



SERVICE DEPARTMENT

ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION

MAINTENANCE INSTRUCTION

LOCOMOTIVE CONTROLLER - ROLLER SWITCH TYPE

DESCRIPTION

The roller switch type of controller, Fig. 1, is a compact mechanism designed to energize the locomotive control circuits through cam operated roller switches.

The entire assembly is fastened by screws through the front mounting plate into a framed opening of the driver's control stand. The advantages of such an arrangement are minimum space requirements and flexibility in application.

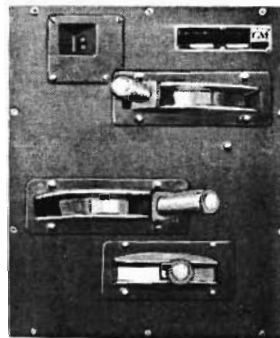
Three handles, which operate the mechanism, protrude from the face of the controller. The following is a brief description of each of these handles and the mechanism inside.

SELECTOR HANDLE

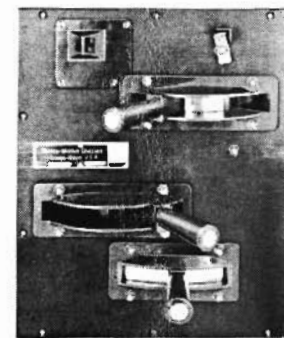
The selector handle located at the top of the controller panel, is applied to the controller to set up electrical circuits for neutralizing the controller, using automatic transition or field shunting, and setting up dynamic brakes. It also controls the dynamic braking effort.

The position of the handle is indicated by the upper illuminated indicating band visible in the opening at the upper left corner of the controller front panel. The handle is spring loaded so that movement in one direction will index the selector cam one notch in that direction. The handle must be allowed to return to starting position before indexing again in either direction.

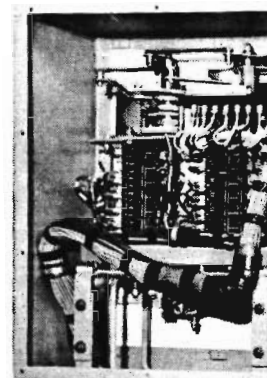
On the GT26MC locomotive a dynamic brake lockout device is mounted on the front panel of the controller, directly above the selector handle. With the lockout handle in the vertical position, a lockout cam prevents the use of dynamic braking by unauthorized personnel. The lockout can be fitted with a size 7 Master lock or equivalent.



GL26MC



GT26MC



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Fig. 1 - Controller Assembly

The following positions can be obtained with the selector handle:

1. Position 2 is for open line work where frequent reversing is not required (this position allows automatic transition or field shunting, and provides additional mechanical interlocking against inadvertent directional handle operation).
2. Position 1 is for shunting work where frequent reversing of the locomotive is necessary (this position prevents automatic transition and/or field shunting).

*This bulletin is revised and supersedes previous issues of this number.

3. Position N, neutral, mechanically locks throttle in IDLE position, and is normally used for trailing unit operation.
4. Position B (large) sets up the electrical circuits for dynamic braking.
5. Series of B (small) covers 75° range of handle travel in dynamic brake. In this range, there are no notches and the selector handle moves freely to control a braking rheostat.
6. With the GT26MC lockout device in the locked position, the selector handle can only be moved between the N, 1, and 2 positions.

THROTTLE HANDLE

The throttle handle, located between the other two handles, actuates switches within the controller to establish low voltage circuits to the engine governor for the purpose of controlling engine speed. The throttle has nine positions, namely: IDLE, and running speeds 1 through 8. Each of these positions is shown in the illuminated indicator (lower band) in the upper left hand corner of the controller.

The IDLE position is as far forward as the throttle handle can be moved, (away from driver, short hood leading).

DIRECTIONAL HANDLE

The directional handle, located at the bottom of the controller panel, has three positions: forward, center and reverse. Direction in which the locomotive moves is controlled by placing this handle in the desired position. With the handle in the center position, no tractive effort will be developed if the throttle is opened. The directional handle should be moved only when the locomotive is not in motion.

The directional handle can be removed from the controller only when the handle is in the center position, the throttle is in IDLE, and the selector handle is in position N or 1. Removal of the directional handle locks the operating controls in the controller.

INTERLOCK MECHANISM

The interlock mechanism is located in the lower portion of the controller. The interlock consists of an interlocking and notching detent device positioned between two plates. The throttle and

selector axles extend upward from the top of the interlock, and are positioned by bushings in the switch chassis and top plate. The bushings are sintered bronze, and the axles are zinc or cadmium plated. Close tolerances between bushings and axles provide positive alignment and easy turning.

A metal cam plate is attached to each axle, the lobes and notches of which interact with pivoted rollers and the directional indexing plate to provide the necessary mechanical interlocking. This interlocking prevents the movement of an operating handle, unless the other handles are in a position where the operating handle can be safely moved. The throttle cam plate has equally spaced detents, located on the same radius, on the top and bottom of the plate, Fig. 2. These detents are paired directly opposite each other, and are engaged by spring loaded steel balls. The detents hold the axle in the selected "notch." A moderate pull on the handle overcomes the detent for movement to the next "notch." Throttle escapement (imposed stopping at each notch) is not employed, therefore the throttle may be moved through all throttle positions without hesitation.

The selector cam plate is positioned by a single fixed detent assembly, which engages holes in the cam plate only from the top. The cam plate in the interlocking mechanism, below the switch chassis, complements the selector handle escapement mechanism, located above the switch chassis.

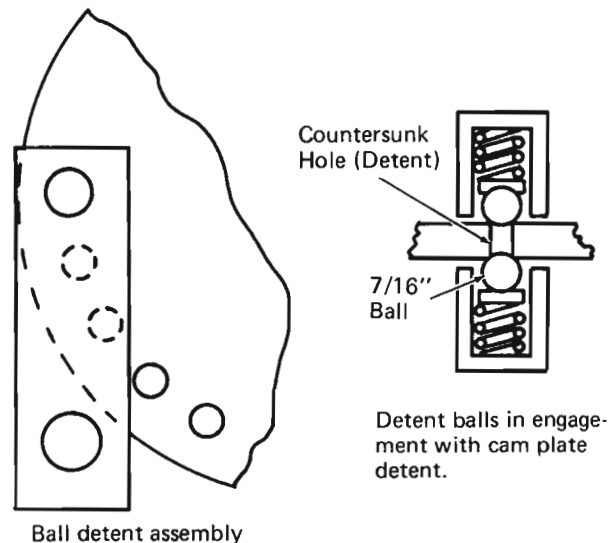


Fig. 2 - Detent Assembly

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CAM DRUM ASSEMBLIES

The controller has three molded phenolic cam drum assemblies. These are identified as the selector, throttle, and direction drums, Fig. 3. The throttle and direction drums are molded in one piece, and the selector drum is assembled from separate pieces.

