GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

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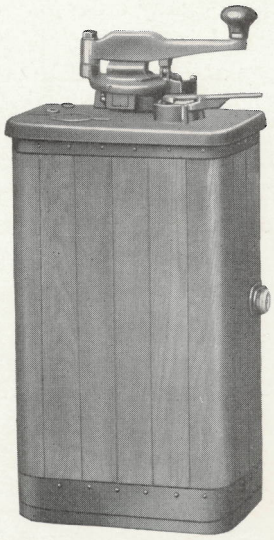
DRUM-TYPE CONTROLLERS FOR RAILWAY SERVICE

The three important types of drum controllers for railway service are Types K, B, and R, each having distinctive characteristics.



TYPE K-75 CONTROLLER WITH LB-2 CONTROL DEVICE

The Type K is essentially a two-speed controller for series and parallel operation and is the type most generally in use.

The Type B is also for series and parallel operation but is not so extensively employed, since it is arranged to function for both power and braking.

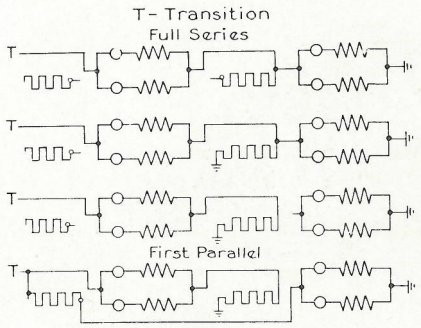
The Type R differs from both Types K and B, inasmuch as it is designed for resistance control of either a single motor or groups of motors always in fixed relation; that is, in series or in parallel. The application of this type of controller is somewhat limited. It is seldom used except for small single-motor equipments for special service such as the control of motors for revolving brooms of snow plows, and other auxiliary devices.

Type K Controllers

The principal characteristics of this type of controller have remained unchanged for many years, although marked improvement in details have been made from time to time to meet the increasing requirements of service. Furthermore, many features in the design of Type K controllers are common to all types and are essentially as follows:

1. Separate power and reverse cylinders with their respective handles mechanically interlocked to prevent improper operation.
2. Star wheels for both main and reverse cylinders to give pronounced steps and locations for various positions of the handle.
3. Magnetic blowout and arc-resisting shields with suppressor plates to rupture arcs promptly when breaking circuits.
4. Cutout switches for disconnecting a damaged motor or pair of motors while still permitting the operation of the remaining motors.
5. Asbestos-lined, wooden covers which can readily be removed.
6. Easy replacement of parts subjected to wear, such as fingers and segments.
7. Emergency stops can be made with either the four-motor or two-motor controllers by converting the motors into generators. For four-motor controllers, this is done by throwing the reverse cylinder to the position which would give the opposite direc-

tion of car motion with power on. For two-motor controllers, in addition to turning the reverse cylinder, the circuit breaker must be opened and the controller handle turned to some parallel position.



TRANSITION CONNECTIONS

Transition

Type K controllers effect the change from series to parallel connections of motors by cutting off the power from only half the motors on a car. In this manner, the circuit is never interrupted. This results in smooth acceleration.

With controllers for small motors, the transfer of connections from series to parallel is effected by the "K" method, where the low side of half of the motors on the car is grounded before the circuit is opened, the second half then being put in parallel with the first.

With larger motors, the "T" method of transfer is used where ground is tapped in through a resistance between half the motors on the car before the second half is put in parallel.

Details of Design

Individual magnetic blowouts for each finger or group of fingers in parallel, which is subjected to arcing, are used for the main cylinder for all but low-capacity controllers. This type of blowout insures the arc being ruptured positively and with little burning at the tips and segments. For some of the smaller controllers where only low currents are ruptured, the single-coil blowout with a magnetic field common to all fingers gives efficient results.

Substantial contact fingers of the hinged type with renewable tips are now standard for cylinders where current is broken. These fingers seldom have to be replaced and give practically uniform pressure irrespective of tip wear.

Segments with renewable lap-type burning tips effectively held in place are used on the main cylinder.

Body castings which carry the segments are insulated from the shaft by removable hexagonal insulation.

Cable troughs for incoming leads, improved cutout switch with reinforced contact blades, better reverse-cylinder construction, provision for installing the line breaker control device on the cap plate, and many other improvements are now incorporated in modern controllers, insuring satisfactory and economical operation.

Type K Controller for 600 Volts

The Types K-35 and K-75 are representative railway controllers for 600-volt car equipments where the peak potential does not exceed 750 volts.

