

SIEMENS

SpaceMaker II

MOTOR

CONTROLLER

WARNING

Dangerous voltages are present inside controller compartments.
Always use safety precautions when entering.

De-Energize all incoming power if conditions exist which are the
contrary to those described in this instruction book or which are
otherwise unusual.

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***Pay close attention to these pages. This information is very important.**

The information contained within is intended to assist operating personnel by providing information on the general characteristics of equipment of this type. It does not relieve the user of responsibility to use sound Practices and Safety Procedures in the installation, application, operation and maintenance of the particular equipment purchased.

If drawings or other supplementary instructions for specific applications are forwarded with this manual or separately, they take precedence over any conflicting or incomplete information in this manual.

SIEMENS-ALLIS

P.O. Box 89, Wichita Falls, Texas 76307

INTRODUCTION

GENERAL INFORMATION

This Manual provides complete instructions on installation, operation and maintenance, and will be of value only when read and applied by all personnel responsible for the equipment.

Pay particular attention to the information about interlocks and their adjustments. These paragraphs are starred.

WARRANTY

See sales contract.

GENERAL DESCRIPTION

Each *SpaceMaker II* controller consists of a stationary, rigid, self-supporting steel enclosure with a front hinged, high voltage compartment door containing a

rear-mounted, isolated, low voltage control device compartment.

Two full voltage squirrel-cage motor controllers can be mounted one above the other in the 36-in. wide, 32-in. deep, 90-in. high cubicle. Each controller has a full rating of 1500 hp maximum at 2300 volts or 2500 hp maximum at 4000-5000 volts. At unity power factor, the maximum ratings of synchronous motor controllers are 1750 hp at 2300 volts and 3000 hp at 4000-5000 volts. With current limiting fuses, each controller has an interrupting capacity of 200 MVA at 2200-2500 volts or 350 MVA at 4000-5000 volts.

Mounted in the high voltage compartment are the current transformers, stationary disconnect plugs, shutter and racking mechanisms, line and load

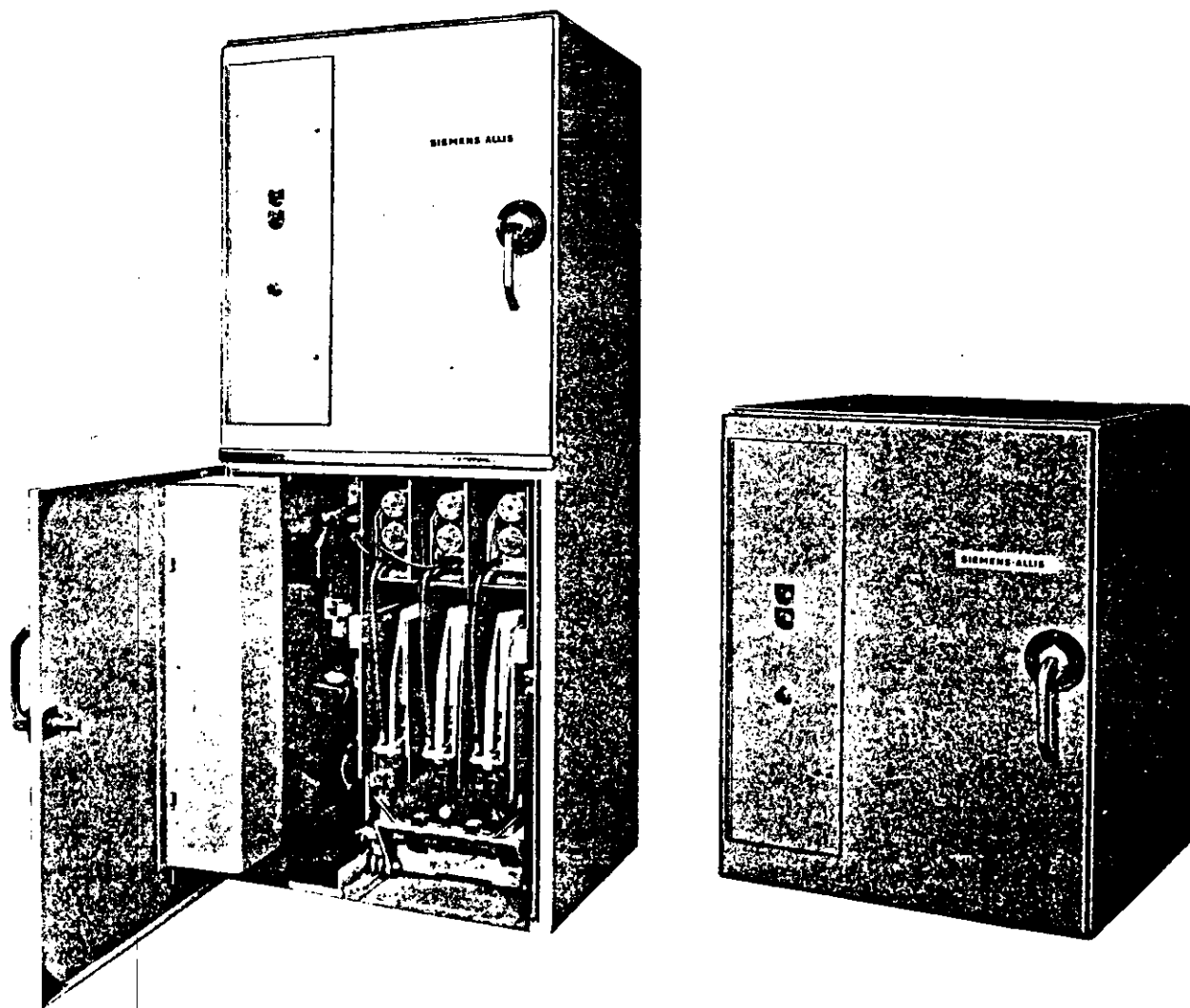


Fig 1 - Single and two-high SpaceMaker II controller for squirrel-cage motors.

connections, mechanical and electrical interlocks, and the drawout contactor. The contactor itself mounts the current limiting power fuses, the movable disconnect fingers, the control power transformer with two current limiting primary fuses and two secondary fuses, a double-throw (test-normal) knife switch and a disconnecting control terminal block. (A separate manual is available with information on the contactor - ICD6030.)

Door Handle

Convenient operation of the racking mechanism is provided by the externally operated door handle which rotates 180 degrees from the contactor "Connected" to the "Open" position. A coupling on the door handle assembly permits opening the door only in the door "Open" position. An indicator on the handle gives positive indication of the mechanism position; that is, carriage "Connected", carriage "Disconnected", or door "Open". The door handle can be locked with up to three padlocks in either the "Connected" or "Disconnected" position.

Automatic Shutter Mechanism

An isolating shutter covers the line terminals when the racking mechanism is in the carriage "Disconnected" or the door in the "Open" position. This prevents operating and maintenance personnel from accidentally coming into contact with the live line terminals.

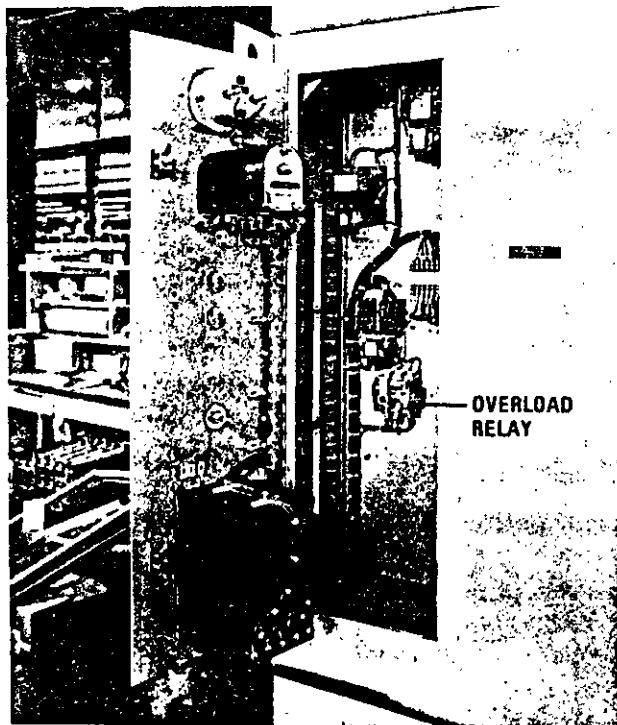


Fig. 2 - Overload relay mounted in the SpaceMaker II controller front access compartment.

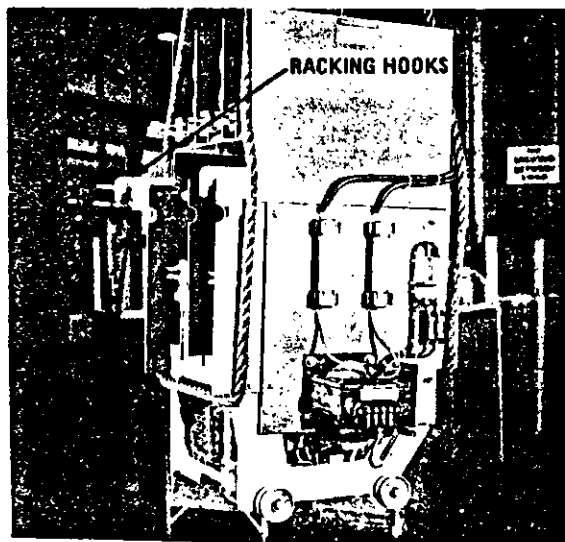
Separately Accessible Control Compartment

The isolated low voltage control is accessible through a hinged door in the high voltage compartment door. Access to the control compartment is permitted at all times for operational inspection by turning the two slotted-head ¼ turn latches. This compartment contains all of the control and metering devices required by the particular application and permitted by space limitations.

RECEIVING — Handle With Care

Before moving or unpacking any units, examine all shipping sections to determine if any damage has occurred in transit. If damage is detected, unpack the unit and thoroughly inspect the contents for damage. (See Inspection.) The contactor carriages and the controller cubicle are shipped in separate packages. Check the entire shipment against the packing list for any shortages. Determine the extent of the damage or shortage, if any, and notify the carrier and your Siemens-Allis sales office immediately.

The cubicles and carriages are shipped on separate wooden bases. Move the cubicles by lifting with a crane using the lifting angles provided. Lift the carriages as shown in Fig. 3. Do not lift with racking hooks at rear of carriage. If no crane facilities are available, rolling or other methods may be used, but apply force only to wooden shipping pallet. Do not place carriages into cubicle until the units are at the permanent location, all the suggested inspections have been made, and the "Installation" Section of this book has been read. If units will not be used immediately, see "Storage".



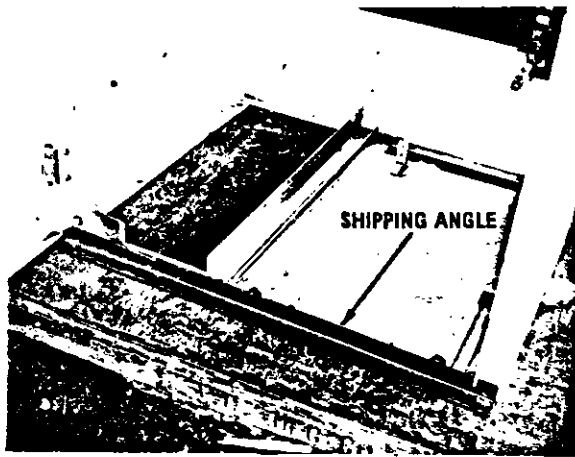


Fig. 4 - Remove this shipping angle only after cubicles have been mounted and leveled.

INSPECTION

Remove all packaging, blocking, and external bracing. Do Not remove the angle iron brace (See Fig. 4) across the bottom of the front of the cubicle opening until the units have been leveled and bolted into place. Inspect as follows:

- a. Check all components for evidence of loose bolts, nuts, accessories, freedom from distortion and for general good condition.
- b. Inspect the main power fuses for proper mounting. The fuse clips should also be checked for distortion.

- c. Check that the control transformer primary fuses are properly positioned in their respective clips and are not damaged.
- d. Operate the contactor manually by pulling down the armature of the magnet to close the contacts. Upon releasing, the movable contact assembly should fall freely.
- e. Check the control panel on the side of the contactor to assure that all wire connections are secure and that the circuit is in good operating condition.
- f. Check the condition of the arc chutes.
- g. When more than one controller is involved in an installation, make certain that each carriage is matched with the nameplate in its respective compartment. A stick-on nameplate, provided on the carriage and the compartment, gives the following data: controller part number, carriage part number, controller rating, control transformer and current transformer ratios, fuse ratings, overload relay setting and wiring diagram drawing number.

STORAGE

If the controller will not be installed in its operating location, store it in a clean, dry place along with the carriages. Never store the controller and carriages in an environment for which they were not designed. If space heaters are furnished, keep them energized.

INSTALLATION

CAUTION

Controllers must be installed on a flat, level foundation. Slope, if any, must be toward the rear. Slope must not exceed 1/8 inch.

CUBICLE MOUNTING

The importance of mounting the cubicle on a flat and level foundation cannot be overstated. All four corners of the cubicle must be touching, securely bolted, and continuously supported across the front and back. Provide an apron extending a minimum of three feet on the same level as the front of each cubicle for inserting and removing the carriage. Install the extreme left hand unit at least 14" from any obstruction to allow the compartment floor to swing wide enough for the carriage movement in or out. Remove all temporary blocking, packing, ties, retaining tape, etc. from all devices and mechanisms. Remove the angle iron (Fig. 4) across the bottom of the front of the cubicle. This was only a temporary shipping brace and can be discarded. If the side lift angles were used, remove these and replace the hardware furnished in the bolt holes. Touch up any scratches with the spare paint provided. Correct any cubicle distortions, installation or shipping damage, etc. if diagonal measurements of cubicle are

not equal within 1/8". Also examine alignment, per page 7.

CONNECTIONS

(Refer to Figs. 5-11 and Tables I, II and III)

Make all incoming power, load, and control connections in accordance with the information given in these tables and illustrations. Make all connections as indicated in the connection diagrams. The cable arrangements given for incoming line connections are maximum size based on compartments being free of incoming line accessories.

However, a limited number of accessories (e.g. potential transformers, current transformers, lightning arrestors, surge capacitors, etc.) may be used depending on the size of the accessory and the available space. Consult the factory when numerous devices are required in incoming line compartments.

