instructions

AMPGARD

high voltage starters

2000 to 5000 volts a.c.

air break contactor

cema class E1 and E2

Canadian Westinghouse Company Limited
Switchgear and Control Division
Hamilton
Canada
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table of contents

AMPGARD

high voltage motor starters

This instruction book has been prepared to familiarize the Purchaser's Engineering and Operating Staff with the Canadian Westinghouse line of AMPGARD high voltage motor starters (2000 - 5000 Volt class). While this book relates to standard designs, it may also be used for special designs which differ from standard because of electrical or mechanical modifications. The information contained herein should be carefully studied before proceeding with installation and operation of the equipment.

Proper installation, operation and maintenance are necessary to assure continued satisfactory performance. The equipment should not be called upon to operate at voltages or currents beyond its rating. Effective measures should be taken to assure optimum performance where unusual service conditions prevail such as moist, dusty, or corrosive atmospheres or high ambient temperatures. A regular inspection schedule should be established.

For instructions pertaining to a particular device supplied as part of a starter, refer to the instruction book or leaflet applying to that particular device.

caution: *only authorized and properly trained personnel should be permitted to install and service this equipment.*

application

Canadian Westinghouse "AMPGARD" high voltage magnetic starters comprise a complete line for protection and control of squirrel cage, wound rotor, and synchronous motors with voltage ratings in the 2500 - 5000 Volt range, and with horsepower ratings as shown in Table I, Columns 5 and 6.

These starters are CSA approved and conform to CEMA Industrial Control standards for Class "E1" and "E2" controllers.

The Class "E1" starters rely upon the main contactor to interrupt short circuit currents. The interrupting rating of these starters is shown in Table I, Column 3. The Class "E2" starters employ current limiting fuses to limit and interrupt short circuits. These starters may be used in circuits having available short circuit capacity up to the maximum shown in Table I, Column 4.

co-ordinated protection

In CEMA Class "E2" starters, the current limiting main power fuses, current transformers, contactor and overload relays are co-ordinated with motor characteristics to provide:—

1. Protection of the motor against sustained overload condition by means of the ambient temperature compensated thermal overload relay.

2. Protection of the fuses against sustained currents above their continuous ampere rating but below their melting value by means of the overload relay.

3. Protection of the circuit by means of the contactor within the interrupting limits of the contactor and below the operating time of the fuses.

4. Protection at maximum fault current of the circuit, the contactor, the current transformers and the overload relay by fuses having the proper current limiting ability and short time interrupting characteristics.

fault reclosing protection

The control circuit should provide means to prevent repeated reclosing of the contactor on low current faults. If the source of control circuit power is the same as that of the power load, control voltage will reach very low values during fault conditions and the contactor may open.

Should the fault current fail to blow the fuse, control voltage will be restored when the contactor opens and it may immediately reclose if the control circuit arrangement permits. This cycle can be repeated rapidly and can easily cause serious damage. An instantaneous low voltage protection scheme will prevent repeated reclosing, but special precautions are necessary if a two wire control circuit is required.

Two wire control definitely should not be used on a power system incapable of delivering enough current to blow the fuses quickly. The control circuit should incorporate an extra relay for low voltage protection. For the same reason, time delay undervoltage protection is not universally recommended.

table 1

Voltage Rating of System	Contactor 8 Hr. Rating Amperes	Symmetrical 3 Phase Available Short Circuit Capacity in KVA 50/60 Cycles		Horse Power Rating	
		Class E1	Class E2	Induction and 80% P.F. Synch. Motors	100% P.F. Synchronous Motors
Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
2200 to 2500	90	50,000	200,000	350	450
	180	50,000	200,000	700	900
	360	50,000	200,000	1500	1750
4000 to 4600	90	50,000	360,000	625	750
	180	50,000	360,000	1250	1500
	360	50,000	360,000	2500	3000

description

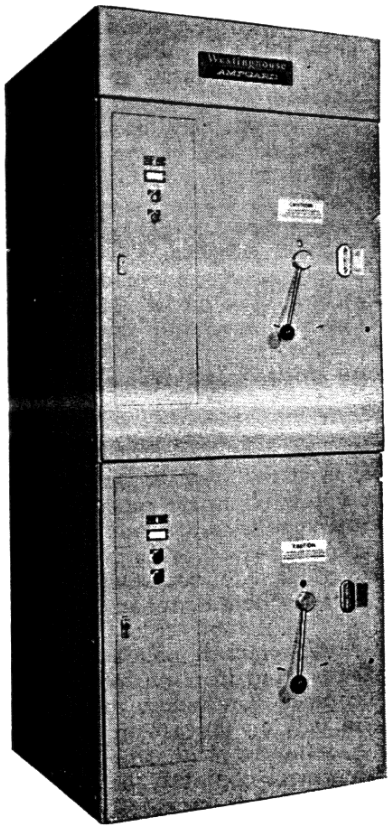


Figure #1

Two class 11-202-HS4 starters in a single 90″ high enclosure

general

The basic CEMA Class "E2" full voltage non-reversing starter for squirrel cage induction motors consists of a stationary housing and a drawout contactor assembly. The housing supports the control panel and contains the power bus, current transformers and circuit connections. The drawout contactor assembly consists of a type "HH" air break contactor, control transformer, and fuses mounted on a wheeled chassis. The standard structure is designed for mounting two starter units in a single 90″ high enclosure as illustrated in Figure 1.

The AMPGARD Starter line includes three separate classes of control:

—Class 11-202 Squirrel Cage Motor Starters
—Class 13-202 Wound Rotor Motor Starters
—Class 14-202 Synchronous Motor Starters

Synchronous motor starters include type ASR Slipsyn or Static Slipsyn equipment to apply automatically the motor field when the rotor reaches the proper speed and is in the proper phase position.

The reduced voltage type of starter for the above classes differs only in the power circuit components used.

enclosure

The standard enclosure is CEMA Type 1, general purpose free standing of welded and bolted construction with segregated compartments, hinged front doors and bolt-on top, side and rear covers. The starter is completely front accessible and suitable for mounting against a wall or for back-to-back mounting of similar structures. It is 90″ high x 36″ wide x 36″ deep and is made up of two modules. The lower module 40″ high houses the basic starter unit. The upper module 50″ high contains space for an additional starter unit (two high construction), or alternatively may be used in one high starters to house additional equipment such as control panels, potheads, potential transformers, etc. The upper module also contains space 10″ high at top for enclosed 1000 ampere horizontal power bus. The general construction, arrangement of devices, and compartmentation for the low voltage control devices is shown in Figures 2 and 6.

