ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION
SERVICE DEPARTMENT
MAINTENANCE INSTRUCTION

DYNAMIC BRAKE GRID RESISTORS

INTRODUCTION

A properly maintained dynamic brake grid system will provide a grid life equal to the life of the motive power equipment. Associated equipment directly affects the grid resistor. Therefore, proper functioning of cooling fans, regulators, and cabling is essential.

DESCRIPTION

The locomotive dynamic brake grid is a 700 ampere resistor, and the Off-Highway Vehicle (OHV) grid is rated for 1075 amperes. Each grid is encased in a sturdy frame comprised of tandem "half-box" construction, Fig. 1. A front "air in" and rear "air out" ribbon assembly converts electrical energy into heat. The ribbon assembly has a consistent preset thermal expansion gap, and is held firmly in place by clips. The ribbon side having wider spacing, Fig. 1, allows insertion of additional ribbon convolutions as required to ensure optimum resistance. A polyester baffle along each side ensures proper air flow.

Since the grid is built by assembling two basic "half-boxes", partially failed grids can be easily and economically repaired by replacing the defective "half-box."

Several dynamic brake resistors with associated cooling fan and motor are usually grouped in a subassembly which in turn is mounted in the superstructure of the locomotive. A typical SD-2 grid and fan configuration involves 6 grids and 2 fans, Fig. 2, and a typical GP-2 configuration consists of 4 grids and 1 fan, Fig. 3.