For units without bus, the incoming cables are connected to the line terminals in each compartment of a

two-high controller. For a single controller in the lower compartment, the incoming cables are connected to the line terminals in the lower compartment. In all cases, the outgoing motor leads connect to the current transformers, located on the left-side wall of the compartment.

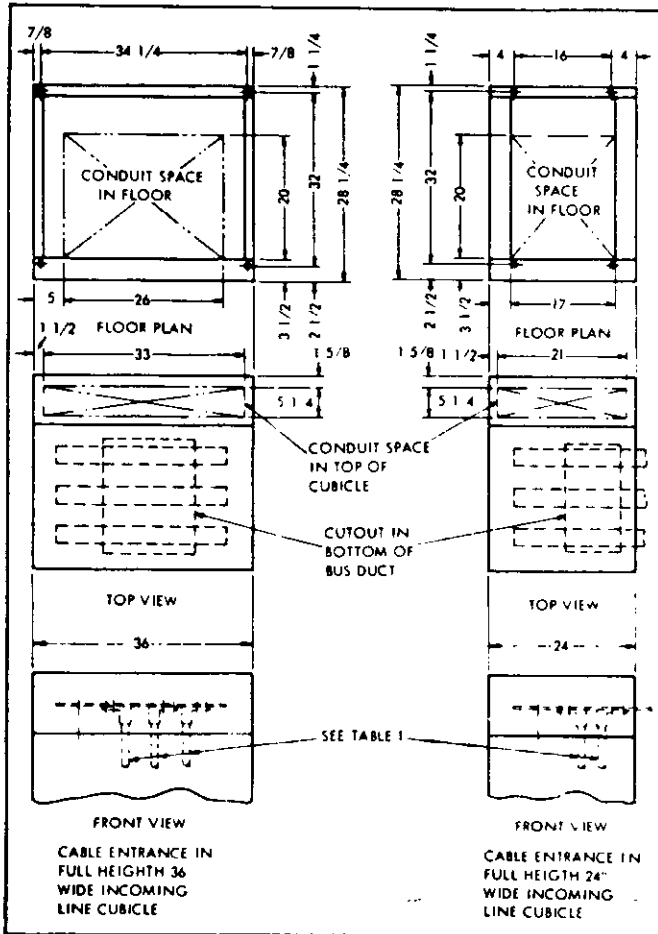


Fig. 5 - Cable Entrances (Refer Table I).

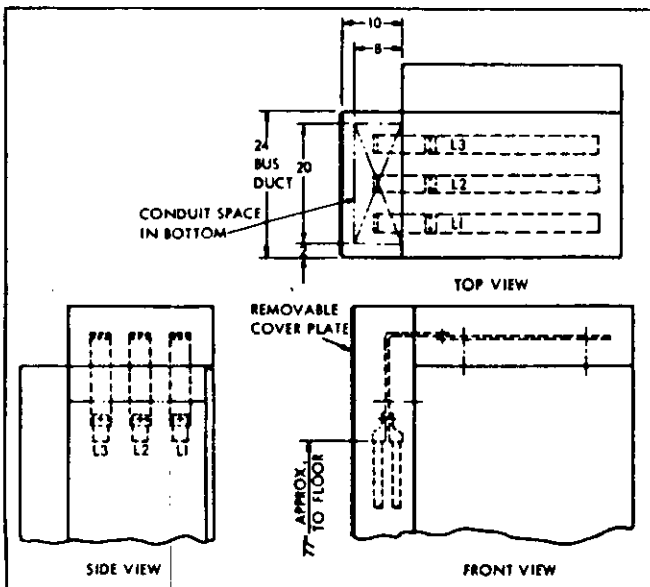


Fig. 6 - Cable Entrances (Refer Table II).

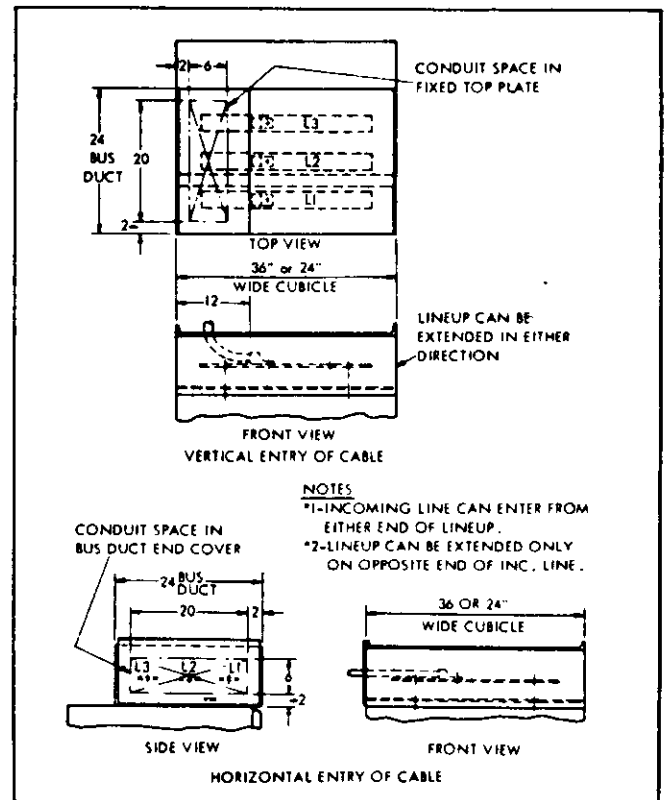


Fig. 7 - Cable Entrances (Refer Table III).

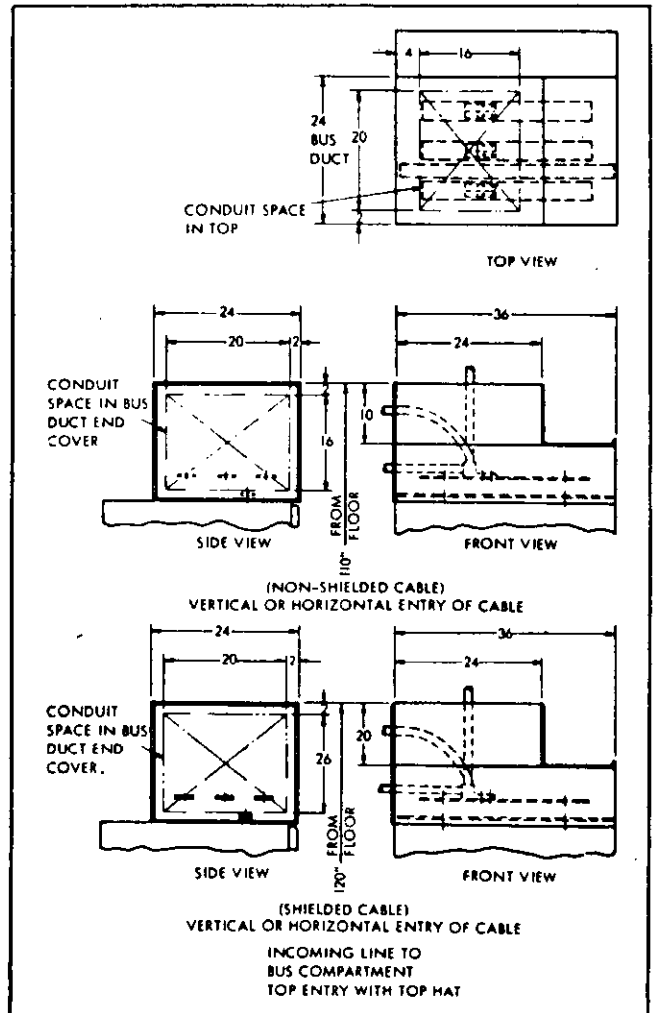


Fig. 8 - Cable Entrances (Refer Table III).

MAXIMUM CABLE SIZE PER PHASE				
Cubicle Width	Entry	Nonshielded	Shielded With Stress Cones	Potheads
36"	Top	(4) 500 MCM or (3) 750 MCM	(4) 500 MCM or (3) 750 MCM	(2) Size 750 MCM
36"	Bottom	(6) 500 MCM or (4) 750 MCM	(6) 500 MCM or (4) 750 MCM	(2) Size 750 MCM
24"	Top	(3) 500 MCM or (2) 750 MCM	(3) 500 MCM or (2) 750 MCM	(2) Size 500 MCM
24"	Bottom	(4) 500 MCM or (3) 750 MCM	(4) 500 MCM or (3) 750 MCM	(2) Size 750 MCM

TABLE I Figure 5 - 24 or 36 inch auxiliary cubicle.

Cubicle Width	Entry	Nonshielded	Shielded With Stress Cones	Remarks
10"	Bottom	(3) 750 MCM per phase	(2) 750 MCM per phase	Max. of 3 bus feed C.T. mounted in bus duct

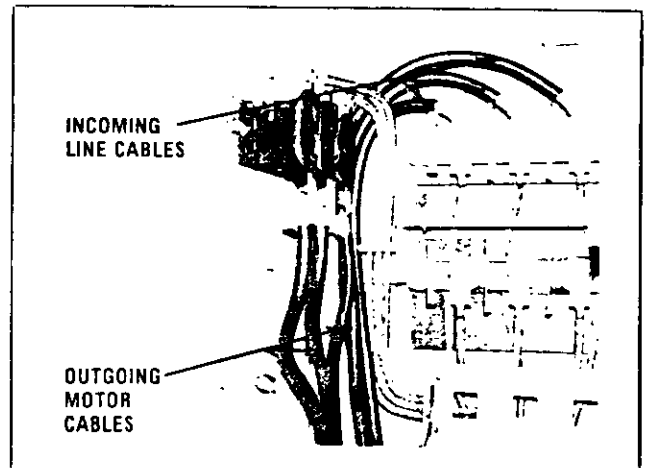
TABLE II Figure 6 - Incoming line through vertical bus duct on either end of lineup.

Entry	Orifice	Nonshielded	Shielded With Stress Cones	Remarks
Vertical	20X6	(1) 250 MCM	-	12" Wide top plate
Vertical	20X16	(2) 750 MCM	(2) 750 MCM	24" W x 10" H top hat
Horizontal	20X6	(1) 250 MCM	-	-
Horizontal	20X16	(2) 500 MCM	(2) 500 MCM	24" W x 10" H top hat

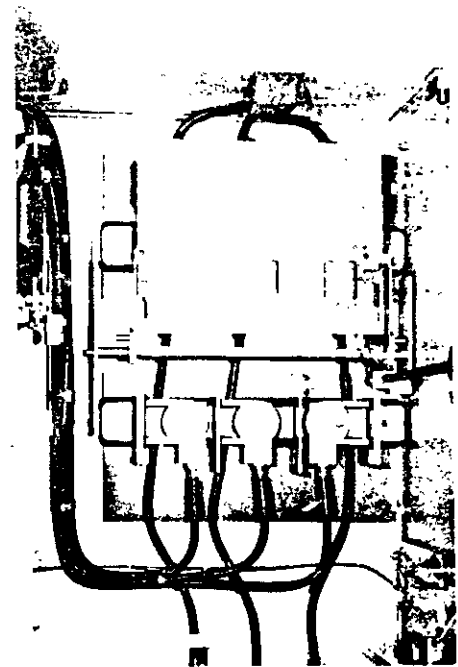
TABLE III Incoming lines to bus compartment maximum cable sizes per phase. Figures 7 and 8

When a two-high (Style Y) controller is furnished, the interconnections between the upper and lower compartments are factory installed. When the controller is furnished with a bus, interconnections from this bus to the line terminals are factory installed. The insulated tube furnished only on two-high controllers, permits pulling motor cables through an energized compartment.

NOTE: All line terminals are energized unless the incoming line is opened.



212186
Fig 9 - Cable connections for incoming line and outgoing motor connections. Shutter removed to make incoming cable terminals accessible.



223015
Fig 10 - Line cables internally connected between upper and lower compartments.

When a nine-plug carriage used on reversing controllers is furnished, stub cables are provided for the customer to connect the incoming line to the line terminals.

If larger size incoming cables or more cables per phase (See Table I) are required, a special compartment can be supplied. These additional compartments can also provide the space requirements for metering, potheads, current transformers, etc.

Control Connections

Remote control or metering connections are made to the terminal blocks located on the left-side wall of the compartment and are accessible from the low voltage control compartment. If the control devices are located in a separate compartment, the remote connections will normally be made to terminal blocks located in that compartment. Be sure to remove any temporary jumpers when connecting the remote devices.

EQUIPMENT CHECKOUT

Checkout all equipment systematically prior to engineering and placing in service. This checkout can be performed by the installer or operator or contact your Siemens-Allis sales representative for a quotation for the services of a serviceman. The following is a recommended check list sequence:

Electrical

1. Check all high voltage cable (including factory installed) for tight and proper connections. Make sure all proper mechanical and electrical clearances have been maintained.
2. Check all power connections behind protective barriers or shutters.
3. Check all external power and control connections against wiring diagrams.

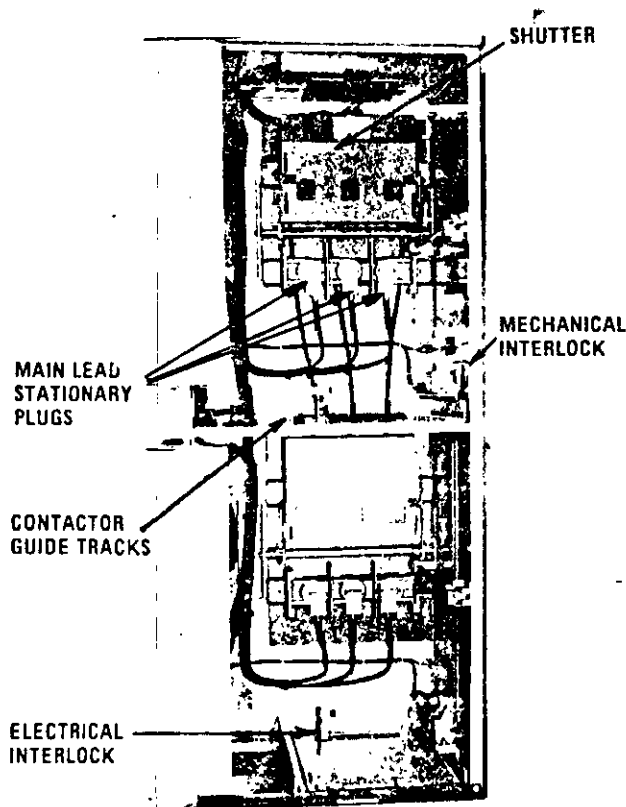


Fig 11 - Layout of SpaceMaker 2-high (Style Y) controller compartments.