The two types differ primarily in that the K-75 has been designed in contemplation of the motorman remaining seated during operation, and cutout switches are omitted; while the K-35 requires

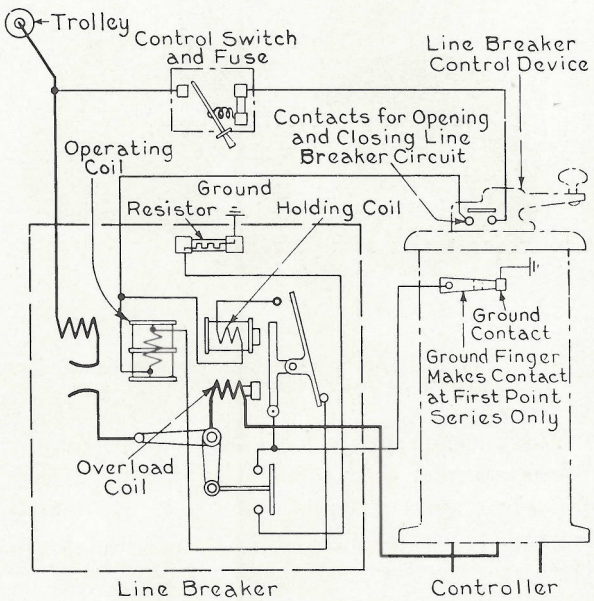


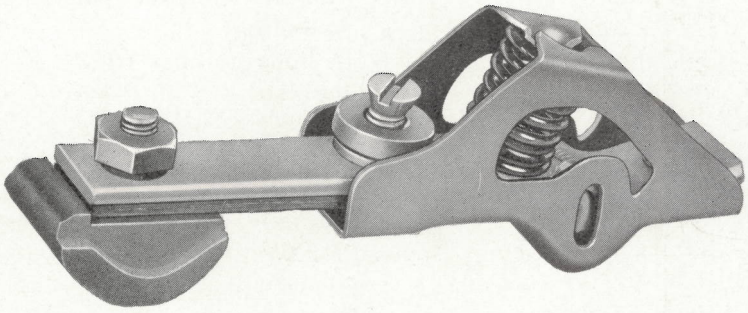
DIAGRAM OF CONNECTIONS FOR LB-2 DEVICE AND DB-986 LINE BREAKER

him to stand, and the cutout switches are part of the controller.

The K-75 is, therefore, much lower and lighter than the K-35 and simpler because of the omission of the cutout switches, which are located elsewhere. However, when it is desirable to operate the K-75 controller at a height which corresponds to the Type K-35, it can be mounted upon a pedestal box known as the DH-99A especially developed for its support and as a convenient housing for the cutout switches.

When the support is not used, Type DH-98 cutout switches are located under the car. One cutout switch per car is used, which permits series-parallel operation of the motors after a pair has been cut out.

The physical characteristics, such as dimensions and general appearance of these two controllers, as well as their rating, are given in accompanying tables and cuts together with similar data for various other standard Types K, B, and R controllers.

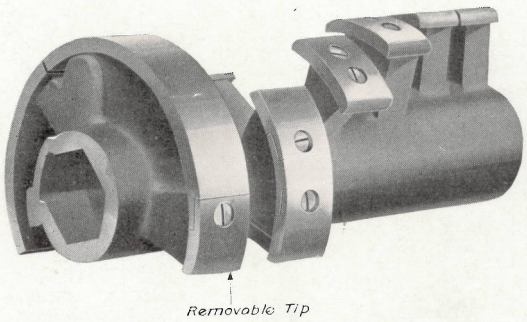


HINGED-TYPE FINGER

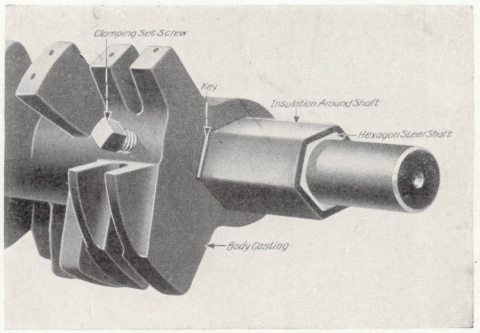
Type K Controller for 1500 Volts

The K-47 controller is suitable for 1200- and 1500-volt operation, but in all cases must be supplemented by a line breaker and line breaker control device.

The controller is designed for series and parallel operation and is essentially the same as those for 600 volts although arranged for higher insulation and increased creepage surfaces.