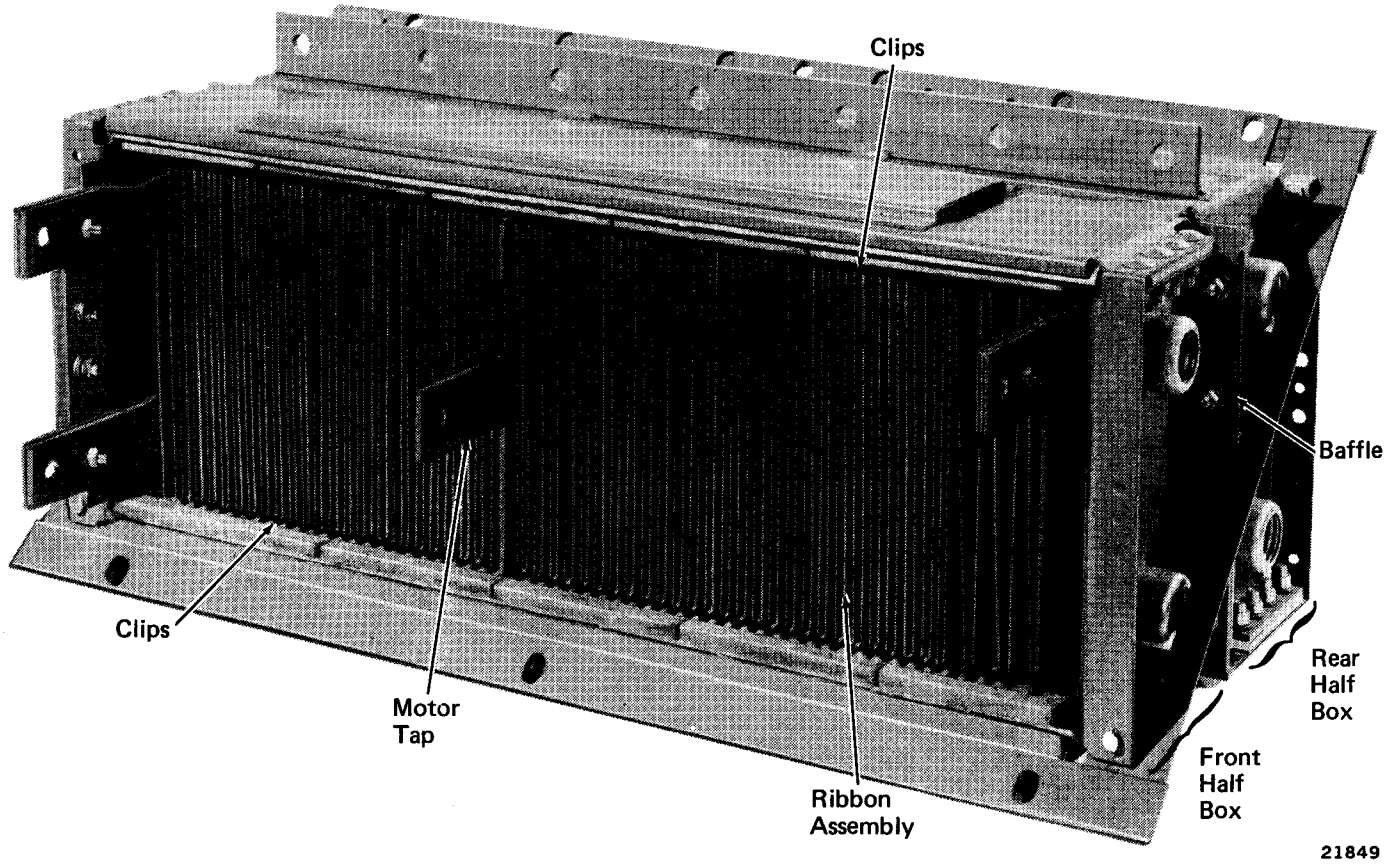
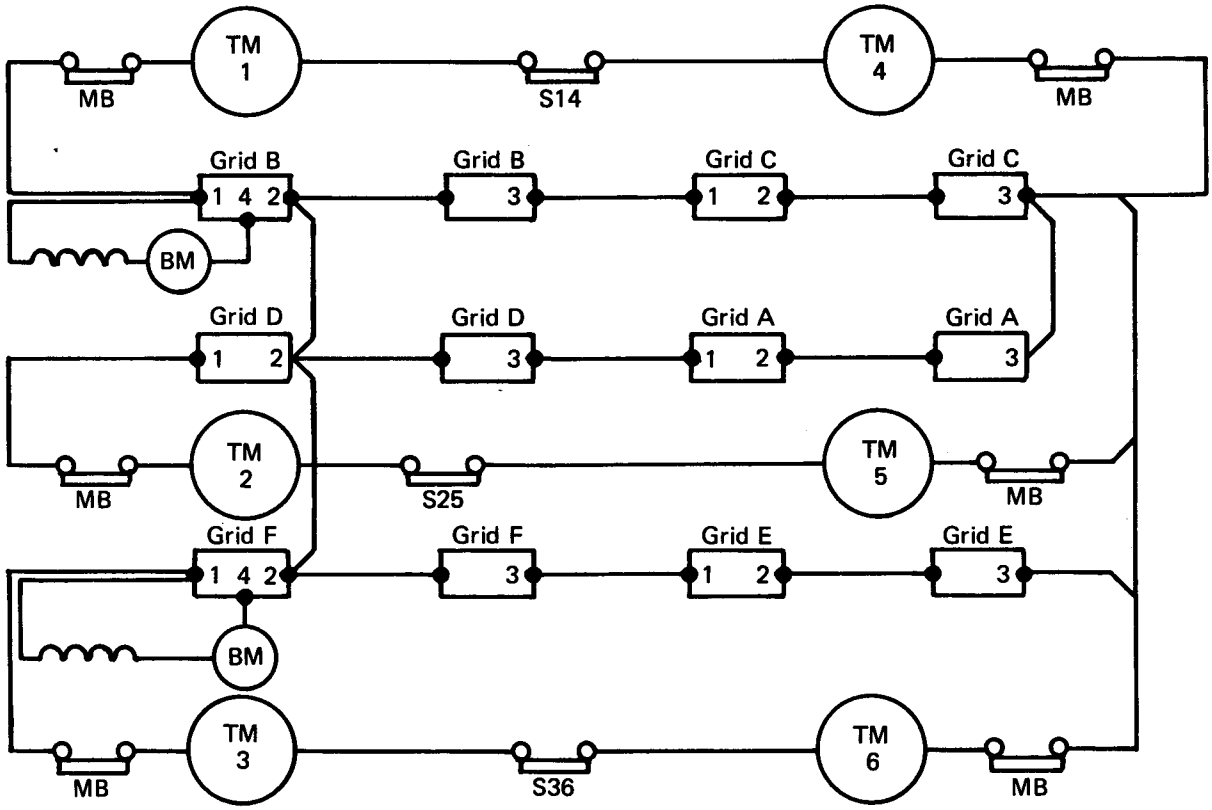
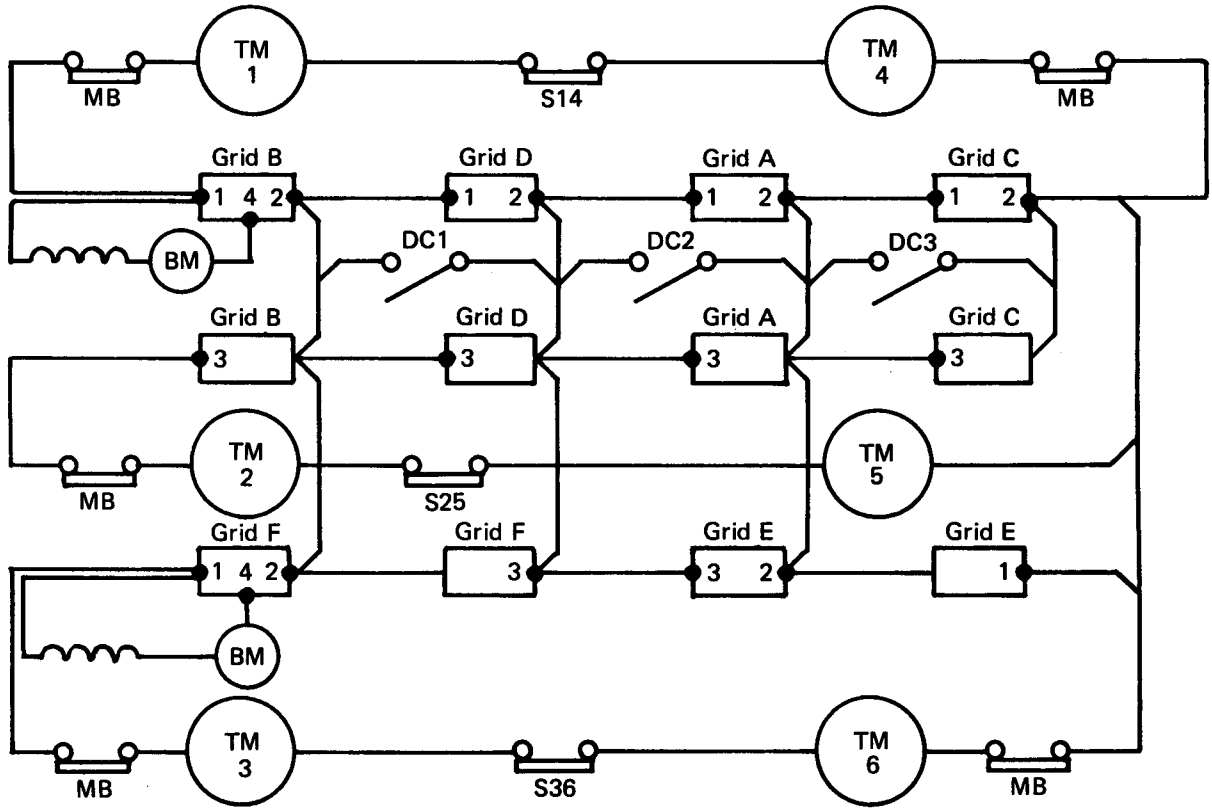


Fig. 1 – Dynamic Brake Grid Resistor (With Motor Tap)



