision is made in the switchgear, in the form of heavy duty terminal blocks, for the connection of these control source leads. The leads should first be checked for proper electrical sequence before the connection is made.

Secondary and Control Connections

All secondary and control connections on the switchgear are factory wired in accordance with the connection diagrams applying to the installation. The secondary and control connections for all outgoing connections are wired to terminal blocks accessible to the conduit connections.

Control connections between housings are provided through openings in the side sheets of the switchgear. When shipment is made in groups of several units each, the cross connections between groups are installed at the factory, one end of each of the group connectors is then disconnected and tagged. Care should be taken to insure that all these connections between groups are securely remade when the groups are placed together again.

INSTALLATION OF BUS BAR CONNECTION BETWEEN GROUPS

The main bus in each group is assembled in the factory complete. It is spliced at the shipping splits located at either end of the group and is unbolted for shipment.

All contact surfaces at all bolted joints in the bus are silver plated. These contact surfaces should be cleaned and then bolted together. Conductivity of a bolted or clamped joint depends upon the pressure applied. The contact surfaces may be cleaned by first rubbing lightly with fine steel wool, then wiping with cloth saturated with carbon tetrachloride. Take care not to remove silver plating.

After bolting the sections of the main bus at junction point of shipment groups, torque ½ inch diameter hardware 30 to 45 foot-pounds to insure adequate electrical connection.

TESTING AND INSPECTION

With the housings erected, assembled, and connected, observe the following precautions:

1. Remove all extraneous matter and see that all internal parts are free of dirt, grease, and moisture. If moisture has penetrated, dry out with air or heat.

2. Remove all blocks in relays used for protection in shipment.

3. Apply potential tests to check for any damaged insulation.

60 CYCLE, RMS, WITHSTAND VOLTAGES (1 MINUTE)		
Rated	**Factory Test**	**Field Test**
60 volts	500 volts	375 volts
61 to 220 volts	1500 volts	1100 volts
221 to 600 volts	2200 volts	1650 volts
4800 volts	19,000 volts	14,600 volts
7200 volts	36,000 volts	27,000 volts
13,800 volts	36,000 volts	27,000 volts

CAUTION: IF PHASE TO PHASE TESTS ARE MADE IN ADDITION TO PHASE TO GROUND TEST, CARE MUST BE TAKEN THAT NO SHUNT CONNECTED COILS SUCH AS POTENTIAL TRANSFORMERS ARE CONNECTED DURING THE TESTS.

4. Check continuity of all circuits. A great deal of this work can be done after the circuit breakers are installed by energizing the control source and operating the equipment with the main circuit dead. Indicating instruments check the continuity of current transformer and potential transformer circuits after the main circuit is energized.

5. Set all relays, regulators, and other devices for proper operation of loads. No relays are set at the factory. Remove screws from short circuiting strip on terminal blocks in current transformer circuits. Screws should be stored in tapped holes in corners of the blocks. See SAFETY PRECAUTIONS.

6. If finish has been marred during shipment or installation, apply touch-up paint (which may be secured from the factory).

IMPORTANT: PROPER PHASING OF ALL MAIN CIRCUITS SHOULD BE CHECKED ACCORDING TO DIAGRAM.

FINAL INSPECTION

After the switchgear together with the apparatus which it is to control has been installed and all interconnections made, it should be given a final check and test before being put into service. This is necessary to insure that the equipment has been correctly installed and that all connections are completed. Extreme care must be exercised to prevent the equipment to be controlled from being connected to the system while the preliminary tests are being conducted.

If disconnecting switches are not part of the apparatus or switchgear, the line leads should be disconnected to accomplish this. The testing equipment required will depend entirely on the type of installation. Portable voltmeters both a-c and d-c with a wide range of scales will usually be required.

Some simple portable device for ringing or lighting out circuits should be included in the testing equipment.

STANDARD CONSTRUCTION

BUS INSULATION

All bus work in the switchgear with the exception of the ground bus is supported with Gould-Brown Boveri standard insulation, "Polyester Laminate." The insulation is designed to assure safe operating clearances of all bus work, phase to phase and phase to ground, when bus is subjected to the stresses of the short circuit current available.