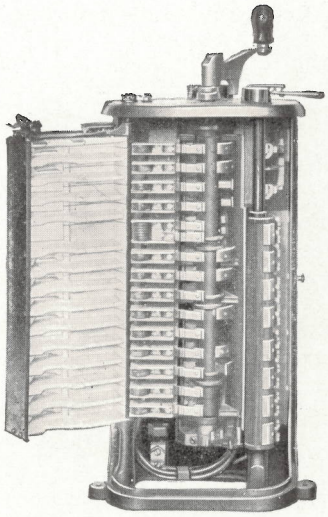
BODY CASTING FOR TYPE K CONTROLLERS SHOWING METHOD OF FASTENING REMOVABLE TIPS



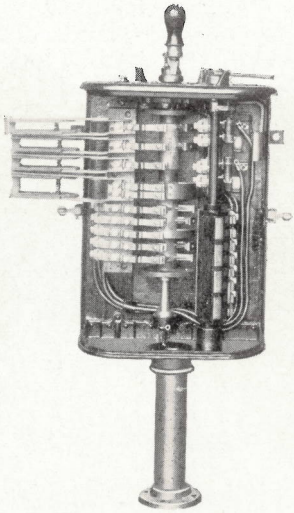
CYLINDER CASTING WITH REMOVABLE SHAFT INSULATION

Type K Storage Battery Controllers

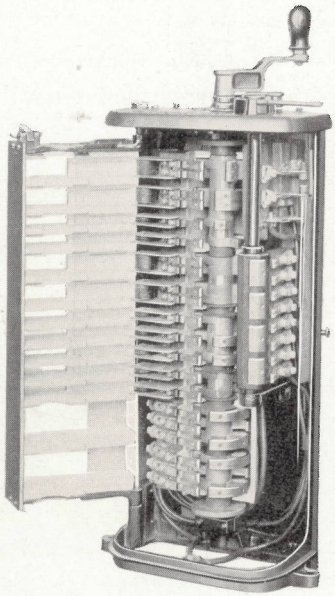
The K-45 and K-52 controllers have been developed especially for storage-battery cars. The former are for use with two 125-volt or 250-