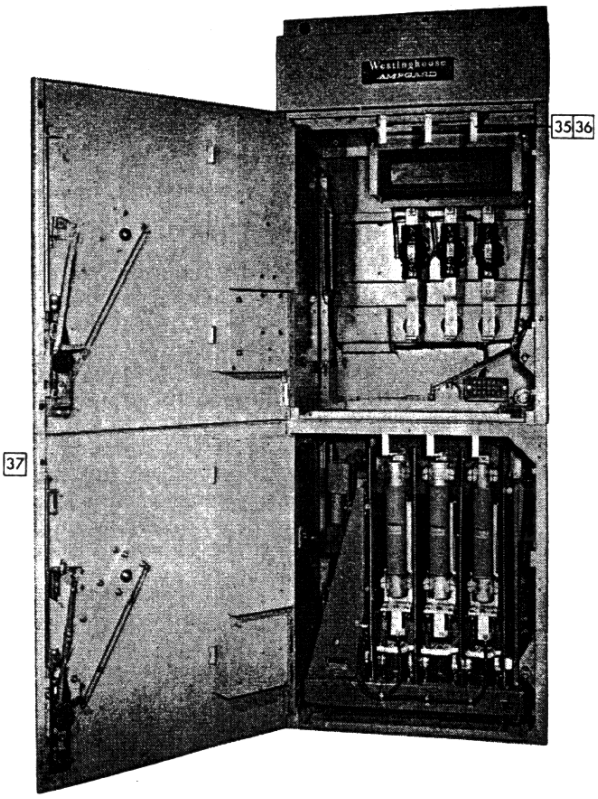


Figure #2

drawout contactor assembly

The drawout contactor assembly includes elements essential to the protection and control of the motor. The assembly includes the contactor, high voltage power and control fuses, control transformer, closing rectifier, economizing resistor and associated closing accessories all as illustrated in Figures 3, 4 and 16. The unit features readily removable barriers and tilt-back arc chutes for quick inspection of contacts while the contactor is in the cell.

The contactor is fully drawout with automatic electrical connections to provide complete accessibility for detailed inspection and maintenance or emergent replacement.

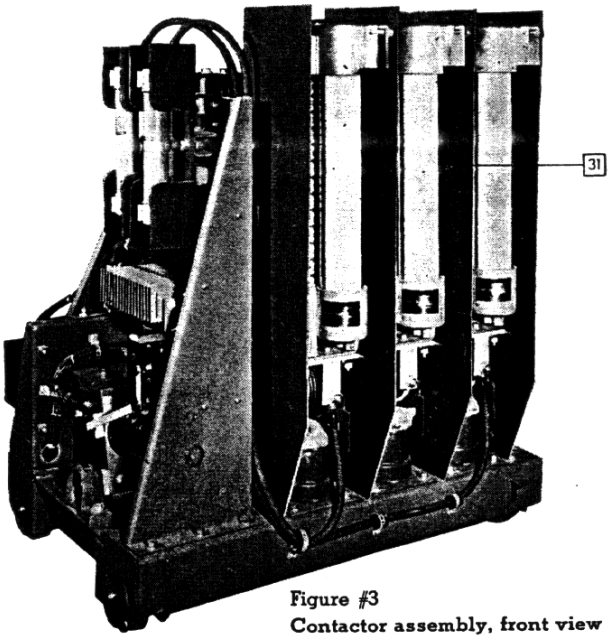


Figure #3
Contactor assembly, front view

high voltage current limiting fuses

The three main power fuses are mounted vertically on the front of the drawout contactor assembly.

The type CLS-1 single barrel and CLS-2 double barrel main power fuses have short circuit interrupting rating of 200,000 KVA at 2,300 Volts and 360,000 KVA at 4,160 Volts. Since these fuses are self protecting, any fuse which has not operated to interrupt an overcurrent can be safely left in service. In starters equipped with type BAL-LR fuses the resistance of the fuses should be checked after every abnormal overcurrent condition, and whenever one or more fuses in a group of three blows, to ensure satisfactory operating condition.

The drawout mechanism ensures isolation and grounding of the fuses before the contactor compartment door can be opened. With the door open, isolation and grounding can be visually confirmed and the fuses can be safely removed.

The control transformer high voltage current limiting fuses are type BAL, rated 0.5 amperes, and are mounted on the left hand side of the drawout contactor as seen in Figure 3. These fuses should rarely require replacement as any fault on the secondary

type "HH" contactor

The type HH contactor is designed for power systems up to 5,000 Volts AC maximum and is available in continuous ratings of 100, 200, and 400 Amperes. It is suitable for use with motor ratings up to 3,000 HP maximum (See Table I). The interrupting rating of the contactor without fuses is 50,000 KVA three phase symmetrical 25-60 cycles.

The contact system, arc interrupting chutes and closing mechanism are of the same field proven design used in previous AMPGARD starters.

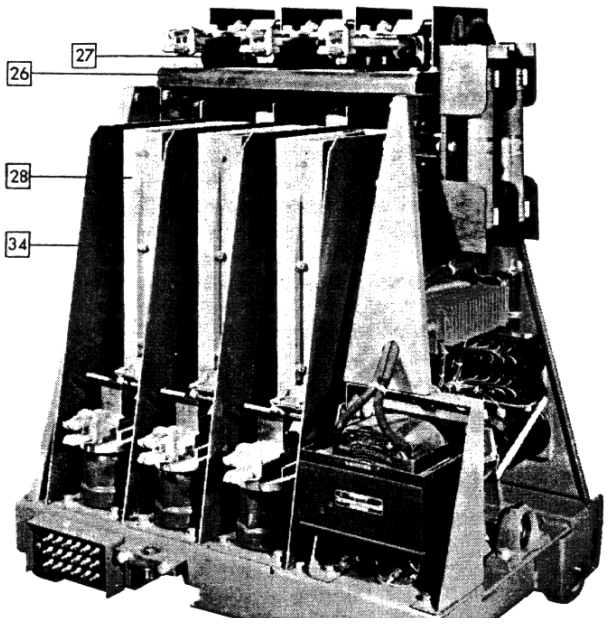
The contactor is equipped with a DC closing magnet having two coils operated in series energized through a rectifier from the AC control supply.

Economizing resistors are used to conserve DC power when the contactor is in the closed position.

When opening heavy fault currents the magnetic forces react in such a manner as to accelerate the contactor opening. This opening speed may become high enough to cause bouncing and even re-touching of the contacts unless preventive means is taken. A mechanical latch is provided on the contactor to engage and hold the magnet armature in the open position, and thus eliminate rebounding. The latch is magnetically retracted when the contactor is energized. It is released through an auxiliary interlock contact when the contactor closes and is in position to engage the magnet armature on contactor opening.

