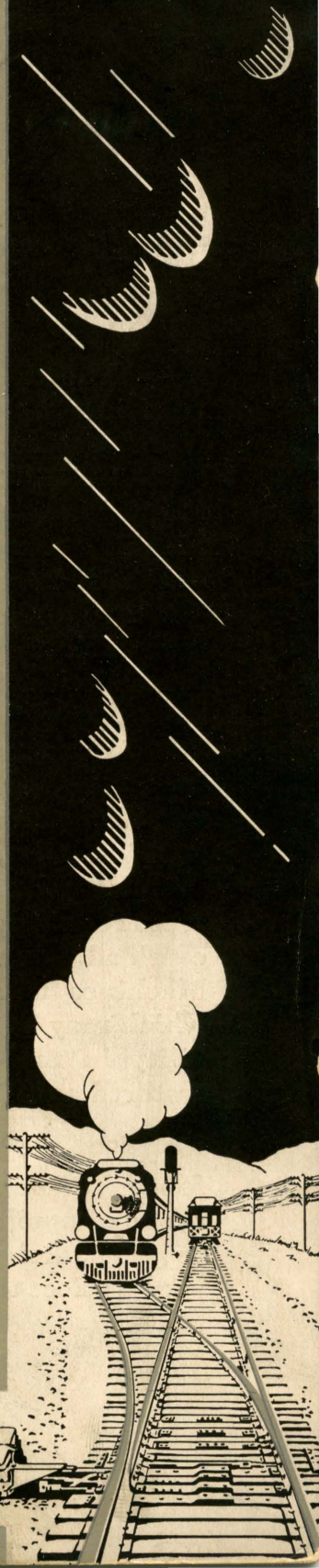


SWITCH MACHINES

FOR YOUR
MAIN LINE SWITCHES

Bulletin 161 - July 1930
GENERAL RAILWAY SIGNAL CO.



Switch Machines

for your Main Line Switches

The demand for self-contained, compact switch machines, having the general features of the well-known Model 5A Machine but incorporating other features such as DUAL CONTROL and a simpler means of RELAYED CONTROL, has led to the development of three additional G-R-S Machines, Models 5B, 5C and 5D, all based on the design of the Model 5A and using the same parts as far as possible. These new machines are highly efficient for the purposes for which they were designed, and incorporate desirable features that have never before been included within any switch machine. For example, when switches were operated from a source of power either supplied over bus wires or by a storage battery located at the switch, it has been necessary to employ an external unit to obtain reversibility in mid-stroke, and where overload protection is required this has also been external to the switch machine, in some cases requiring a reset by hand after being operated by an overload. One of the features of the Models 5C and 5D Machines is a built-in SWITCH MACHINE CONTROLLER which may be operated over two line wires, giving reversibility in mid-stroke and overload protection which is restored automatically upon reversal of control lever.

The G-R-S line of Switch Machines identified under four main classifications, as listed on page 3, covers a wide range of applications and it is the object of this Bulletin to give sufficient description and operating data to enable you to select the machine best suited to the work you wish to do.

Model 5A Switch Machine (*Single Control)

110 Volt, D-C 110 Volt, D-C (Low Speed) 220 Volt, D-C 110 Volt, A-C	}	***Direct Operation, Dynamic Indication, Central Energy, —ordinarily used for Interlocking purposes.
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Model 5B Switch Machine (Dual Control)**

110 Volt, D-C 110 Volt, D-C (Low Speed) 220 Volt, D-C 110 Volt, A-C	}	***Direct Operation, Dynamic Indication, Central Energy, —ordinarily used for Interlocking purposes.
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Model 5C Switch Machine (*Single Control)

110 Volt, D-C 220 Volt, D-C 20 Volt, D-C	}	****Direct or Relayed Control, Relayed Operation and Indication, Local Energy D-C.
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Model 5D Switch Machine (Dual Control)**

110 Volt, D-C 220 Volt, D-C 20 Volt, D-C	}	****Direct or Relayed Control, Relayed Operation and Indication, Local Energy D-C.
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By **SINGLE CONTROL** is meant that the switch machine is intended for power operation only, no means other than a hand crank being provided for manual operation.

**

By **DUAL CONTROL** is meant that the switch machine is equipped for both **POWER** and **MANUAL** operation, having two built-in hand-throw levers, one to select the means of operation (power or hand-throw) and the other to throw the switch manually.

By **DIRECT OPERATION** is meant that the switch machine is operated direct from the control lever without the intervention of any relay device.

By **RELAYED OPERATION** is meant that the switch machine is operated through the medium of a relay device.