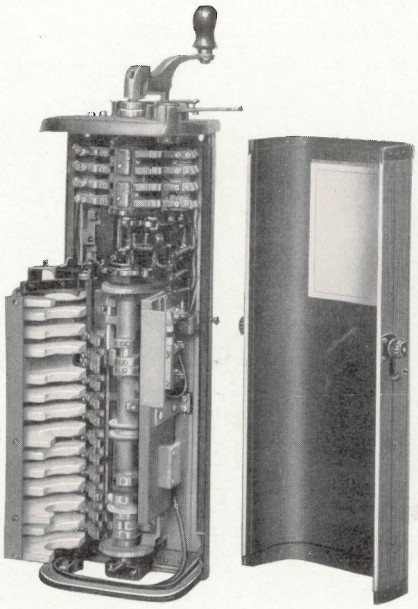
TYPE K-35 CONTROLLER



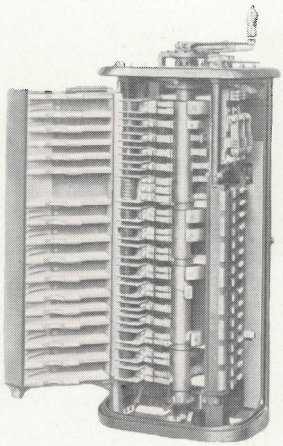
TYPE K-45 CONTROLLER



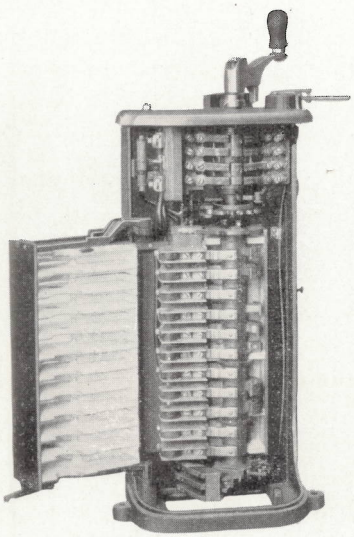
TYPE K-51 CONTROLLER



TYPE K-63 CONTROLLER



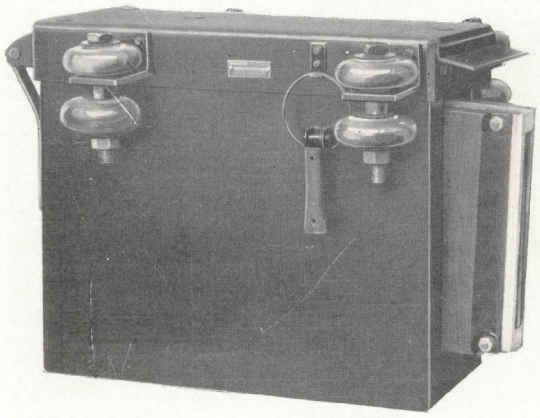
TYPE K-64 CONTROLLER



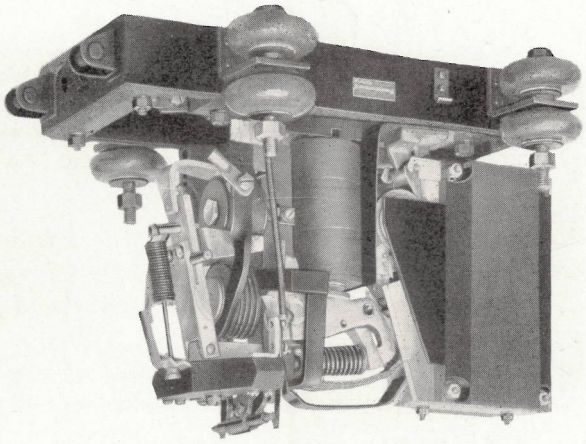
TYPE K-68 CONTROLLER

volt motors, and the latter with four 125-volt motors.

The general features of 600-volt controllers are embodied in these controllers.



DB-986-A LINE BREAKER



DB-986-A LINE BREAKER, COVER REMOVED

Type B Rheostatic Braking Controllers

The fundamental principle upon which the action of rheostatic braking is based is the conversion of the motors into generators which derive their power from the momentum of the car and convert it into electric energy for rheostatic absorption. The retardation of the car is, therefore, entirely independent of the current from the trolley and is proportional to the energy absorbed in the resistors.

Controllers for this service are known as the Type B and are essentially the same as the Type K with additional contacts for establishing the circuits necessary for braking. Their operating handles may be turned forward through a number of notches to give series and parallel connections for power running, as in K controllers, or may be turned in the reverse direction from the off position through a number of notches to establish braking connections and to vary the braking effort by varying the resistance in the circuit.

Additional braking effort may be obtained by the use of magnetic brake shoes energized by the current thus generated.

The Types B-54 and B-65 are representative and standard types of controllers for rheostatic braking, the B-54 being designed for two-motor and the B-65 for four-motor control. The two types differ mechanically, inasmuch as the commutation of connections for braking is effected by segments mounted on the reverse cylinder for the B-65, while, for the B-54, braking connections are established by segments on a wooden drum mounted on the main cylinder shaft. The manual operation of the controllers is, however, essentially the same.

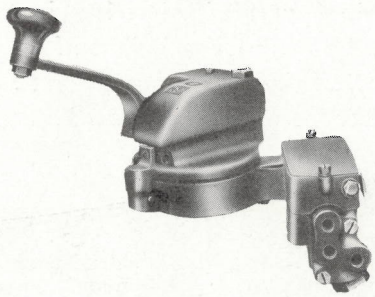
Type R Controllers

Type R controllers are, in general, similar in construction to the Types B and K controllers but with fewer parts, as they neither change the grouping of motors by series and parallel connections nor function for braking.

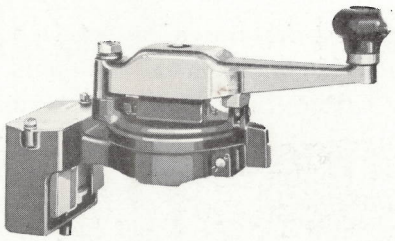
In the larger types, the fingers are provided with individual blowouts, while for small capacities a single coil and common magnetic field for all fingers are employed to rupture the arcs. The standard types and forms of R controllers with rating and other characteristics are given on page 7.

Line Breaker Equipment for Drum Controllers

Line breaker equipments are available as auxiliary apparatus for drum controllers designed primarily for the purpose of preventing severe arcing from the controller fingers by



LB-4 CONTROL DEVICE FOR CARS EQUIPPED WITH SAFETY AIR FEATURES



LB-2 CONTROL DEVICE FOR CARS WITHOUT SAFETY AIR FEATURES

transferring the circuit to be ruptured to a line breaker located under the car body.

The G-E line breaker equipment consists of a magnetically actuated contactor with control resistances and overload trip coil encased in a sheet-metal box suitable for installation under the car; a control device for mounting on the cap plate of the controller for operating the contactor in conjunction with the controller; and a combined switch and fuse for the control circuit which replaces the usual hood circuit breaker. The schematic diagram on page 2 shows the method of wiring and typical connections.