The contours on the face of each drum are arranged to actuate the proper roller switches as dictated by the movement of each operating handle. No switch contact adjustment is necessary or provided.

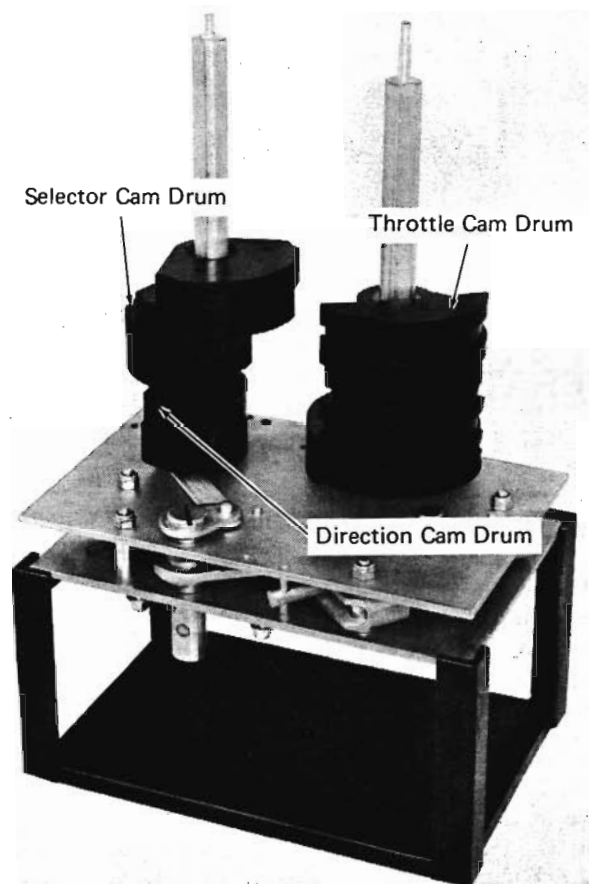
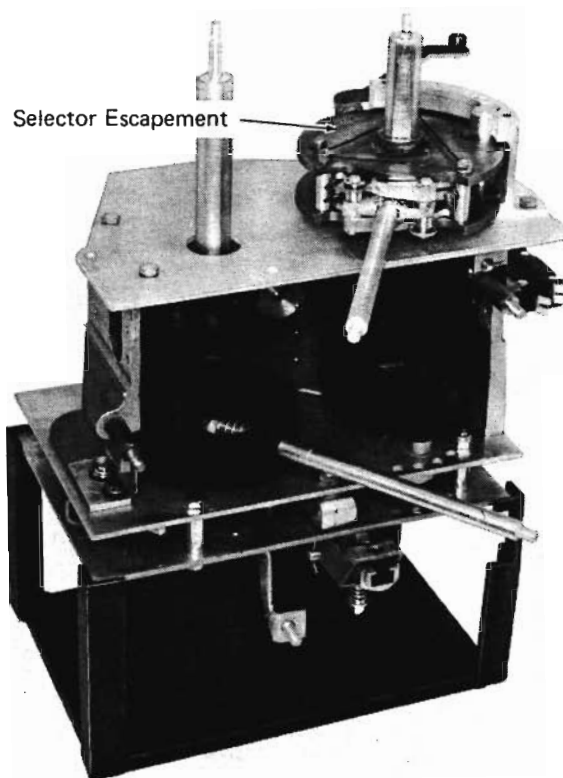


Fig. 3 - Cam Drum Assemblies

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SELECTOR ESCAPEMENT

The selector escapement, Fig. 4, is mounted on the selector axle, and is located between two plates on top of the switch chassis. The escapement permits transition of the handle from selector to dynamic brake operation. Locating pins are used to provide correct alignment of parts.



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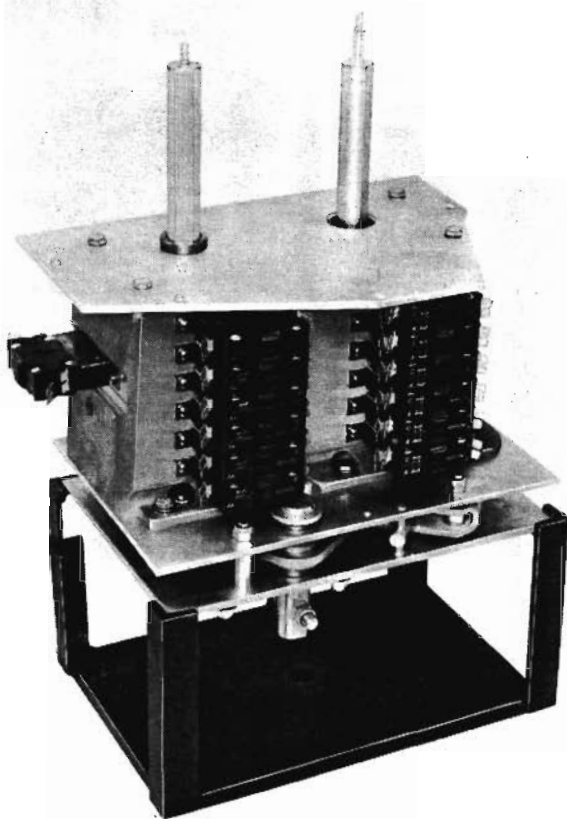
Fig. 4 - Selector Escapement

SWITCH CHASSIS

The switch chassis, Fig. 5, is a box shaped cast aluminum frame machined to close tolerances. The roller switches are mounted on the back and side machined surfaces. Bushings for the throttle and selector axles are set in the top. The chassis is bolted to the top plate of the interlock assembly and positioned by three locating pins, which ensure the correct relation between the roller switches and the cam drums.

SWITCHES

Each roller switch consists of a two-piece housing, which encloses one or two sets of silver alloy contacts, rated for 10 amperes. The movable bridge contacts are carried by a stem, called the contact carrier. The carrier projects through the housing and is spring lifted to the fully extended position. The stationary contacts are positioned in slots in the housing halves. Contact arrangement is such that, with the contact carrier fully depressed, the contacts are open .060". Total travel of the carrier is .090" which gives a .030"



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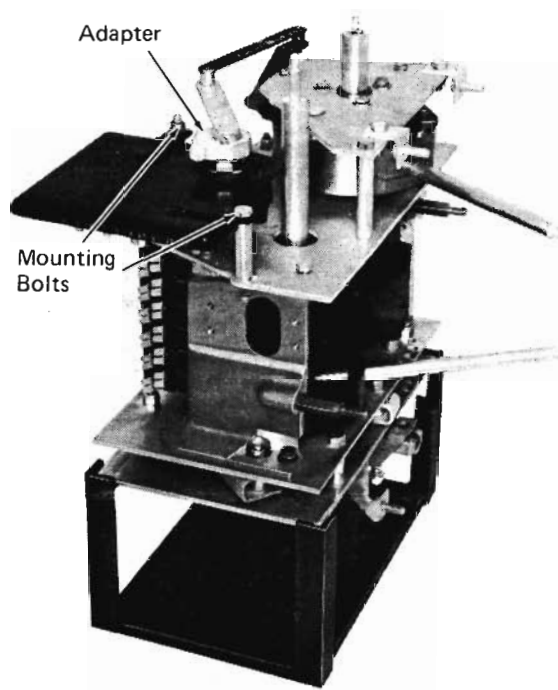
Fig. 5 - Switch Chassis

overtravel, or contact lift, when the contact carrier is in normal position.