The arc chute on each pole serves to extinguish rapidly arcs resulting from current interruption and prevents escape of conducting arc gases. Blowout coils assist in moving the arc up into the chute by energizing a laminated steel yoke to direct magnetic flux across the main contacts. Removable insulating barriers are provided to increase the level of insulation between phases and between outer phases and contactor end frames.

caution: *arc chutes and barriers must be properly installed before energizing contactor.*



The standard contactor is supplied with a 4 pole type RC auxiliary switch. This is a shaft-operated rotary type switch rated 600 volts, 15 amperes continuous. A second 4 pole switch may be mounted if additional interlocking contacts are required.

Line and load disconnect finger clusters rated 600 amperes are mounted on the contactor rather than in the enclosure so they may be drawn out for ease of inspection and maintenance. Control disconnecting contacts (bottom left Figure # 4) provide connections for the control leads between the draw-out contactor and the stationary housing. These contacts are rated 600 volts, 20 amperes continuous consisting of round, two segment silver-plated pins fitting into silver-plated sockets. (See also figure # 5).

contactor compartment

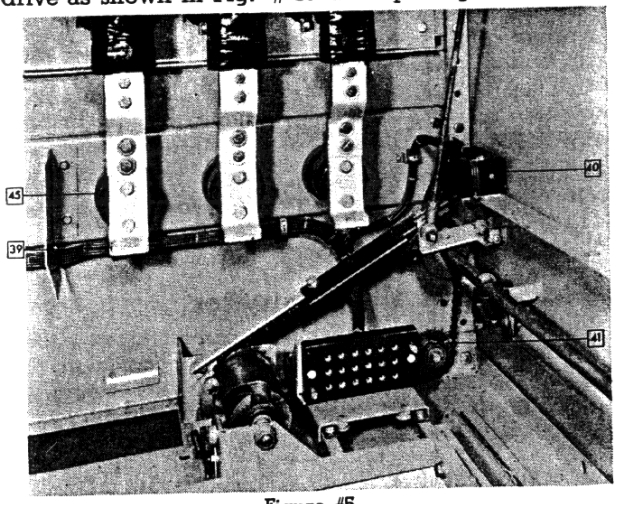
The contactor compartment contains the shutter box enclosing the line stabs, load stabs, current transformers, draw-out operating mechanism and associated components.

Pressure type cable terminals are provided for the customer's incoming and outgoing cables. When a main power bus is provided the cables between the bus and the line stabs are factory installed.

Low voltage terminal blocks are provided for customer's control circuits. In addition a terminal block is provided for an external test supply. This circuit is wired through a changeover switch to prevent energization of the control transformer and thus eliminate high voltage from being reflected into the primary circuit.

The shutter box (Figure # 9) is fully hinged to permit easy access to the line terminals during installation and is totally enclosed for complete safety to personnel. The shutter is mechanically raised and lowered by direct linkage from the operating shaft and held closed when the contactor is withdrawn. The shutter is pivoted to eliminate friction commonly associated with sliding parts and does not rely on gravity for closing.

The draw-out operating mechanism consists essentially of the drive cam, operating shaft and chain drive as shown in Fig. # 5. The spiral groove of the drive cam engages with the cam follower, contactor mounted, to move the contactor forward into the operating position when the cam is rotated clockwise and to withdraw the contactor when the cam is rotated counter-clockwise. The cam is chain driven by the operating shaft actuated by the operating handle on the front door. The drive cam is safety interlocked to prevent the rotation of the operating handle unless the contactor is fully in the test position.



Accurate disconnect alignment is maintained by engagement of the contactor wheels with the cell guide rails.

contactor positions

Three draw-out contactor positions are inherent in the design.

1. **operating position** — contactor line and load cluster fingers are fully engaged with the cell stabs to connect line and motor to the contactor assembly. In this position the control draw-out contacts are fully engaged to energize the control circuits from the control transformer for normal operation.

2. **test position** — line and load finger clusters are disengaged to isolate the contactor assembly from the line and motor. The control circuit remains connected as in the operating position to permit sequence testing of the starter from a separate source of control supply. All 3 phases of the contactor assembly are grounded to the metal enclosure by visible contact fingers to safeguard personnel.

3. **maintenance position** — both line and load finger clusters and the control circuit contacts are disconnected to isolate the starter completely for routine inspection and maintenance purposes. In this position the contactor extends approximately 3 inches beyond the front of the enclosure. The fuses and the line contacts of the contactor assembly are still grounded by the visible contact fingers.

isolation of contactor assembly

Isolation of the contactor from its power supply is accomplished by rotating, counterclockwise, the operating handle on the starter door (Fig. # 6) from the "closed" to the "open" position. The total rotational movement of the handle is 330°. This corresponds to 4" of linear travel of the contactor assembly in the compartment.

In connecting the contactor, the first 165° clockwise rotation of the operating handle moves the contactor 3" forward to the point of contact. The final 165° moves the contactor 1" further to engage fully the line and load finger clusters in the operating position. The large second half rotational travel of the handle multiplies the mechanical advantage to overcome the large frictional forces of the finger clusters at the point of engagement. With this arangement a very nearly constant torque is required

With the operating handle in the "open" position the compartment door may be opened by upward movement of the right hand portion of the door "release". The contactor line finger clusters should be visually checked to ascertain that the line contacts are fully disconnected and the shutter fully closed before any maintenance or inspection is undertaken. As a further safeguard to personnel the line contacts of the contactor and fuse holders are grounded to the cell enclosure before the door can be opened.

The finger clusters have very limited interrupting capacity. Do not open them when connected to a load of any kind.

They will interrupt the magnetizing current of a 3.0 KVA control transformer but any load in excess of this may not be interrupted. To minimize contact burning resulting from the making or breaking of control transformer magnetizing currents the operating handle should be rotated continuously without hesitation between end positions.

low voltage compartment

Control relays, protective relays, control fuses, pushbuttons and other auxiliary equipments are completely enclosed in a low voltage compartment recessed in the front door of the starter. This auxiliary equipment is accessible independent of the position of the draw-out contactor. The low voltage compartment door is provided with a key latch.