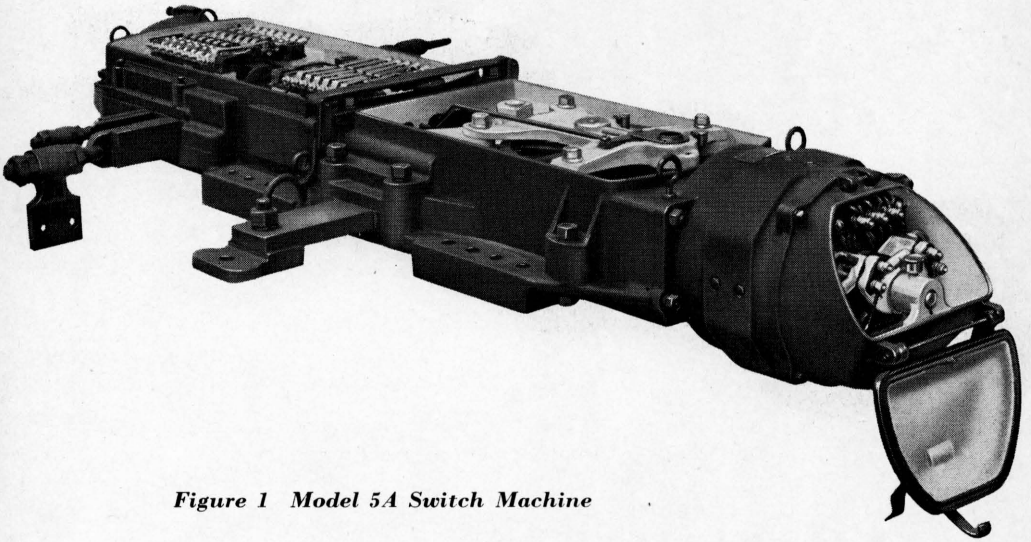


Figure 1 Model 5A Switch Machine

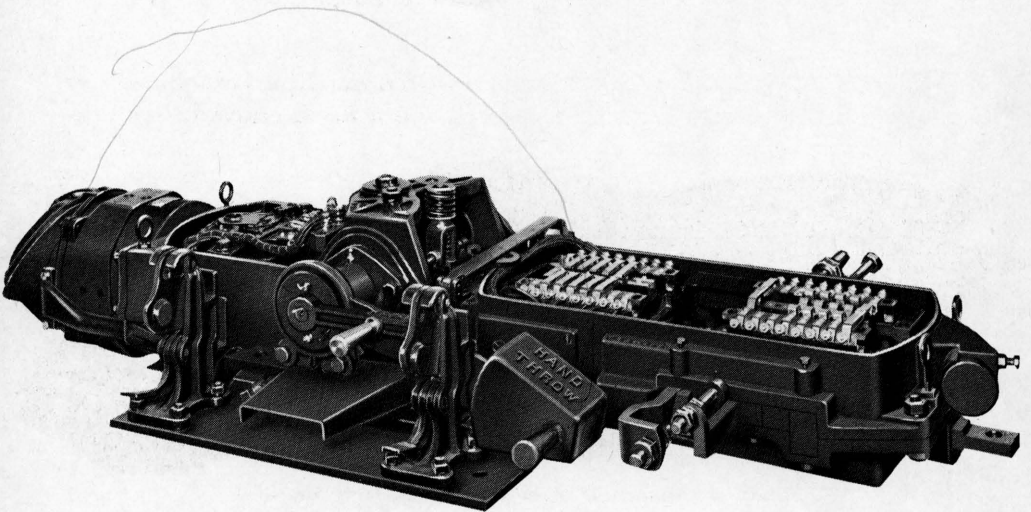


Figure 2 Model 5B Dual-Control Switch Machine

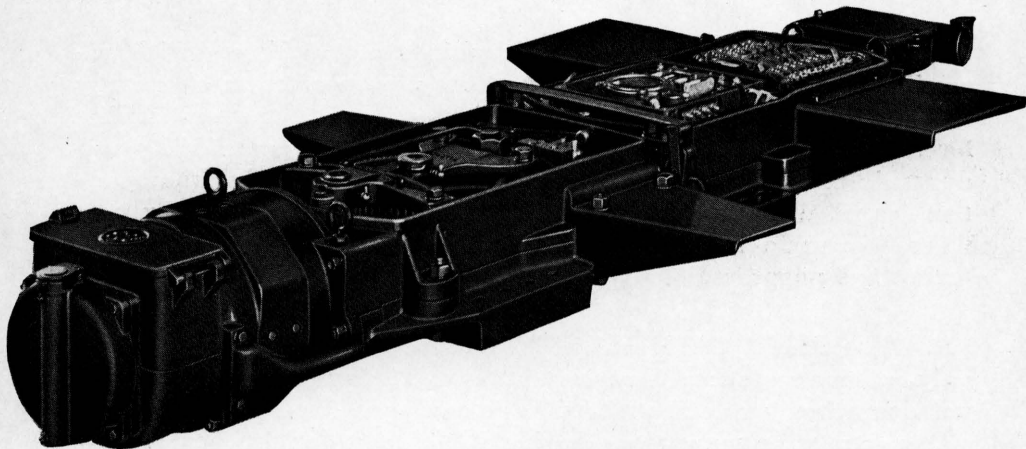


Figure 3 Model 5C Switch Machine

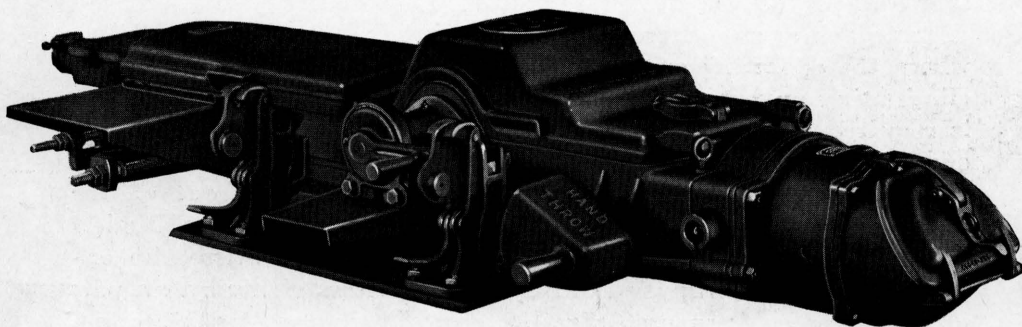


Figure 4 Model 5D Dual-Control Switch Machine

Distinguishing Characteristics

Models 5A and 5B Switch Machines are equipped with reversible pole-changers in which contacts are operated mechanically at the end of the stroke and electrically in case the controlling lever is reversed in mid-stroke. This provides for reversibility and dynamic braking when machines are operated directly from control levers, which makes them best adapted for interlocking uses where dynamic braking is employed for indication and cross-protection purposes.