4. Check remote sequence interlocking connections for correctness of contact and make certain conduit wiring is not grounded. (Extremely long remote control runs in conduit of a few hundred feet or more may prevent the control relays from dropping open to stop motor because of capacitance between wires in the conduit. If this condition exists, use interposing DC control relays. Consult factory regarding this situation.)
5. Exercise extreme care that all secondary circuits of current transformers are closed. The open circuits can occur when instruments are shipped separately or are mounted remotely.
6. Check all control devices for any foreign matter. All devices must be free to function normally.
7. Check all fuses for continuity and proper rating. (See page 10 for fuse replacement.)
8. Check settings on all protective relays using appropriate instruction manuals.

Mechanical

1. Match the fused carriage with the corresponding cubicle. Check the rating data of the label on the front left-hand side of the carriage with the inside of the compartment door.

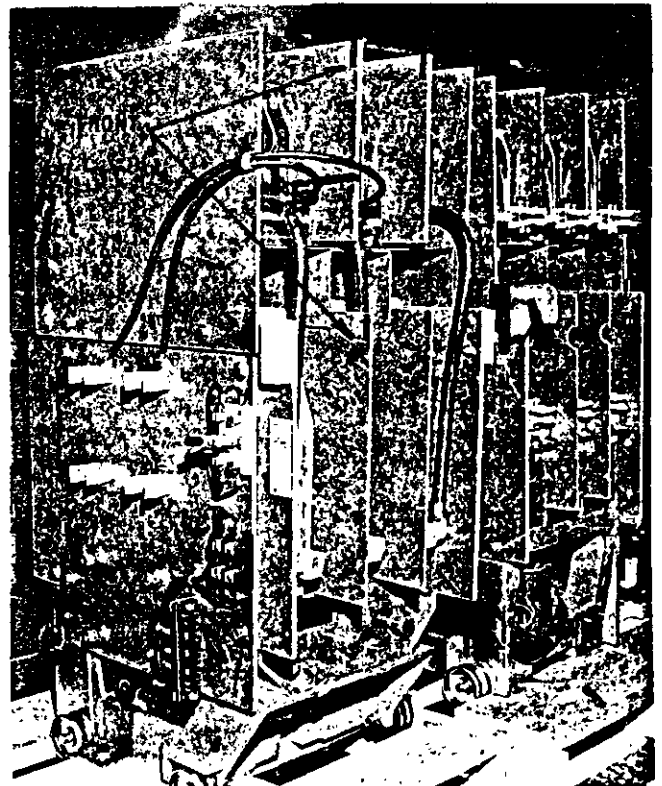
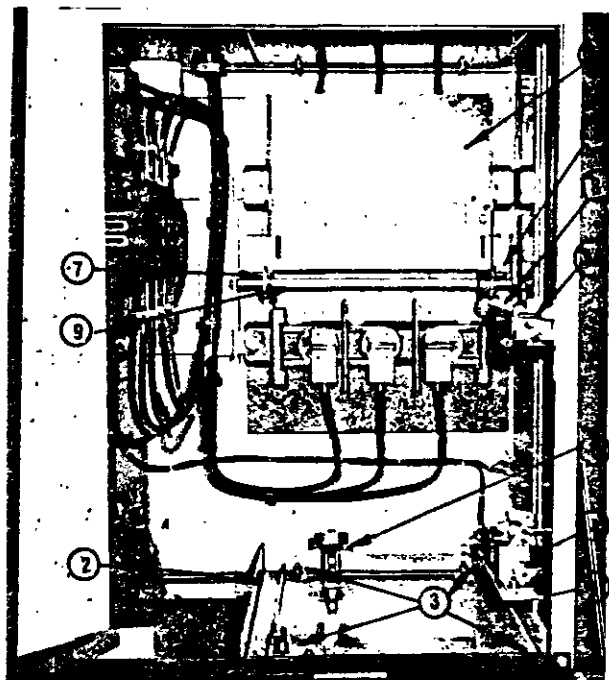


Fig 12 - Note Label "FRONT"



- [1] Guide Plate or Support Plate
- [2] Guide Rail
- [3] Hold down bolts
- [4] Anti-racking Interlock
- [5] Line Switch Interlock (LSI)
- [6] Shutter Panel
- [7] Racking Pins
- [8] Side Shaft [note flat spot 8A]
- [9] Rear Shaft

Fig. 13 - SpaceMaker II Controller Cubicle.

2. Check arc chutes in carriage for proper placement. Examine chutes to make certain they are not cracked or have pieces broken off. If any pieces are missing, check contactor carefully for any fragments that may have fallen into the mechanism. Any foreign material that prevents contactor operation could end in extensive damage. (See page 10 for arc chute placement.)
3. Check contactor and fuse interphase barriers. (See Fig. 12.) Barriers must be in place with the edges labeled "front" as shown.
4. Check racking interlock manually to assure free movement. Check spring for proper placement. (See page 11 for adjustment.)

With the spring in place and the plunger still not operating freely, check for binding of the interlock mechanism.

Some special controllers, such as reversers, have two-high and/or side by side units with inter-compartmental linkage between anti-racking interlocks that prevent opening any one compartment door when any of the contactors in the other com-

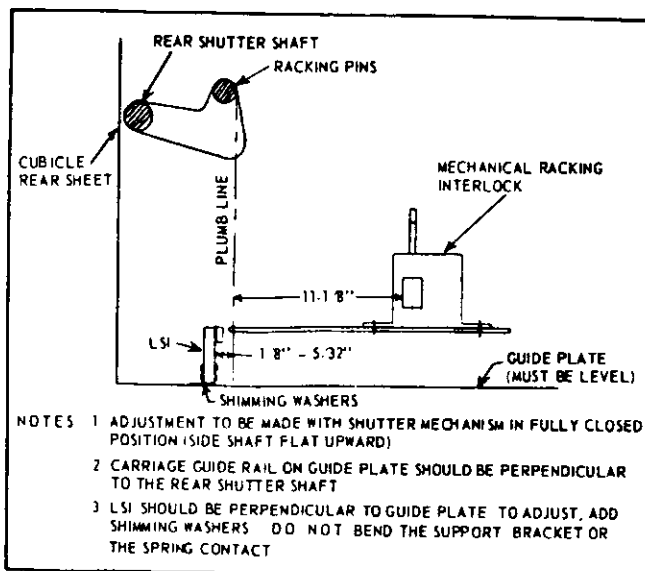


Fig. 14. - Line switch interlock and racking interlock dimensions.

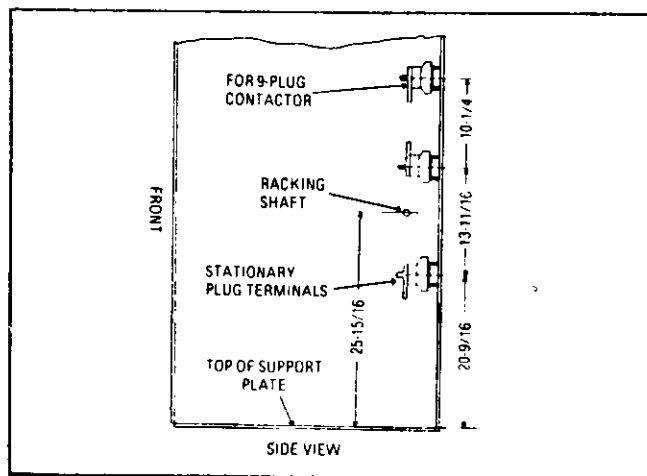


Fig. 15 - Alignment of stationary plug terminals on rear compartment wall should be checked before inserting carriage.

partments are closed. Consult factory for adjustment of these multi-linkage interlocks.

At this point, check the guide plate (support plate). This plate, the LSI and the interlocks have been factory adjusted. Check dimensions as shown in Fig. 14. (See page 11 for adjustment.)

5. Rotate the side shaft of the cubicle to make certain that the shutters move freely. Check alignment of the stationary power plugs on the rear compartment wall according to the dimensions shown in Fig. 15. (Illustration shows a nine plug carriage.) The dimensions to the centers of the plug terminals are measured from the top of the plate which supports the carriage wheels. (See page 13 for adjustment.) Leave the side shaft in a position with the flat side horizontal and facing upward so it will mate with door handle coupling. (See page 12 for adjustment.)

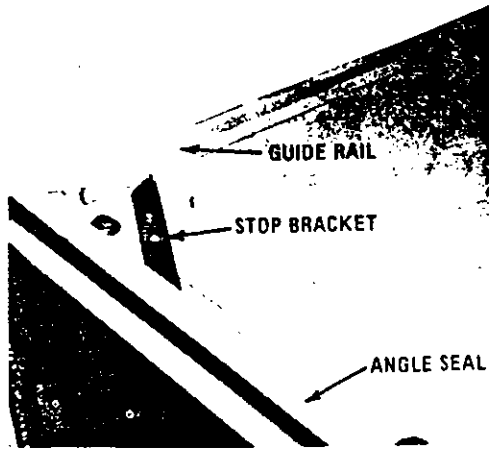


Fig. 16 - Stop bracket and angle seal (Angle seal only on special NEMA enclosures).

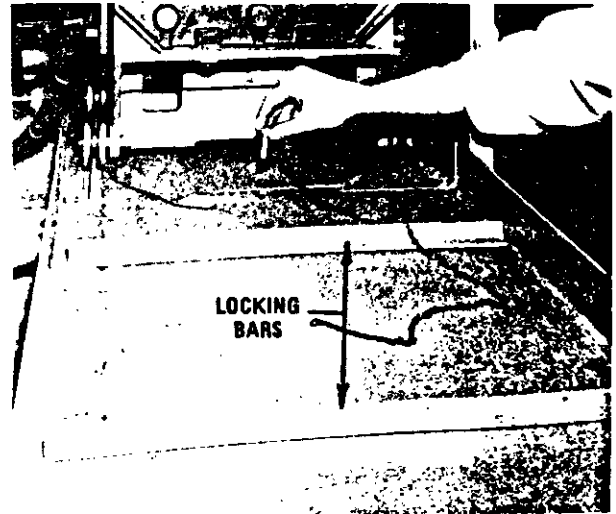


Fig. 17 - Locking pin holds dolly safely to controller frame. (Refer page 28)

6. Clean guide plate and compartment floor thoroughly. Assemble stop bracket (See Fig. 16) to guide plate per Fig. 37.

NOTE: Some NEMA special purpose enclosures have an angle at the bottom of the compartment (Fig. 16) to form a seal with a gasket on the lower inside of the compartment door. Remove this angle only to roll carriages in or out of compartments. When carriage has been installed and completely checked for proper operation, replace this angle.

For upper compartments, use the transfer dolly. The carriages can be safely lifted onto the dolly with a rope sling and chain hoist. Place the rope sling under the four ends of the carriage side plates, as shown in Fig. 3, but not across the knife switch or fuses. Do not lift with racking hooks. Be sure that the locking bars are in place while the carriage is on the dolly and that the dolly is level and properly adjusted to the height of the upper compartments.

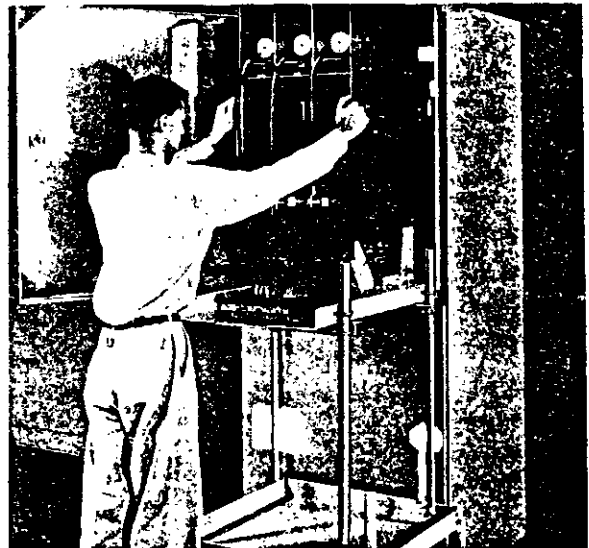


Fig. 18 - Transfer dolly permits safe removal of carriage from upper compartment (Refer page 28)

Position the dolly in front of the proper compartment and insert the dolly locking pin. (See Fig. 17 & 18.) Make sure no cord or wire is in the path of carriage wheels.

7. Roll the carriage into the compartment (with the grooved left wheels straddling the guide rail) as far as the racking shaft safety interlock will allow. This interlock prevents ramming the carriage completely into the compartment while the door is open. Turn stop bracket to butt against guide rail.

8. Remove control circuit plug from clamp on left side of compartment and plug into mate on carriage. (See Fig. 19.) Tighten the two fasteners and check that all leads are secure to plug-in block. **CONTROLLER TEST.** The controller can be tested in this position. See the instruction label posted to the carriage next to the knife switch for test procedure. (See Fig. 20.) After a successful test, **MOVE THE CARRIAGE SWITCH INTO THE NORMAL (UP) POSITION,** turn the external racking door handle upwards, so the pointer indicates open, and close the compartment door. The door handle bearing must mate with the shaft when the flat spot on the shaft is facing upward. (See Fig. 13.) If the handle does not fit, adjust as shown on page 13.

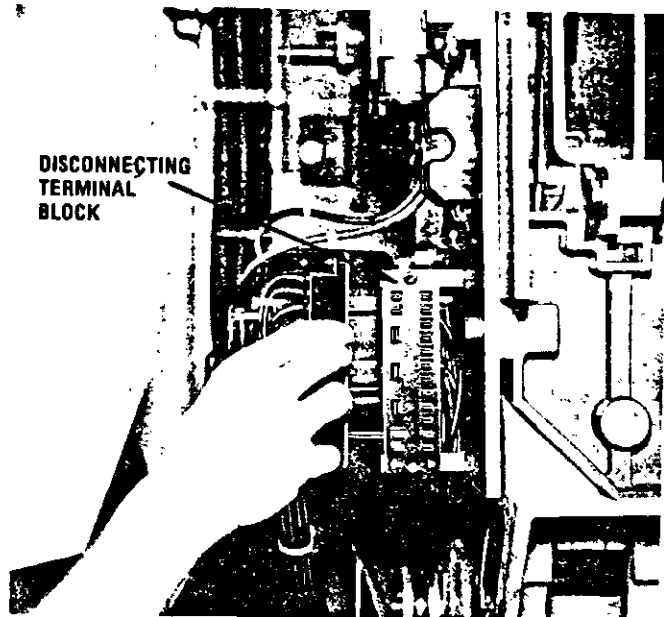


Fig. 19 - The disconnecting terminal block connects all secondary wiring to the carriage.