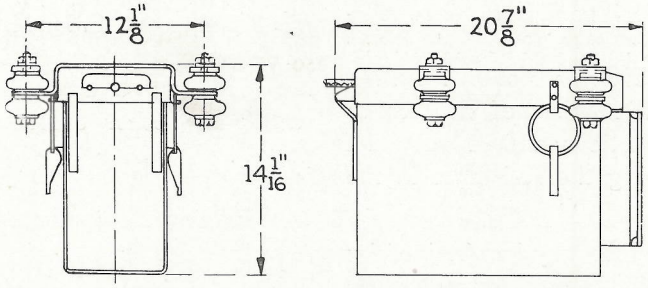
Line Breaker

The line breaker is magnetically operated and is provided with contact tips that can easily and economically be renewed. A powerful magnetic blowout coil with an adequate arc chute insures the rupturing of the arc under all service conditions. The trip, which causes the line breaker to open the main motor circuit on overload, or short circuit, has a wide calibration range, thereby permitting a setting at almost any desired overload value. The line breaker operates over a large variation in trolley voltage.

There are two standard types—the DB-986-A line breaker for ordinary car equipments not employing safety air features, and the DB-987-A for equipments using the safety air features. The DB-987-A is the same as the DB-986-A except that it is provided with an air cylinder for tripping the relay armature to apply the brakes and is controlled by an air valve in the LB-4 control device.

Line Breaker Control Device

The operating handle, known as the line breaker control device, is designed to turn the controller cylinder and operate the line breaker for drum controller equipments. This device replaces the usual main operating handle of the controller, as well as the ratchet switch, slip-ring, or cam-operated contacts which formerly were placed inside the controller.



OUTLINE OF DB-986 LINE BREAKER BOX

TYPE B CONTROLLERS FOR 600-VOLT ELECTRIC BRAKING SERVICE WITH MAXIMUM PEAKS OF 750 VOLTS

Type	No. of Motors	MAXIMUM ALLOWABLE CAPACITIES OF EACH MOTOR (NEITHER TO BE EXCEEDED)		NUMBER OF POINTS			Approx. Wt. in Lb.	Remarks
		Hourly Rating Hp. at 600 Volts	Continuous Rating Amperes	Series	Parallel	Braking		
B-50-B	4	60	53	5	4	9	492	Individual blowout coils
B-51-B	2	120	105	5	4	9	492	Individual blowout coils
B-54-E	2	75	75	4	3	7	288	Individual blowout coils
B-65-A	4	50	50	5	4	6	337	Individual blowout coils

The important characteristics of the device is that the movement of the handle and the opening or closing of the control contacts take place before the controller drum is moved. This is accomplished by providing a small amount of lost motion between the operating lever to which the knob is attached and the shroud which is keyed to the controller shaft. In this way the motor circuit is opened by the line breaker rather than by the controller.

The LB-2 control device has a fixed handle and is designed for use on cars not equipped with safety air features. The LB-4 control device is similar to the LB-2 except that it has a small pilot valve which actuates the safety features of the standard safety car equipment and employs a removable operating handle Cat. No. 234199 which is identical with that used with the standard safety car equipment.

The LB-2 control device complete weighs 13 pounds, and the LB-4 complete with handle weighs 20 pounds.

TYPE R RHEOSTATIC CONTROLLERS, 600 VOLTS MAXIMUM

Type	No. of Motors	MAXIMUM ALLOWABLE CAPACITIES OF EACH MOTOR (NEITHER TO BE EXCEEDED)		Number of Points	Approx. Wt. in Lb.
		Hourly Rating Hp. at 500 Volts	Continuous Rating Amperes		
R-17-A	1	50	55	6	180

TYPE R CONTROLLERS FOR 1500-VOLT RHEOSTATIC CONTROL SERVICE WITH MAXIMUM PEAKS OF 1650 VOLTS

Type	No. of Motors	MAXIMUM ALLOWABLE CAPACITIES OF EACH MOTOR (NEITHER TO BE EXCEEDED)		Number of Points	Approx. Wt. in Lb.	Remarks
		Hourly Rating Hp. at 750 Volts	Continuous Rating Amperes			
R-200-B	2	90	65	6	245	Individual blowout coils. Two motors are connected permanently in series and treated as one