Locomotives Equipped With Basic Dynamic Brakes



Locomotives Equipped With Extended Range Dynamic Brakes

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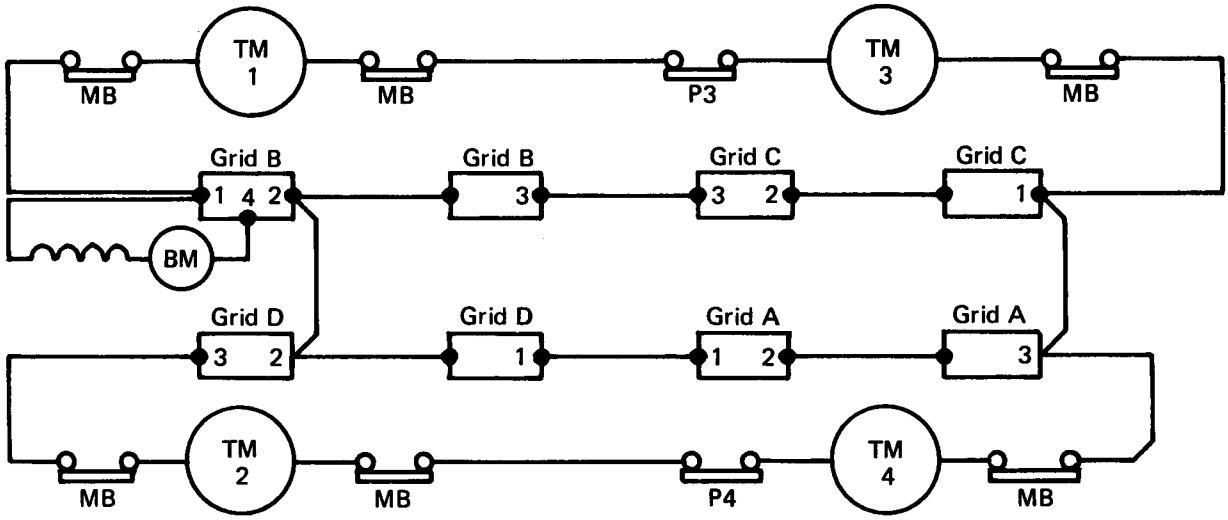
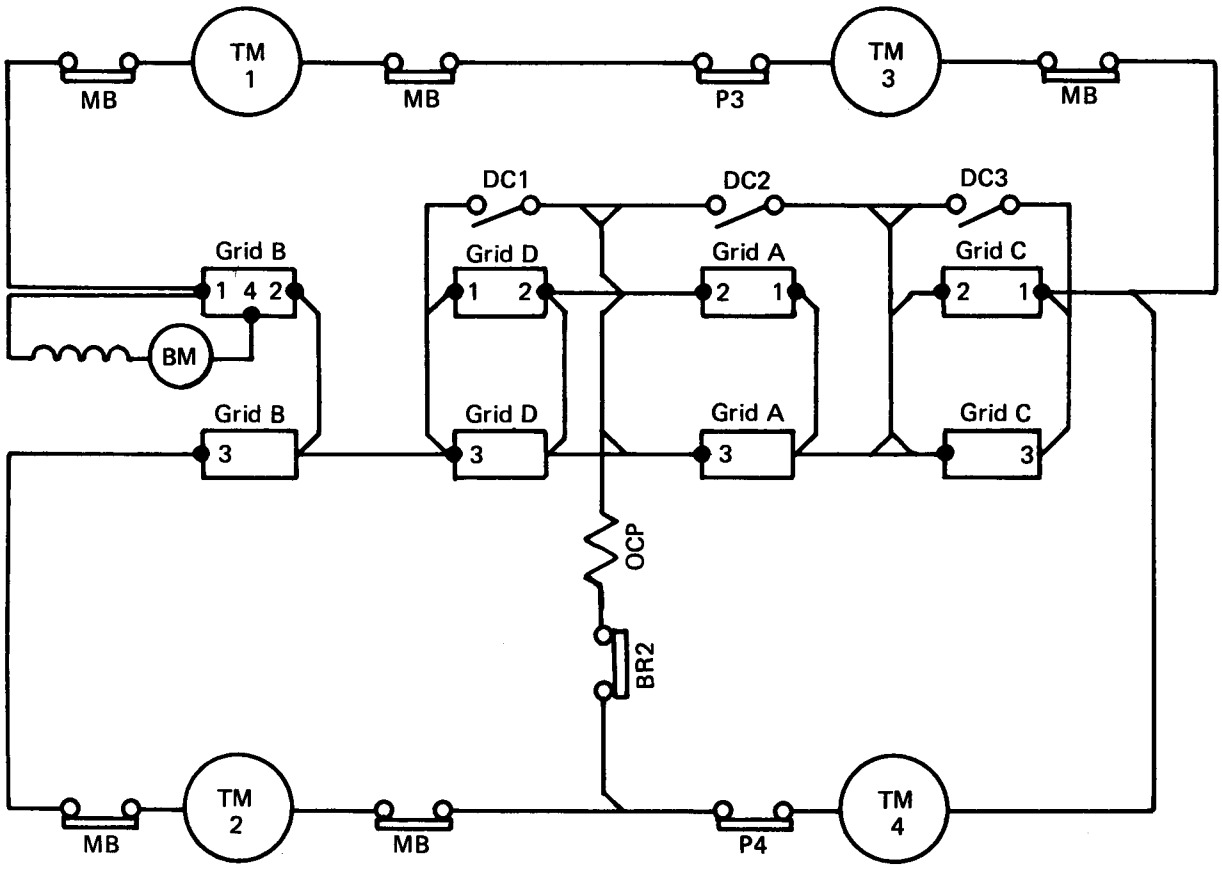
Fig. 2 – Typical SD-2 Configuration



Locomotives Equipped With Basic Dynamic Brakes



Locomotives Equipped With Extended Range Dynamic Brakes

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Fig. 3 – Typical GP-2 Configuration

NOTE: Electrical schematics, Figs. 2 and 3, cover both basic and extended range dynamic brake systems.

A typical OHV grid and fan arrangement is shown in Fig. 4. Grids are located on the vehicle upper deck.

OPERATION

Dynamic braking is a system used to retard speed through conversion of kinetic energy into electrical energy. During dynamic braking, power developed by the traction motors acting as separately excited generators is dissipated through the dynamic brake grid resistors in the form of heat.