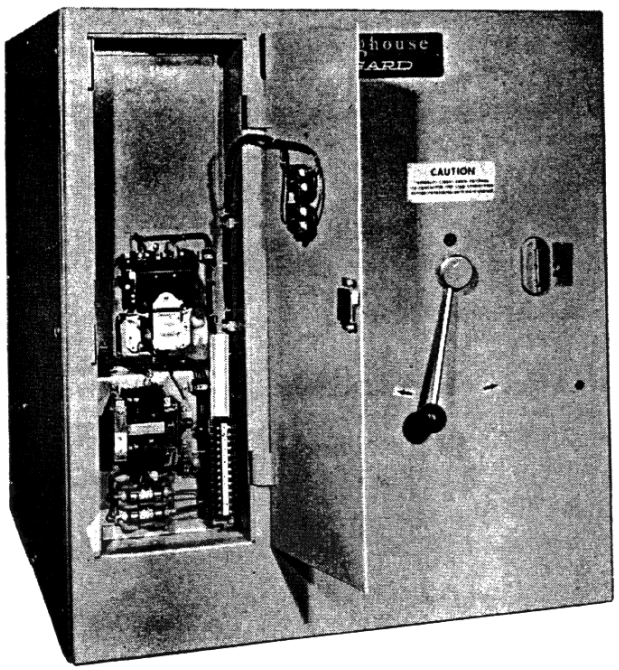


Figure 6

40" high starter unit with low voltage compartment door open

mechanical and electrical interlocking

The AMPGARD contains a complete system of

door release—holds the door closed when the operating handle is in the "open" position. The right portion of this "release" must be moved upward to release the starter door. The door release forms a locking arrangement with the operating mechanism and can accommodate up to three independent padlocks. Thus the contactor may be padlocked in either the "connected" or the "disconnected" position. Locking the door release with the operating handle in the "open" position prevents opening of the door.

door interlock—provides additional two point safety latching to the enclosure to positively hold the door closed when the contactor is moved to the "connected" position.

contactor position interlock — located on the drive cam mounting, ensures that the contactor is in proper "test" position before the operating handle can be rotated. This interlock in conjunction with the cam index roller, locks the complete drive mechanism when the contactor is withdrawn and prevents opening of the shutter to expose high voltage line stabs.

shutter interlock cam — operates in conjunction with the pivoted arm and roller assembly to raise and lower the shutter. The cam is keyed to the drive shaft to ensure positive action. The shutter is mechanically closed and held when the contactor is withdrawn.

contactor interlock pivot — is actuated by the contactor and engages the drive shaft to prevent the withdrawal of the contactor while the contactor is "closed".

changeover switch—operated by a separate section of the shutter interlock cam is arranged to provide back-up protection to the contactor interlock pivot and to transfer the control circuits from the control transformer to a separate source. The contacts are "early break" to ensure the de-energizing of the contactor before the finger clusters are disconnected and "late make" on changeover to ensure that the test voltage is not applied until the contactor is in the proper "test" position.

concealed door release—permits external operation of the door interlocks and opening of the door under EMERGENCY conditions. Removal of the "plug" button below the "door release" permits insertion of a tool into a 3/8" diameter hole to pry up and release the door.

caution: *starter must be visibly disconnected from the high voltage supply before concealed door release is used.*

grounding of the contactor

The chassis of the draw-out contactor assembly is grounded to the starter enclosure in all positions by a spring loaded contact finger bearing on a copper rubbing guide. This provides positive grounding not relying upon the contact between the wheels and track.

High voltage power fuses are automatically grounded to the enclosure when the contactor is withdrawn

ground bus connections

Single section enclosures include a grounding stud with pressure type solderless cable connectors for customer grounding. Multi-section enclosures include a ground bus in each section. Connecting links between adjoining shipping sections are supplied for field installation.

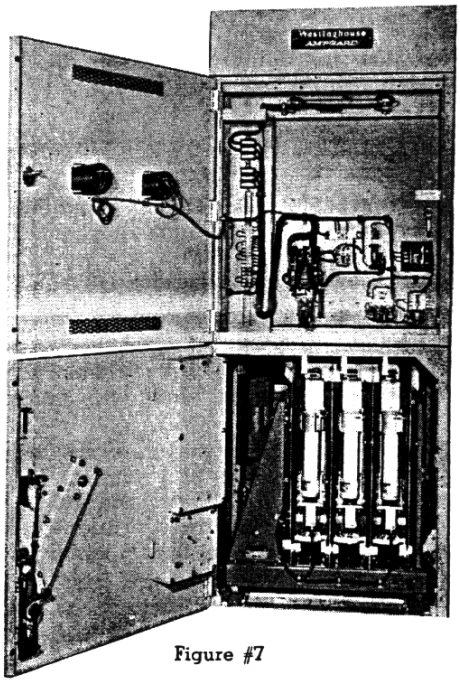


Figure #7

Synchronous Ampgard showing Slipsyn panel in upper compartment

installation

receiving, handling and storage

The AMPGARD enclosures are shipped as complete units or groups of units bolted together to a wood shipping skid. Normally the shipping groups consist of as many units as can be conveniently handled by the customer. The contactor assemblies with arc chutes, fuses and insulating barriers are packed and crated separately from the enclosure.

Lifting eyes are provided on single sections and lifting angles on multi-section structures for attachment of hooks or slings so that the complete structure may be lifted by a crane. These lifting means can be removed when no longer required. Lifting by crane is preferable, but where crane facilities are not available, the structure may be moved by use of rollers under the shipping skids.

Immediately upon receipt, the equipment should be checked against the shipping lists to be sure that all parts have been received. This will avoid delays in installation. If damage is found or suspected, claims should be filed as soon as possible with the

synchronous motor starters

Synchronous motor starters require a full 90" enclosure (Fig. #7). The Slipsyn field application devices are contained in the upper compartment. The devices are mounted on a hinged swing-out panel to provide access to the space behind the panel for mounting of optional equipments such as potential transformers or potheads.

wound rotor motor starters

For these starters the contactors for secondary switching may be mounted in the upper compartment as shown in Fig. #8. Secondary resistors are mounted separately.

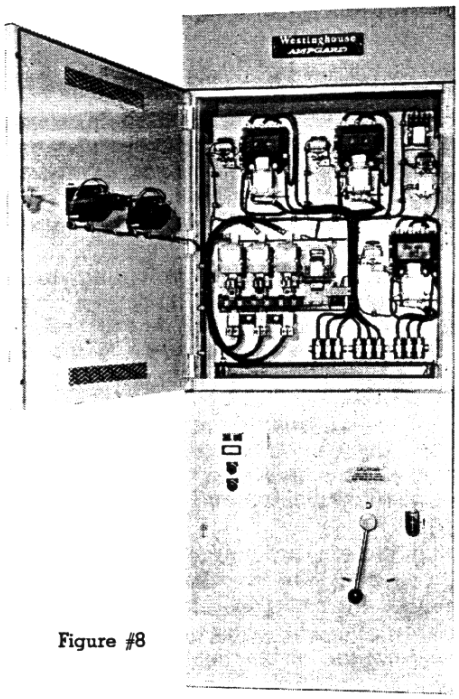


Figure #8

Wound rotor Ampgard showing motor secondary contactors in upper compartment

If the equipment is to be stored or held for some time before installing, it is advisable to unpack the shipment sufficiently to check the equipment for completeness and condition. Crating material and packing should be restored to provide protection during subsequent storage and handling.

The storage area should be maintained clean and dry to eliminate moisture and condensation and to exclude dust and dirt. Storage outdoors, even when protected by tarpaulin, is inadequate.

location and foundation

The location should provide protection, accessibility and ventilation to the starter. The enclosures are designed for operation in a maximum room ambient temperature of 40 °C.