CORRECT CONTROL DEVICES FOR VARIOUS CONTROLLERS

Type of Controller	Hourly Rating at 600 Volts	CONTROL DEVICES			
		Without Safety Air Features	Cat. No. of Equipment	With Safety Air Features	Cat. No. of Equipment
B-54-E	2 75-hp. Motors	LB-2-E	2822886	LB-4-D	71-D-123
K-35-PP	4 65-hp. Motors	LB-2-A	2668870	LB-4-A	81-C-95
K-35-QQ	4 65-hp. Motors	LB-2-A	2668870	LB-4-A	81-C-95
K-35-KK	4 65-hp. Motors	LB-2-A	2668870	LB-4-A	81-C-95
K-35-JJ	4 65-hp. Motors	LB-2-A	2668870	LB-4-A	81-C-95
K-68-A	2 70-hp. Motors	LB-2-A	2668870	LB-4-A	81-C-95
K-51-D	2 70-hp. Motors	LB-2-G	71-D-131	LB-4-E	71-D-134
K-63-G	2 40-hp. Motors	LB-2-A	2668862	LB-4-A	81-C-102
K-64-D	4 110-hp. Motors	LB-5-A	81-C-31		
K-75-A	4 50-hp. Motors	LB-2-F	71-D-84	LB-4-C	71-D-86

DIMENSIONS OF TYPE K CONTROLLERS (Inches)

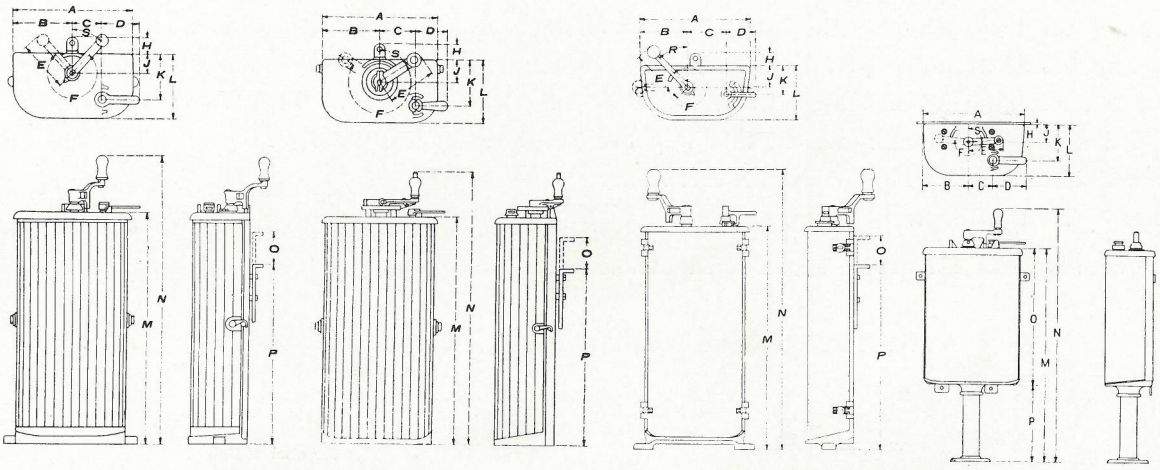


FIG. 1 FIG. 2 FIG. 3 FIG. 4

Type	Fig.	A	B	C	D	E	F Deg.	H	J	K	L	M	N	O	P	R Deg.	S
K-35-JJ, -KK, -PP, -QQ	1	18 5/8	9 11/16	4 5/8	5 3/4	8	264	2 11/16	3 1/4	6 9/16	9 3/4	36 7/8	44 7/8	4 1/2	26 15/16		48
K-68-A, -C	1	16 3/4	10	4	5 3/4	8	264	2 11/16	3 1/4	6 1/4	9 13/16	36	44 1/2	4 5/8	27 11/16		48
K-39-C	1	16 3/4	10	4	5 3/4	8	264	2 11/16	3 1/4	6 1/4	9 13/16	39 1/2	48	4 1/2	31 7/16		48
K-40-B	1	18 5/8	9 11/16	4 5/8	5 3/4	8	264	2 11/16	3 1/4	6 9/16	9 3/4	42	50 1/2	4 1/2	26 15/16		48
K-45-F, -G	4	17 3/4	8 3/16	4	5 3/4	6	190	3/8	3	6	8 5/8	36	42 15/16	23	13		85
K-47-C	2	22 1/4	10 5/8	6 1/2	5 3/4	8	300	2 11/16	4 1/8	8 3/8	11 7/8	43 11/16	52 1/8	4 1/2	33 1/2		30
K-51-D	1	18 1/16	9 5/16	4 5/8	5 3/4	8	290	2 19/32	3 9/16	6 7/8	10 1/16	36 3/8	44 7/8	4 1/2	30 7/16		35
K-52-B	1	17 3/4	8 3/16	4	5 3/4	6	190	1/4	3	6	8 5/8	36	42 7/8				89
K-63-G	1	12 5/8	6 7/16	4	4 1/2	8	300		3 3/16	6 3/16	8 1/8	35 1/2	44 9/16				30
K-64-D	2	22 1/4	10 5/8	6 1/2	5 3/4	9 1/2	244	2 11/16	4 1/8	8 3/8	11 7/8	43 5/8	51 1/2	4 5/8	33 1/2		58
K-75-A	5	15 3/4	7 9/16	4 1/4	5 3/4	8 1/4	317		3 15/16	6 11/16	10 9/16	25 1/8	32 11/16	10 9/16	10 7/8		30

