Signal Training Bulletin

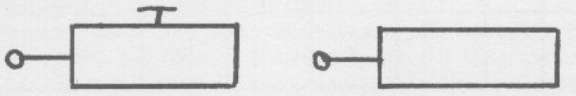
COMMITTEE G: Education & Training
Communication & Signal Division, AAR

A-10B Model 5 Power Switch Machines

Approved July 1985

Definition: A device that provides for electrical indication of position, and that may be remotely controlled to mechanically unlock, operate and lock a switch, moveable-point frog or a derail.

Symbol:



DUAL CONTROL NOT DUAL CONTROL

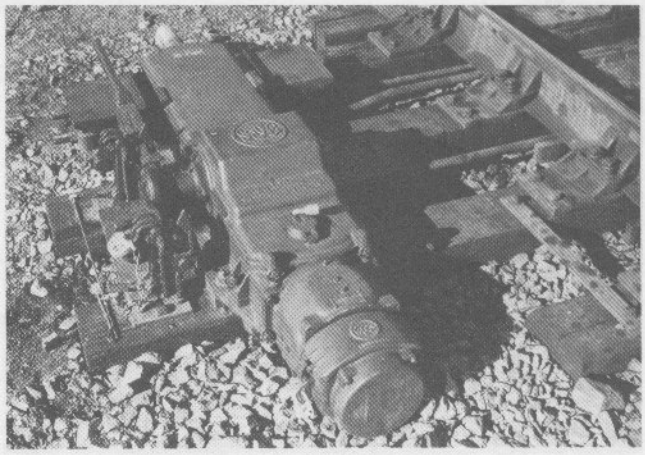
Description: The electric switch machine consists of a waterproof metal housing containing an electric motor, a gear train, a mechanical locking device, a circuit controller, point detector, and lugs to permit connections to the switch rods and switch point.

Purpose and Application: To make possible remote control of switches, moveable-point frogs, and derails, and provide for safe routing of trains in traffic control territories, interlockings and yards.

General Information: The first of the GRS switch machines was the Model 5 which is a power-only switch machine now used only on rapid transit properties. Then came the model 5A, a power-only operated machine. Next, the Model 5B, essentially a model 5A machine with the dual-control feature incorporated, was developed.

Subsequently, as modifications to the switch machines were made, the older models were superseded in pairs. That is, the Models 5A and 5B were superseded by the Models 5C and 5D. The 5C being a power-only machine and the 5D being the dual-controlled machine. The Models 5E, 5F, 5G and 5H are the last of the Model 5 series. The operating characteristics of these switch machines are shown in Figure 1.

Power switch machines are generally installed on the normally closed-pointside of the track switch. Since a switch turnout may be either to the left or right, switch machines are designated as left hand or right hand. To determine whether a machine is right or left hand, stand at the motor end of the machine, facing the machine, and observe the throw rod connecting lug. If this lug is on the right side of the machine, the machine is a right hand machine; if on the left side of the machine, it is a left hand machine. A left hand machine can be converted to a right hand machine, and vice versa, by following the instructions found in the manufacturer's manual.



Picture: A Model 5F power-operated switch machine with dual controls for power and manual operation.

Detailed Operation: A power switch machine consists of three major components: motors and motor controller; gear train; and point detector and pole changer.

Motors and Motor Controller: Motors are available for direct current or alternating current operation. High voltage and low voltage motors are available for dc operation. The high voltage ac motors and switch machines are no longer furnished. (See Figure 1).

The modern motor braking method is dynamic snubbing using the motor as a generator to stop itself. Older machines, no longer manufactured, may have friction brakes to stop and hold the motor. (See Figure 2). Current machines are held at end of stroke by magnetic detents. The magnetic detent consists of two permanent magnets, one rotating with the motor shaft and one fixed.

The motor controller is a biased-neutral relay assembly, enclosed in an aluminum box, mounted near the point detector contacts. It consists of two biased-neutral contactors an overload stick relay and a snubbing rectifier. It may have

	DUAL CONTROL	INTERNAL CONTROLLER	CONTROLLER VOLTAGE DC		MOTOR VOLTAGE DC			SWITCH MACHINE CURRENTLY AVAIL.	OUTBOARD BRAKE	MAGNET	OPERATION		INDICATION	
							AC-							
			10-12V	20-24V	110V	24-32V	110V				DIRECT	RELAY	DYNAMIC	RELAY
5A					X	-X	-X	X	OPTIONAL	OPTIONAL	X		X	
5B	X				X	X	-X		OPTIONAL		X		X	
5C		X	X	X	X	X			-X			XI		X
5D	X	X	X	X	X	X			-X			XI		X
5E					X	X		X		X		XE		X
5F	X				X	X		X		X		XE		X
5G		X	X	X	X	X		X		X		XI		X
5H	X	X	X	X	X	X		X		X		XI		X