Some switches are equipped with permanent magnet blowouts. Polarity must be observed when connecting these switches.

DYNAMIC BRAKE RHEOSTAT

The dynamic brake rheostat, Fig. 6, has no internal resistance but is a series of contact points for externally mounted resistance. It is connected to the selector escapement handle through connecting rods and an adapter. It has 23 individual steps. The first step consists of 8 contact bars shorted together, and the 23rd step consists of 6 contact bars shorted together. The 21 contact bars in between are singular. Faston terminals are located on the base plate, and terminal identification is shown on the side of the plate. The brush is made of silver graphite and must make contact with each bar. The brush drive pin must contact all segments when the brush is removed.



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Fig. 6 - Removal Of Dynamic Brake Rheostat

OPERATION

Interlocking of the throttle, directional, and selector handles is as follows:

DIRECTIONAL HANDLE

1. Handle is removable in center position only, provided throttle handle is in IDLE and selector handle is in position 1 or N. With the directional handle removed, throttle handle is locked.
2. When the handle is inserted, and is in the center position, the following selections can be made:
 - a. Throttle handle can be moved to any position, provided the selector handle is in position 1.
 - b. Selector handle can be moved between positions 1 and N only, provided throttle handle is in IDLE.
3. When the handle is in forward or reverse position, the following selections can be made:
 - a. Throttle handle can be moved to any notch, provided selector handle is in position 1 or 2.

- b. Selector handle can be moved to any position, provided throttle handle is in IDLE.
- c. Selector handle can be moved only between positions 1 and 2 while throttle handle is in positions 1 through 8.

THROTTLE HANDLE

1. When handle is in IDLE the following selections can be made:
 - a. Directional handle can be moved to any position, provided the selector handle is in position N or 1.
 - b. Selector handle can be moved to any position, provided directional handle is in forward or reverse.
2. When the handle is above IDLE, the following conditions exist:
 - a. Directional handle is locked.
 - b. Selector handle can be moved between positions 1 and 2, but not between 1 and N.

SELECTOR HANDLE

1. When the handle is in N position the following conditions exist:
 - a. Directional handle can be moved to any position.
 - b. Throttle handle is locked in IDLE.
2. When the handle is in position 1, the following selections can be made:
 - a. Directional handle can be moved to any position, provided the throttle handle is in IDLE.
 - b. Throttle handle can be moved to any position.
3. When the handle is in position 2, the following conditions exist:
 - a. Directional handle is locked in forward or reverse.

- b. Throttle handle can be moved to any position.

4. When the handle is in position B and braking range, the following conditions exist:

- a. Directional handle is locked in forward or reverse.
- b. Throttle handle is locked in IDLE.

MAINTENANCE

This controller has been carefully designed and manufactured to provide excellent service for many years without maintenance or attention under normal operating conditions. However, under extreme dusty or humid conditions, occasional inspection is advisable to determine if all components are functioning properly and efficiently. If sluggishness, tightness or a gritty feeling is experienced, controller should be disassembled, cleaned and lubricated. After assembly, the controller should be thoroughly checked to qualify it for service. This work would be more conveniently performed on a bench.

REMOVAL

NOTE: Maintenance or repair may be performed on the dial lamp, switches, and the dynamic brake rheostat without removing the controller from the control stand.

DIAL LAMP

To replace burned out dial lamp, remove the four screws holding the indicator escutcheon plate. The lamp socket is on the back of this plate. See Service Data for lamp part number.

CAUTION: Remove plate carefully to prevent breaking the plastic throttle indicator band.

SWITCHES

Although designed for long life, after extended service the switches may need to be replaced. See Service Data for specifications on switches. The switches are accessible by removing the back cover plate from the driver's control stand in which the controller is housed.

NOTE: Polarity must be observed when installing switches equipped with magnetic blow-outs.

DYNAMIC BRAKE RHEOSTAT

Remove the dynamic brake rheostat as follows:

1. Remove back cover plate from the driver's control stand in which controller is housed.
2. Set selector handle in large B position and loosen the 5/16"-18 hex-head bolt which tightens C-clamp type adapter to connecting rod shaft, Fig. 6.
3. While holding rheostat brush stationary, position selector handle to approximate middle of dynamic brake range, and remove the two 8-32 fillister-head screws and lockwashers holding adapter to rheostat shaft.
4. Identify, tag, and remove wires from terminals.
5. Remove two 5/16"-18 hex-head bolts and self-locking nuts holding rheostat to chassis.

See Service Data for specifications of rheostat. When assembling rheostat to controller, follow the reverse procedure of disassembly. After assembling adapter to shaft of rheostat, the following procedure must be followed to obtain proper angular movement of rheostat.

1. Place and hold the brush on the Nos. 3 and 4 contact bars, which are in the counter-clockwise position as viewed from below, Fig.

7, and move the selector handle until the large B appears in the indicator window.

2. Tighten 5/16"-18 hex-head bolt which tightens C-clamp type adapter to the connecting rod shaft.
3. Move selector handle until the last small B appears in the indicator window. Check that brush is positioned on any of the last six bars at the clockwise end of the rheostat. If not, loosen the 5/16"-18 hex-head bolt holding the C-clamp and adjust until brush contacts any of the last six bars with the selector handle in the last small B position, and any of the first eight bars with the selector handle in the large B position.

CONTROLLER

1. Remove back plate of control stand.
2. Loosen two clamps on bottom plate at rear.
3. Identify, tag, and disconnect all electrical leads at the controller.
4. Remove the ten screws in front mounting plate securing the controller assembly to the control stand.
5. Remove the controller from the control stand and place on bench using support stand as shown in Fig. 8.