DIMENSIONS OF CONTROLLERS (Inches)

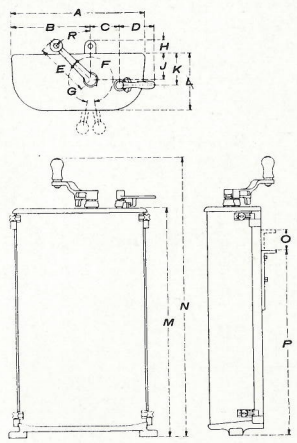


FIG. 5

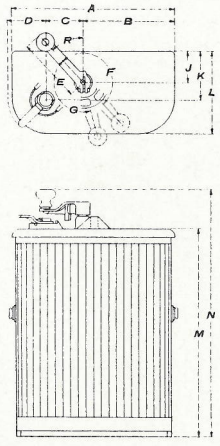


FIG. 6

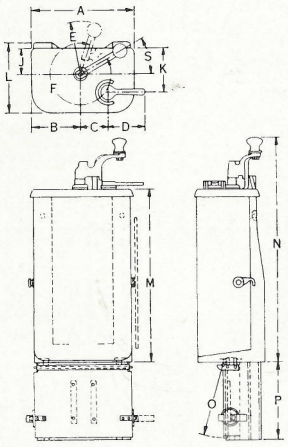
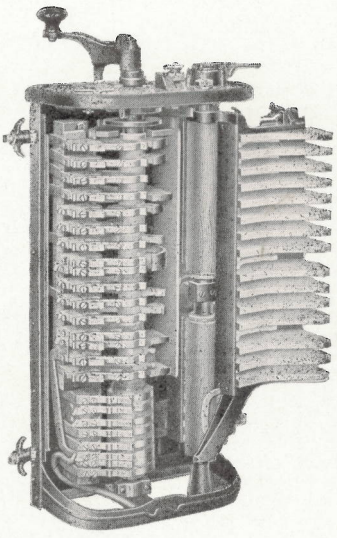
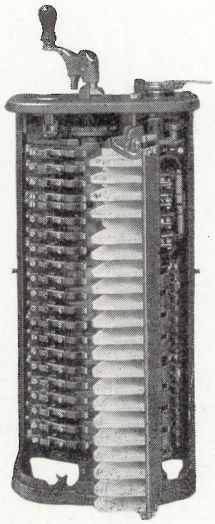


FIG. 7

Type	Fig	A	B	C	D	E	F Deg.	G Deg.	H	J	K	L	M	N	O	P	R Deg.	S Deg.
B-50-B	6	25	14	$5\frac{5}{8}$	6	$9\frac{7}{8}$	185	148		$4\frac{3}{4}$	$7\frac{1}{4}$	$12\frac{3}{4}$	$43\frac{1}{4}$	$49\frac{1}{8}$			45	
B-51-B	6	25	14	$5\frac{5}{8}$	6	$9\frac{7}{8}$	185	148		$4\frac{3}{4}$	$7\frac{1}{4}$	$12\frac{3}{4}$	$43\frac{1}{4}$	$49\frac{1}{8}$			45	
B-54-E	7	$18\frac{5}{8}$	$8\frac{3}{8}$	$5\frac{7}{8}$	$5\frac{3}{4}$	$8\frac{1}{4}$				$4\frac{5}{16}$	$6\frac{5}{16}$	$10\frac{1}{2}$	$35\frac{7}{8}$	$41\frac{7}{16}$		$30\frac{1}{8}$		
B-65-A																		
R-17-A	3	$17\frac{1}{2}$	$7\frac{7}{16}$	$6\frac{11}{16}$	$5\frac{3}{4}$	8	315		$2\frac{1}{2}$	$3\frac{3}{16}$	$4\frac{5}{16}$	$8\frac{3}{16}$	$33\frac{3}{16}$	$41\frac{11}{16}$	$4\frac{5}{8}$	$28\frac{15}{16}$	45	
R-200-B	1	$18\frac{5}{8}$	$9\frac{11}{16}$	$4\frac{5}{8}$	$5\frac{3}{4}$	8	205		$2\frac{11}{16}$	$3\frac{1}{4}$	$6\frac{9}{16}$	$9\frac{3}{4}$	$36\frac{3}{8}$	$44\frac{15}{16}$	$4\frac{1}{2}$	$26\frac{15}{16}$		$77\frac{1}{2}$