X Type and character of switch machine furnished

-X No longer available from manufacturer

XI Internal by built in controller

XE External by case mounted relays

Figure 1: Operating characteristics of Model 5 switch machines.

a heater. One contactor operates to energize the motor with the polarity required to drive the switch points to the normal position; the other contactor operates to drive the switch points to the reverse position. The contactors are interlocked to prevent simultaneous operation of both contactors. This interlock centering device forces the contactors to assume a center position when the coils of both relays (contactors) are not energized. The centering device also forces the de-energized contactor to close its back contact when the energized contactor closes its front contact.

Some older machines may be controlled by relays housed externally.

Overload Relay: The overload relay operates to open the contactor circuit when the motor current remains high for an abnormally long period. The primary purpose of the overload relay is to protect the motor circuit components from damages that could result from switch points blocked by obstructions.

The overload relay has a pickup coil and a holding coil. It has a non-ferrous metal slug and washers to prevent undesired pickup of the relay during momentary surges of current that occur during motor starting. The pickup time is adjustable. A slotted head screw located in front of the armature may be rotated clockwise or counterclockwise to change armature spring pressure, which, in turn, changes the relay pickup time. The pickup coil is connected parallel with a resistance wire inserted in series with the motor circuit. If the motor current remains too high for a prolonged period, the resistance wire heats, its resistance becomes greater, and the voltage drop across it reaches the pickup value of the pickup coil. Once the overload relay is picked up, it is retained by the holding coil. The holding coil circuit will remain energized until the motor control circuit is interrupted. The motor control circuit may be interrupted by the control point calling for the switch to be operated in the opposite direction or by manual manipulation. The resistance wire must be allowed to cool off between tests of pickup time of the overload relay.

Gear Train (Refer to Figure 2): Switch machine operating power is supplied by the motor. This power is transmitted from the motor pinion through the friction clutch and the intermediate gear to the main gear. The unlocking, operating and locking functions are accomplished through the rotation of the main gear. The main gear is connected to the locking bar and throw bar by the throw bar and locking bar roller which is attached to the underside of the main gear.

The relative position of the throw bar and the locking bar roller to the locking bar and throw bar, as shown in Figure 2, are shown with the switch in the locked position. Let's assume that the switch is in the normal position; that is, with the switch machine having thrown and locked the switch points in position. The throw bar is locked by the locking bar.

To operate the switch from this position, the motor rotates in the direction to drive the main gear counterclockwise. The throw bar is engaged by the roller on the main gear. Further rotation of the main gear moves the roller to

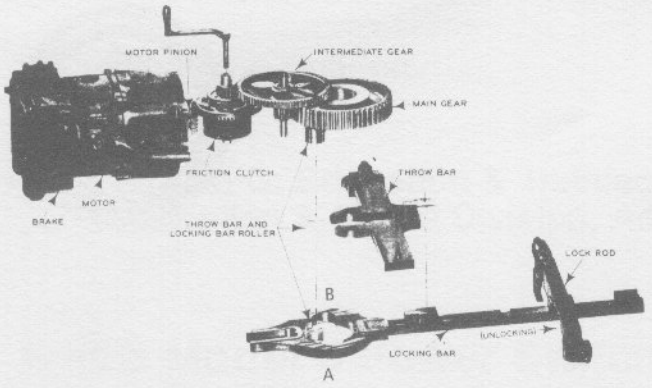


Figure 2: Schematic diagram of gearing of single control switch machine. Hand throw gears of dual control switch machine are omitted for simplicity.

indent in the locking bar at point A. Continued rotation unlocks the lock rod and the throw bar. Then the throw bar is moved. Next, the roller enters indent B in the cam bar. The roller then causes the cam bar to lock the lock rod and the throw bar. Lastly, during the overrun, the roller leaves the throw bar. The sequence of events is reversed to operate the switch back to the normal position.

Point Detector. The point detector, a vitally important part of the switch machine, is a circuit controller that indicates switch point position. In some switch machines, the point detector also operates in conjunction with the biased-neutral controller (relay) to control the motor-operating circuit.