9. Rack in carriage by turning handle 180° counter clockwise until the handle is vertical and the pointer indicates the carriage is "Connected". A snapping action will be noticed as the racking mechanism locks in near the end of the racking travel.

NOTE: DO NOT USE FORCE. If the carriage does

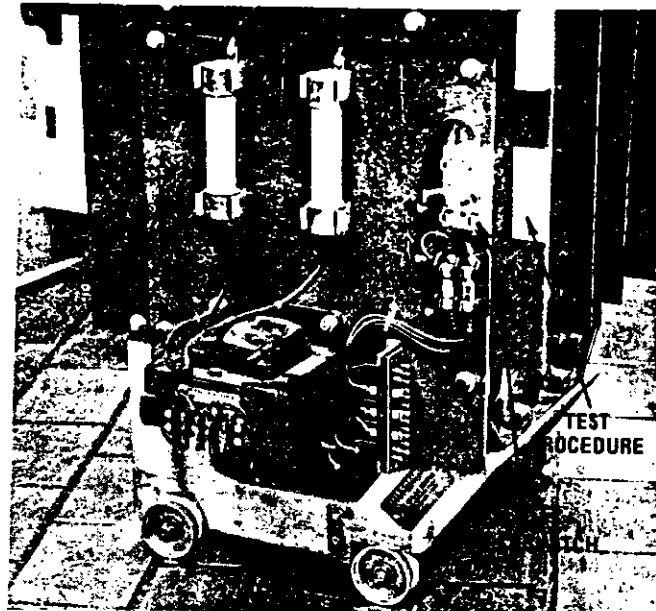


Fig. 20 - Knife switch used to test controller.

not rack in easily, adjust the racking hooks as shown on page 13. Also check the gear mesh as shown on page 12.

If all of the above steps have been checked, and adjustments are correct, the motor controller is ready for operation. Proceed to the section on Operation.

OPERATION

The standard SpaceMaker II circuit for a full-voltage, squirrel-cage motor controller is shown in Fig. 21.

NORMAL

With the control knife switch in the normal position, the carriage racked to the "Connected" position and the incoming line energized, pressing the start button energizes the master relay coil (MR). A contact of MR energizes the contactor rectifier and coil circuit, and another MR contact provides half of the start button seal. An M contact completes the seal when M closes to apply power to the motor. The start button can then be released.

Pressing the stop button de-energizes the master relay. The contacts of MR open, de-energizing the main contactor and breaking the start button seal. The M contact in the seal circuit opens when the main contactor drops out.

In the case of an overload, the normally closed overload contact (OL) in series with the master relay coil will open, and the sequence will be the same as a normal stop. After returning the circuit to the start conditions, the motor may be put back on line through the normal start sequence.

TEST

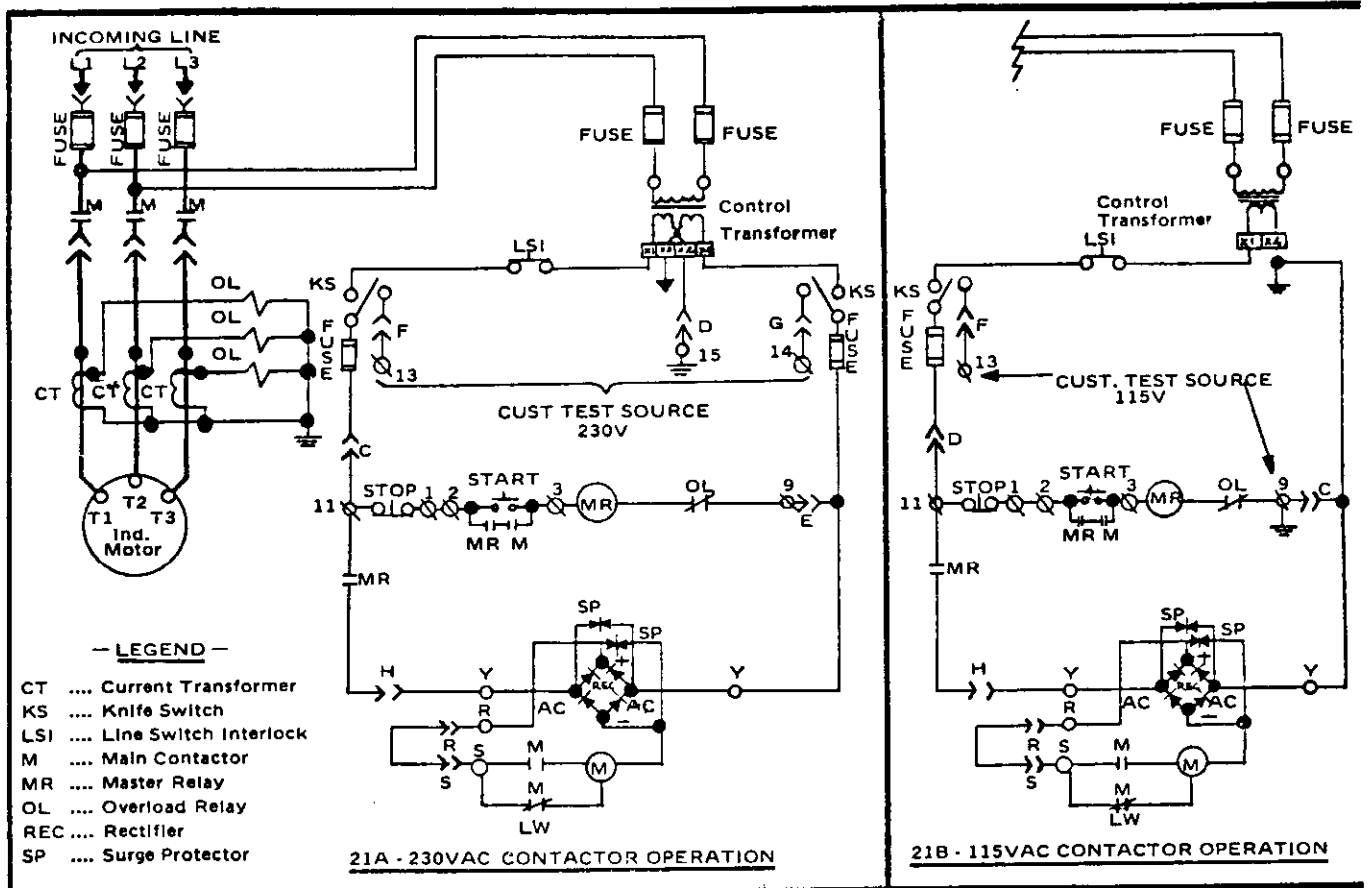
Leave the control disconnect block attached to the carriage and move the carriage several feet from the compartment. The control circuit will not operate because the primary and secondary of the control power transformer are open.

The main contactor may be supplied with a coil circuit requiring either 115 volts or 230 volts A.C. Depending on the type of coil furnished, perform the following steps to test the controller:

230VAC Contactor - Connect a single-phase, 230 volt, 60HZ power source to points 13 and 14 on the compartment terminal board. If the control circuit includes 115V devices, then the test power must be from a three-wire 230/115V source connected to terminals 13, 14 and 15 with point 15 grounded.

115VAC Contactor - Connect a single-phase, 115 volt, 60HZ power source to points 9 and 13 on the compartment terminal board. Ground, if any, must be connected to terminal 9.

After connecting test power, move the knife switch to the test position. The control circuit will now function in the normal manner. Always return the knife switch to the normal position when testing is completed.



ADJUSTMENT

This section describes and illustrates all adjustments for the carriage and compartment.

*FUSE REPLACEMENT (See Fig. 22)

Remove fuse barriers if necessary. Place fuses in the holders so that the target button on the end of the fuse is toward the front of the carriage. If the fuse blows, the target will extend 3/8 to 1/2 in. Remove fuses from the holders by lifting one end and withdrawing the other end from the fuse clip. If difficulty is encountered in removing the fuse, a screwdriver handle or wrench may be placed under the fuse, between the fuse and the fuse tongue, and a prying motion used. Replacement fuses should fit tightly against the semi-circular stop located at the bottom of the fuse holder.

*ARC CHUTES

To insert arc chutes, slide in rear of chutes first, then push down on front and back of chutes, making sure that the arc runners are properly seated over the stationary contacts. Arc chutes are properly seated when a positive click is felt on both ends of the chute and the groove on the side of the arc chutes is horizontally even with the blowout plates.

CAUTION

Make sure the arc chute is properly inserted, rear end to back, as shown in Fig. 23. Failure to insert the arc chute properly will result in damage to the controller.

To remove arc chutes, lift the back end of the chute until it releases and then lift the entire chute upward, slide forward and out.

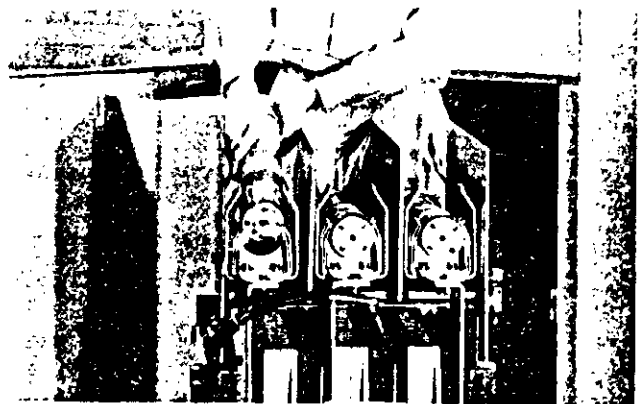


Fig. 22 - No special tools required for fuse installation.

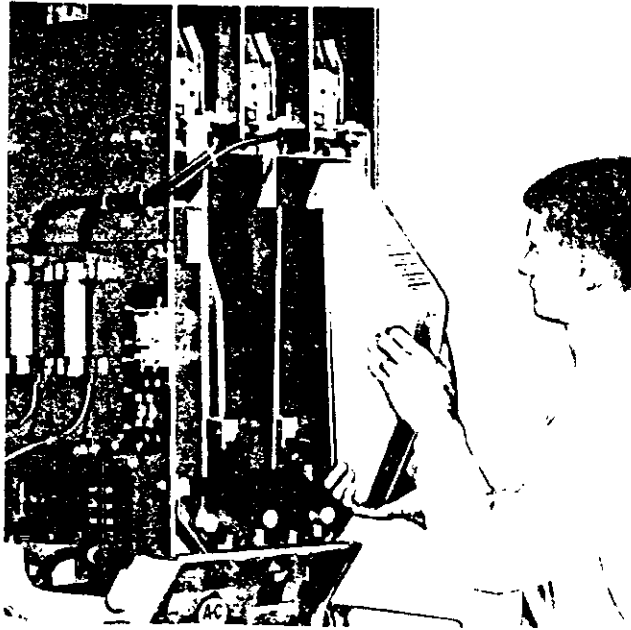
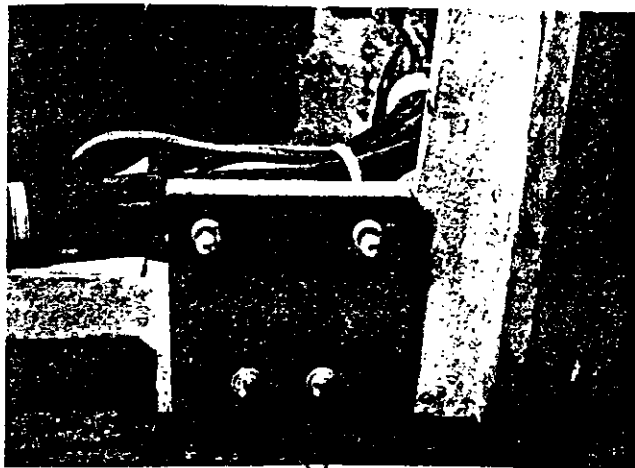


Fig. 23 - Inserting arc chute



STUDS
Fig. 24 - Mating contact studs for LSI

*LSI, GUIDE PLATE, AND ANTI-RACKING MECHANISM

(Refer to Fig. 13, 14, and 24 thru 28)

Check dimensions as shown in Fig. 14.

If the plumb line dimensions check indicates both interlocks have shifted the same amount and in the same direction, loosen the four bolts that hold down the entire guide plate (Fig. 13). Shift the guide plate until the proper dimensions are obtained. (Guide plate clearance holes are oversized to permit adjustment.) Tighten the four bolts securely.

If adjustment of the LSI only is required, observe the following: Adjust any obvious distortions to the leaf spring. A steel backing plate is located behind the

spring to prevent over bending when carriage is racked in.

DO NOT CHANGE THE LENGTH OF THE MATING CONTACT STUDS (See Fig. 24). These studs have been factory set with an assembly fixture. This setting must be maintained to allow interchanging carriages in various compartments. Remember that substitution of carriages requires matching data with compartment door labels.

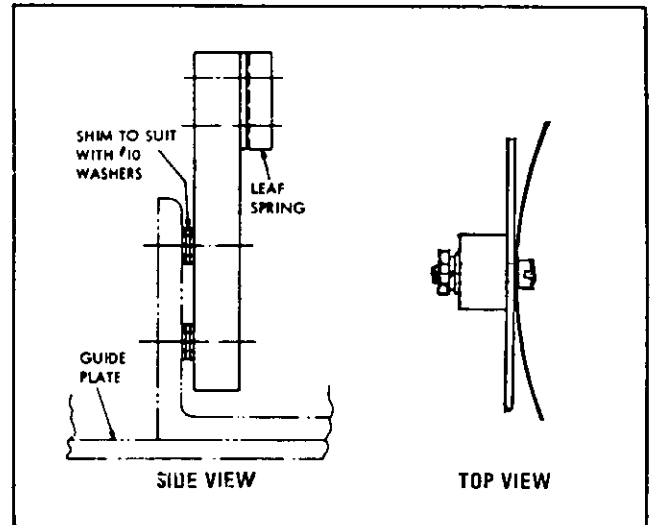


Fig. 25 - Adjust LSI with washers as shown

Normally, when the carriage is in the racked in position, the leaf spring will be 50% compressed. (See Fig. 26 and Instructions page 12.)