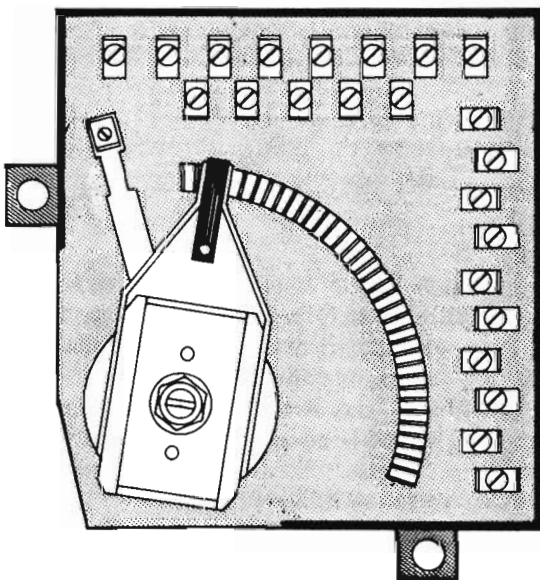


Fig. 7 - Dynamic Brake Rheostat

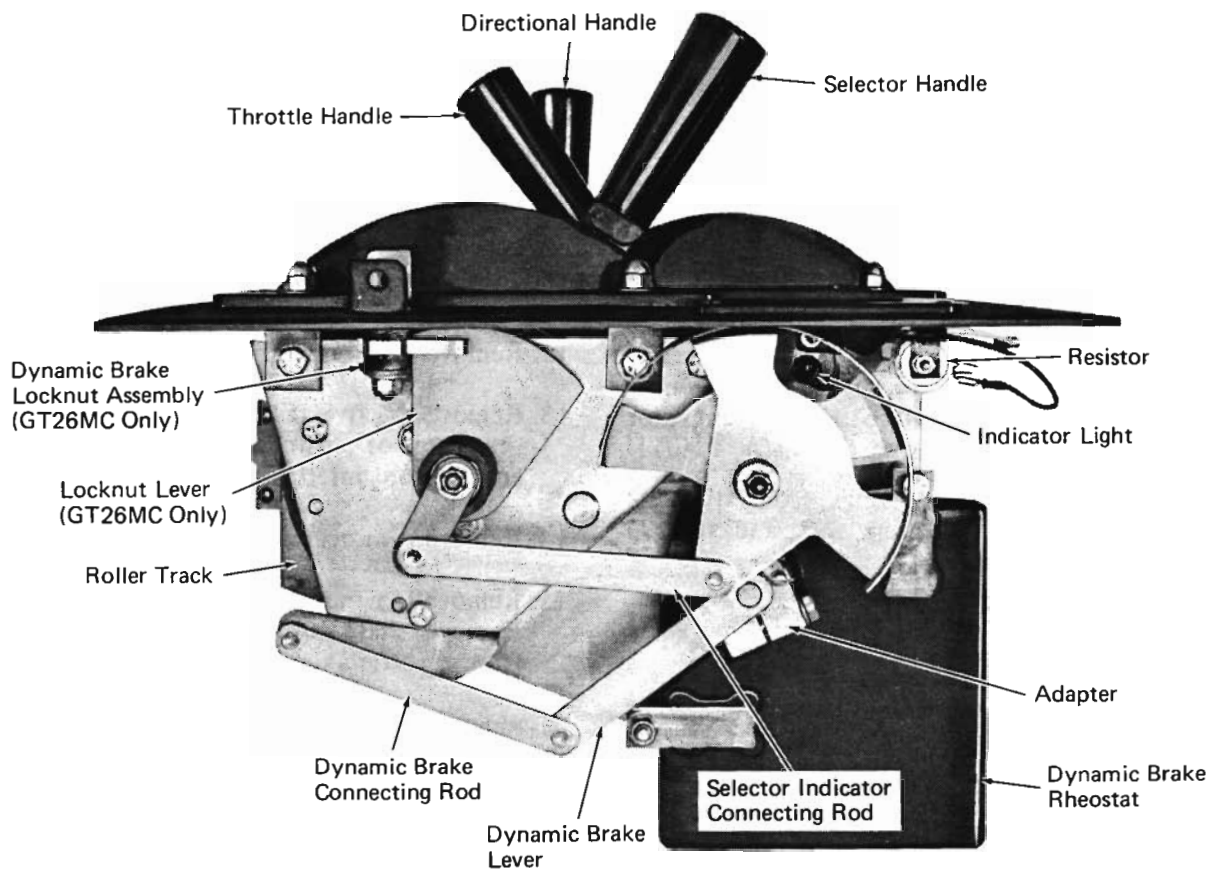


Fig. 8 - Controller Support Stand

DISASSEMBLY

1. Place throttle handle to IDLE position, selector handle to position 1, and directional handle to center position.
2. Remove directional handle by pulling out of controller, Fig. 9.
3. Remove throttle and selector handles by prying out chromed button plugs and removing 5/16"-24 self-locking nuts, washers, and spacers.
4. Remove four screws holding indicator escutcheon plate. Leave escutcheon hanging by wires.
5. Remove five crown nuts and lockwashers indicated by X in Fig. 10.
6. Move selector shaft to the right from position 1 to N and, while holding the selector handle against spring pressure in position N, rotate the mounting plate counterclockwise approximately 30° and slide off.

CAUTION: Remove plate carefully to prevent breaking the plastic throttle indicator band.



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Fig. 9 - Controller - Top View

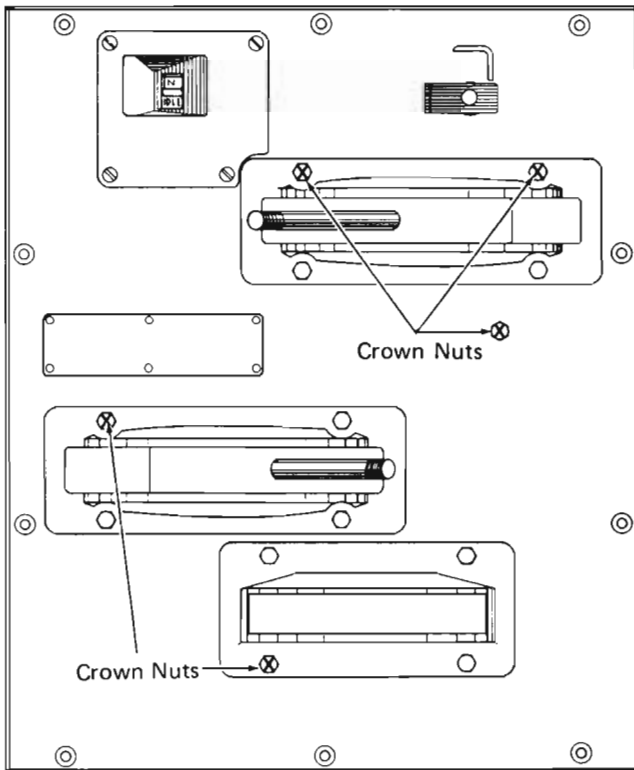


Fig. 10 - Removal Of Controller Front Mounting Plate (Locknut Device On GT26MC Only)

7. Remove the nuts securing the throttle and selector indicator assembly and the connecting bars to the throttle and indicator shafts. Remove parts from the shafts, Fig. 11.
8. Remove two retaining rings from dynamic brake rheostat connecting rod, and remove the connecting rod.