Careful preparation of the concrete floor is vitally important because simplicity of erection and satis-

starter is to be erected. The entire concrete floor must be true and flat. Special attention should also be paid to the accurate levelling of the floor adjacent to the enclosure on the contactor drawout side to facilitate installation and removal of the contactor.

Floor channels to be supplied by the Purchaser unless specifically ordered with the equipment must be aligned and grouted full as recommended in Figure #11. The structure should be bolted (½"–13 bolts) or welded to the floor channels.

A minimum aisle space of 42" must be provided to permit the removal and installation of the drawout contactor.

Check the Canadian Electric Code Part I or other applicable regulations to determine the size of conductors and the number and size of conduits.

cable connections

When a power bus is provided as in multi-section enclosures the incoming line connections are made to solderless terminals supplied on the power bus. The line connections between the power bus and the shutter box of the individual starters are factory installed.

In single section enclosures containing one or two starters the customer's incoming supply cables are brought through the opening in the rear of the shutter box and connected directly to the draw-out line stabs in the shutter box (Figures #9 and #11). To make this connection the shutter box cover is opened by disconnecting the shutter link and removing the two cover securing bolts. After completing the supply connections the shutter box must be reclosed, cover bolts secured and the shutter link reconnected.

In 2-high starters the interconnecting power cable is factory supplied and the customer is free to enter either shutter box with his incoming supply.

The feeder cables from the motor are connected to the upper terminal of the current transformers. In lines where a current transformer is not provided the connection is made to the draw-out load stab.

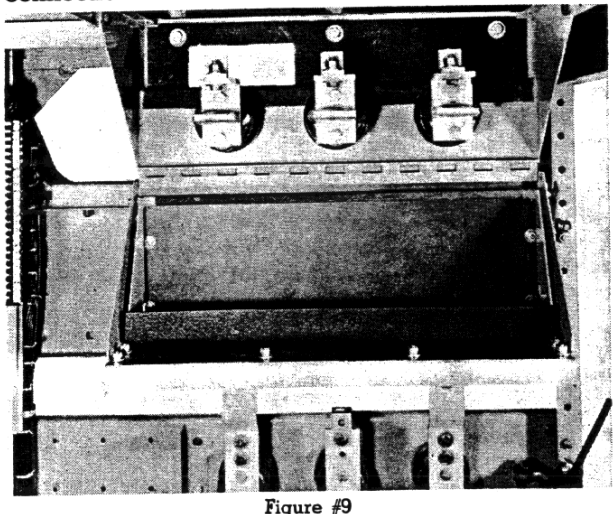


Figure #9

Cables in the rear of the contactor compartment must be securely fastened by insulation clamps to the rear cross channels to preclude any possible interference with the draw-out contactor.

Ample number of 600 Volt terminal blocks are conveniently located at the left, rear of the starter compartment for connection to the customer's control circuits.

The starter is designed to provide customer cable entry and exit from either the top or the bottom of the enclosure with equal ease (Figure #11).

preparation of contactor for service

The drawout contactor assembly should be uncrated carefully and thoroughly inspected. The following summarizes the steps to be followed in preparing the contactor for service:

1. Remove all bracing and blocking added to the contactor for shipment.
2. Use compressed air or vacuum cleaner to remove dust or foreign materials which may remain after removal of packing.
3. Tilt the arc chutes back and carefully inspect the inside of the arc chutes and contacts for broken parts or presence of any foreign material. Release magnetic latch on armature and operate the contactor manually to ensure that it moves freely.
4. Inspect the main disconnect and control contacts for possible damage to the contacts or insulators.
5. Wipe insulating barriers clean and install between poles and between outer poles and end frames.
6. On contactors with power fuses, check to ensure that the fuses are securely mounted in the fuse clips.
7. **caution:** *arc chutes and insulating barriers must be properly installed before placing the contactor into service.*