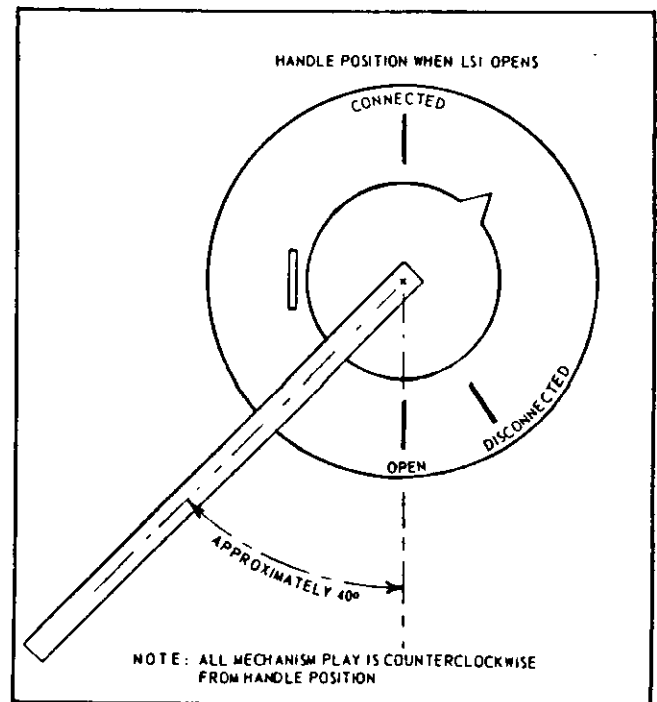


Fig. 26 - Handle shows line switch interlock relationship.

Adjust LSI by adding washers as shown in Fig. 25. A further check of the LSI is as follows:

1. Connect a buzzer and battery to terminals 9 and 11. (If there is power to the unit, connect a 300 volt meter to terminals 9 and 11.)
2. Rack the carriage in until buzzer sounds or VM indicates contact.
3. Rack carriage out slowly. Contact should be broken at 35° to 45° of handle rotation. (See Fig. 26.)

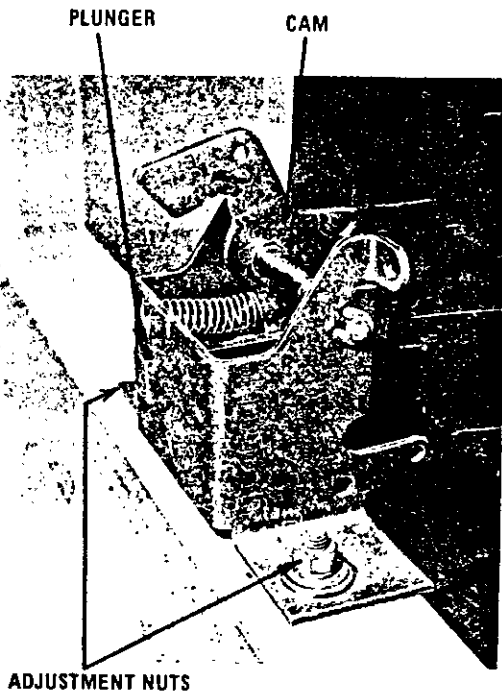


Fig. 27 - Anti-racking interlock.

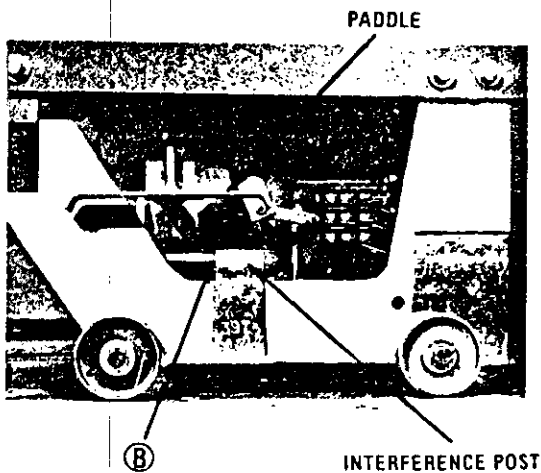


Fig. 28 - Interference post on carriage.

If adjustment of the anti-rack interlock is required, observe the following:

1. Loosen the two mounting nuts. (See Fig. 27.)
2. Shift the interlock assembly to the front or rear as required.
3. Use the dimensions shown in Fig. 14. The plunger must clear the interference post on the carriage by 1/4" maximum at B when the carriage is racked in. (See Fig. 28)

*CARRIAGE RACKING MECHANISM

The gear meshing of the side and back racking shafts cannot be off one tooth in either direction for proper operation. Proper meshing can be checked by making the checking fixture shown in Fig. 29, and using it as follows:

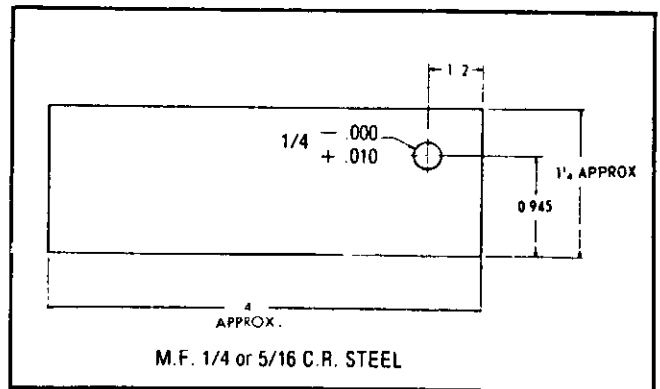


Fig. 29 - Gear mesh checking fixture.

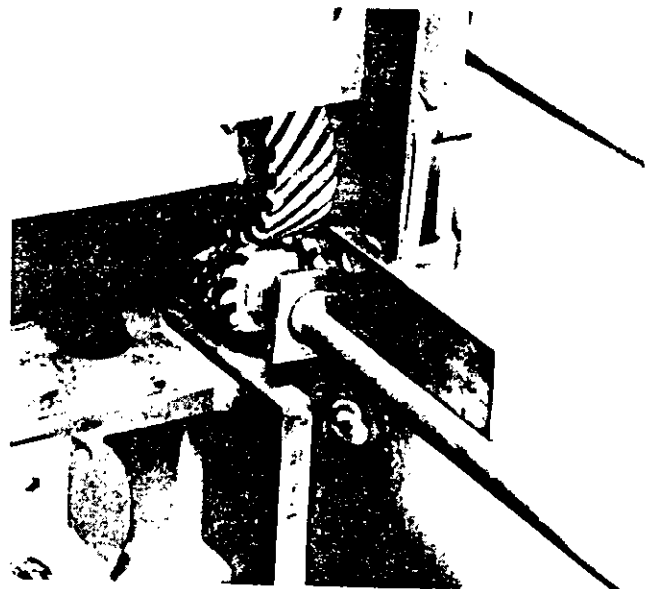


Fig. 30 - Fixture placement for checking gear mesh.

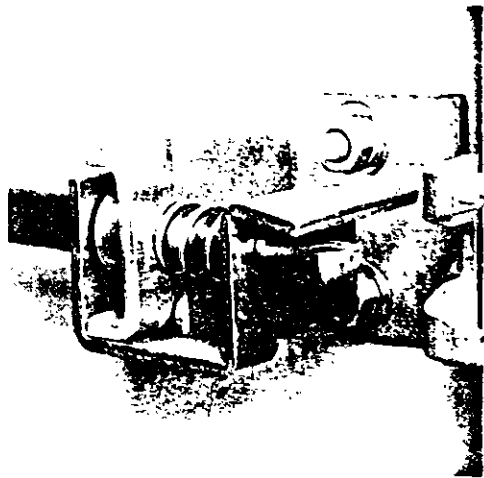


Fig 31 - Front side shaft support.

With the side shaft turned so that the flat is horizontal and the stop pin is against the stop on the front bearing support, place the checking fixture on the shutter drive arm pin on the racking cam (Fig. 30). The edge of the fixture should be flush with the side shaft with the shutter completely closed. With the side shaft horizontal, adjust the front and rear side shaft supports for free mechanism movement and minimal end play.

To change the gear mesh, remove the front and rear side shaft supports. (See Fig. 31.) Disengage the gearing and rotate the side shaft to the proper mesh position. Reinstall the front and rear supports and align as described above.

*Power Plugs and Rear Racking Shaft

Check dimensions as shown in Fig. 15. If the shaft height is off, adjust the channel support. If an individual set of plugs is out of position, adjust the individual insulator support independently.

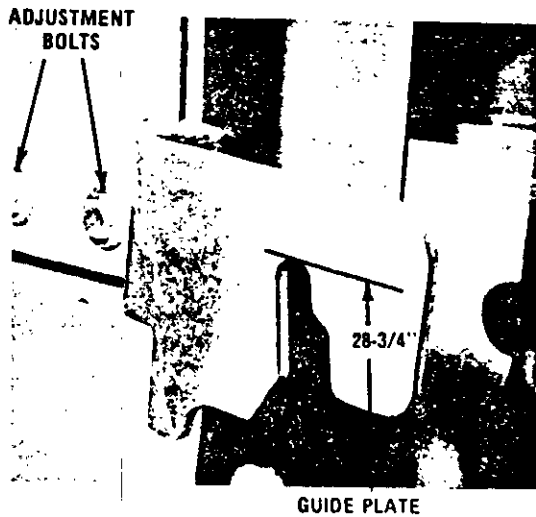


Fig 32 - Racking hook dimension.

*Carriage Racking Hooks

The carriage must be drawn into proper electrical contact with even pull on the racking hooks. If any interference occurs, adjust the hooks forward or back until the carriage rolls freely. The hooks may also require adjustment up or down to obtain proper carriage locking. The point indicated in Fig. 32 should be 28 3/4 in. from the floor to the top of the slot in the racking hook.

*Door Handle and Side Shaft

Remove the screw that fastens the handle to the square shaft of the coupling. Remove the handle, pointer and lock plate, spring washer and indicating plate, carefully noting the assembly sequence. Loosen but do not remove the three bearing screws which are now exposed.

Close the door and position the coupling and bearing for proper mating to the side shaft. The door latch, which is mounted on the inside flange of the cubicle, may need adjustment to clear the coupling. With the door closed and the coupling in its proper position, tighten the three bearing alignment screws. Reassemble the door handle in the proper sequence and double check for proper indication and handle position. (See Fig. 33.)

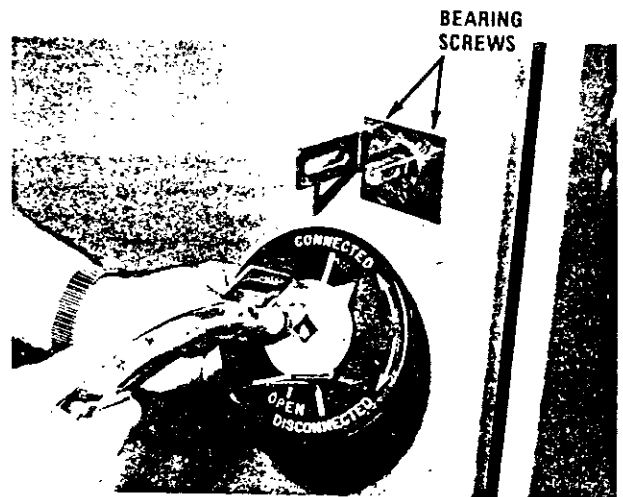


Fig 33 - Disassembled door handle showing the bearing alignment screws

RACKING SHAFT SAFETY INTERLOCK

A safety interlock is provided on the *SpaceMaker* compartment racking shaft mechanism. The shaft lock (Figure 34) consists of a lock bracket (48) and compression spring (49) mounted on the racking shaft at the front bearing support. The lock bracket prevents rotation of the racking shaft through interference with the stop pin when the compartment door is open. The purpose of this safety feature is to lock the line shutters closed when the compartment door is open.

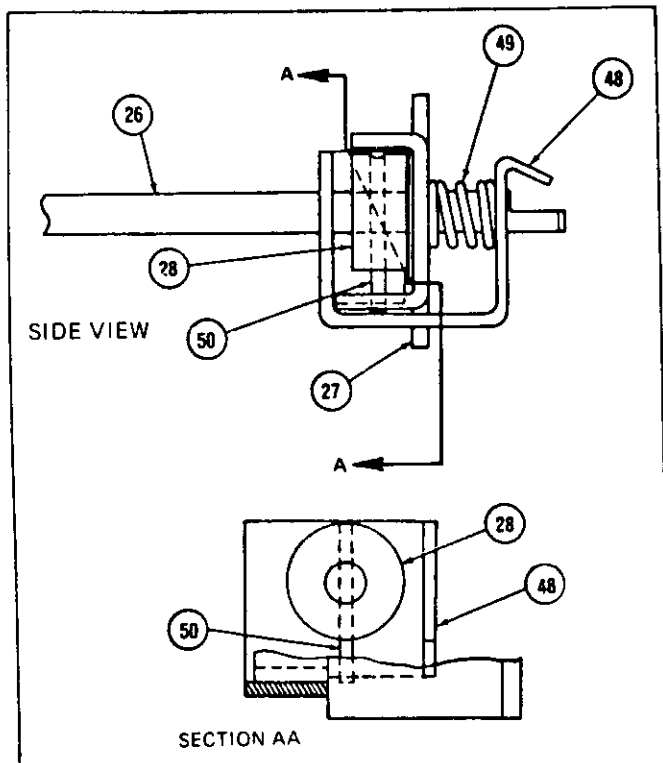


Fig 34 - SpaceMaker II Shaft Interlock Installation

Without this interlock, the racking mechanism can be operated freely by hand or other externally applied force to open the shutters and expose the energized line terminals. With the interlock the shutters can be opened for inspection purposes by bypassing the interlock. This is done by pressing the lock bracket inward to the point where the pin clears the bracket and then rotating the shaft 180° by hand (Figure 35).

WARNING

Perform this operation with extreme care. High voltage exists on the terminals.

CAUTION

Perform this inspection only with the carriage removed from the compartment. Be sure to rotate the shaft back to its original position so the shutters are closed after the inspection (Figure 36).

In normal racking operation, the interlock is released only when the compartment door is fully closed. As the door is closed, the racking handle coupling (23) engages the front edge of the lock bracket (48) and pushes it back to provide clearance for the stop pin (50) as the racking shaft (26) rotates. The lock bracket is held in the disengaged position with spring compressed during all racking functions. The compression spring will drive the lock bracket forward to lock the shaft only when the carriage is disconnected, the operating handle is in the "open" position and the door is open. High voltage compartment door must be pushed and held fully closed against the spring pressure before handle can be rotated.