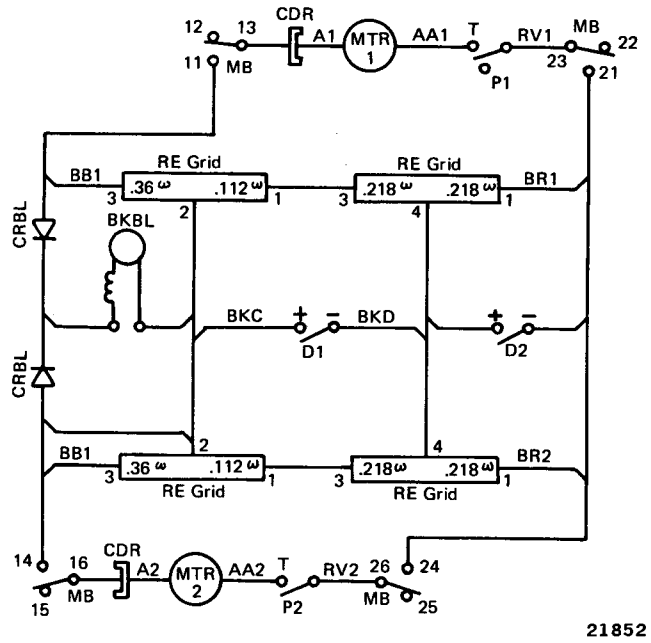


Fig. 4 - Typical OHV Configuration

The amount of kinetic energy that is converted into electrical energy is proportional to I^2R where I is braking grid current and R is the effective resistance of the braking grids. Grid current increases to its maximum value at the speed where maximum braking effort is attained and is regulated to the maximum value at all higher speeds.

RATING FACTORS

There are many types of dynamic brake hatch assemblies, and ventilation is usually by suction to provide the most uniform cooling. However, many factors influence the effectiveness of the cooling air:

1. Distance of fan from grids.
2. Angle at which the grids are set.
3. Presence of protective gratings.
4. Fan motor size.
5. Fan size.
6. Location of motor tap on motor tap grid.

Ampere rating of the grid in a specified hatch and location is established to provide an adequate safety margin for wind direction, ambient temperature, and variations which occur in other areas directly affecting the grid cooling power.

The grid rating is established by gradually increasing the current loading in the dark. The current (in amperes) at which the first grid in the configuration starts to show a very dull red haze is noted. The maximum operating current for this resistor configuration is established as 10% less than the current which existed at the color threshold.

RESISTOR TYPES

In every given configuration of resistors, there is at least one resistor with a special tap for the blower motor, Fig. 1. This resistor has a different resistance value from the companion resistors as well as having an extra tap.

The motor tap is positioned to provide a desired fan speed at a given value of current, and the total value of the grid resistance is such that the total power consumed by the motor tap grid and the cooling fan motor is the same as that consumed by one of the untapped grids in the same configuration when a given current flows through them.

Certain resistors are provided with center taps, Fig. 5. These taps are used for control purposes or for series parallel arrangement when loading the engine.

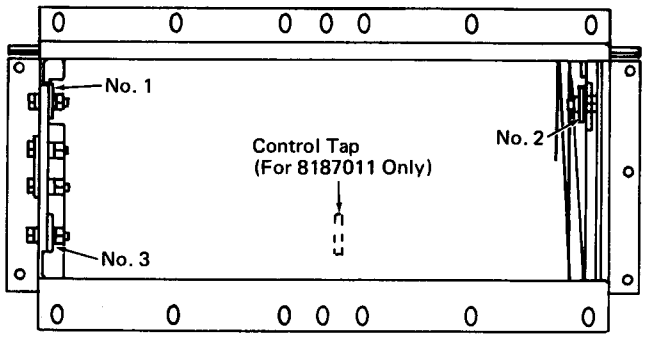


Fig. 5 - Dynamic Brake Grid Resistor (With Control Tap)

VENTILATION

All resistors require a large amount of ventilating air when operated at rated current value. The proper amount of air is furnished by the dynamic brake grid blower (fan) which is tapped across a section of one of the resistors.

NOTE: A particularly integral relationship exists between the grid blower fan and grid resistor. Proper maintenance of the cooling fan motor components (including bearings, brushes, cabling, and alignment procedures) is stressed. (Refer to M.I. 4104.)

INSULATION

In operation, the entire resistor is "above ground" electrically. As a component of a new or rebuilt unit, the resistors are expected to withstand a 3200 VAC 60 hz high potential test for

one minute. During operation, the resistors are usually electrically isolated by disconnecting the ground connection of the power circuit.

A potential of 500-600 volts exists between the terminals of a resistor, and it is common practice to put two resistors in series with the armature outputs of two traction generators. Therefore, 1200 volts-to-ground may exist during operation. If insulation is damaged, a portion of a resistor may short out either directly or by a "double-ground."

TERMINALS

Since the current carrying capacity of the grids is measured in hundreds of amperes, the cable carrying current to the grids is of necessity, bulky and stiff. The grid terminals are ruggedly constructed to withstand severe pulling or twisting at the cable lugs.

NOTE: The contact surfaces of cable lugs and terminals must be kept free from corrosion.