PRIMARY DISCONNECT DEVICE

Each primary terminal of a drawout circuit breaker is equipped with a disconnect device consisting of a circle of fingers compressed by a garter spring or a set of in-line fingers compressed with compression springs. The mounting of these fingers on the circuit breaker permits inspection of them when the circuit breaker is withdrawn. This is a high pressure, self-aligning device, whose parts are silver plated to reduce the resistance to a minimum. The springs are outside the current path.

The tubular or flat stationary element is rigidly mounted in an insulating molding located in the housing.

SECONDARY DISCONNECTING DEVICES

All electrically operated circuit breakers are provided with separable disconnecting devices of the self-aligning pressure-type. These devices are amply proportioned for carrying the required amount of current. The flexible member of the device is mounted on the breaker frame

to facilitate inspection and maintenance. These devices make contact in the fully connected and test position, and no test jumper is needed.

GROUND BUS AND CONTACTS

The extension of the ground projecting toward the front on the lower left of breaker compartment rear barrier. The ground bus contacts are located on the rear structure of the circuit breaker and engage the ground bus extension when the breaker is in the connected, test, and any intermediate position.

CONTROL WIRES

The main control leads are mounted in the rear of the bus compartment. All electrically operated equipment is connected to these control wires through a suitable control circuit protective device.

CIRCUIT BREAKERS

GENERAL

Circuit breakers are boxed and shipped separately. Movable parts of the breakers are not blocked for protection in shipping.

On each switchboard all circuit breakers of like rating are interchangeable unless the secondary (control) circuit requires otherwise. In these cases interlocking will be used to prevent interchangeability.

Circuit breakers and housing are each set in a jig at the factory.

Circuit breakers have three positions in the housing. In the "DISCONNECT" position the main and control disconnecting devices on the breaker are disengaged and separated a safe distance from the stationary part of the devices located on the housings. In the "TEST" position, also, the main disconnecting devices are disengaged, but certain of the control contacts are connected so that the circuit breaker may be operated.

In the third or "CONNECTED" position, the main disconnecting devices are engaged. All control contacts, except those connected to the push buttons on the breaker, are connected.

Interlocks prevent moving a circuit breaker from one position to another unless the breaker is open, and prevent closing the breaker between positions.

For handling of circuit breakers, for the procedure of inserting them into the switchgear compartment and removing them, refer to the separate bulletin covering the breakers.

PLACING SWITCHBOARD IN SERVICE

GENERAL

Before energizing any part of the switchboard, make a complete check of mechanical operation of all devices. Remove any blocking wedges that may have been inserted in relays, circuit breakers, meters, etc. to prevent movement during shipment. Operate all circuit breakers and relays by hand and make sure that there is no binding of moving parts.

Make sure that no foreign matter, tools, etc. have fallen into or been mislaid in the rear of the switchboard.

SAFETY PRECAUTIONS

THE CIRCUIT BREAKERS SHOULD BE IN TEST POSITION WHEN PRACTICABLE. WHEN A THOROUGH INSPECTION OR WORK IS REQUIRED ON A BREAKER, IT MUST BE REMOVED FROM THE HOUSING. THE BUS SHOULD BE DE-ENERGIZED AND GROUNDED WHENEVER POSSIBLE WHEN WORK IS TO BE DONE ON SWITCHGEAR.

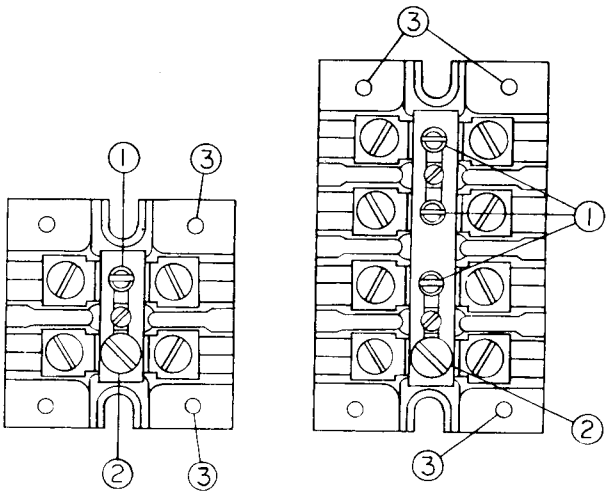
The secondary circuits of energized current transformers SHOULD NEVER BE OPEN CIRCUITED. Current transformer secondaries are short circuited when shipped from the factory.