TYPE B-54 CONTROLLER



TYPE B-65 CONTROLLER

STANDARD TYPE K CONTROLLERS

These controllers are standard for commutating pole motors. The ratings in the following tables are based on the hourly rating of the motors at normal voltage, and the continuous rating at three-quarters normal voltage. Care must be taken in selecting controllers for a given motor equipment not to exceed either the hourly rating in horsepower or the continuous rating in amperes. The tabulation of controllers and central devices on page 8 will serve to identify standard controllers for which the control device is applicable.

TYPE K CONTROLLERS FOR 250-VOLT STORAGE BATTERY SERVICE WITH MAXIMUM PEAKS OF 275 VOLTS

Type	No. of Motors	MAXIMUM ALLOWABLE CAPACITIES OF EACH MOTOR (NEITHER TO BE EXCEEDED)		NUMBER OF POINTS		Approx. Wt. in Lb.	Remarks
		Hourly Rating Hp. at 250 Volts	Continuous Rating Amperes	Series	Parallel		
K-45-F	2	32	70	4	3	122	For full field operation
K-45-G	2	32	70	4	3	122	For shunted field operation
K-52-B	4	16	35	4	3	127	For shunted field

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

Type	No. of Motors	MAXIMUM ALLOWABLE CAPACITIES OF EACH MOTOR (NEITHER TO BE EXCEEDED)		NUMBER OF POINTS		Approx. Wt. in Lb.	Remarks
		Hourly Rating Hp. at 600 Volts	Continous Rating Amperes	Series	Parallel		
K-35-JJ	4	65	60	5	3	290	
K-35-KK	4	65	60	5	3	228	
K-35-PP	4	65	60	5	3	228	
K-35-QQ	4	65	60	5	3	290	Aluminum alloy frame
K-68-A	2	70	66	4	4	225	
K-39-C	4	70	66	4	4	230	
K-40-B	4	65	60	5	3	280	For metallic return circuit
K-51-D	2	70	66	5	4	250	For metallic return circuit
K-63-G	2	40	38	4	3	135	For tapped field motors
K-64-D	4	110	105	6	4	450	
K-75-A	4	50	50	5	3	148	
K-80-A	2	50	50	5	3	148	

TYPE K CONTROLLERS FOR 1200-VOLT SERVICE WITH MAXIMUM PEAKS OF 1350 VOLTS

Type	No. of Motors	MAXIMUM ALLOWABLE CAPACITIES OF EACH MOTOR (NEITHER TO BE EXCEEDED)		NUMBER OF POINTS		Approx. Wt. in Lb.	Remarks
		Hourly Rating Hp. at 250 Volts	Continuous Rating Amperes	Series	Parallel		
K-47-C	4	75	65	6	4	437	Two motors permanently connected in series

SIZES OF CABLE FOR CAR EQUIPMENTS

Hp. of Motor at 600 Volts	TROLLEY AND GROUND CABLE		MOTOR CABLE		RESISTOR CABLE		
	2-Motor	4-Motor	1-Motor	2-Motor	1-Motor	2-Motor	4-Motor
25	5	2	6	5	6	6	5
40	4	1	6	4	6	6	4
50	4	0	6	3	6	6	3
65	3	2/0	5	1	6	5	1
75	1	3/0	4	0	6	4	0
100	0	4/0	3	2/0	6	3	20
125	2/0	300000CM	2	3/0	5	2	3/0
140	3/0	350000CM	1	4/0	5	1	4/0
165	3/0		1		4	1	
190	4/0		0		3	0	

Cables for Car Equipment

The cables for car equipment have seven tinned copper strands for all sizes smaller than No. 1 B & S gauge, while No. 1 B & S and larger have nineteen tinned copper strands. Cotton or paper, depending upon the size of cable, is used as a separator between the bare cable and rubber compound, the compound conforming to the National Electric Code standards. As a final protection, the rubber is covered with a single layer of rubber-treated tape and one of cotton braid, and the cable is then subjected to a weather-proofing process.

In the above table, 1-motor, 2-motor, etc., indicate that the cable carries the current of a single motor in the former and of two motors in the latter case. The numbers are American Wire gauge sizes.

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