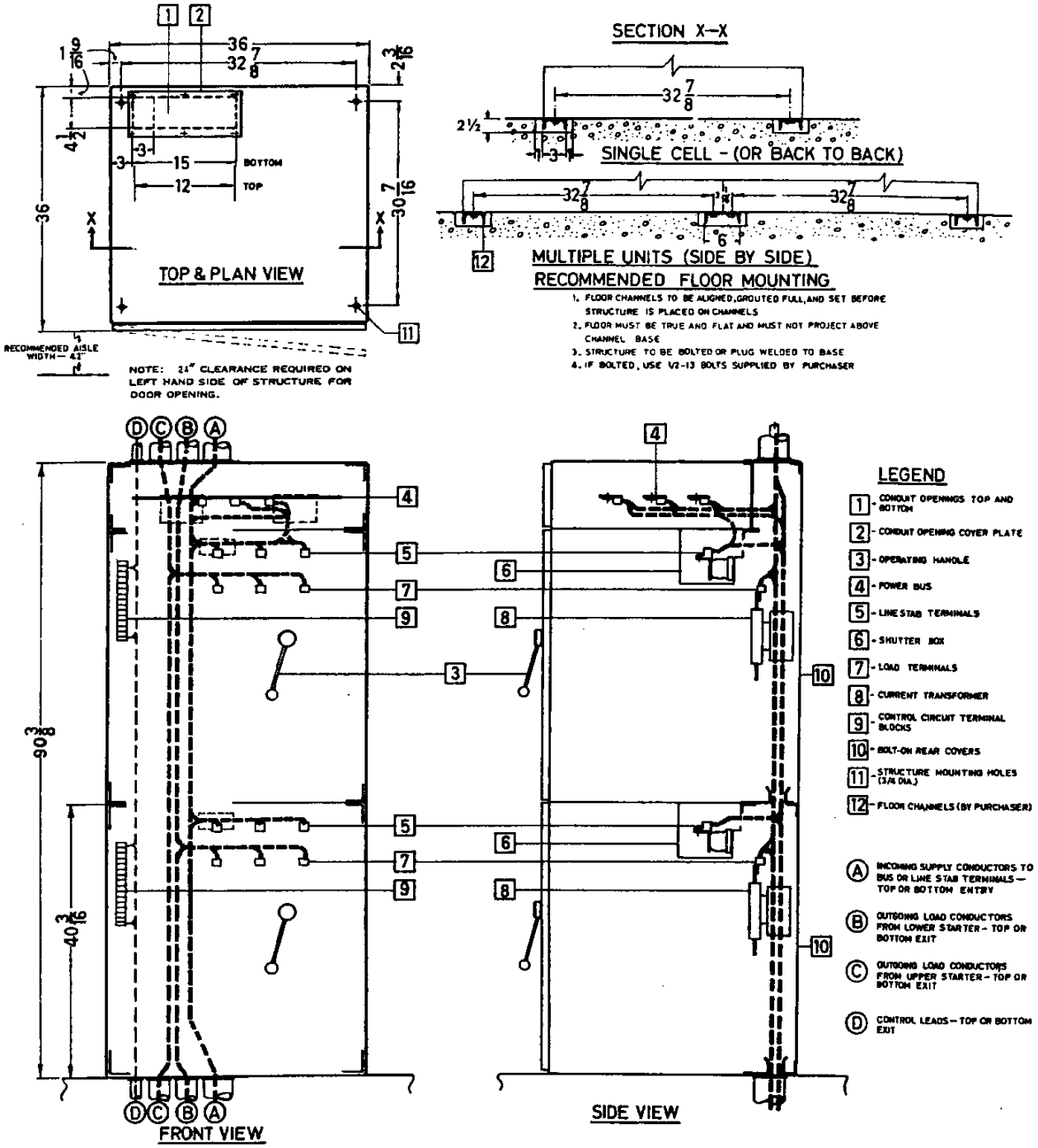


Figure #11

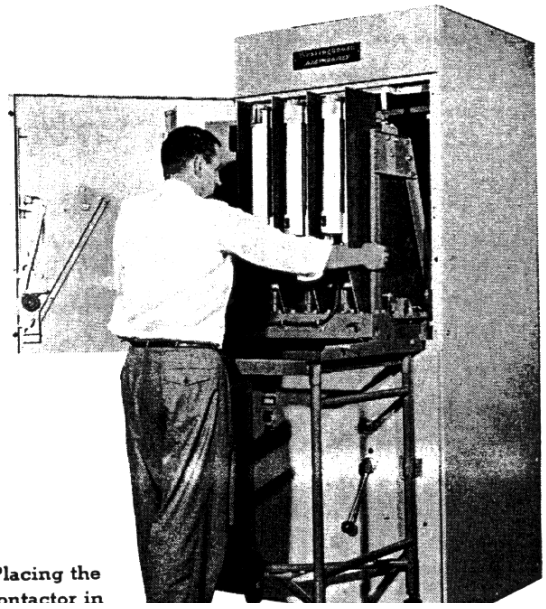
Section views of structure showing routing of power and control cables and recommended installation of floor channels

placing contactor into compartment

Always refer to equipment bill of material, contactor combination number, and fuse rating to make certain the draw-out contactor assemblies including fuses are properly matched to their ratings.

The placing of the contactor into the compartment is accomplished as described in the following paragraphs.

1. Open contactor compartment door and remove door sill (Figure # 10).
2. Place the contactor so that it is directly in front of the compartment and aligned so that the wheels will engage with the guide rails.
3. Move the contactor slowly by hand into the compartment making sure that the wheels engage the guide rails and watching carefully for any interference. The test position is reached when the contactor release latch, Figure # 3, engages second detent.
4. In the test position the contactor can be operated electrically from a separate control supply (provided by customer) without connection to power circuit or motor to check that all devices are functioning properly.
5. Replace the door sill and close compartment door.
6. Advance the contactor to its operating position by rotating the operating handle clockwise from "open" to "closed" position without hesitation.
7. The contactor can be removed by reversing the above procedure noting that the contactor release latch must be depressed at the "test" and "maintenance" position before the contactor can be withdrawn from the enclosure.
8. Placing of a contactor into the upper compartment of a two-high enclosure requires the use of a dolly Figure # 12. The dolly should be adjusted to the upper compartment as indicated in the instruction leaflet provided with the dolly. The dolly should always be firmly bolted to the upper compartment before entering or withdrawing the contactor.



Placing the contactor in

caution: *the contactor should be securely bolted in place on the dolly before attempting to move the dolly.*

9. The contactor may be lifted on or off the dolly by a fork truck or by a lifting hook. If a lifting hook is used a specially designed spreader with hooks (Figure # 13) should be used.

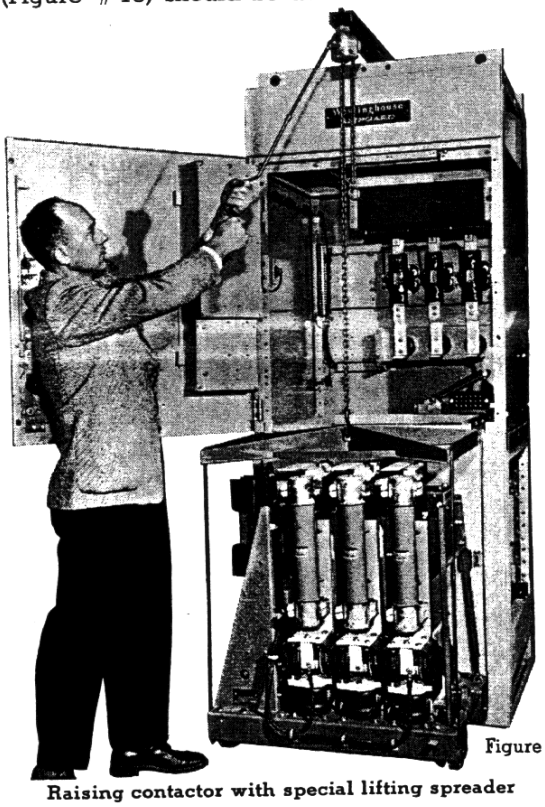


Figure #13

Raising contactor with special lifting spreader

start-up precautions

Before attempting to put a newly installed starter into service, study the wiring diagram and instruction literature. Be sure that:

1. The corresponding starter and motor are connected as shown on the starter diagram.
2. The starter is connected to a suitable power supply with characteristics in accordance with motor and control nameplate markings. This is particularly essential with this type of starter as the selection of fuses, current transformers and overload heater elements is based on the characteristics of the particular motor to be controlled.
3. The mechanical and electrical interlocks operate freely, are properly adjusted and that all bolts and nuts are tight.
4. The motor and the machine it drives are properly lined up, bolted down, lubricated, free of obstructions and ready to go.
5. Connections are neat and tight. Devices should be inspected for connections that might have worked loose during shipment.
6. Main fuses have been installed, and arc chutes and barriers are in place.
7. Equipment has been cleaned of dirt, scraps of wire, tools, temporary bracing and all other

maintenance

general

Personnel authorized to perform maintenance work on the AMPGARD starter should have a complete understanding of its operation and must have a thorough training in the safety precautions to be taken when working with dangerous voltages.

A maintenance program should be initially established to provide for monthly inspections of the starter. After it has been inspected a number of times and the condition noted, the frequency of inspection can be increased or reduced to suit the conditions found.

The equipment should be kept in a clean dry condition. If necessary, space heaters should be used to prevent condensation of moisture inside the enclosure. Dust should be removed by blowing off with compressed air or use of a vacuum cleaner.