The Model 5A Machine is equipped for power operation only, no means other than a hand crank being provided for manual operation, while the Model 5B is equipped for DUAL CONTROL, either power or manual operation. Dual control is obtained by means of two built-in hand-throw levers similar to those used at hand-throw switches, one lever being used to select the means of operation, power or hand-throw, and the other to throw the switch. Otherwise, the two machines are substantially the same.

Models 5C and 5D Switch Machines have a built-in SWITCH MACHINE CONTROLLER in lieu of a reversible pole-changer and an electro-magnetic brake is employed in lieu of dynamic braking. The controller unit provides a self-contained means of control and overload protection for the motor, eliminating the necessity of employing an external control relay to obtain reversibility where the operating current is supplied locally at the switch, also eliminating an external cut-out device where overload protection is required. The electro-magnetic brake stops the motor at the end of switch-machine stroke and holds it positively whenever current is cut off. This is desirable where current is cut off for approach and detector locking purposes. Therefore, the Models 5C and 5D Machines are best adapted to locations where the operating current is supplied locally at the switch, either over a pair of bus wires or from a storage battery. These two machines are not equipped with A-C motors.

In other respects, the Model 5C Machine parallels the 5A; and the Model 5D, Dual-Control Machine parallels the 5B.

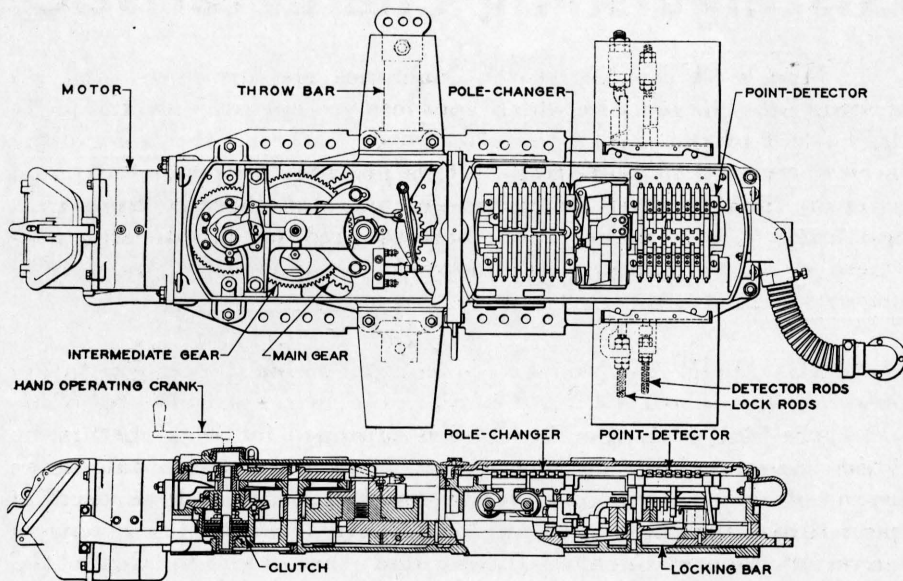


Figure 5 Model 5A Switch Machine, Single-Control

Description and Operating Data

The Model 5A Switch Machine

The Model 5A Switch Machine is a compact, self-contained, powerful mechanism, incorporating all features required in meeting standard interlocking practices for all types of switches regardless of variation in switch fitting standards and weights of rail. The machine was originally intended as an all-purpose machine and with the least possible change in parts may be fitted for varied types of service. It is a single unit, designed for two-tie support, and consists essentially of a motor, gearing, operating and locking members, pole-changer, point-detector of the over and locked type, and lock and detector rod combinations for any specified requirements. Figure 5 shows a general assembly view of the machine.

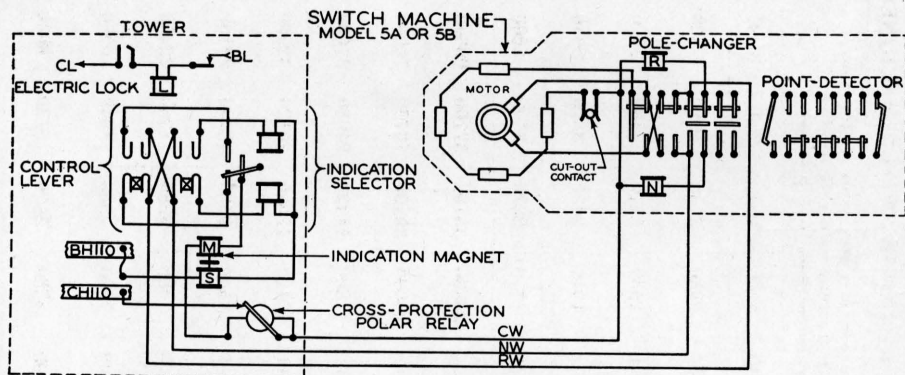


Figure 6 Typical Circuit Showing Control of Switch Machines, Models 5A and 5B, Using Dynamic Indication

The Model 5A Machine is regularly supplied with motors, as listed on page 3, for use in dynamic-indication interlocking as shown by typical circuit, Figure 6. Useful operating data for this application is given in table, Figure 7. This data is based on switches being in reasonably free working condition. In special cases, as the A-C machine, for example, it may be desired to operate the machine from energy supplied locally at the switch. This can be done by the use of an external control relay. The Model 5A Machine can be supplied with low-voltage motors.