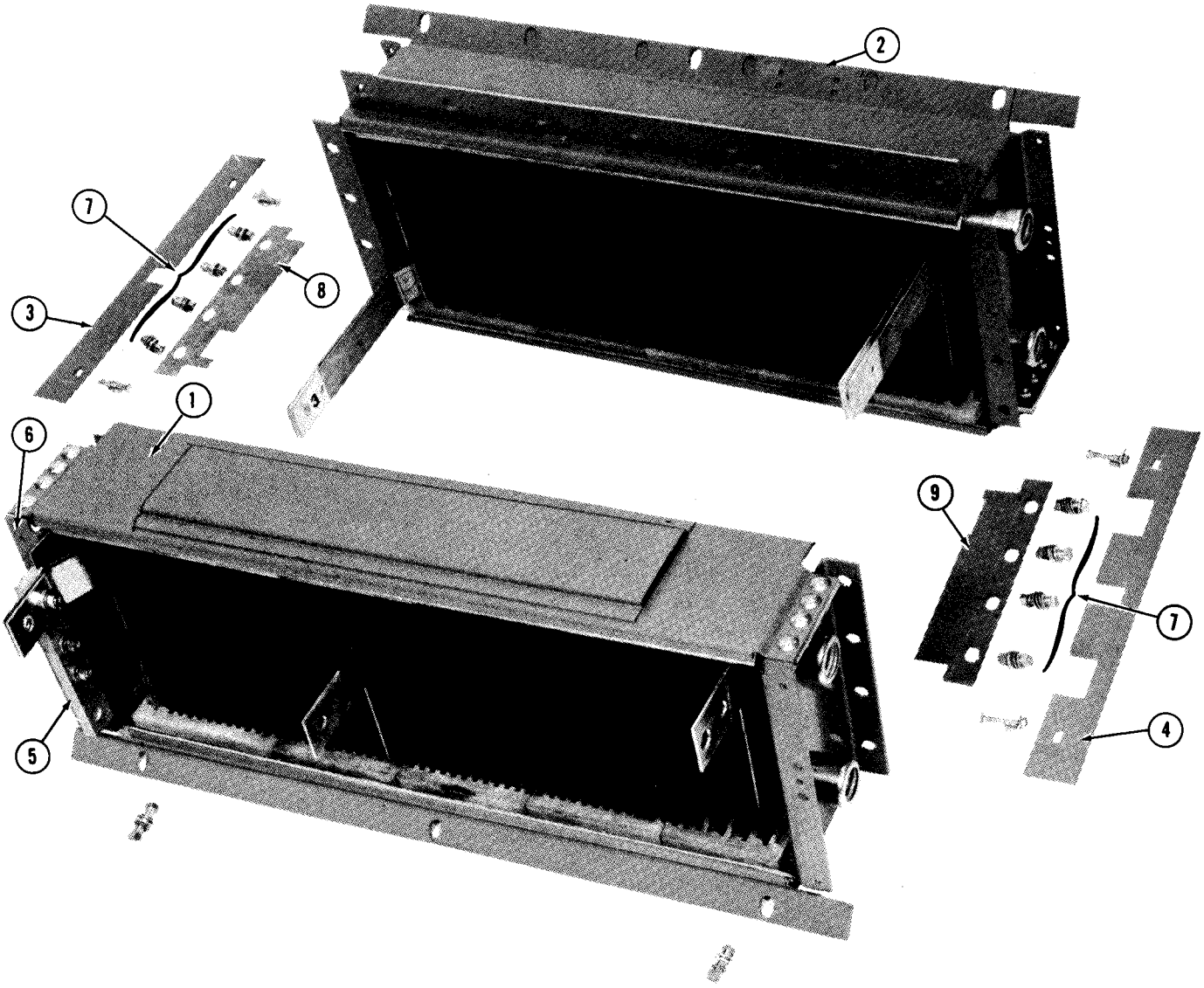
DISASSEMBLY

Minor variations in disassembly/assembly procedures exist among the various grids. Determine applicability and perform one of the following procedures. (Refer to Service Data to determine proper procedure.)

PROCEDURE NO. 1 (Fig. 6)

NOTE: Retain all parts removed during disassembly for possible reuse.

1. Prior to disassembly, it is necessary to remove the six bolts and lockwashers which attach grid to structure.



1. Front half box
2. Rear half box
3. Side plate
4. Side plate
5. Terminal support
6. Support bracket
7. 3/8"-16 x 1.25" hex mounting screws
8. Polyester air baffle
9. Polyester air baffle

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Fig. 6 – Exploded View Dynamic Brake Grid Resistor

2. Remove two 1/4"-20 x 1.75" hex screws and self-locking nuts from each side plate (3) and (4).

3. Remove terminal support (5) and support bracket (6).

4. Remove the 3/8"-16 x 1.25" hex screw from the No. 2 terminal.

5. Remove four 3/8"-16 x 1.25" hex mounting screws (7) from each end of the assembly.

6. Partially separate the front and rear half boxes and remove the two polyester air baffles (8) and (9) that were retained between the front and rear half boxes.

7. Slide the rear half box (2) straight back until the terminals stamped "3" and "2" clear the front half box (1) frame.

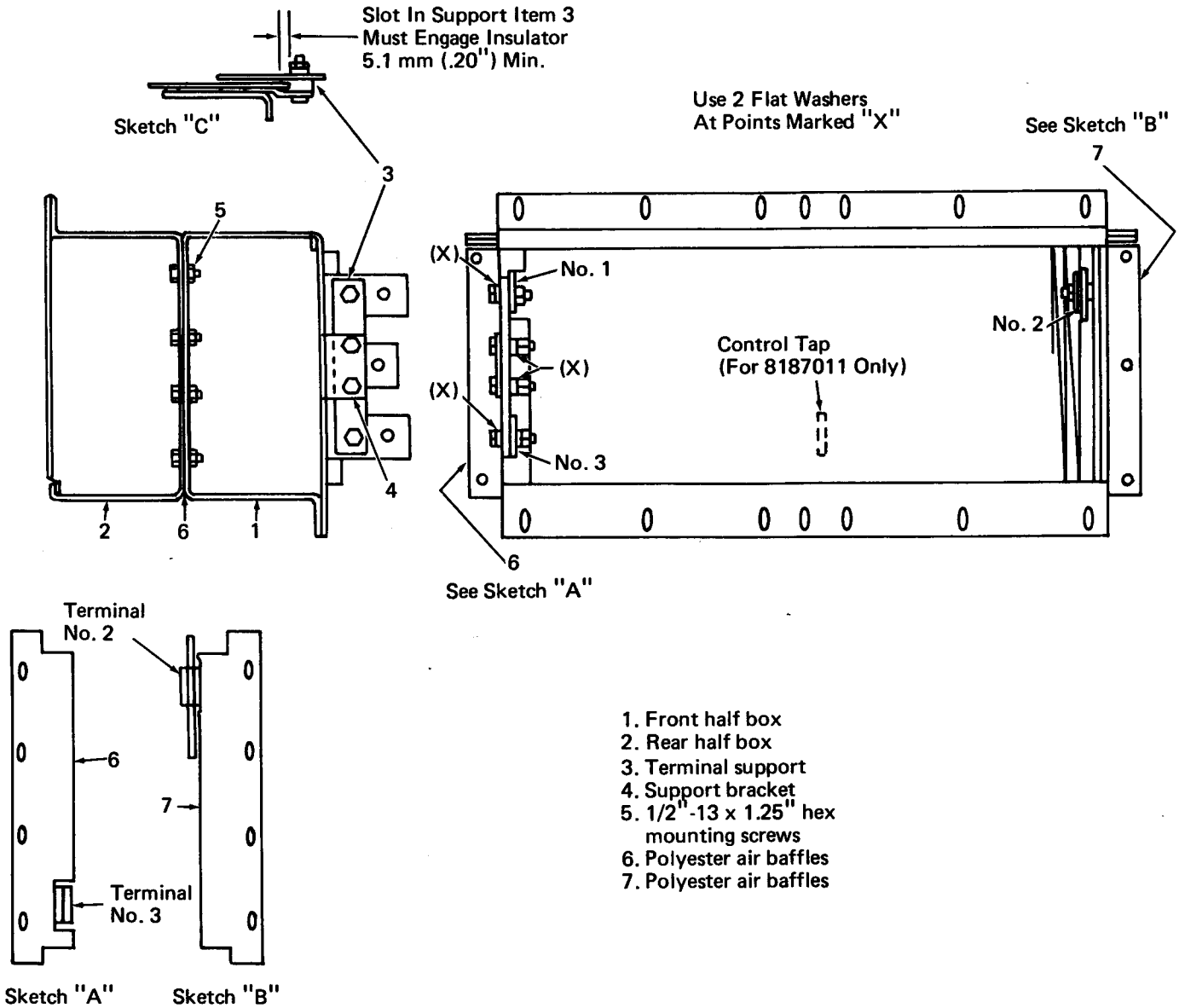
PROCEDURE NO. 2 (Fig. 7)