The point detector is the over-and-locked type. This means that the switch points must be in the closed position and locked before the detector contacts close. The point detector contacts are physically controlled by both the locking bar and the detector rod. Both must be in agreement before the detector contacts can close. The locking bar must be in the locked position, and the detector rod must be in correspondence with the switch point position.

For point detector operation, refer to Figure 3. Point detector contact P, shown in (2a), is physically controlled by rocker arm A and rollers C anc C1. When the switch machine is locked in the normal position, roller C is in the detector rod notch that corresponds with the normal position of the switch points, and rollers R, shown in (1a) and (2a), are in the positions shown in (1a). Note that rollers R are operated by the locking bar and rollers C and C1 are operated by the detector rod.

Now when the switch machine is operated from normal to reverse, the first event is the unlocking of the switch. When the first movement of the locking bar occurs, the locking moving in the direction of the arrow in (1a), rollers R are forced into the slot in dog 4 as shown in (1b). This forces the point detector contacts to the center position as shown in (2b).

While the switch machine is unlocked, rollers R are held in the slot in dog 4 as shown in (1c). When the switch points are in transit from normal to reverse, rollers C and C1 are retained on top of the detector rod as shown in (2c). When the switch movement is completed and the points are fitting properly in the reverse position, roller C1 is positioned in the detector rod notch that corresponds to the reverse position of the switch points as shown in (2d). Then when the switch is locked, rollers R are released from the slot in dog 4 and are positioned as shown in (1d).

Now that the detector rod is in the proper position, and the switch is locked, the point detector contacts close their reverse contacts as shown in (2d). The operation from reverse to normal is similar.

It is noted that the point detector contacts would be opened if the switch point were pried open while the machine is locked. Switch point movement would cause roller C or C1, whichever was in place in accordance with switch point position, to be lifted out of the notch in the point detector rod.

Pole Changer: The pole changer mechanism is located in the contact compartment. Its function is to:

1—Open the motor circuit when the switch points are closed and locked;

2—Establish the circuit for dynamic indication permitting the motor to "snub" and bring the machine to rest without undue shock; and

3—Permit the machine, when unlocked, to follow the movement of the control lever (facilitate reversing the movement of the machine from the mid-stroke position).

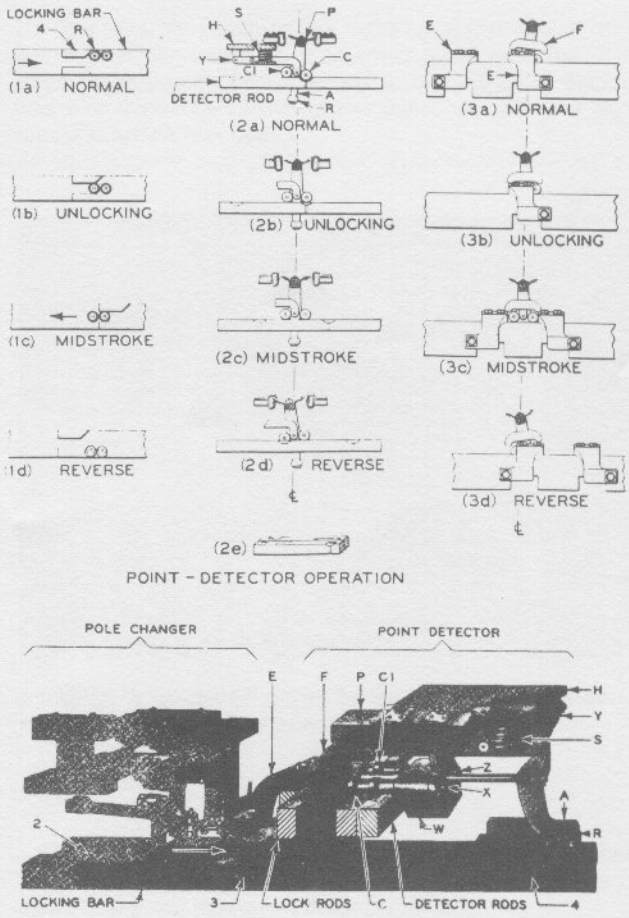


Figure 3: Point detector and pole-changer movement.

On switch machines equipped with lock rods, the pole changer contact is operated mechanically, during normal operation of the switch machine, by movements of the locking bar and the lock rods.

On switch machines not equipped with lock rods, the pole changer is operated by movements of the locking bar, and through link motion, in conjunction with movement of the throw bar. The pole changer is operated electrically by solenoid coils for reversal in midstroke.

Note: The material shown in this training bulletin is typical and shown for descriptive purposes only. Equipment nomenclature and application should be in accordance with individual railroad requirements.