INSTALLING THE INTERLOCK ON EXISTING CONTROLLERS

The shaft interlock safety mechanism can be field-installed on existing early model (Pre-1971) *Space-Maker II* controllers; these are equipped with the formed square tube handle which rotates through an

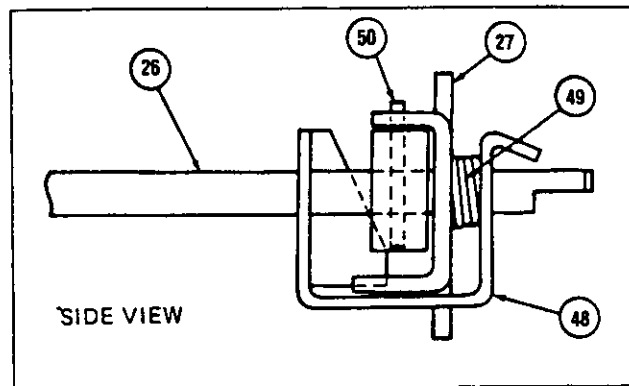


Fig 35 - Interlock with Door Closed and Shutter Open.

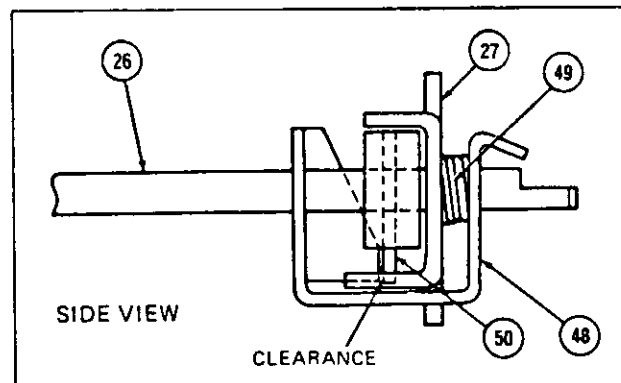


Fig. 36 - Interlock with Door Closed and Shutter Closed

arc of 180°. The new mechanism is not adaptable to the older *SpaceMaker* model which employed a reversible ratchet type racking handle which rotates through 320°. The new shaft lock mechanism can be simply installed on *SpaceMaker II* units without the need for machining any of the existing parts. If this safety feature is to be added on existing controllers, one lock bracket 25-204-209-001 and one compression spring 25-120-212-001 are required for each *SpaceMaker II* racking compartment. Proceed as follows to install the lock bracket and spring in the field. Refer to Figures 34 and 44.

CAUTION

Throughout this installation, carriage must be removed from cubicle and unit must be disconnected from the line to de-energize the line stabs located behind the shutter.

1. Drive out roll pin (50) from collar (28) and racking shaft (26).
2. Unbolt and remove rear bearing (29) and bearing bracket (27) from cubicle.
3. Pull bearing bracket (27) and collar (28) from racking shaft.
4. Reassemble parts on shaft (26) in the following order: back half of the bracket (48), collar (28), bearing bracket (27), spring (49), and front half of bracket (48).
5. Reinstall the front and rear supports, making sure that shutters are closed when the shaft has the flat side horizontal and facing up. (See Carriage Racking Mechanism, page 12.)
6. With shutters closed and shaft with flat side up, reinsert roll pin and drive through collar and shaft. The pin should be flush with top of collar and on the right side (when facing unit) of the bearing bracket's lower lip.
7. Disassemble and remove door mechanical interlock which connects from door to guide plate.

The racking shaft safety interlock mechanism described above includes all of the safety functions that were provided by the door operated mechanical interlock.

This mechanism consisted of an interference cam mounted on floor plate at left hand side of carriage and actuated by curved connecting rod attached at lower left hand corner of compartment door. The mechanism blocks complete entry of the *SpaceMaker* carriage into the compartment when door is open and permits entry only when compartment door is about 4" from being fully closed. The door-operated mechanical safety interlock is now superseded by the new shaft interlock mechanism.

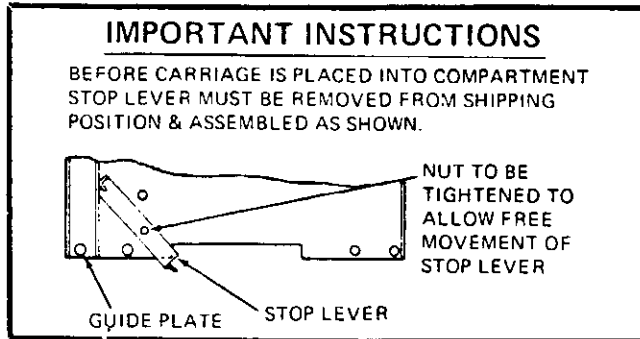


Fig. 37 - Stop Lever Assembly Instruction Label

25-118-524-002

CARRIAGE STOP SAFETY LEVER

A change has been made in the design and in the shipping installation of the carriage stop lever shown in its operating location in Figure 37. This lever is mounted on the floor plate at the front left corner. When the carriage is inserted, the lever blocks the left front carriage wheel with the carriage in the "disconnected" position. The stop lever must be rotated parallel to the guide rail by hand before the carriage can be completely inserted in the compartment. When the compartment door is closed, the door flange rotates the lever counterclockwise thus blocking the carriage wheel behind the interference end of the stop lever (Fig. 40). When the door is closed, the interference end of the lever should contact the guide rail and thus prevent motion of the carriage. Bend the tab on the end of the lever that contacts the door if necessary, so that this condition exists. When the door is opened, manually rotate the lever clockwise so it is parallel to the guide rail and the carriage can then be removed. The interference end of the lock lever has been redesigned to provide greater interference and added strength.

A somewhat different arrangement for the carriage stop lever exists for NEMA special gasketed enclosure types where formed steel sealing strips are bolted across the bottom of the *SpaceMaker* compartments. See Figure 16. The purpose of these strips is to provide a sealing edge to bear against the gasket material on the inside of the door. Where these sealing strips are installed, the operating end of the lever has been shortened and will be in position to block the carriage with the strip in place. The formed strip must be temporarily removed when the carriage is initially installed in its compartment or when the carriage is to be removed from its compartment. The sealing strip must be in position at all other times in order to provide an effective seal for the *SpaceMaker* compartment.

A new temporary location is provided for the carriage guide rail on the left hand side of the compartment floor

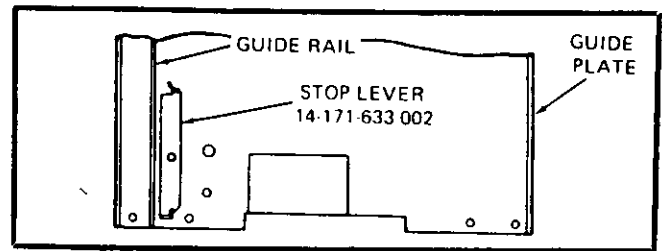


Fig. 38 Location of Stop Lever in Shipping Position

(Figure 38). After the *SpaceMaker* unit has been set in its final location, remove and discard the temporary shipping angle (Figure 4). The carriage stop lever in its shipping position will block entry of carriage. The lever thus must be unbolted from its temporary position and installed on the threaded stud as shown in Figure 40. The friction nut provided to hold the bracket in place must be turned down on the stud to the point where the lever can still be moved freely by hand.

CAUTION

Make certain that the stop lever is properly installed at its operating location in each *SpaceMaker* carriage disconnect compartment. An instruction label (Figures 37 and 40) is provided showing the relocation of the stop lever from its temporary shipping position to its permanent position.

SPACEMAKER CARRIAGE POSITION INDICATOR

A carriage position indicator plate (Figure 39) is now standard equipment in each *SpaceMaker* carriage compartment. The indicator plate (part number 25-118-524-003) is mounted at the right front on the compartment floor (Figure 40) and is readily visible as soon as the compartment door is opened. This indicator supplements the carriage position indication provided by the racking handle when compartment door is closed. A large arrow on the indicator plate indicates the normal location of the carriage in the "disconnected" position. The plate can readily be installed on existing units without any machining operation.

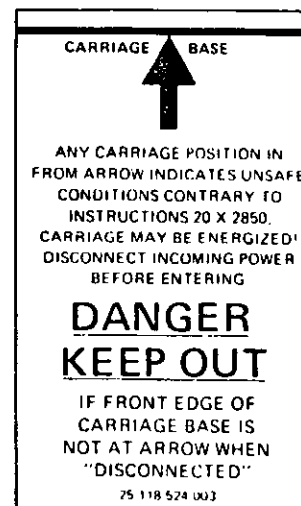


Fig. 39 - Carriage Position Indicator Plate

SPACEMAKER OPERATING CIRCUITS

Certain controllers are now furnished without the master relay. The circuit shown in Figure 21 is modified to use pilot devices to directly energize the contactor rectifier.

TYPE 456 CONTACTOR Choice of Dropout Time

A choice of opening time after de-energization of the *SpaceMaker* type 456 contactor is available. This is accomplished by alternate connections between terminals R and S in the DC operating coil circuit as indicated in the circuit diagram (Figure 21). Carriage terminals R and S correspond to compartment terminals 25 and 26 for most *SpaceMaker* controllers.

Standard circuits are arranged to provide an inherent dropout time of 400-500 milli-seconds for the type 456 contactor on de-energizing its coil circuit. This operation is provided by opening the AC input to the operating rectifier only. The dropout delay has proven extremely beneficial in maintaining uninterrupted motor operation on power systems experiencing severe voltage dips of short duration. The operating circuit of the type 456 contactor also remains sealed at approximately 40% normal voltage.

Certain special controller applications require a much faster dropout time where contactors are used for fault interruption within 50 MVA capability or where the faster dropout time is needed for close up stream protective coordination. A dropout time of 70-80 milli-seconds can readily be obtained. This is accomplished by simultaneously opening the AC input and DC output circuits of the contactor operating rectifier. The fast dropout circuit would thus be provided by the addition of a master relay (MR) normally open contact between terminals R and S in the output circuit of the rectifier. In practice, this is normally accomplished by removing the jumper between terminals 25-26 on the compartment terminal blocks and connecting in the relay contact as described. The quick dropout feature may be already provided in the original factory *SpaceMaker* controllers to correlate with specific application requirements.

SERVICE DOLLY

The service dolly (part number 14-234-878-801) used for withdrawing a *SpaceMaker* carriage mounted in an upper compartment. The service dolly platform is continuously adjustable at heights of 45 to 52" to conform to upper compartment floor heights.

CAUTION

If service dollies are required for *SpaceMaker* units which are to be mounted on raised pads, units must be installed with front edges flush with pad.

The service dolly can be used for a carriage mounted in the lower compartment if the unit is installed on a pad which is elevated 12" or more. The dolly platform can be adjusted down to a minimum height of approximately 12". However, for such a pad height, the

service dolly will not accommodate an upper compartment. The construction of a lightweight portable platform is normally recommended to service bottom compartment carriages when *SpaceMaker* units are installed on a pad above aisle elevation. The factory should be consulted where service dollies are required for heights above 52".

CARRIAGE DISCONNECT FINGER ASSEMBLIES

An increase in the contact pressure has been made in the power disconnect finger assemblies item 1, Figure 41, part number 71-240-055-501. An increase in pressure of contact fingers was initiated for improved performance in corrosive environments such as paper mills and chemical plants. The original music wire springs had a 15 pound rating and were zinc plated and dichromate treated. Disconnect finger assemblies now being supplied are equipped with stainless steel springs rated at 25 pounds and have an orange color for easy identification.

SpaceMaker carriages equipped with the new, higher pressure disconnect finger assemblies with orange springs require a slightly higher racking force. Contact finger of stationary terminals are factory coated with a thin film of high temperature lubricant in order to minimize racking forces and to provide increased life of silver plating. The presence of thin lubricating film will increase the wear life of silver plating by a factor of 10 or more. Lubricant such as AC contact lubricant (8.0 oz. tube, 15-171-370-002) should be applied thinly on the contact surfaces of disconnect fingers and stationary contacts.

*EMERGENCY ENTRANCE

To gain access to the high voltage compartment:

WARNING

AFTER IT HAS BEEN DEFINITELY DETERMINED THAT A MALFUNCTION HAS OCCURED, THE FOLLOWING PROCEDURES ARE TO BE PERFORMED BY AUTHORIZED PERSONNEL ONLY. ALL POWER TO THE CONTROL MUST BE REMOVED BEFORE THESE PROCEDURES ARE ATTEMPTED, AND POWER MUST REMAIN OFF UNTIL THE CONTROLLER IS IN OPERATING CONDITION.

- a. Remove the screw which fastens the handle to the square shaft of the coupling. Remove the handle, indicator and lock plate, spacer washers and indicating plate, carefully noting the assembly sequence. The door should now open. If there is slight interference between the coupling and the door handle bearing, loosen the three bearing alignment screws to clear the coupling.
- b. Remove the carriage from the compartment and correct the problem.
- c. Reassemble and realign the door handle.