NOTE: Retain all parts removed during disassembly for possible reuse.

1. Prior to disassembly, it is necessary to remove the six bolts and lockwashers which attach grid to structure.

2. Remove terminal support (3) and support bracket (4).

3. Remove the 3/8"-16 x 1.25" hex screw from the No. 2 terminal.



1. Front half box
2. Rear half box
3. Terminal support
4. Support bracket
5. 1/2"-13 x 1.25" hex mounting screws
6. Polyester air baffles
7. Polyester air baffles

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Fig. 7 – Grid Resistor - Procedure No. 2

4. Remove four 1/2"-13 x 1.25" hex mounting screws (5) from each end of the assembly.

5. Partially separate the front and rear half boxes and remove the two polyester air baffles (6) and (7) that were retained between the front and rear half boxes.

6. Slide the rear half box (2) straight back until the terminals stamped "3" and "2" clear the front half box (1) frame.

PROCEDURE NO. 3 (Fig. 8)

NOTE: Retain all parts removed during disassembly for possible reuse.

1. Remove terminal support (3) and support bracket (4).
2. Remove the 3/8"-16 x 1.00" and the 1/2"-13 x 1.25" hex screws from the No. 4 terminal.
3. Remove four 1/2"-13 x 1.25" hex mounting screws (5) from each end of assembly.
4. Partially separate the front and rear half boxes and remove the two polyester air baffles (6) and (7) that were retained between the front and rear half boxes.
5. Slide the rear half box (2) straight back until the terminals stamped "3" and "4" clear the front half box (1) frame.

INSPECTION

Visually inspect grid(s) and remove all foreign material which has lodged in the resistor. This can be accomplished by blowing compressed air through the ribbons. Inspect the half box assemblies for warped or burned ribbon by looking through the ribbon assemblies. If warped or burned ribbon is found, replace the half box assembly with the proper replacement part number. (Refer to Service Data.)

ASSEMBLY

PROCEDURE NO. 1

1. Place the rear half box (2, Fig. 6) directly behind the front half box (1), with the No. 3 and No. 1 terminal at the same end.
2. Slide the front and rear half boxes (1) and (2) together with the single No. 2 terminal of the front half box (1) positioned between the double No. 2 terminal of the rear half box (2).
3. Reinstall the two polyester air baffles (8) and (9) between the front and rear half box frame, Fig. 9.
4. Reinstall four 3/8"-16 x 1.25" hex tandem mounting screws (7, Fig. 6), and 3/8" lockwashers and nuts at each end of the resistor. Use two 3/8" flat washers on each side of the frame flange. Align front and rear frame at top and sides within 1.6 mm (1/16") before tightening the bolts. Raising the front half box (1) 6.3 mm (1/4") will aid alignment.

NOTE: Reuse original terminal support parts except when they are supplied with the new front half box.

5. Reinstall the terminal support bracket (6) using two 3/8"-16 x 1.00" hex screws, lockwashers, and nuts. Do not tighten.
6. Reinstall the polyester terminal support bar (6) using 3/8"-16 x 1.50" hex screws through the support bracket and 3/8"-1 x 1.75" hex screws through the two terminals. Install as shown using two flat washers against the support bar at points marked "X." Add 3/8" lockwashers and nuts.

NOTE: Ensure the slot in the support bar (6) engages the 1.52 mm (.060") thick barrier extending from the front half box a minimum of 5.1 mm (.20"), Fig. 10.

7. Tighten all terminal support and support bracket mounting bolts.
8. Reinstall a 3/8"-16 x 1.25" hex screw through the small diameter holes in the No 2 terminal "sandwich" assembly using 3/8" flat washers, lockwashers, and nut. Ensure a 1/2" diameter rod or bolt will pass through the large diameter hole before tightening.
9. Mount the two side plates (3 and 4, Fig. 6) using 1/2"-20 x 1.75" hex screws, "L" shaped clamp, and locknut. Center side plates. Do not overtighten.
10. Recheck all mounting hardware and part alignment.
11. Hi-pot completed assembly. (See Hi-pot Test section.)

PROCEDURE NO. 2 (Fig. 7)

1. Place the rear half box (2) directly behind the front half box (1) with the No. 3 and No. 1 terminal at the same end.
2. Slide the front and rear half boxes (1) and (2) together with the single No. 2 terminal of the front half box (1) positioned between the double No. 2 terminal of the rear half box (2).