Attention is called to the 110-volt D-C, Low-Speed Machine which operates from a central source of 110-volt D-C supply with identically the same control as our regular 110-volt machines, but requiring a longer time for operation. This machine is particularly desirable for operating outlying switches from an existing interlocking plant, since switches located four miles from the interlocking tower may be operated directly over #10 B. & S. G. copper line wire, the maximum allowable resistance in control circuit being 45 ohms.

Attention is also called to the 220-volt D-C machine which has recently come into use at interlocking plants where many of the switches are located at considerable distances from the control tower. Maximum allowable resistances in control circuit are four times those given for 110-volt machines. Heavy switches located $1\frac{1}{2}$ miles from the control tower are being operated directly over control wires no larger than would be required for 110-volt machines located at one-quarter the distance from the tower.

OPERATING DATA AND CONTROL WIRE SIZES FOR MODELS 5A AND 5B SWITCH MACHINES

Kind of Switch	Size of Rail	Type of Switch Machine Model 5A or 5B	Normal Voltage (At Tower)	Oper. Amp.	Nom. Time Sec.	Maximum distance in feet over control wire from tower to Switch Machine with various sizes of soft-drawn Copper Wire, B & S Gauge.						
						3 #14	3 #12	3 #10	3 #9	3 #8	3 #6	3 #4
Single Switch or Derail	105# or less	Reg.	110 D-C	5	3	930	1475	2350	2950	3730	6020	9400
	over 105#	Reg.	110 D-C	6	3	795	1260	2000	2530	3170	5130	8000
D.S.S. or M.P.F.	105# or less	Reg.	110 D-C	7	3	595	950	1510	1910	2400	3870	6040
	over 105#	Reg.	110 D-C	8.5	3	555	880	1400	1770	2220	3590	5600
Single Switch or Derail	105# or less	Low Speed	110 D-C	1.25	8 to 15	8940	14100	22500	28500	35700	57700	90000
	over 105#	Low Speed	110 D-C	1.75	8 to 15	7540	11900	19000	24000	30100	48700	76000
Single Switch or Derail	105# or less	Reg.	220 D-C	2.5	3	3720	5900	9400	11800	14920	24080	37600
	over 105#	Reg.	220 D-C	3	3	3180	5040	8000	10120	12680	20520	32000
D.S.S. or M.P.F.	105# or less	Reg.	220 D-C	3.5	3	2380	3800	6040	7640	9600	15480	24160
	over 105#	Reg.	220 D-C	4.2	3	2220	3520	5600	7080	8880	14360	22400
Single or Derail D.S.S., M.P.F.	Any Size	Reg.	*110 A-C 60 ~	8	3.5	595	940	1500	1900	2380	3840	6000
		Reg.	*110 A-C 25 ~	10	3.5	795	1260	2000	2530	3170	5130	8000

*Figures given for A-C machines are based on the use of transformers with taps arranged for adjusting line voltage to give approximately 100 volts at machine when motor is operating under load.

Figure 7 Operating Data and Control Wire Sizes for Models 5A and 5B Switch Machines, Dynamic-Indication Interlocking

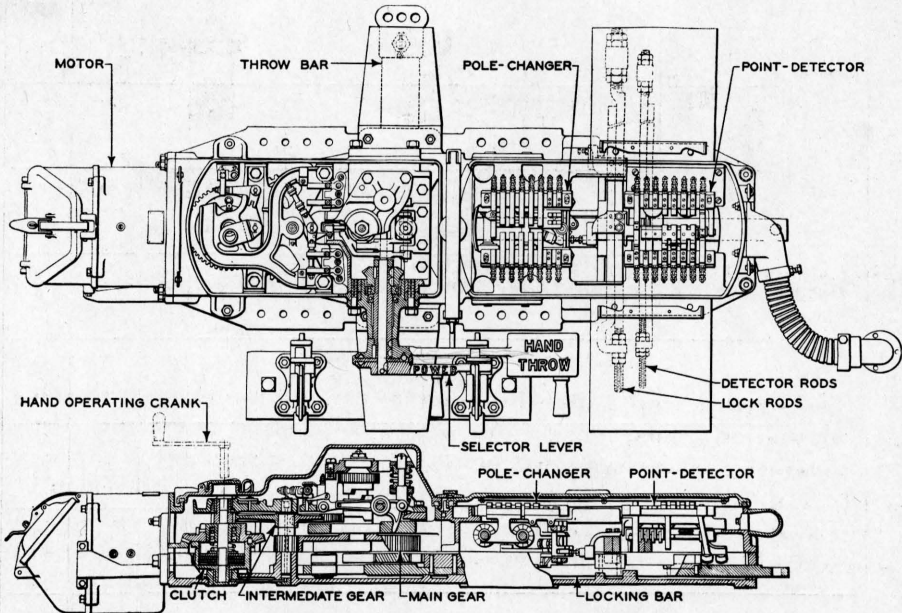


Figure 8 Model 5B Switch Machine, Dual-Control

The Model 5B, Dual-Control Switch Machine

As now regularly supplied, the Model 5B parallels the Model 5A Machine in every respect, except for the addition of parts required for manual operation by hand-throw levers. By referring to Figure 8, it will be noted that these additional parts are confined to the gear compartment housing. Figure 9 is a simplified sketch showing the gear arrangement. When power operated, the motor drives the main gear in the usual way, operating the cam crank, locking members, and all parts exactly as in the 5A Machine. When the machine is to be manually operated, a hand-throw selector lever is reversed which disconnects the main gear from the operating cam crank and connects the hand-operated gears to this crank. Then, when the hand-throw lever is operated, the cam crank moves the throw bar and switch points in a manner similar to a hand-throw switch stand, the locking members being left in the unlocked position during manual operation and restored to the locked position when the selector lever is restored to the power position.