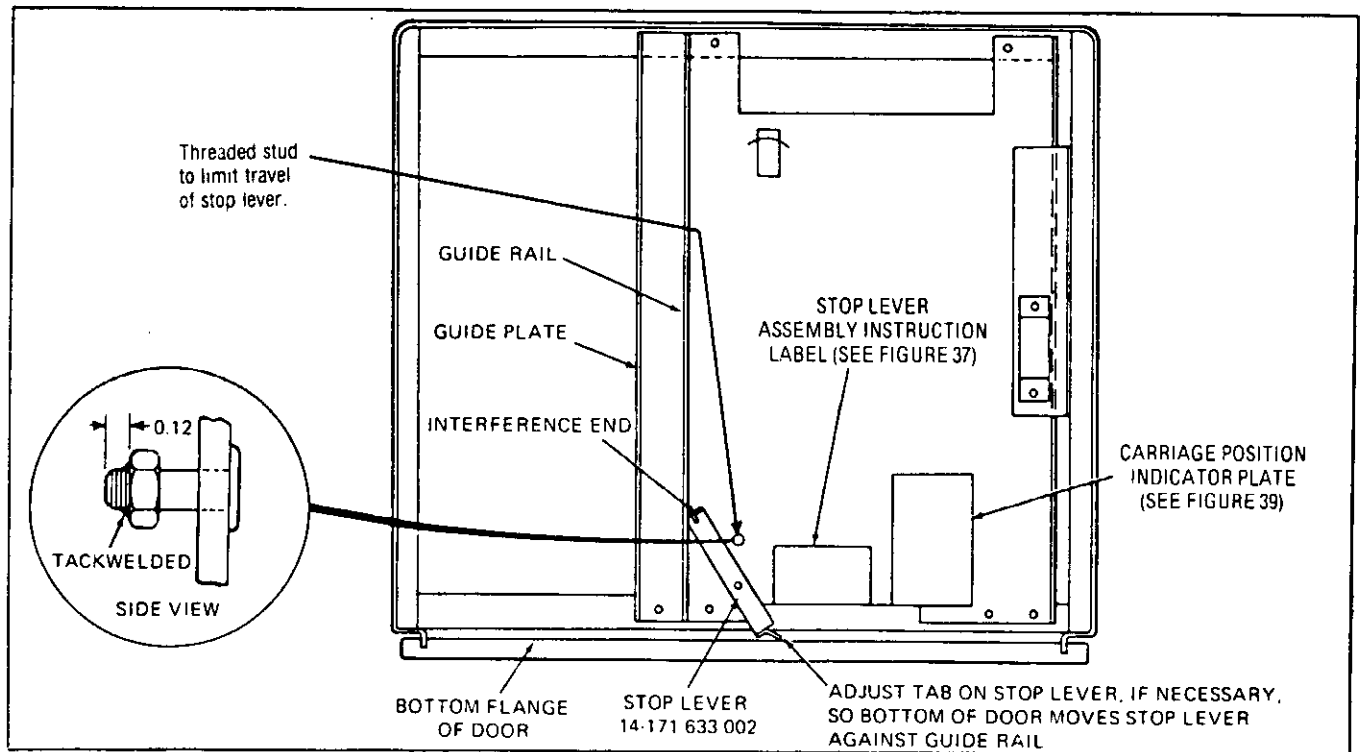


Fig. 40 - Installation and Adjustment of Stop Lever

MAINTENANCE

GENERAL

The importance of regular and thorough inspection and cleaning procedures cannot be overemphasized. A routine inspection once a week will suffice when the control is operating under normal conditions. Under severe operating conditions, such as dusty or contaminated atmospheres, it is suggested that a more frequent check be made.

CARRIAGE RACKING MECHANISM

The carriage racking mechanism must operate smoothly. Only a light coating of grease is required on the bearing points of the mechanism and on the gears to keep the movement operating smoothly.

AIR-BREAK CONTACTOR

WARNING

MAKE CERTAIN THAT THE CONTACTOR AND ITS OPERATING MECHANISM ARE DISCONNECTED FROM ALL POWER SOURCES BEFORE ATTEMPTING INSPECTION OR REPAIR OPERATIONS.

Inspect the air-break contactor at least once a month, or more often if the contactor operates on a rapid or heavy-duty cycle. Examine the contacts for alignment and wear. With the contactor closed, align the movable contacts with the stationary contacts so that the contact surfaces bear with firm and uniform pressure. Replace badly pitted or burned contacts immediately. If contact surfaces are only roughened, smooth down with a fine file. See contactor instruction manual for maintenance instructions.

The "Installation" section's Equipment Checkout can be used for a maintenance inspection. For isolated irregularities in equipment operation, use the "Trouble Shooting chart". The pages following that chart include spare parts identification. Order spare parts through your Siemens-Allis representative.

TROUBLE SHOOTING CHART

TROUBLE	CAUSE	REMEDY
Compartment door not square with cubicle opening.	Cubicle not bolted down tightly on perfectly level surface.	Using a level, add shims as necessary at mounting bolts and fasten mounting hardware securely.
	Cubicle sprung out of shape.	Straighten or repair cubicle.
	Door hinges not properly adjusted.	Add spacer washers as shims between hinge flange and cubicle flange at top or bottom hinge as required to compensate for error.
	Handle improperly assembled.	See section on "Adjustment".
Door will not close completely; door handle mechanism does not line up with operating shaft when door is closed.	Cubicle or door sprung.	Straighten or repair.
	Cubicle not level.	Check level, shim and tighten mounting bolts.
	Door handle assembly out of adjustment.	See section on "Adjustment".
	Vertical position of compartment door out of position.	Remove door hinge pins and add or remove adjusting washers between hinge bracket and bearing tube until correct height adjustment is obtained.
	Side shaft may have been manually rotated and not returned to normal position.	DANGER: High voltage terminals may be exposed. Turn shaft by hand counterclockwise until front stop pin hits stop with flat of shaft end up and horizontal.
Right-hand side of carriage rubs against shaft bracket or door handle coupling rubs against carriage.	Cubicle sprung or not level.	Straighten and level.
	Guide plate for carriage platform out of position.	Loosen four mounting nuts and shift plate for correct position.
	Door not fully closed to allow proper engagement between shaft and handle socket.	Close door firmly and correct any interference that prevents door from reaching fully closed position.
<i>SpaceMaker</i> carriage will not rack in with operating handle.	Locked carriage wheels.	Remove wheels and check for interference between wheel and carriage frame. Look for and remove any foreign material or rust in wheel bearing or shaft.
	Foreign objects or materials on compartment guide plate in path of carriage wheels.	Plate must be free of all foreign particles, including gravel, hardware and so forth.
	Interference between carriage disconnect fingers and compartment stationary plugs.	Check elevation of carriage fingers and stationary plug terminals, setting elevations in accordance with instruction book.

TROUBLE	CAUSE	REMEDY
(cont'd.)	Shutter may be binding or operating links connected to rear racking shaft may be off or broken.	Check insulated shutter hardware for breakage.
	Improper mesh between side pinion gear and rear racking gear.	See section on "Adjustment".
	Broken or bent racking shaft.	Replace entire shaft.
	Mechanical interlock interference. Interlocks out of adjustment or improperly set.	See section on "Adjustment".
	Carriage racking hooks hit racking shaft pins.	Check height position of shaft location and position of racking hooks on <i>SpaceMaker</i> carriage in accordance with instruction book. Adjust so that edges of hooks will pass over the racking pins with shutters down.
	Inner phase barriers in <i>SpaceMaker</i> carriage installed backwards.	Check each fuse barrier and contactor barrier to make certain that each is in proper direction and properly seated.
Carriage racks in but requires unusual and abnormal racking force.	Partial interference or improper racking mechanism.	Check for signs of scraping or rubbing on carriage and other moving parts; check for freedom of operation of racking mechanism by operating shaft by hand and making necessary adjustments or corrections.
	Racking pins not engaging carriage hooks at proper position.	Adjust both carriage hooks evenly at correct position in accordance with "Adjustment" section.
	Carriage disconnect fingers and/or stationary power plugs in need of lubrication.	See Page 16 for lubrication procedure.
Carriage will not rack out with racking handle.	<i>SpaceMaker</i> contactors in controller may be energized.	Operate stop button to stop motor before attempting to rack out carriages.
	Racking mechanism may be broken or defective.	Disconnect incoming power, obtain entrance to compartment by removing door handle assembly and remove door-operated mechanical safety interlock screws in lower left-hand corner of door; remove sufficient mechanism to allow carriage to be withdrawn and make necessary repairs or adjustments.
	Mechanical jamming of contactor in closed position, causing contactor to be blocked in by mechanical safety interlock.	Disconnect incoming power, remove door interlock hardware at lower left-hand corner of door and remove handle assembly to gain entrance to compartment. Remove the carriage and check the contactor thoroughly to determine cause for jamming in the

TROUBLE	CAUSE	REMEDY
Carriage will not rack out with racking handle. (cont'd.)		closed position. Such causes might be welded contacts, broken arc chute, foreign material in contactor mechanism, loose or broken contactor parts, excessive rust, corrosion or dust, etc. Refer to Type 456 high voltage air-break contactor instruction manual ICD6030 for this maintenance. Contactor should be completely restored to normal before returning it to service.
	Jamming of mechanical interlock although contactor open.	Rack carriage all the way back in with racking handle. This should reduce friction at the point of contact between the plunger of the anti-rack interlock mechanism and the interference plate on the carriage. If this is not successful, remove door interlock hardware and handle assembly to gain access to compartment. Disconnect incoming power. Mechanical interlock, located on right-hand side sheet, must be set forward to allow 1/16 to 1/8-in. clearance between interference plunger and stop plate on contactor when contactor is closed. If position is satisfactory, check for broken spring or binding in mechanical interlock assembly. Interlock should release abruptly when operated by hand.
<i>SpaceMaker</i> carriage can be racked out but requires abnormal racking force.	Friction or binding in racking mechanism.	Correct alignment and free sliding shutter mechanism.
	Racking hooks on carriage not adjusted equally.	See section on "Adjustment".
<i>SpaceMaker</i> carriage forces shutters open when it is pushed into compartment.	Entire compartment and carriage out of adjustment and alignment.	Adjust and align compartment guide plate, mechanical interlocks, racking shafts, shutter mechanism, carriage hooks and other details in strict accordance with instruction book.
Binding of safety shutter mechanism or breaking of insulated shutter hardware.	Carriage striking movable shutter during racking operation.	Set alignment and proper mesh of side shaft and rear shaft. Replace or repair movable shutter driving arms.
	Warpage of safety shutters.	Add additional insulated spacer washers between shutter sections to provide additional clearance, or replace shutter assembly if warpage is severe or damage has occurred.

TROUBLE	CAUSE	REMEDY
(cont'd.)	Rough handling during transportation and installation.	Adjust shutter assembly and replace broken insulated hardware.
Apparent absence of control power with carriage racked in.	Incoming power line not energized.	Close feeder circuit breaker or tie switch.
	Electrical interlock switch "LSI" not adjusted properly.	See section on "Adjustment", specifically the LSI.
	Blown fuses.	Check three main motor power fuses, control transformer primary fuses, and control transformer secondary fuses and replace if blown.
	Control cable not plugged into <i>Space-Maker</i> carriage.	This is the disconnect type terminal block that must be connected in order to provide circuitry between compartment and carriage. The mating halves of the terminal block must be engaged, and clamp screws at top and bottom tightened to hold halves together. Control wire connections in the block are made through slide-type terminals. See that all terminals are securely in position.
	Test-normal control switch on left-hand side of carriage not in proper position.	Switch should be in "normal" position for operation from control transformer power. When carriage is racked out, switch can be placed in test position to operate contactor through normal sequence, with auxiliary power connected to compartment terminal block. Place switch in "normal" position before racking carriage in to operate motor.
	Overload relays or other protective relays in operated or "trip" position.	Reset relays to close contacts and complete control circuit.
	Missing jumpers, loose connections, remote connections, etc.	Check wiring and connection diagram carefully to make certain that all external or alternate connections have been made satisfactorily. This is especially true where remote protective or control devices are used. Where remote AC ammeters or wattmeters are used, shorting jumpers in the <i>SpaceMaker</i> compartment must be removed when external connections are made. Check all terminal connections to make certain that they are tight and are making metal-to-metal contact.

TROUBLE	CAUSE	REMEDY
Motor will not start, although normal control voltage available.	Sequence of control circuit being interrupted.	Check for and correct remote device connections, tripped protective contacts, burned out coils or relays and contactors, faulty rectifiers, blown fuses, mechanical interference in the operation of relays and contactors, burned contacts, broken contact springs, excessive dust or other foreign materials in mechanism and between contacts.
Contactor does not pick up, although control circuit voltage available.	Contactor held open by mechanical interlock.	Rack in contactor completely. Reset interlock on guide plate if not in correct position. Check interlock for freedom of operation.
	Arc chutes or phase barriers not properly installed in contactor.	Make certain that phase barriers are in proper direction and in proper position and that arc chutes are in proper direction, with arc runners properly seated.
	Burned out coil or rectifier on Type 456 contactor.	Check coil and rectifier. Make certain that the long wipe normally closed contact is in proper working condition and is open in the closed magnet position to reduce seal current (refer to Type 456 high voltage air-break contactor instruction book, (ICD 6030). Check for mechanical interference or foreign materials in contactor mechanism and in magnet air gap. Make certain all contactor parts are in satisfactory operating condition and are properly tightened.
Burnout of Type 456 contactor rectifier.	Faulty operation of normally closed long wipe contact.	Replace or correct normally closed contact assembly or operating finger if necessary. Normally closed contact must open as magnet reaches fully operated position to reduce coil seal current.
	Voltage surges from power line.	Check protective surge suppressor across DC terminals of rectifier.
	Burnout of operating magnet coil.	Replace magnet coil and check circuit for shorted terminals, etc.
Overload relays trip during starting or soon after motor is up to speed.	Motor overloaded.	Limit starting load and running load to motor capabilities.
	Motor being started too frequently at close intervals.	Jogging and starting operations must be limited to capabilities of the motor. Check starting limitations in motor instruction manual before repeated starts.

TROUBLE	CAUSE	REMEDY
(cont'd.)	Excessive acceleration time.	The starting of high inertia loads may not permit the use of standard overload relay application. Where accelerating time approaches 12 seconds or more, special overload relay by-pass devices and circuits would usually be required. Contact the factory regarding such problems and supply complete data on locked-rotor starting current and total accelerating time under maximum load conditions.
	Low line voltage.	Line voltage should be maintained between +10% and -10% of motor name-plate voltage.
Overload relays trip during motor operation.	Motor being overloaded.	Reduce load or correct conditions causing overload.
	Overload relay not adjusted to motor capabilities.	Adjust relay setting in accordance with instructions for the overload relay. Adjustment should correspond to thermal rating of the motor, including temperature rise, duty and service factor.
	Incorrect relay installed.	Contact factory.
	Relays set incorrectly.	Set in accordance with relay instructions.
Overload relays fail to trip on overload current.	Relay tripping mechanism jammed.	Replace relay.
	Incorrect relay or relay set incorrectly.	Check relay selection and adjustment per overload relay instructions.
	Current transformers with improper ratio or with short-circuited secondary terminals.	Current transformers must have a step-down ratio to correspond to full load motor current and relay selection. Protective jumpers may be provided at current transformer secondary terminals or on terminal block connections to guard against open transformer secondary circuit, and jumpers must be removed before placing equipment in operation.
Blowing of motor power fuses.	Short circuit on the load side of the motor fuses.	Use Megger and other test instruments to locate fault and correct.
	Jogging or too frequent starting.	On frequent starting, fuses accumulate abnormal heat and cool more slowly than do overload relays. Since fuses more closely follow cooling and heating of motor windings, successive starting operations must be limited to the safe capacity of the motor to prevent fuse blowing from

TROUBLE	CAUSE	REMEDY
(cont'd.)	(cont'd.)	this cause. Check size rating on fuse nameplate against data label on carriage and data label in <i>SpaceMaker</i> compartment. All three must agree. Fuses are selected on the basis of motor full load current, locked-rotor current and starting time. Approximate sizes can be determined from Siemens-Allis price book section.
	Fuses internally damaged because of improper handling.	Motor power fuses are made up of multiple strands of fine silver ribbon which may be broken if fuses are dropped or roughly handled. Several individual strands can be broken without the trip target indicating a blown fuse. Handle fuses carefully, installing them in clips on top of the <i>SpaceMaker</i> carriage, with target indicator toward the front.
Blowing of primary control transformer fuses.	Shorted primary winding in control transformer.	Replace or repair transformer.
	Fuse may be "open" due to rough handling before installing.	Replace fuse.
	Secondary fuses not properly coordinated.	Melting characteristic of secondary fuse should not intersect melting characteristic of primary fuse. Rating of standard NEC fuse should not exceed twice the secondary current rating.
Blowing of secondary control transformer fuses.	Abnormal current or short circuit in control.	Check for faulty operation of long wipe economizing contacts, shorted magnet coils, shorted rectifiers, grounds, loose or bent connections, mechanical binding in relay and contactor mechanisms, excessive operations and incorrect secondary terminal connections.
Overheating of carriage disconnect fingers.	Improper alignment and overtravel on stationary terminals.	Adjust position and alignment of stationary terminals in back of compartment in accordance with instruction book.
	Loose mounting hardware or broken segment springs.	All mounting hardware must be secure, and all current carrying surfaces must be clean before bolting. Contact springs for each pair of fingers must be in place and have original temper. Contact surfaces on fingers and stationary terminals must be free of deep voids, corrosion, oxidation and foreign materials, such as dust, etc. Imperfect finger assemblies are a serious hazard and should be replaced. Make sure that the finger retainer shims are in place.

