PC Multiple Unit Control

General Electric Company
SCHENECTADY, N. Y.

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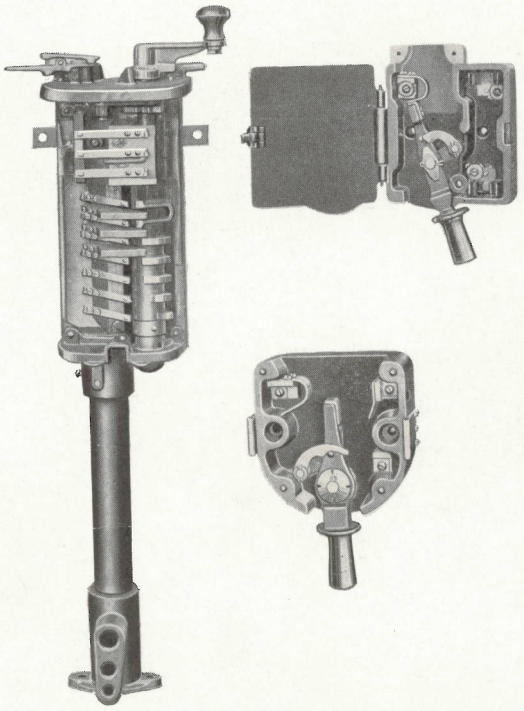
RAILWAY APPARATUS

TYPE PC MULTIPLE UNIT CONTROL



Master Controller and Cab Switches

The Sprague-General Electric multiple unit control system was designed primarily to permit trains of motor cars, when coupled in any combination, to be operated as a single unit from either end of any car of the train. It has also been very generally used on individual equipments.

Fundamentally, the system for each motor car may be considered as consisting of a motor controller, master controller, resistors, cable and motors. The motor controller comprises a set of apparatus, which handles directly the current for the motors, while the master controller merely governs the operation of the motor controllers and consequently does not handle the larger currents necessary in the motor circuit.

The latest development in the Sprague-General Electric multiple unit control system is the cam-operated motor controller, known as Type PC. Before designing this controller, a thorough analysis of all existing control systems was made. The result is the improvements in design and operation, which practically eliminate the failures in service previously experienced.

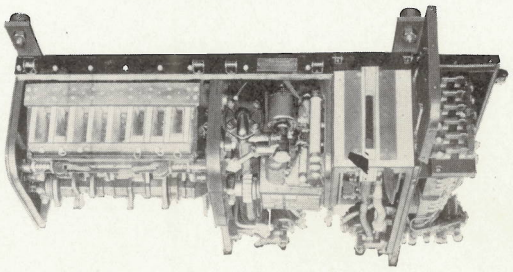
Car equipments may be roughly divided into two classes, one for city and light interurban service and the other for elevated, subway, and heavy interurban work. To meet the requirements of service in the best manner, the Type PC control has been designed in two general sizes. The small size for city and light interurban service is small enough to install on the modern city car with low steps and 24-in. wheels. The large size controller is for elevated, subway, or heavy interurban service. These two sizes are necessary, owing to the difference in current capacities required. Each size possesses the same features of sturdiness, accessibility, and safety.

Various forms of each size of controller cover the car equipment field, which includes cars with two full field motors, cars with two tap-field motors, and the same combinations using four motors. These various forms differ only in the reversers, motor cutouts and wiring. In fact, the four-motor full-field controller is used with four tap-field motors by adding a separate switch for tapping the fields.

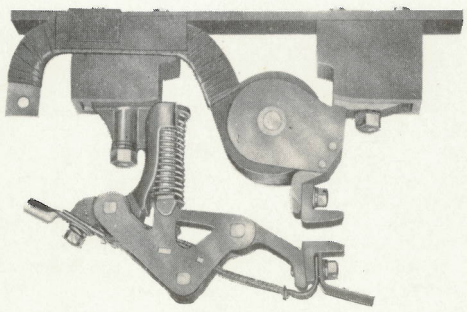
The cam controller is more analogous to the simple drum controller than any previous multiple unit control, as the cams absolutely insure a definite sequence and fixed relationship of closing and opening the contactors, which is unobtainable with individually operated contactors. At the same time, the combining of all the motor circuit control elements, such as the line breaker, overload relay, accelerating relay, contactors, reverser, and motor cutouts in a single box reduces the materials required and time of installing. In addition to this feature there is a decrease in weight of the controller itself as well as the elimination of a number of iron hangers which are needed when suspending an equipment consisting of several separate pieces of apparatus.

The use of cams and cam shaft, giving a definite sequence of closing and opening the contactors, is of particular advantage in that it substitutes mechanical interlocking for the electrical interlocking required with individually operated contactors of previous control systems. This feature makes a very strong appeal to the operating man who has experienced trouble in the past with the small contacts of electric interlock switches.

This substitution of mechanical for electrical interlocking has made feasible a control system for automatic current limit acceleration that is less complicated than previous automatic controls of either magnetically or pneumatically operated contactors.