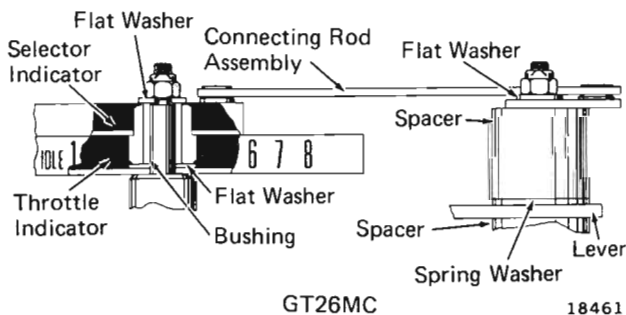
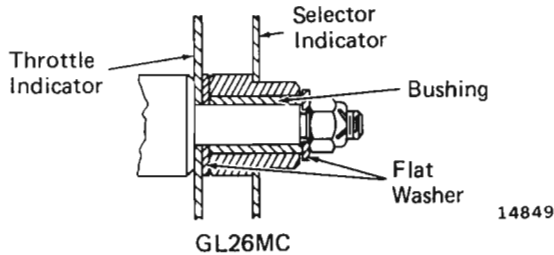


Fig. 11 - Removal Of Throttle And Selector Indicator Assembly

9. Remove two 1/4"-28 cap screws and one 5/16"-18 bolt with self-locking nut securing top plate assembly. Remove top plate assembly and spacer being careful not to lose detent ball, pad, and spring.

NOTE: Do not disturb location of bushing in center of plate unless replacement of parts is necessary.

10. Remove three 1/4"-20 bolts and self-locking nuts holding roller track to plate. Note that rear bolt over switches is installed with head down. Lift selector escapement assembly and roller track high enough to clear locating pins. Remove roller track and roller.

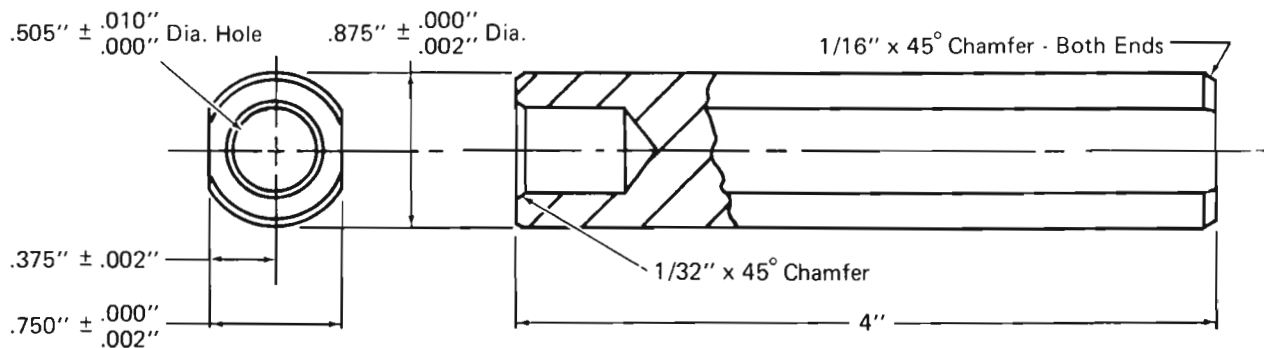
11. Place dummy shaft, Fig. 12, on top of selector axle and slide selector escapement assembly up onto the dummy shaft.

NOTE: If dummy shaft is not used, selector escapement assembly will have to be disassembled before it can be remounted on selector shaft. See Step 20 for disassembly of this unit.

12. Remove the switches from the switch chassis.
13. Remove the five 1/4"-20 mounting bolts from the base of switch chassis. Remove switch chassis from interlock mechanism.
14. Remove cam drums from shafts.
15. Remove jam nut and nut from throttle shaft. Remove shaft, spring, and phenolic segment from throttle axle.
16. Remove 9/16"-18 flat-head slotted screw, lever arm, and connecting rod assembly from directional axle, Fig. 13.
17. Remove seven 5/16"-24 bolts and self-locking nuts securing top and bottom plates of the interlock mechanism. Four of these bolts are clevis pivot points, one of which is spring loaded. Remove top plate without disturbing three axle assemblies.

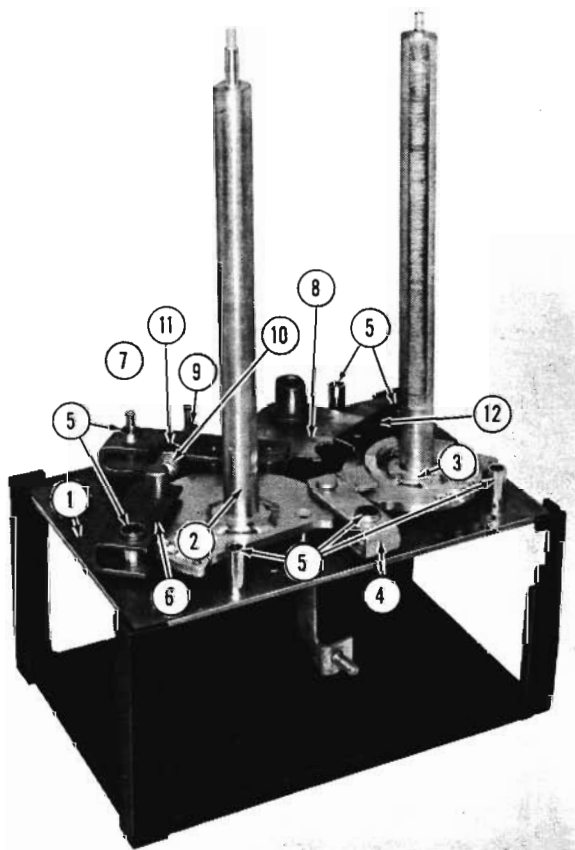
CAUTION: Do not lose detent ball, cap, and spring above selector cam plate.

Inspect mechanism for wear or damage. Remove all remaining loose parts.