Before proceeding with maintenance, consult the wiring diagram and device instruction leaflets supplied with the starter.

warning: *all circuits must be de-energized when working on the equipment.*

contacts

Contacts are readily accessible for inspection and maintenance, as shown in Figure # 14, by removing the interpole barriers and tilting the arc chutes back on their hinges. This can be done when the contactor is in the maintenance position in the enclosure. No special tools are required to remove contact bolts. When replacing contacts, make sure they fit down over the tenons on their supports and rest flat against support surfaces. Tighten bolts firmly until lock washers are fully compressed. All contacts should touch at nearly the same time. The allowable variation is 1/32". *Do not fail to swing arc chutes back into place and re-install barriers before placing contactor into service.*

The final contact pressure, measured with the contactor closed by pulling horizontally on the moving contact bolt, should be approximately 27 to 33 pounds per contact for new contacts. This measurement is made with the contactor out of the enclosure. If means for electrical operation is not available, a wedge can be used to close the contactor after manually operating the anti-bounce latch. The contacts should be replaced when wear causes the final pressure to drop below 20 pounds.

The general condition of the contacts and shunts should be noted, particularly any discoloration other than on the contact faces themselves which would indicate excessive heating due to loose hardware, high current, or low contact pressure.

Dressing or filing of contacts is normally not necessary since a perfectly smooth contact surface is not required. Only major surface irregularities should be removed. For example, a severe interruption may cause metal beads to form around the contacts. These do no harm unless they occur on the contact face proper and are 1/16" diameter or more. reshape the contact face or clean the entire contact face down to bright metal.

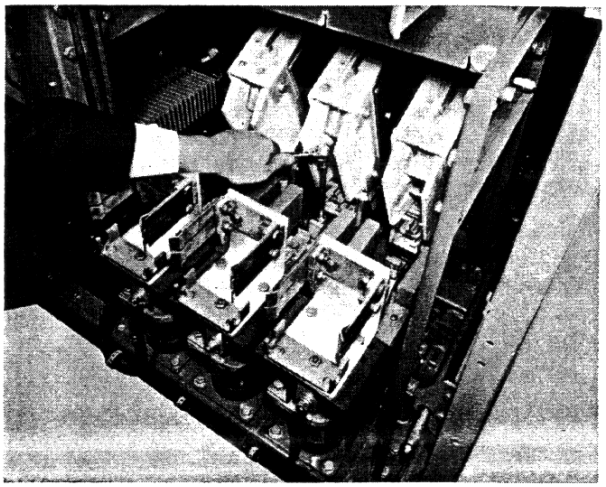


Figure #14

View of the type "HH" Contactor showing replacement of Contacts

replacing magnet coils

To replace an operating magnet coil, disconnect leads from coil terminals and remove the bolt which holds the magnet core to the right angle support bracket. Core and coil will then come off together. When replacing coils, the cushion washers should be placed between the coil and the right angle support. Be careful not to pinch the washers between the core and support. Reconnect as before to be sure of correct magnetic polarity.

To replace the magnetic latch coil, disconnect coil leads and remove four bolts fastening the latch channel to the contactor base. Remove channel and latch complete from the contactor and proceed to remove and replace coil.

contactor auxiliary switch adjustment

The auxiliary switch, Figure # 16, is mounted on a steel plate which bolts to a flange on the contactor end frame. The mounting holes in the flange are slotted to permit adjustment of switch position in relation to the operating lever. The switch position is adjusted at the factory so that the stationary contact fingers are centered on the rotating contact cams in both open and closed position of the contactor.

magnetic latch adjustment

The magnetic latch, as previously explained, prevents armature movement until the magnet coils are energized. There is a normal clearance of approximately 3/64" between armature and latch which permits only enough play to assure freedom of latch movement. When the magnets are energized the latch must retract before the moving armature strikes it.

A light spring biases the latch toward its normal latching position. Since the spring force opposes the magnetic force retracting the latch, it is important to maintain correct spring force and care should be taken to prevent spring distortion when handling or

arc chutes

Arc chute materials in the direct path of the arc are non-organic. Parts exposed to the high voltage arc are zirconium refractories and are not burned by the intense heat of the arc but fuse and become glazed over on the surface. After prolonged use or after interruption of heavy fault currents there may be enough erosion to require replacement of arc stacks. This should be noted at the upper narrow end of the slots in the arc stacks. When the narrow upper end of the slot becomes enlarged beyond 3/16" diameter, the stack should be replaced.

The insulating parts of the arc chute are subjected to the full voltage across the contacts when the contactor is open. Ability to withstand this voltage depends upon the care given to the insulation.

During routine inspections, blow out the arc chute with dry compressed air directed upward from the contact area and out through each of the slots between the outer arc runners. Direct the dry air thoroughly over the refractory surfaces in the lower end of the chute where the arc is drawn.

Periodically a more thorough inspection should be made by removing the arc stacks for cleaning and to permit examination of adjacent parts. Remove any residue of dirt or arc products with a cloth or by light sanding. Do not use a wire brush or emery cloth for this purpose as they may scratch or roughen the surfaces and invite increased future deposits of dirt. The ceramic side plates, arc shields, along with the small grid assembly in the centre bottom, should be checked and replaced if found broken.

The refractory material in the arc chutes may have a dirty appearance after repeated arc interruptions. This does not necessarily indicate low dielectric strength. If in doubt, apply AC test voltage not over 15 KV between outer arc runners for one minute, or check insulation resistance with a megger. The latter reading should be practically infinite.

arc chutes — dismantling and reassembly

Dismantling is best accomplished with the arc box lying flat with cover lamination bolt heads down. Remove six bolts holding jackets together and two screws holding jacket to support bracket, also two nuts holding cover laminations against jacket. Then lift off cover laminations, fishpaper cover and jacket to expose internal parts. To remove internal parts first remove fishpaper shims between outer arc runners and jacket. Internal parts can then be lifted out.