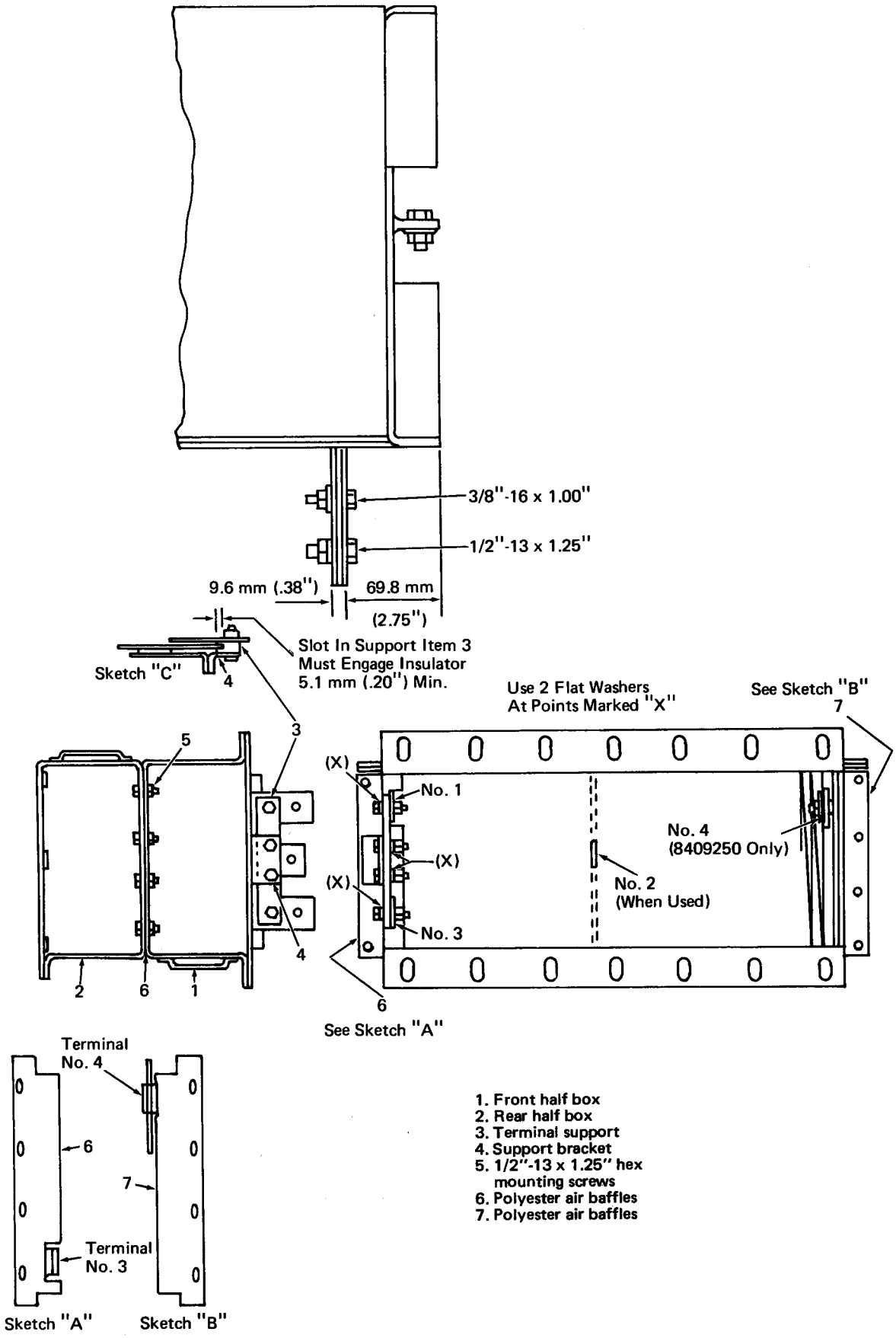

Fig. 8 – Grid Resistor - Procedure No. 3

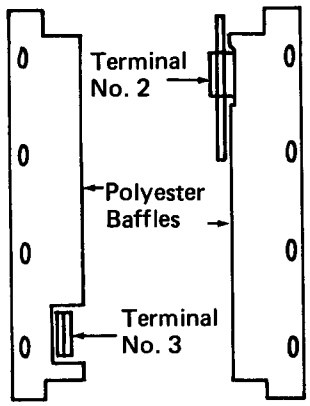

Fig. 9 - Polyester Air Baffles Between Front And Rear Half-Box Frames

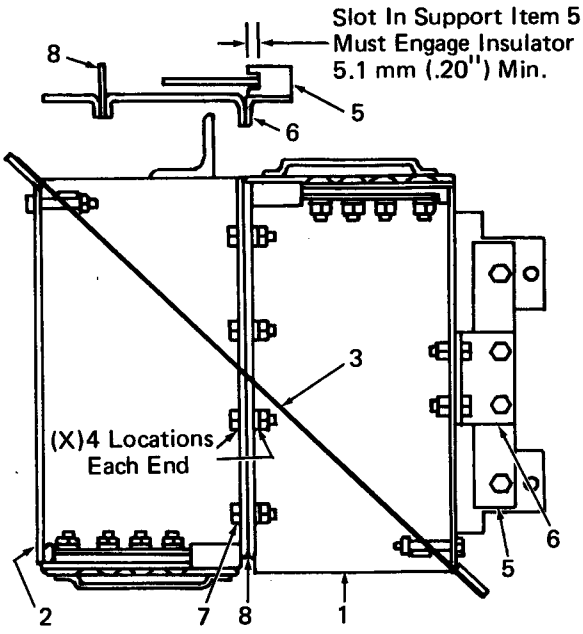

Fig. 10 - Support Bar Engaging Barrier

3. Reinstall the two polyester air baffles (6) and (7) between the front and rear half box frame. Position baffles to engage notches and terminals.

4. Reinstall four 1/2"-13 x 1.25" hex tandem mounting screws (5), and 1/2" lockwashers and nuts at each end of the resistor. Use flat washers on each side of the frame flange.

NOTE: Reuse original terminal support parts except when they are supplied with the new front half box.

5. Reinstall the terminal support bracket (4) using two 3/8"-16 x 1.00" hex screws, lockwashers, and nuts. Do not tighten.

6. Reinstall the polyester terminal support bar (4) using 3/8"-16 x 1.50" hex screws through the support bracket, and 3/8"-16 x 1.75" hex screws through the two terminals. Install as shown using two flat washers against the support bar at points marked "X." Add 3/8" lockwashers and nuts.