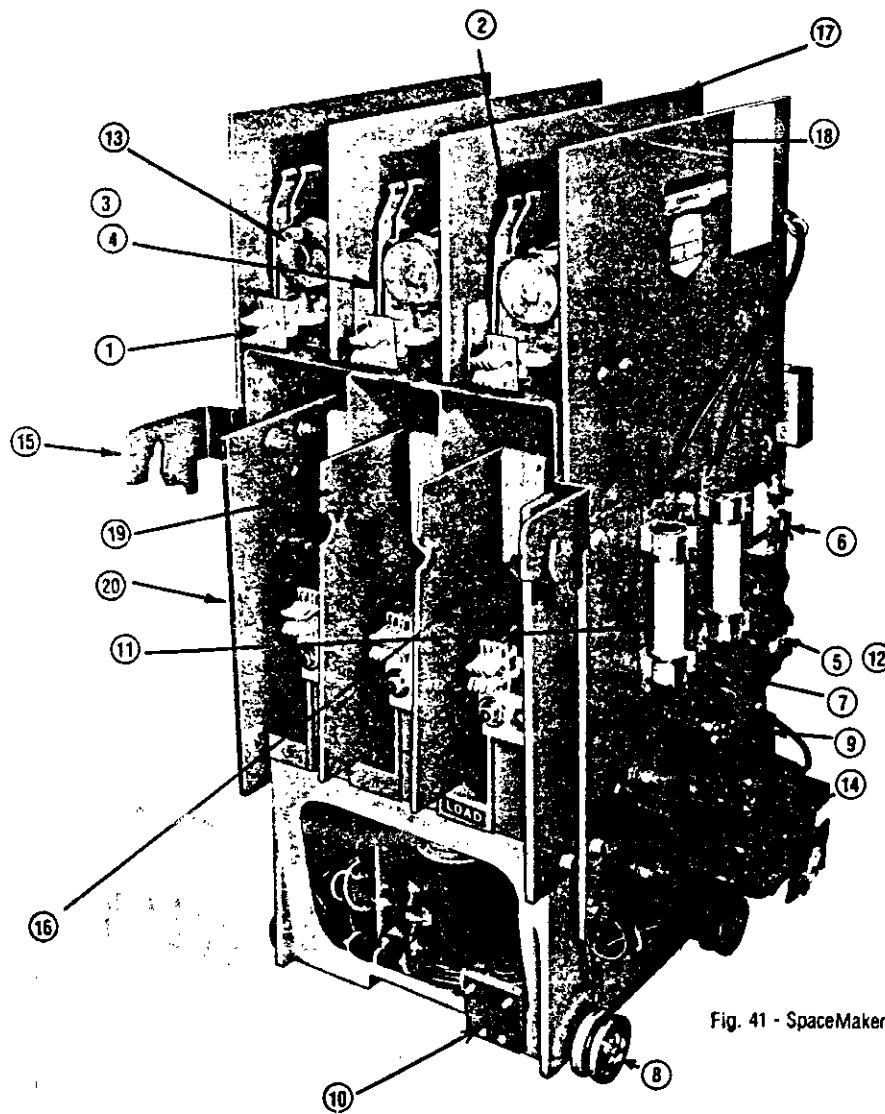


Fig. 41 - SpaceMaker II Carriage

CONTACTOR CARRIAGE — PARTS LIST

Item No.	Description	Part No.	Qty.
1	Disconnect Fingers w/Retainer	71-240-055-501	6
2	Fuse Clamp	14-234-755-001	6
3	Outer Clip	14-234-753-001	6
4	Inner Clip	14-234-754-001	6
5	Fuse Block 2-Pole**	00-871-237-107	1
5A	Fuse Block 1-Pole*	00-871-237-101	1
6	Knife Switch 2-Pole**	14-147-049-001	1
6A	Knife Switch 1-Pole*	25-131-277-001	1
7	Control Power Fuse Clip	25-127-701-001	4
8	Wheel Assembly	14-147-042-501	4
9	Disconnect Block	14-231-983-501	1
10	Electrical Interlock Assembly	14-170-239-501	1
11	Control Transformer Primary Fuse	} See Recommended Initial Stock of Replacement Parts	2
12	Control Circuit Fuse		1* or 2**
13	Main Power Fuse		3
14	Control Power Transformer		1
15	Racking Hook R.H.	14-232-744-502	1
16	Racking Hook L.H.	14-232-744-501	1
17	Fuse Barrier (inner)	14-231-648-002	2
18	Fuse Barrier (outer)	14-231-648-003	2
19	Phase Barrier (inner)	14-133-795-001	2
20	Phase Barrier (outer)	14-147-023-001	2

See contactor Instruction Manual for all other parts (ICD6030)

* - 115VAC Contactor Operating Voltage
 ** - 230VAC Contactor Operating Voltage

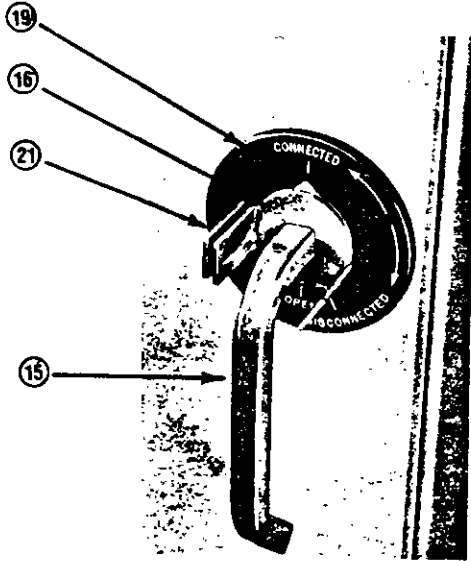


Fig. 42 - Door handle

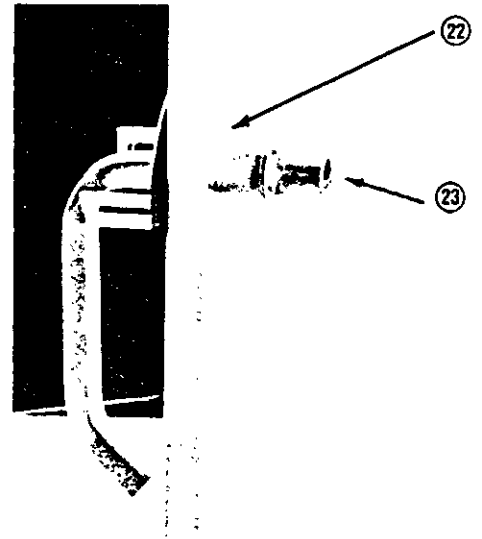


Fig. 43 - Rear view of door handle assembly

DOOR HANDLE ASSEMBLY — PARTS KIT

Item No.	Part Identification	Parts Kit No	Qty.
*15	Handle	} 25-103-302-801	1
*16	Indicator and Lock Plate		1
*17	Spring Washer		1
*18	Spacer Washer		1
*19	Indicating Plate		1
*20	Space Washer		1
21	Padlock Plate		1
22	Bearing		1
23	Coupling		1

*NOTE: Items 15 through 20 are in sequential order.

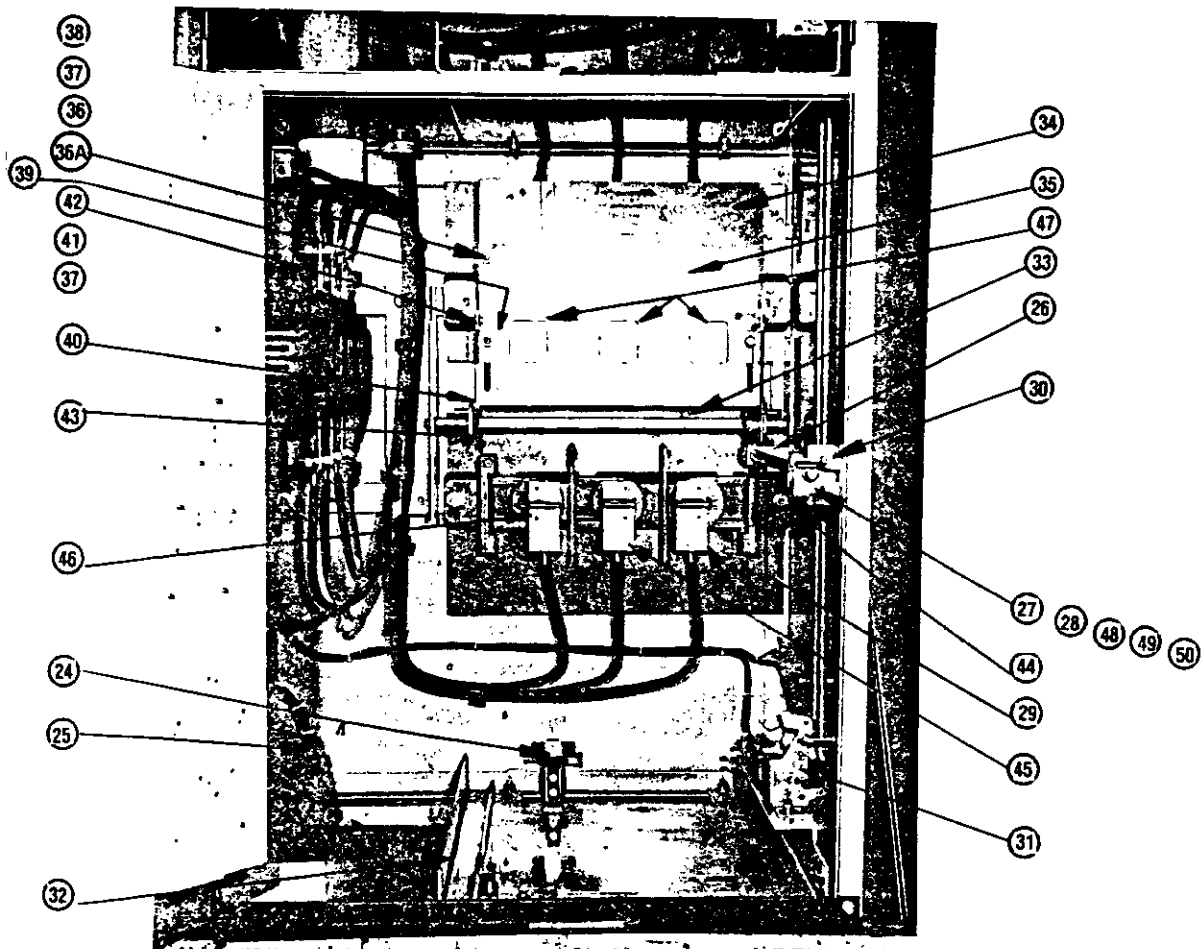


Fig. 44 - Inside view SpaceMaker II compartment

SPACEMAKER II COMPARTMENT — PARTS LIST

Item No.	Description	Part No.	Qty.
24	Line Switch Interlock	14-170-240-501	1
25	Wiring Harness with Plug (230V Contactor)	25-104-745-501	1
25A	Wiring Harness with Plug* (230V Contactor)	25-104-745-502	1
25B	Wiring Harness with Plug (115V Contactor)	25-104-745-506	1
25C	Wiring Harness with Plug* (115V Contactor)	25-104-745-507	1
26	Racking Shaft Assembly	25-201-574-501	1
27	Bearing Bracket	25-103-256-001	1
28	Collar (Behind bearing bracket)	14-171-914-001	1
29	Rear Bearing	14-174-843-001	1
30	Door Latch	14-171-772-001	1
31	Mechanical Interlock Assembly	14-323-199-501	1
32	Guide Plate	14-233-126-501	1
33	Shutter Shaft Assembly	25-201-587-501	1
34	Stationary Shutter	14-231-663-001	1
35	Movable Shutter	14-231-662-001	1
36	Screw	00-617-481-002	3**
36A	Washer	00-653-109-146	3**
37	Washer (Phenolic)	14-423-344-016	5
38	Spacer (Nylon)	25-102-615-001	3
39	Rivet (Nylon)	00-671-501-060	4
40	Shutter Actuating Arm	14-170-748-001	2
41	Shoulder Screw (Nylon)	14-171-259-002	2
42	Hex Nut (Nylon)	00-639-039-116	2
43	Washers (Phenolic)	14-423-344-014	4
44	Terminal Insulator	14-323-043-501	2
45	Terminal	14-171-874-001	2
46	Terminal	14-171-874-002	1
47	Terminal	14-147-037-001	3
48	Shaft Lock Bracket	25-204-209-001	1
49	Spring	25-120-212-001	1
50	Roll Pin	00-671-177-386	1

*Used on one-high 90" controller (Style Z) with carriage in lower and low voltage control in upper compartment.

**Order both items for replacement.