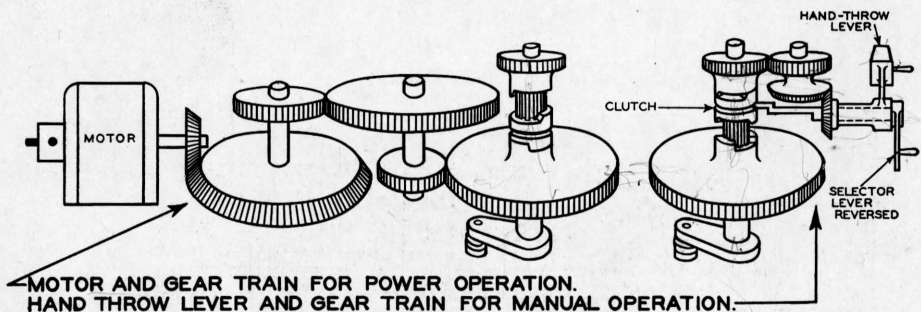


Figure 9 Sketch Showing Gear Arrangement of Dual-Control Switch Machines

The selector and hand-throw levers are interlocked with each other so that in transferring from power to manual operation, the selector lever must be operated before the hand-throw lever can be moved. Contacts operated by selector lever open the motor circuit and the switch-repeating relay circuit (signal circuits) when the lever is moved from power to hand-throw position. The hand-throw lever may be left in either position when selector lever is returned to the power position and the switch will operate to a position corresponding with the control lever.

One of the objects of dual control is to provide a convenient, quick and sure means of operating switches in cases of emergency. The Model 5B does this completely, since lock rods getting out of adjustment or other failures do not prevent hand operation.

The dual-control features, described, apply also to the Model 5D Machine.

The Model 5C Switch Machine

Except for the SWITCH MACHINE CONTROLLER used in lieu of pole-changer and the electro-magnetic brake previously mentioned, the Model 5C Machine is substantially the same as the Model 5A. Therefore, this description will be confined to the parts mentioned and their operation in connection with typical control circuits. Figure 10 shows a general assembly view of a 110-volt D-C, Model 5C Machine.

The Switch Machine Controller is a very compact unit, housed in an inner metal case resiliently supported in the space which in the Model 5A Machine is occupied by the pole-changer. It comprises two operating contactors (one normal and the other reverse), two overload relays (normal and reverse), and a master relay (optional).