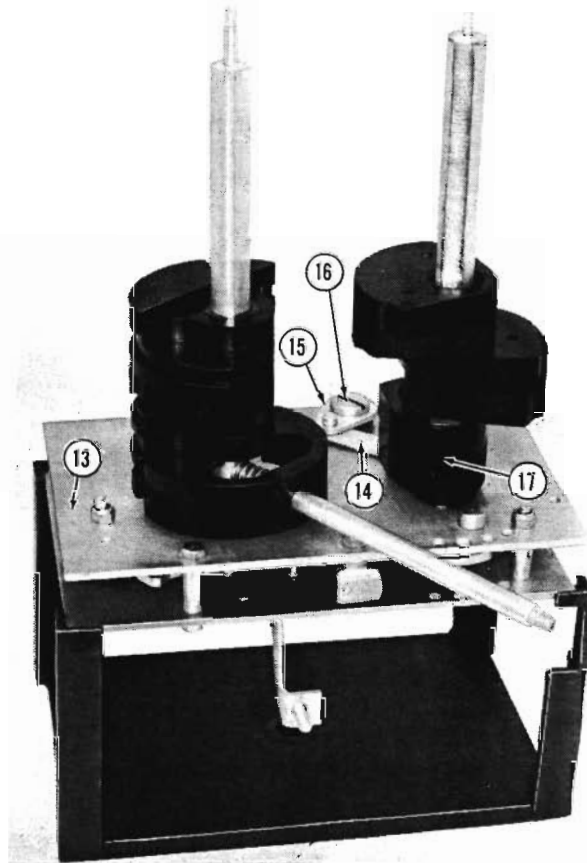


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Fig. 12 -- Dummy Shaft For Selector Escapement Assembly



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- | | |
|---|---|
| <ul style="list-style-type: none"> 1. Bottom Mounting Plate 2. Throttle Axle Assembly
(Shown In Idle Position) 3. Selector Axle Assembly
(Shown In Neutral Position) 4. Clevis Assembly 5. Spacer 6. Ball Detent Clevis 7. Clevis Assembly, Spring Loaded 8. Directional Axle Assembly
(Shown In Center Position) | <ul style="list-style-type: none"> 9. Clevis Bolt 10. Spring 11. Washer 12. Clevis Assembly 13. Top Mounting Plate 14. Connecting Rod 15. Lever Arm 16. Screw 17. Directional Cam
(Shown In Center Position) |
|---|---|

Fig. 13 - Interlock Mechanism Assembly

18. Turn bottom plate over and remove 3/8"-16 self-locking nut securing directional handle carrier assembly to axle. Tap out carrier assembly approximately 1/8", rotate it 30° in either direction, press down locking plate at front of controller and remove handle carrier assembly from directional axle, Fig. 14. Remove the directional axle.
19. Using directional handle to operate carrier assembly, determine if further disassembly is required to clean, lubricate, or repair. If further disassembly is necessary, remove 5/16"-18 special headed bolt, self-locking nut, shaft, and spring. Cut lockwire making note of method of application and disassemble remaining parts, Fig. 14.
20. Inspect selector escapement assembly, Fig. 15, which was left on the dummy shaft to determine if further disassembly will be required

to clean, lubricate, or repair. If further disassembly is required, clamp hole end of dummy shaft securely in bench vise being careful not to distort or damage the surface. Note method of applying each part during disassembly. Cut and remove lockwire, Fig. 16. Remove three 1/4"-28 hex socket cap screws. Remove upper lock plate and three spacers. Remove upper ratchet wheel.

WARNING: To avoid possible personal injury, use extreme care after upper lock plate is removed to prevent accidental release of heavy tension on two centering springs. Carefully release tension on springs and remove.

Remove selector lever assembly with closure segments attached. Remove lower ratchet wheel and lock plate. Place ratchet wheels on

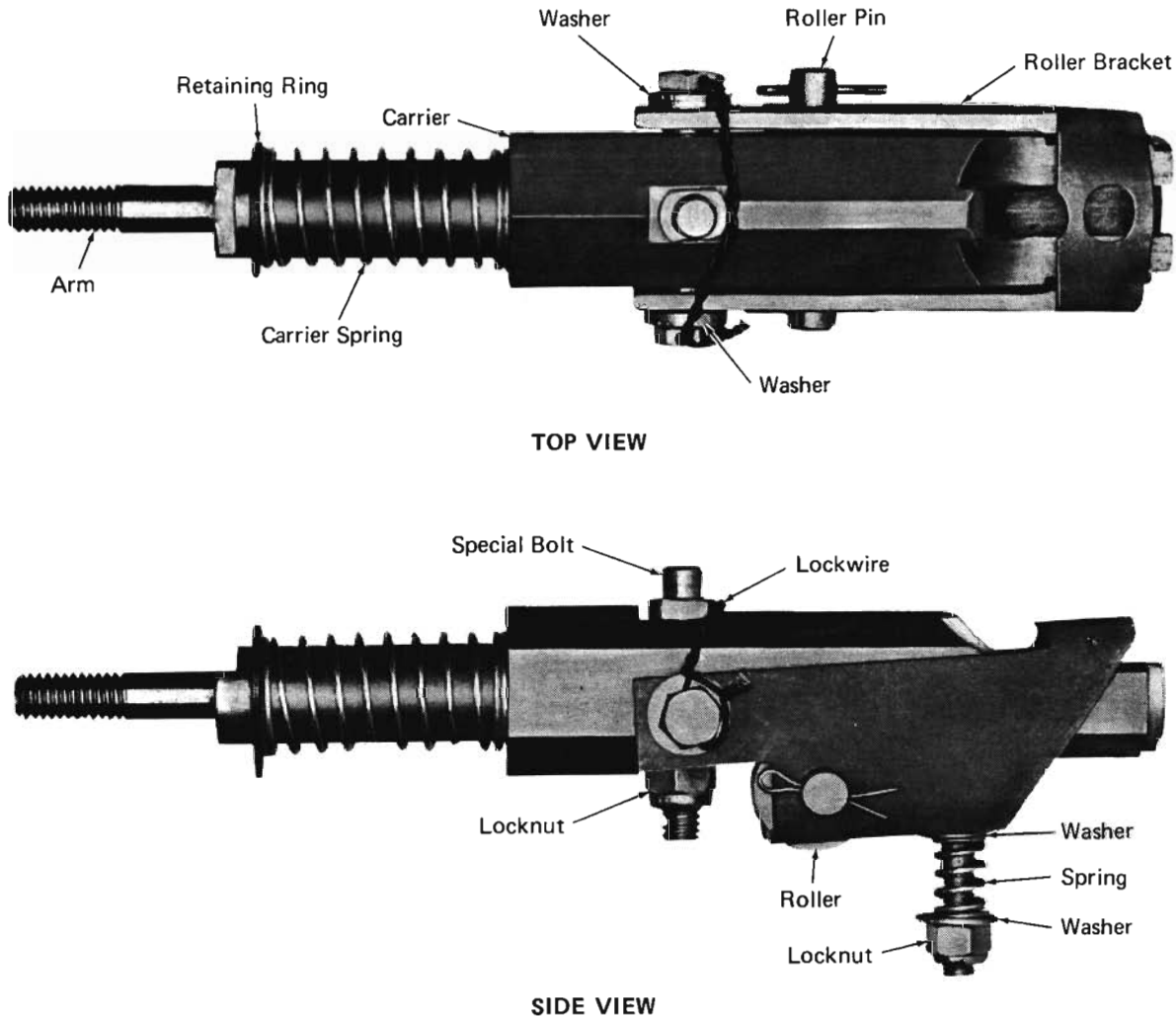
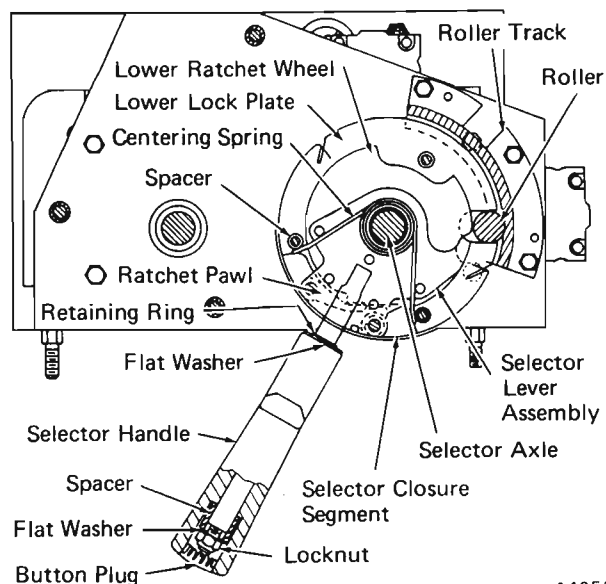