To reassemble ,reverse the above procedure making sure that the narrower of the two arc runners is placed in the hinged side of the chute, also that each arc stack is installed with side having rope spacers turned toward the centre arc runner. Exercise care in handling brittle ceramic parts. Before replacing the cover jacket remove its retaining blocks. When replacing the cover jacket be particularly careful not to exert pressure on the grid assembly, that is make sure that the recess provided in the arc shield clears the grid assembly without fouling. Finally, after replacing jacket, cover and cover laminations, and securing fastenings, install the retaining blocks in the top of the arc chute and secure the two eccentric-

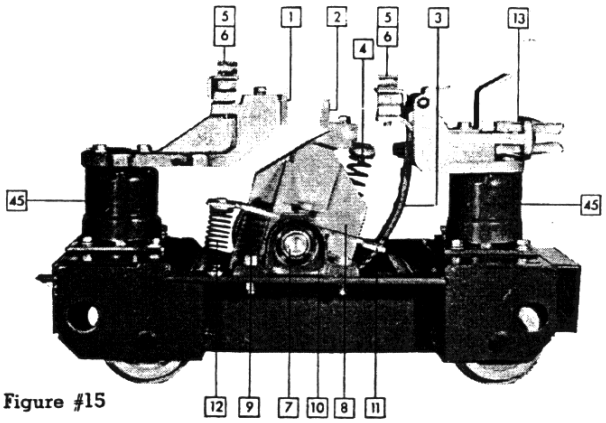


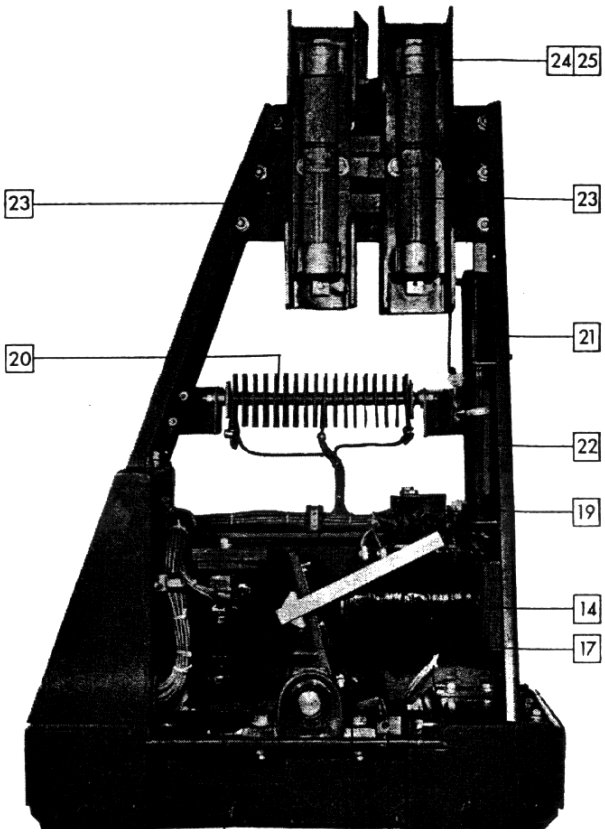
Figure #15

renewal parts

The convenience and advantage that may be gained by carrying in stock a few well chosen comparatively inexpensive renewal parts is so great that the advisability of so doing cannot be over-emphasized.

The following parts are suggested as spares for a typical layout although recommendations may vary for particular installations.

For renewal parts for overload relays, auxiliary contactors and other associated devices, refer to the Renewal Parts Data leaflet for the particular device.



renewal parts list

instructions for ordering — when ordering renewal parts give the starter nameplate data including the shop order (S.O.) number and the description, style number and quantity of each part required.

Ref. Fig.	Ref. No.	Description	Style	No. Per starter	No. recommended For Starters		
					1	2 to 5	6 up
⊕15	1	Stationary Contact	3003A50G01	3	3	6	9
⊕15	2	Moving Contact	3003A50G02	3	3	6	9
15	3	Moving Contact Shunt	739C614G01	3	3	3	3
15	4	Moving Contact Spring	1780601	3	3	6	9
15	5	Arc Chute Contact	540B621G01	6	..	..	..
15	7	Shaft	569C679H01	1	..	..	..
15	8	Moving Contact Insulator	1781166	3	1	1	1
15	9	Shunt Insulator	1781165	3	1	1	1
15	10	Shaft Bearing	706A850	2	.	.	..
15	11	Kickout Spring Lever	526A755H01	1	..	..	..
15	12	Kickout Spring	1780600	1	1	1	1
15	13	Power Disconnect Finger Assembly	1491904	6	6	6	6
16	15	Magnetic Latch Coil 125 V.D.C.	1780418	1	1	1	2
16	16	Magnetic Latch Spring	1780602	1	1	1	1
16	17	Armature Plate — Vertical	569C680G02	1	..	..	..
16	18	Armature Plate — Horizontal	569C680G03	1	..	..	..
16	19	Auxiliary Switch Complete	737D491G06	1	1	1	1
16	23	Control Transformer Prim. Fuse CLE 5kv, 1.0E	758C433A23	2	2	2	2
—	23a	Control Transformer Prim. Fuse CLE 2.5kv, 2.0E	758C433A13	2	2	2	2
16	24	Control Fuse Clip 5 kv	1114884	4	..	..	..
—	24a	Control Fuse Clip 2.5 kv	451D420H02	4	..	..	..
16	25	Control Fuse Spring 5 kv	1242030	4	..	..	..
—	25a	Control Fuse Spring 2.5 kv (none)	—	..	..	..	..
4	26	Top Disconnect Finger Support Channel	703A336H01	1	..	..	..
4	28	Arc Chute Complete	45A1755G03	3	..	3	3
△	29	Main Refractory Arc Stack	1799417	6	6	6	6
△	30	Auxiliary Arc Stack	219A117G01	3	3	3	3
3	31	Main Power Fuse	★	3	3	3	3
△	32	Chassis Grounding Contact	1574755	1	1	1	1
△	33	Chassis Grounding Contact Spring	1535393	1	1	1	1
4	34	Insulating Barrier	569C712H01	4	..	4	4
ϕ2	35&36	Safety Grounding Contact Assembly (3 pole)	709A613G01	1	..	..	..
2	37	Rubber Door Bumper	527A387H01	2	2	2	2
△	38	Line Stab Connector (in shutter box)	530B668G01	3	..	..	..
5	39	Load Stab Connector	530B668H02	3	..	..	..
5	40	Changeover Switch Complete	737D491G08	1	1	1	1
5	41	39½ inch Chain	349P387H01	1	1	1	1
△	42	Connecting Link # 26	349P374H01	2	1	1	1
△	43	41½ inch Chain — (on door)	349P388H01	1	1	1	1
△	44	Offset Link No. 30	349P373H01	1	1	1	1
5 & 15	45	Insulator 5 KV	349P378H01	12	3	3	6
			240 Volt Control				
			Selinium / Silicon				
			120 Volt Control				
			Silicon				
#16	20	Rectifier Bridge	Not available / S#2018A40G02	S#2018A40G02	1	1	1	1
16	21	Resistor	S#349P275	S#687D136H39	S#687D136H29	1	1	1	1
	21		S#349P212			1	1	1	1
16	14	Operating Coil	S#333P977G01	S#333P977G01	S#333P979G01	2	2	2	2

ϕ — Figure illustrations show the older type Grounding Contact
⊕ — Refer to I. L. H11-011-2 for installation instruction
★ — As required for specific H.P. and Voltage Rating.
△ — Not illustrated
— Figure illustrations show the older Selenium Rectifier.