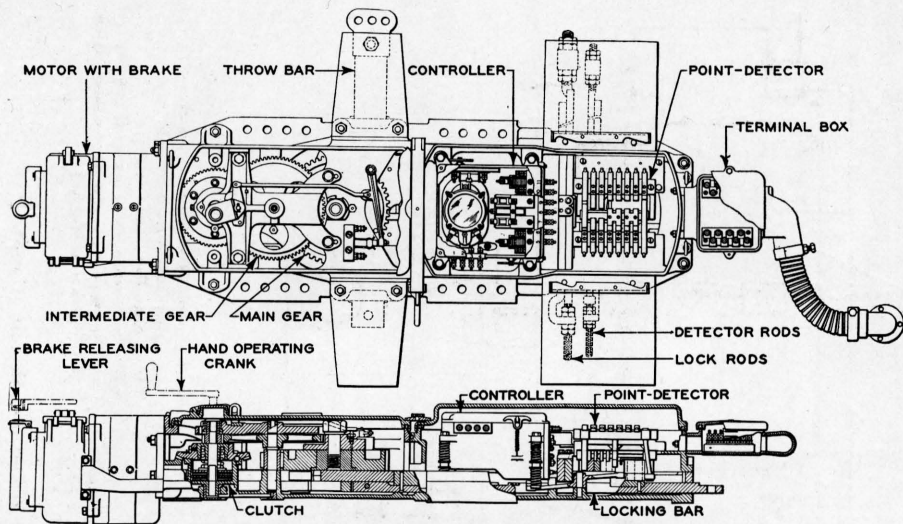


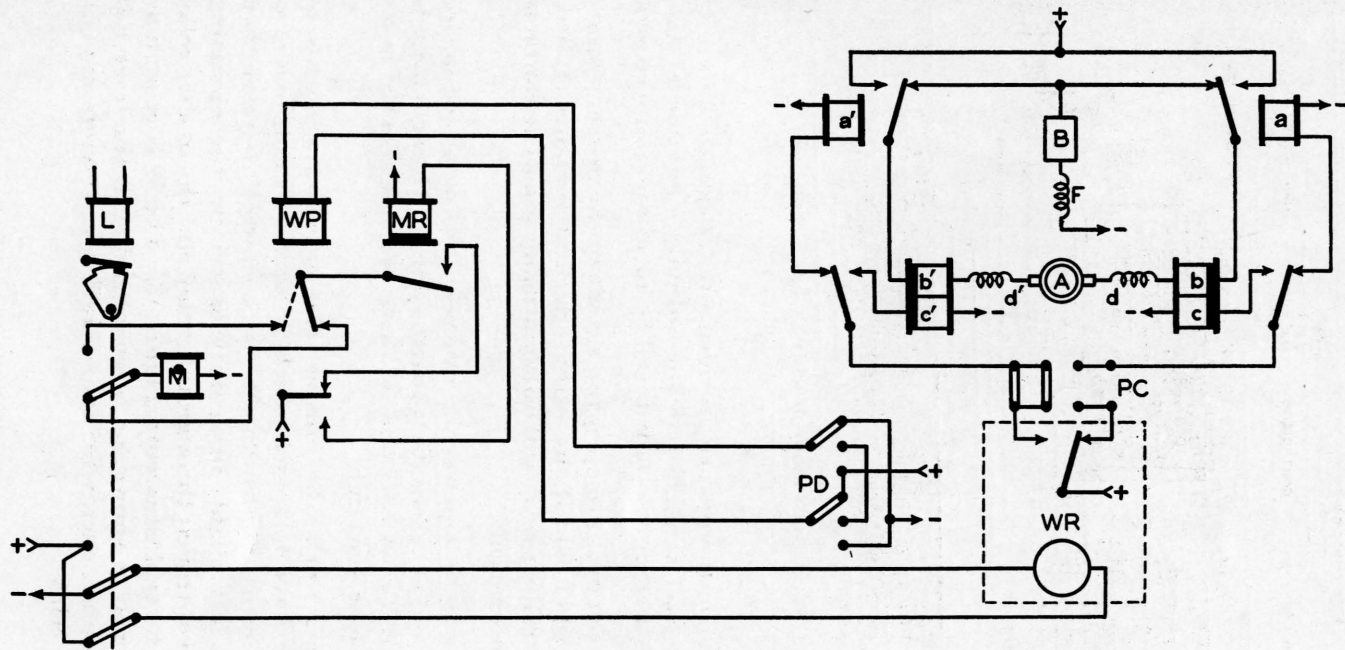
Figure 10 Model 5C Switch Machine, Single-Control

The operating contactors are provided with magnetic blowouts so designed that any arc occurring in the ordinary operation of machine, or in case the machine is stalled, will be adequately suppressed.

The overload relays act to open the circuit to the proper operating contactor only when and if the switch machine becomes stalled. The reversal of controlling relay will automatically reset the contacts ready for the next operation.

The master relay is a powerful, two-position, polarized device strongly biased normal or reverse by a toggle spring. The armature is supported in its center of gravity and is, therefore, not affected in its positioning by shock or vibration.

In interlocking work, the master relay provides a means of control direct from lever to switch machine over two line wires, as shown by typical circuit, Figure 12. Where a controlling relay used for other purposes is available in vicinity of switch, the operating contactors may be controlled through this relay and the master relay omitted, as shown by typical circuit, Figure 13. The W R relay may be normally energized, as shown, or de-energized with the lever full normal or reverse. Also, energy for the operating contactors may be controlled by track relays.



LEGEND

a - a' - Operating Contactor
 b - b' - Overload Relay Operating Coils
 c - c' - Overload Relay Holding Coils
 d - d' - Blowout Windings
 A - Motor Armature
 F - Motor Field

B - Brake Winding
 WR - Master Relay
 L - Lever Lock
 WP - Switch Repeater Relay
 PC - Motor Cut-off Contacts move central
 when machine unlocks, closing both

contactor circuits at all times except
 when machine is fully locked.
 PD - Point-Detector Contacts
 MR - Indication Relay prevents getting lever
 and switch out of correspondence.
 M - Indication Magnet

Figure 11 Simplified Circuit Showing Control of Switch Machines, Models 5C and 5D

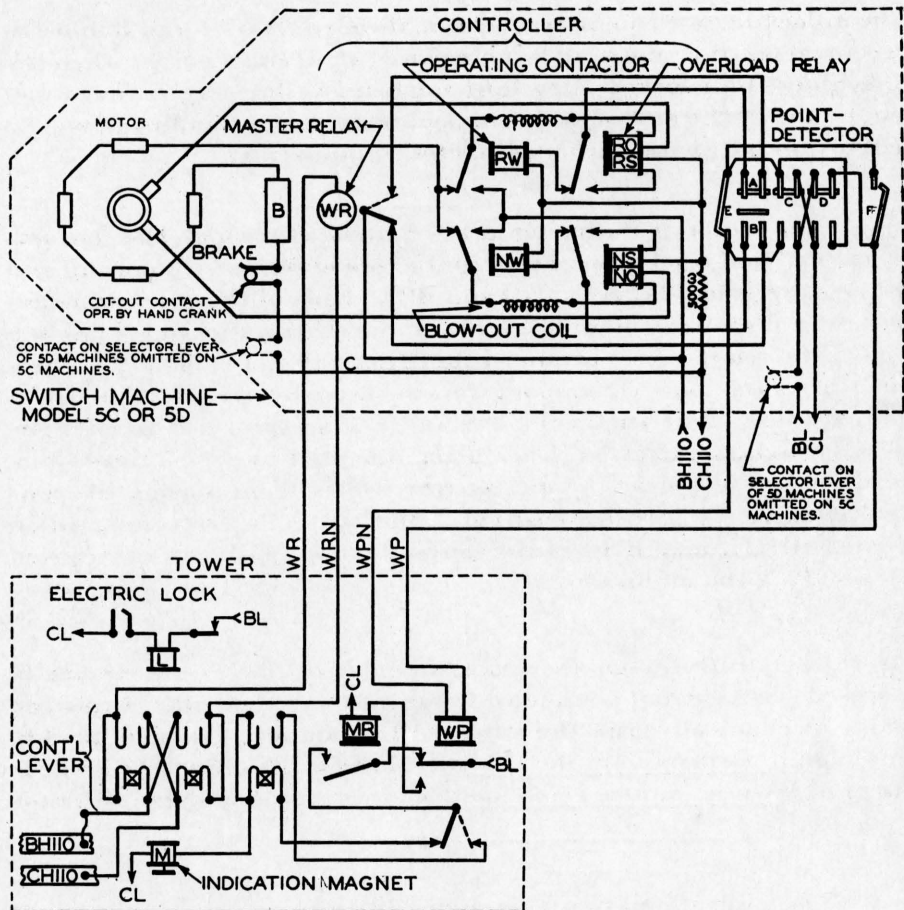


Figure 12 Typical Circuit Showing Control of Switch Machines, Models 5C and 5D, from Interlocker where Operating Current Is Supplied from a Pair of Bus Wires

Figure 11 presents in simplified form the same circuit as Figure 12. It has been included for the convenience of those who find it easier to understand operation by first referring to a simplified circuit.