NOTE: Ensure the slot in the support bar (4) engages the 1.52 mm (.060") thick barrier extending from the front half box a minimum of 5.1 mm (.20"), Fig. 7.

7. Tighten all terminal support and support bracket mounting bolts.

8. Reinstall a 3/8"-16 x 1.25" hex screw through the small diameter holes in the No. 2 terminal "sandwich" assembly using 3/8" flat washer, lockwasher, and nut. Ensure a 1/2" diameter rod or bolt will pass through the large diameter hole before tightening.

9. Recheck all mounting hardware and part alignment.

10. Hi-pot completed assembly. (See Hi-pot Test section.)

PROCEDURE NO. 3 (Fig. 8)

1. Place the rear half box (2) directly behind the front half box (1) with the No. 3 and No. 1 terminal at the same end.

2. Slide the front and rear half boxes together with the single No. 4 terminal of the front half box positioned between the double No. 4 terminal of the rear half box.

3. Reinstall the two polyester air baffles (6) and (7) between the front and rear half box frame. Position baffles to engage notches and terminals.

4. Reinstall four 1/2"-13 x 1.25" hex tandem mounting screws (5), and 1/2" lockwashers and nuts at each end of the resistor. Use flat washers on each side of the frame flange.

NOTE: Reuse original terminal support parts except when they are supplied with the new front half box.

5. Reinstall the terminal support bracket (4) using two 3/8"-16 x 1.00" hex screws, lockwashers, and nuts. Do not tighten.

6. Reinstall the polyester terminal support bar (3) using 3/8"-16 x 1.50" hex screws through the support bracket, and 3/8"-16 x 1.75" hex screws through the two terminals. Install as shown using two flat washers against the support bar at points marked "X." Add 3/8" lockwashers and nuts.

NOTE: Ensure the slot in the support bar (3) engages the 1.52 mm (.060") thick barrier extending from the front half box a minimum of 5.1 mm (.20"), Fig. 8.

7. Tighten all terminal support and support bracket mounting bolts.

8. Reinstall a 3/8"-16 x 1.00" hex screw through the small diameter holes in No. 4 terminal "sandwich" assembly using 3/8" flat washer, lockwasher, and nut. Reinstall a 1/2"-13 x 1.25" hex screw through the remaining large diameter holes using flat washer, lockwasher, and nut.

9. Recheck all mounting hardware and part alignment.

10. Hi-pot completed assembly. (See Hi-pot Test section.)

HI-POT TEST PROCEDURE

The preferable time to perform high potential tests is soon after a locomotive has completed a run. In such instances, the equipment is warm and dry, thus eliminating the possibility of moisture being present in units that have been shut down for an extended period of time.

Prior to making a high potential test, the circuit insulation resistance should be checked with a suitable megohmeter. Readings of less than one megohm should be viewed with suspicion. A high potential test in such instances may cause a breakdown of the insulation. To reduce the risk of this possibility, the cause of low megohmeter readings should be determined and corrected. This may be done by reducing the complete circuit concerned into individual circuits which are then isolated and checked separately. In this way, the circuit portion or equipment causing the low reading can be found. Correction may often be made by thorough cleaning and drying of the affected areas.

TROUBLESHOOTING

As indicated previously, improper maintenance or malfunction of fan motor and related equipment is the major cause of dynamic brake grid failure. Therefore, the following check list is offered as a handy inspection guide to ensure against practices and conditions which may contribute to, or result in, dynamic brake fan or grid failure. If inspection reveals the existence of an adverse condition, proper repair or maintenance procedures should be initiated.

NOTE: The recommended procedure for repairing partially failed grids is "half-box" replacement (Refer to Service Data.) However, replacement parts are available through Electro-Motive Parts Centers. (Refer to Parts Catalog.)

CHECK LIST

FAN MOTOR

1. Overly tight rotation?
2. Bearings noisy?
3. Grease leaks?
4. Flash damage?
5. Brushes short?
6. Shunts frayed or burned?
7. Brush holder studs loose?
8. Check condition of stator insulation.
9. Leads chafed or shorted?
10. Lead supports loose?
11. Check condition of armature wire bands.
12. Fan: Rubbing on I.D. of frame?
    Blades cracked?
13. Check condition of fan motor enclosure.

GRID(S)

1. Ribbons out of clips?
2. Terminal support bolts loose?
3. Lack of ventilation?
4. Polyester baffles in place?
5. Terminal support insulators broken?
6. Impact damage to ribbons or terminals?
7. Ribbons misaligned due to warpage, hot spots, or welds?

NOTE: Ribbon alignment is easily determined by holding a light behind the grid assembly and visually checking.

8. Improper "hoisting" practice causing frame malformation?
9. Foreign material present (nuts, bolts, tape, or paper)?

GENERAL

Ensure electrical controls, wiring, and brake regulating equipment is intact and connected correctly. (Refer to applicable Locomotive Service Manual.)

SERVICE DATA

Tandem Assembly	Front 1/2 Box	Rear 1/2 box	Disassembly/Assembly Procedure
8304193	9097983	9097985	No. 1
8304194	9097984	9097985	
8339532	9097996	9097994	
8339533	9097995	9097994	
8347464	9097986	9097985	
8185703	9097987	9097988	No. 2
8185705	9097989	9097988	
8190834	9097993	9097988	
8187011	9097992	9097990	No. 2
8185704	9097991	9097990	
8409250	9098845	9098847	No. 3
8450766	9098846	9098848	

	Resistance	Motor Tap	Control Tap
8304193	.86 ohm	—	—
8304194	.927 ohm	—	—
8339532	1.072 ohms	—	—
8339533	.97 ohm	—	—
8347464	.922 ohm	X	—
8185703	.66 ohm	—	—
8190834	.69 ohm	X	—
8187011	.66 ohm	—	X
8185704	.66 ohm	—	—
8409250	.472 ohm	—	—
8450766	.439 ohm	X	—

Resistance measurements @ 25° C (77° F).

Hi-pot: 3200 VAC, 60 hz for one minute.

Reference: M.I. 4104
Locomotive Service Manual

Litho in U.S.A.