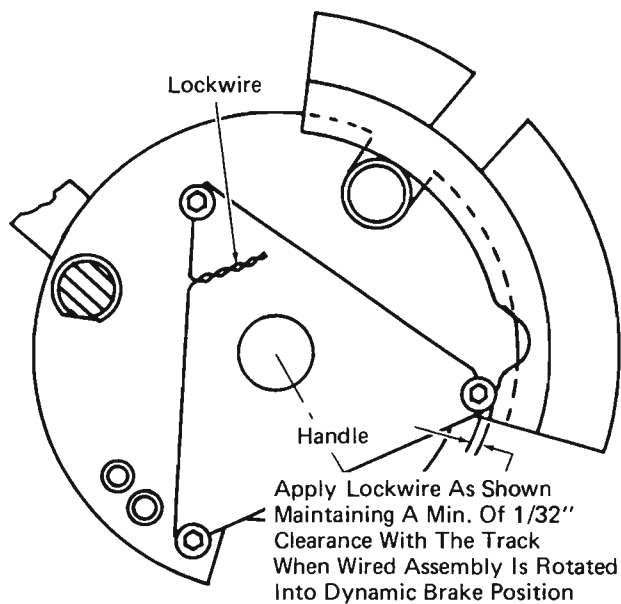
Fig. 14 - Directional Handle Carrier Assembly

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Fig. 15 - Selector Escapement Assembly

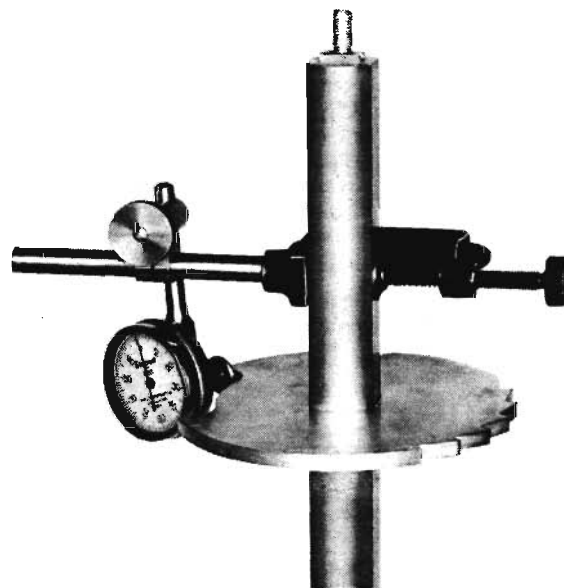


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Fig. 16 - Lockwire Application

selector axle and check to determine if rotating free play of ratchet wheels exceeds .020" allowable limit, Fig. 17. Worn holes may be closed up by carefully staking top and bottom sides of ratchet wheel 1/16" away from edge of hole. Test for snug fit on selector shaft. Make sure top and bottom surfaces are flush and free of burrs after adjusting hole size.

21. Clean all metal parts thoroughly in solvent (do not use degreaser).

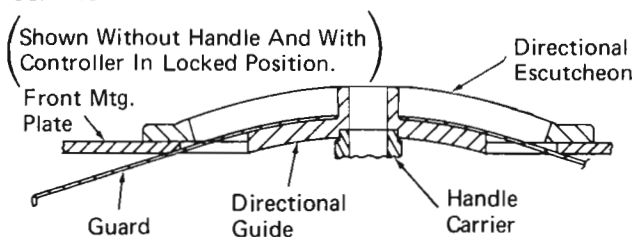


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Fig. 17 - Measuring Free Play Of Ratchet Wheels On Selector Axle

ASSEMBLY

1. To assemble the controller, apply parts in reverse order of their removal, making certain all parts operate freely with their mating parts. Lubricate controller as described in "Lubrication."
2. Apply lockwire as shown in Figs. 14 and 16.
3. While tightening seven 5/16"-24 bolts and self-locking nuts in the interlock mechanism assembly, relieve spring pressure of lock plate against directional handle carrier to prevent binding directional axle in bushings.
4. Centering springs may be bent slightly, if necessary, to adjust center position of selector lever, Fig. 15.
5. When assembling front mounting plate to controller, ensure that phenolic directional guide is centered on handle carrier, Fig. 18. Realignment of directional escutcheon plate may be necessary to match height of carrier assembly.
6. When assembling throttle and selector handles, do not tighten 5/16"-24 self-locking nuts any more than is necessary to remove end play of handle. Further tightening will dislodge retaining ring.