In explanation of the typical circuit, Figure 12, which is usually employed in interlocking where operating energy is supplied over a pair of bus wires, it will be noted that normal and reverse operating contactors are controlled through normal and reverse contacts of master relay in series with contacts A and B on point-detector. During

the unlocking movement of machine, these contacts A and B move to a central position and both remain closed at all times except when the machine is fully locked, their function being to de-energize the proper contactor at the end of switch-machine movement and to provide a circuit for energizing either contactor in mid-stroke.

The motor operating circuit is controlled through the contacts of normal and reverse operating contactors in series with normal and reverse overload relay coils (NO and RO). Each of the overload relays has two coils, one an operating coil and the other a stick-up or holding coil. The relays are so arranged that they will not respond to a momentary surge but will respond to a sustained overload of predetermined value. The stick coils (NS and RS) are provided to hold the overload relays energized, after being operated by a sustained overload, until released by the master relay contacts on moving the control lever to its opposite position. Blowout coils are connected in series with contacts of operating contactors to suppress the arc caused by breaking the motor circuit.

The electro-magnetic brake, designated "B" in the circuit, is released when current is supplied to the motor,—at all other times the brake mechanically grips the armature in a manner to stop it quickly and hold it positively. On the 110-volt, Model 5C Machine, the brake is integral with the motor, being included in the outboard end of motor housing.

The indication circuit, included in Figure 12, is a typical relayed-indication circuit using a switch-repeating relay (WP) in the tower, an indication relay (MR) being connected in the circuit to prevent control lever and switch from getting out of correspondence with each other. Contacts E and F on point-detector shunt the WP relay circuit when switch machine is unlocked.

Typical circuit, Figure 12, may be modified to meet the requirements of the interlocking or control machine; for example, the mechanical locking and indication functions may be removed entirely from the control levers and these functions performed by relays located in the tower. In such cases the circuits within the tower would be modified, leaving the field circuits as shown.

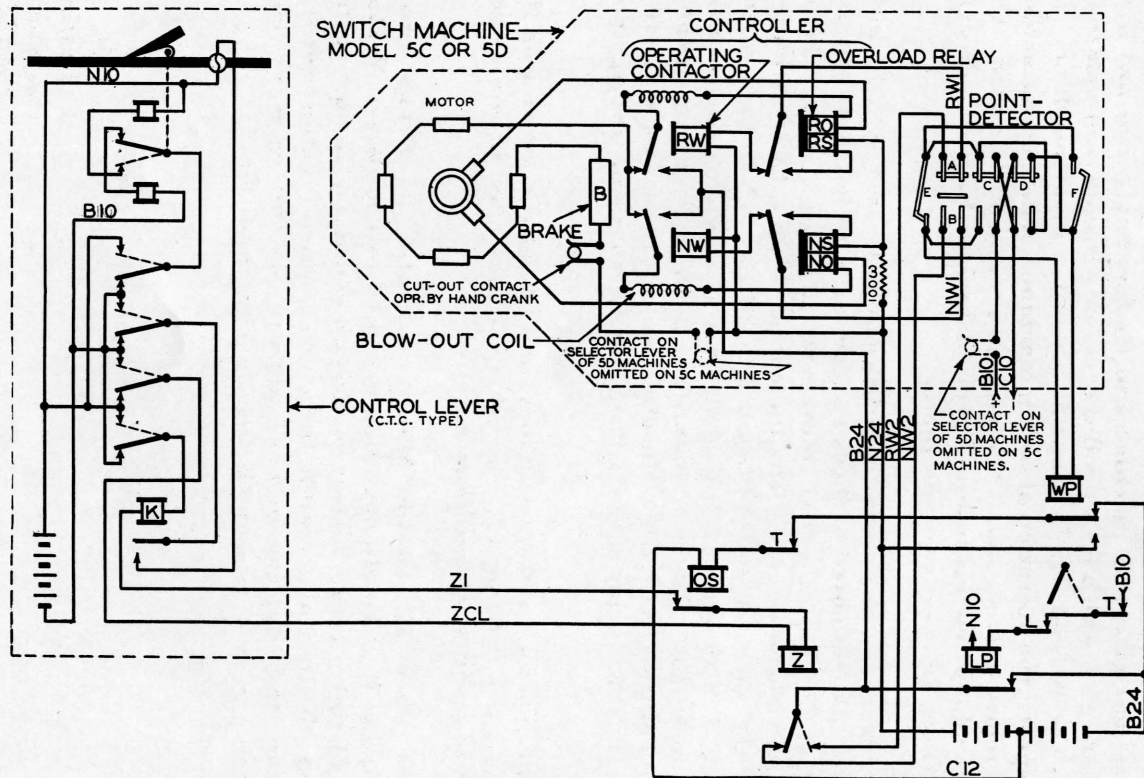


Figure 13 Typical Circuit Showing Relayed Control of Switch Machines, Models 5C and 5D

Figure 13 shows a typical circuit for the relayed control of a 20-volt, Model 5C Switch Machine where the interlocking between switch and signal circuits is accomplished in the field rather than in the control station. In this case, the master relay is omitted from the controller unit of switch machine and its function performed by a polarized Z relay, which is controlled over one wire and common from a G-R-S Centralized Traffic Control type of control machine. In other respects, the operation of switch machine, including contactors, overload relays, motor, etc., is the same as previously described. The 20-volt machine has an inserted type of brake which is bolted in place between the gear case and motor.