To open the short circuiting device:

1. Check current transformer secondary circuits to assure that they are complete. Do not open circuit the secondary of an energized current transformer.

2. Remove the special short circuiting screws from the short circuiting strip. Do not remove the grounding screw.

3. Store the screws in the holes provided at the corners of the moulding. See Fig. 6.



1. Special short circuiting screws in short circuiting position.
2. Grounding screw - DO NOT REMOVE.
3. Holes for storing short circuiting screws.

SHORT CIRCUITING DEVICE
See Connection Diagram for location.
(Symbol ⫩)

Fig. 6

PROCEDURE

The following procedure is recommended when putting the switchboard into service for the first time:

1. Open compartment doors on all drawout type circuit breakers and move these breakers to the "TEST" position. (See "Circuit Breaker Instruction Bulletins".)

2. Trip all stationary type breakers.

3. Check each control switch, making sure that it is in "TRIP" position.

4. Apply control voltage to the switchboard and test all electrically operated breakers for electrical closing and tripping, while they are in the test position. Test all manually operated breakers for closing and tripping while in the test position.

5. Move all drawout type breakers to the full connected position and close compartment doors.

6. Energize the main bus to the main circuit breaker and note if operation of instruments and relays is correct.

7. Close the main circuit breaker and note operation of instruments and relays.

8. Close the desired feeder breakers.

MAINTENANCE

GENERAL

All switchgear installations should be given a general inspection at frequent intervals. Perform a visual inspection, front and rear, to see that there is no evidence of loose parts, warping or undue vibration. Take steps to remedy any deficiencies of this nature that may appear. Keep the assembly dry at all times. If leaks from overhead pipes and dripping from condensation or other sources cannot be eliminated, prevent the moisture from falling on the gear.

SEMI-ANNUAL INSPECTION

At least twice yearly, a thorough inspection of the board must be performed. Prior to this inspection, de-energize all circuits. The following checks in particular are emphasized.

1. Inspect all bolted connections, nuts and screws for tightness.
2. Inspect all cables for tight connections and ample support.
3. Inspect control wiring for signs of wear and damage. Replace wires wherever doubtful.
4. Examine resistors and other devices prone to overheating.
5. Open all hinged panels and remove all bolted panels.
6. Clean all insulation thoroughly.
7. Withdraw all drawout components and clean. (Refer to Circuit Breaker Instruction Bulletin before cleaning circuit breakers.)
8. Clean the stationary portion of the switchgear by wiping with a clean cloth. A compressed air hose will be useful in the relatively inaccessible areas.
9. Remove covers of all panel devices where practicable. Check wiring for secure connections. Clean contacts on relays and switches wherever necessary. Replace covers.
10. Replace all panels and components.

CARE OF FINISH

The exterior finish used on I-T-E Switchgear is of the highest grade baked synthetic enamel. The interior frame work is also phosphatized and finished with oven baked enamel. The switchgear should be kept clean at all times. Wiping with a clean dry cloth will usually suffice. To remove oil and grease marks, use warm water and soap, wiping dry with a soft cloth.

To touch up the exterior or interior finish after final erection, use PPG DZL-3200 light gray primer surfacer and PPG air dry acrylic enamel of the corresponding color. The color finish furnished on the exterior varies, and this information is stated on the front sheet of the Switchgear Bill of Material.

RENEWAL PARTS

The quantity of renewal parts to be stocked varies with the installation. Previous experience and the number of units in service are the best guides available. To order replacement parts, contact the nearest Sales Office of Gould-Brown Boveri. Give a complete description of the parts and the nameplate data of the device requiring these parts. Specify the quantity required.