Small 600-volt PC Cam-operated Controller



Small Contactor

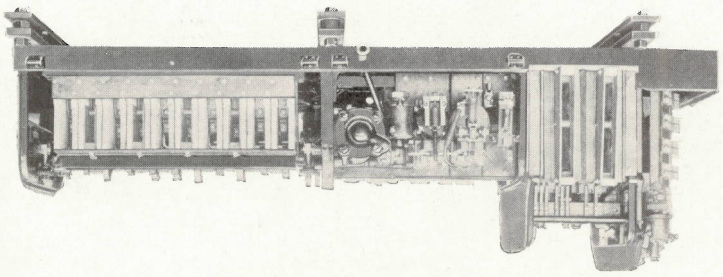
Automatic acceleration has been desired in the past but the additional complication, necessary with individually operated contactors, has more than offset the advantages for all but a few classes of service. The simple arrangement of control circuits with the cam-type control has made it possible to use automatic control for all classes of car equipment. This has proved of advantage in saving power and reducing shocks to the equipment, and as a smooth acceleration is obtained without any attention from the motorman, greater comfort results for the passengers. At the same time the motorman can give his undivided attention to signals or to traffic in front of the car. This is of great importance today with the congested condition of traffic in city streets.

RAILWAY APPARATUS

TYPE PC MULTIPLE UNIT CONTROL

While an acceleration depending upon a fixed current value is suitable for all normal conditions of electric car operation, emergencies arise, such as starting a car on a steep grade or on a curve, where some means of increasing the torque on the motors is essential. Provision is made in the cam system control for such emergencies by including on the master controller a separate handle, called an advance lever. The control is so arranged that pushing this lever forward advances the motor controller one step, independently of the current flowing through the accelerating relay. By releasing the advance lever and again pushing it forward, the motor controller will advance another step. If desired the motor controller may be advanced through its entire progression in this manner, independently of the current in the accelerating relay.

As the cam controller requires only a very small amount of electric energy for operating its magnet valves, either battery or trolley current may be used as a source of supply. On 600-volt equipments, trolley potential is used with resistor tubes connected in series with the operating coils to reduce the current to a value low enough for the satisfactory operation of the coils. In special cases where some other feature of the equipment has determined the control voltage, as automatic electric couplers, controllers for battery potential have been manufactured.

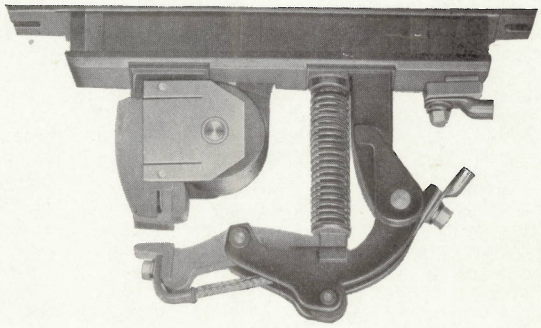


1500-volt PC Controller

The ability to operate the control with very little electric energy and from almost any voltage is particularly fortunate with 1500-volt equipments, where some low-voltage source of power is essential for the auxiliary circuits.

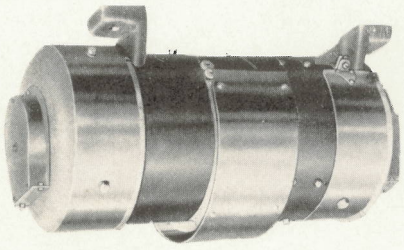
As the control does not determine the voltage, a value can be selected for these auxiliary circuits that will allow the car lights to be connected in parallel instead of the usual practice of several circuits, each circuit having five lamps connected in series, and will also permit of the use of a headlight without an external resistance. Thirty-two volts meets these requirements admirably as this is a standard voltage for train lighting lamps and as it also allows the filament of a headlight lamp to be concentrated near the focal point of the reflector. A headlight with one of these lamps gives a powerful beam on the tracks with sufficient side diffusion to show up objects readily along the sides of the railroad.

The current for these auxiliary circuits is supplied from the trolley through a unique type of motor-generator set. This set furnishes almost constant generator voltage even though the motor voltage may vary through a wide range. This regulation is accomplished without the use of an external regulator. The constant potential insures having a powerful and brilliant headlight and uniform interior lighting of the car, which latter is readily appreciated by all.



Large Contactor

TYPE RVG CAR LIGHTING SET



The RVG Car Lighting Set

This motor-generator set is also suitable for 600-volt interurban car lighting. With the common line variations of 450 to 650 volts, the generator voltage varies a maximum of ½ of a volt.

This means 6 per cent change in the candle-power of the MAZDA lamp instead of 70 per cent as would have been the case with the lamps operating direct from the line.

Several installations have been in service where it has been shown that not only better car lighting and safer, more powerful headlight service has been obtained by use of the Type RVG car lighting set, but that its installation has resulted in greater operating economies than were possible with the ordinary series layout.