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Fig. 18 - Centering Handle Carrier
Directional Guide

LUBRICATION

1. Clevis rollers should be free and lubricated with a graphite oil such as is used in lock tumblers. Use same oil to lubricate directional handle lock plate pivot points.
2. Apply a film of Lubriplate to contact (wear) surfaces of all moving metal parts mentioned below:

Directional handle carrier sub-assembly

Arm (inside spring and carrier)

Roller and pin

Spacers

Directional axle and bushing

Directional handle locking plate lip (where handle carrier makes contact with lock plate)

Clevis sleeves, spacers and rollers

Detent ball sockets

Detent ball tracks

Bottom plate bushings and axles

Interlock surfaces of cam plates

Top plate bushings and axles

Directional cam connecting rod (bottom side and both pins)

Directional cam bushings and selector axle (cam must operate free without binding)

Switch housing bushings and axles

Selector escapement

Bushings

Ratchet pawl pivot pins

Ratchet pawl spring grooves

Ratchet teeth

Between two selector closure segments

Roller sockets

Roller track

Selector escapement detent ball socket and track

Top plate bushing and selector axle

Selector indicator bushing on throttle axle

Selector indicator connecting rod bushings

Dynamic brake connecting rod bushings

Dynamic brake lockout shaft and spring (GT26MC only)

MECHANICAL INSPECTION

The following mechanical checks should be made to qualify the controller for trouble-free operation:

1. Check the indicating drums to see that:
 - a. The proper position is indicated for each throttle and selector position.
 - b. The numbers or designations are reasonably lined up in the center of the opening.
2. Check to see that the handles are tight on their respective axles or shafts, and that they move freely enough so that the spring-loaded detent action on the respective axle segment plates can "center" each position as follows:
 - a. Directional Handle

As the handle approaches the forward, center, or reverse positions a slight pull aiding the movement to the final position

should be experienced. This is due to spring action of the directional cam interlocking clevis.

b. Selector Handle

The handle has two functions – one as a ratchet, and the other as a smooth rheostat control.

As a ratchet, the handle will move; only to the right from position 2; to the right or left from positions 1 and N; and only to the left from position B (large). After each ratchet action, the handle must return to its "center" position automatically, (a click will be heard) before another action can take place. Each 15° ratchet action establishes a new ball detent location, which holds the switch cam drum in that position until a different function is selected. The ball detent action on the selector axle cam plate should automatically pull the selector switch drum and indicator into the next position at the end of each ratchet stroke.

As a rheostat control, the handle should rotate smoothly 75° to the right of its "center" position, provided that selector indicator is in large B position and handle has been allowed to return to its "center" position. A detent ball in both the

selector escapement assembly and selector axle cam plate will slightly resist movement into dynamic brake. These detents will again be felt upon returning from dynamic brake to large B position.

c. Throttle Handle

Free play in each throttle position should not exceed 1/2°. Full movement of the throttle handle from one notch to the next is 10° with one-half of this movement being required to get out of the previous notch. The effort required to shift the ball detent between notches should not exceed 7 lbs. measured at the end of the handle. The throttle handle should automatically fall into the next position as the ball detent passes over the hump between positions. No "hanging up" should be noticed between positions.

ELECTRICAL INSPECTION

In order to check the electrical operation of the controller, or to validate repairs which have been made, make the following tests:

1. Operate controller handles through their entire range, checking to see if the proper switches are energized for each position. Refer to switch sequence chart, Fig. 19.

		POSITION		
		FOR	OFF	REV.
RH-R	A-B			●
	C-D			●
RH-F	A-B	●		
	C-D	●		

DIRECTIONAL HANDLE

		POSITION								
		IDLE	1	2	3	4	5	6	7	8
POWER	TH-IDLE	●								
	TH-1 THRU 8		●	●	●	●	●	●	●	●
	TH-5 & 6				●	●				
	TH-3 THRU 8				●	●	●	●	●	●
TH-2,4,6,8	A-B				●	●	●	●	●	●
	C-D				●	●	●	●	●	●

THROTTLE HANDLE

		POSITION		
		FOR	OFF	REV.
RH-R	A-B			●
	C-D			●
RH-F	A-B	●		
	C-D	●		

DIRECTIONAL HANDLE

		POSITION								
		IDLE	1	2	3	4	5	6	7	8
POWER	TH-IDLE	●								
	TH-1 THRU 8		●	●	●	●	●	●	●	●
	TH-5 & 6				●	●				
	TH-3 THRU 8				●	●	●	●	●	●
TH-2,4,6,8	A-B				●	●	●	●	●	●
	C-D				●	●	●	●	●	●

THROTTLE HANDLE

SH-NEU, 1 & 2	SELECTOR CAM POSITION	
	BRAKING (BG)	NEU. 1 2
SH-NEU B & BG	TH IDLE	
SH-BG	TH 1-8	
SH-2	TH 5 & 6	
SH-1-2	TH 3-8	
RH-R	TH 5-8	
RH-F	TH 2,4,6,8	

SWITCH LOCATION (REAR VIEW)

	SELECTOR CAM POSITION			
	BRAKING (BG)	B	NEU.	1 2
SH-NEU BBBG	●	●	●	
SH-BG	23 RH50	1		
SH-2				●
SH-1-2				●
SH-N, 1 & 2	A-B		●	●
	C-D		●	●

SELECTOR HANDLE

GL26MC

14846

SH-NEU, 1 & 2	SELECTOR CAM POSITION	
	BRAKING (BG)	NEU. 1 2
SH-NEU B & BG	TH IDLE	
SH-B & BG	TH 1-8	
SH-2	TH 5 & 6	
SH-1-2	TH 3-8	
RH-R	TH 5-8	
RH-F	TH 2,4,6,8	

SWITCH LOCATION (REAR VIEW)

GT26MC

	SELECTOR CAM POSITION			
	BRAKING (BG) SMALL "B"	B	NEU.	1 2
SH-NEU, B & BG	A-B	●	●	●
	C-D	●	●	●
SH-B & BG	A-B	●	●	
	C-D	●	●	
SH-2	TH			●
	C-D			●
SH-1 & 2	A-B			●
	C-D			●
SH-NEU, 1 & 2	A-B		●	●
	C-D		●	●

SELECTOR HANDLE

18458

Fig. 19 - Controller Sequence Charts

2. Shake the handle in each position. While shaking handle avoid starting a definite motion towards next position. If switches are good, this should not affect the established circuits. Defective switches should be replaced as a unit.

3. Check dynamic brake rheostat, which is in series with "BBG" switch. Ensure electrical contact is made from "C" terminal on rheostat through brush, contact bars, and on to each terminal No. 1 through No. 23. The first eight bars are connected to terminal No. 1, and the last 6 bars are connected to terminal No. 23. Only one bar is connected to each of the remaining terminals - Nos. 2 through 22.

NOTE: Polarity must be observed when installing switches equipped with magnetic blow-outs. See Service Data for proper switch part numbers.

4. Check voltage on the indicating dial lamp. It should be 6-8 volts with 74 volts applied to the series circuit of the lamp and resistor.

SERVICE DATA

SWITCH ASSEMBLY

2 contacts - 1 N.O. - 1 N.C.	8296750
1 contact - N.C. with arc suppressor (permanent magnet)	8296752
2 contacts - N.C.	8298178

DYNAMIC BRAKE RHEOSTAT

Contact Bars	35
Current	5 Amps @ 74 VDC - continuous duty
Backlash	2.5° Max.
Brush	Silver Graphite
Hi-Pot Terminals to ground	600 V RMS 60 cycles AC for one min.

DIAL LAMP 8140357

LUBRIPLATE (1 lb can) 8196886