In Figure 13, the switch-repeating relay is located in the vicinity of switch and is employed to check the operation of signals directly, so that the indication of switch movement in control station is for information purposes only. The indication is given by a distinctive flash of "OS" light on control board when the switch unlocks at the beginning of its movement, and again when it is locked upon completion of movement. This is accomplished by the momentary opening of Z relay control circuit when the direction of current flow is reversed through the "OS" relay as the WP relay is de-energized, and again as it picks up.

The approach and detector locking is provided by cutting off the operating current by an LP relay which is controlled in connection with signal circuits as conditions require.

The Model 5C, 110-volt Machine operates the average single switch in 3 to 3½ seconds, operating current 5 to 6 amperes. Not less than a 24-volt storage battery is recommended for 20-volt switch machines, the time of operating the average switch ranging from 8 to 12 seconds, operating current 5 to 7 amperes. In both cases, switches are assumed to be in reasonably free working condition.

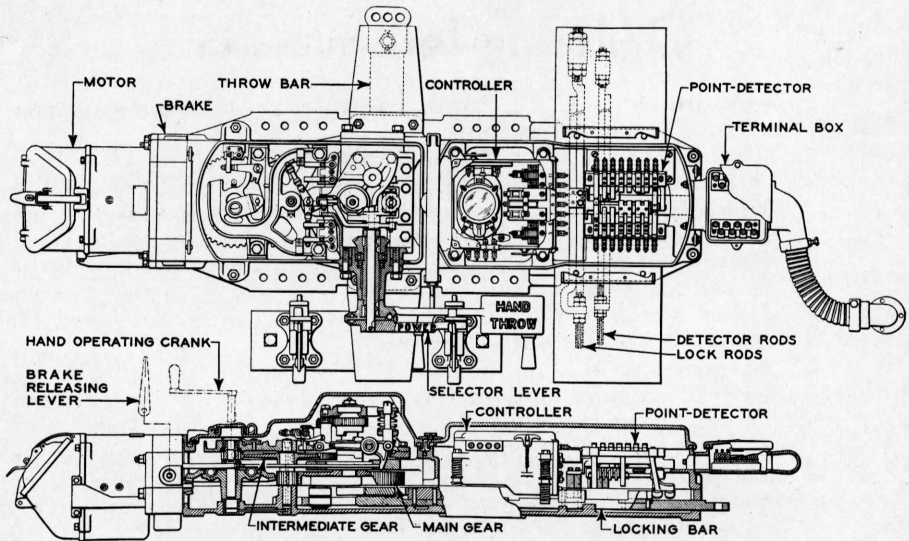


Figure 14 Model 5D Switch Machine, Dual-Control

The Model 5D, Dual-Control Switch Machine

This is the preferred machine for outlying switches because it has the built-in hand-throw levers like the Model 5B, whereby the switch can be hand operated quickly and conveniently in any emergency or for switching, and it also has the compact, self-contained controller unit and brake of the Model 5C, three desirable features that are not all available in any other machine.

The gear case assembly, containing the gearing and hand-throw levers, is identically the same as previously described for the Model 5B Machine. The controller unit assembly, including the optional master relay, two operating contactors and two overload relays, is identically the same unit employed with the Model 5C Machine.

All Model 5D Machines have the inserted type of electro-magnetic brake which is a separate unit bolted in between the gear case and motor. The brake is mechanically released by the reversal of selector lever from power to hand-throw position, otherwise it operates as previously described.

Ordering Information

In ordering Switch Machines, simply mention this Bulletin No. 161 and specify the following:—

1. Model number of machine desired.
2. Whether right or left-hand machine. (A right-hand machine is one located on right-hand side of track as you face the switch points.)
3. Voltage of motor required. (See page 3 of this bulletin.)
4. Lock and detector rod combination required. (See Catalog E Vol. 2, Sec. J, Part 31, Plate J 3127.) If lock rods are to be omitted, specify on order.
5. In ordering Models 5C and 5D Machines, specify whether with or without master relay. (See typical circuits, Figures 12 and 13, of this bulletin.)
6. If machines are required for unusual or special conditions, give full details.
7. Switch fittings, such as tie plates, throw rods, connecting rods, etc., are not included with switch machines, but we will furnish such fittings to meet the standard requirements of any railroad when provided with the proper plans and information.

GENERAL RAILWAY SIGNAL COMPANY
Rochester, N. Y.



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GENERAL RAILWAY SIGNAL IBERICA-S. A. E.
Layetana, 18, Barcelona, Spain

GENERAL RAILWAY SIGNAL COMPANY
Pty. Ltd.
440 Little Collins St., Melbourne, Australia

Order of Formation

1. The undersigned, being of legal age and sound mind, do hereby certify that the following persons have been admitted to the membership of the [Organization Name] on this [Date] day of [Month], 19[Year].

2. The names of the persons so admitted are: [List of Names]

3. The names of the persons who have been elected to the office of [Position] are: [List of Names]

4. The names of the persons who have been elected to the office of [Position] are: [List of Names]

5. The names of the persons who have been elected to the office of [Position] are: [List of Names]



ORDER OF FORMATION

NEW YORK CITY
MAY 1900

THE [Organization Name]
[Address]

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