Complete information may be had upon application.

RAILWAY APPARATUS

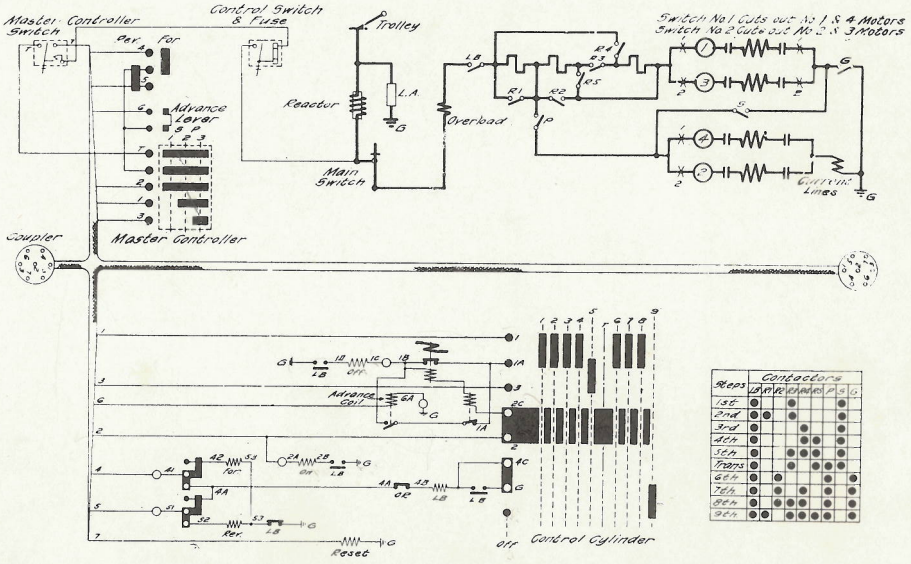
TYPE PC MULTIPLE UNIT CONTROL

TYPE PC CONTROLLERS FOR 600-VOLT SERVICE WITH MAXIMUM PEAKS OF 750 VOLTS

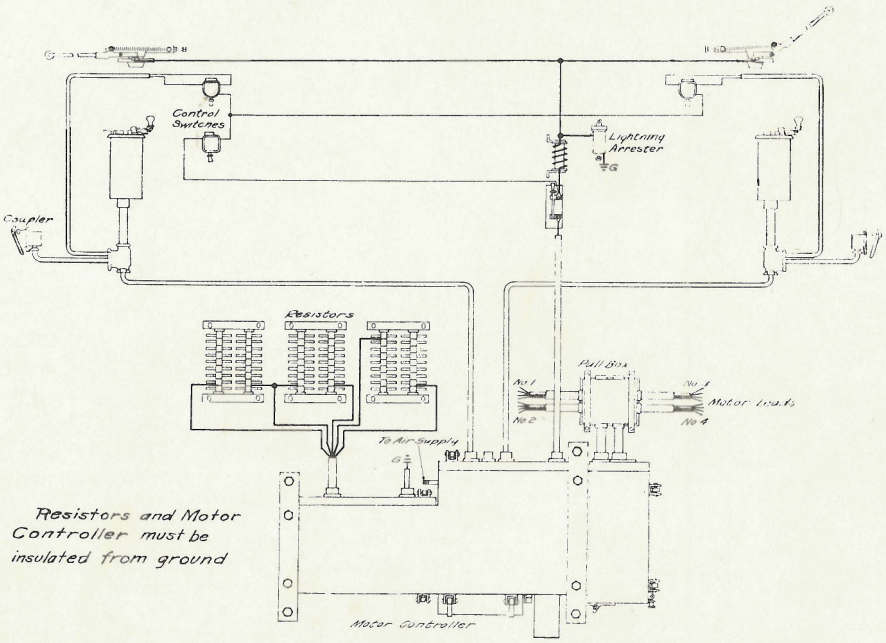
Controller	No. of Motors	MAXIMUM ALLOWABLE CAPACITY OF EACH MOTOR		Field	Weight in Lb.	Return Circuit
		Hourly Rating H.P. on 600 Volts	Continuous Rating Amperes			
PC-5	4	70	75	Full	530	Ground
PC-6	2	140	135	Full	530	Ground
PC-9	2	70	75	Tap	530	Ground
PC-10	2	250	200	Full or Tap	1027	Ground
PC-12	4	150	140	Full	980	Ground
PC-13	2	250	200	Full	1025	Metallic
PC-14	4	125	110	Full	1000	Metallic
TYPE PC CONTROLLER FOR 1200- AND 1500-VOLT SERVICE WITH MAXIMUM PEAKS OF 1650 VOLTS						
PC-101	4	150	140	Full	1140	Ground

For complete information refer to our nearest sales office.

CONNECTIONS



Connections of PC Cam-operated Controller and Four Motors



Arrangement of Car Equipment with PC Cam-operated Controller