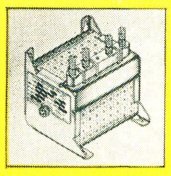
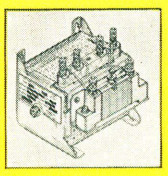
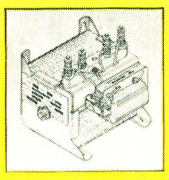
A G-R-S RECTIFIER FOR EVERY SIGNALING NEED



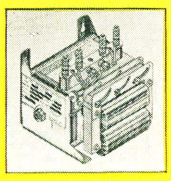
B
Rectifier with no regulating means.



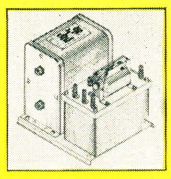
BR
Rectifier and resistor for regulating charge rate.



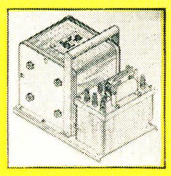
BX
Rectifier and adjustable reactor for regulating charge rate.



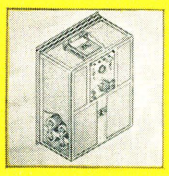
BT
Rectifier and adjustable reactive transformer.



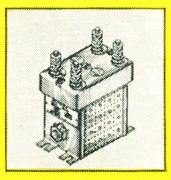
BQX
Rectifier and reactor and transformer with or without taps.



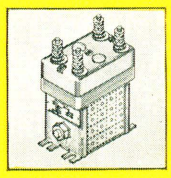
BQX Portable
Same as BQX, equipped with handle, snap-on connectors.



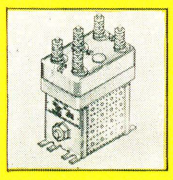
BP
Rectifier with control board, jacks, meters, rotary switch for adjusting charge rate.



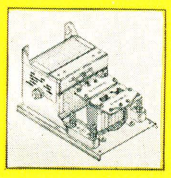
B½
Low capacity rectifiers with no regulating means.



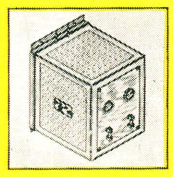
BQ½
Low capacity rectifier with transformer.



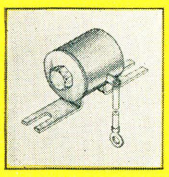
BQA½
Low capacity rectifier with transformer, center-tapped primary.



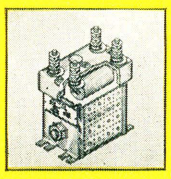
BQ
Rectifier with tapped primary and secondary windings.



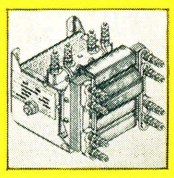
BPA
Rectifier, tapped transformer, voltmeter, ammeter, and fuses on board.



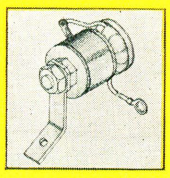
B¼
Half-wave low capacity rectifier.



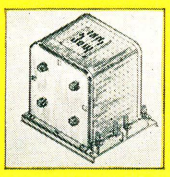
BR½
Low capacity rectifier and resistor for regulating charge rate.



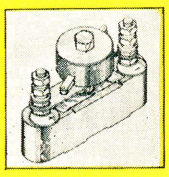
BBY
Rectifier and automatic transformer which increases the rectifier output, as the load increases.



BS
Rectifier for snubbing motors.



BA
Rectifier with no regulating means for switch machine operation.



BB
Rectifier with no regulating means for continuous train control territory.

NEED	TYPE	GENERAL INFORMATION
A. RECTIFIERS FOR BATTERY CHARGING		
1. For **low voltage battery charging** where suitable low voltage secondary is available on an existing transformer, and an adjustable resistor or reactor is available for regulating the charge.	**B**	Size 116—Up to 6 lead cells— 4.2 watts Size 132—Up to 12 lead cells— 8.4 watts Size 232—Up to 20 lead cells—16.8 watts Size 432—Up to 35 lead cells—33.6 watts Any frequency.
2. Same as No. 1, **with a resistor** provided as part of the rectifier assembly for regulating the charge.	**BR**	Size 116—Up to 6 lead cells—4.2 watts Any frequency.
3. Same as No. 1, **with a reactor** provided as part of the rectifier assembly for regulating the charge. Micrometer screw adjustment on reactor.	**BX**	Size 116—Up to 6 lead cells— 4.2 watts Size 132—Up to 12 lead cells— 8.4 watts Size 232—Up to 12 lead cells—16.8 watts Size 432—Up to 12 lead cells—33.6 watts Frequencies of 25 and 60 cycles. Furnished for 100 cycles, if specified.
Much space may be saved in the above three rectifier applications when several rectifiers can be connected to the secondaries of one transformer. A separate secondary winding should be provided for each rectifier, if their d-c. load circuits are interconnected.		
4. For **a self-contained unit** to be directly connected to the a-c. supply. This unit has its own regulating means, an adjustable reactive transformer. Micrometer screw adjustment of laminated yoke.	**BT**	Size 116—Up to 6 lead cells— 4.2 watts Size 132—Up to 12 lead cells— 8.4 watts Size 232—Up to 20 lead cells—16.8 watts Size 432—Up to 60 lead cells—33.6 watts Frequencies of 25, 40, 50, and 60 cycles. 110- and 220-volt primary winding. Furnished for 100 cycles, if specified.
5. For **a rectifier with a wide range of adjustment.** Obtained with a tapped transformer and an adjustable reactor, provided as part of the rectifier assembly. Coarse adjustment with transformer secondary taps; fine adjustment with micrometer screw of adjustable reactor.	**BQX**	Size 232—Up to 6 lead cells—16.8 watts Size 432—Up to 6 lead cells—33.6 watts 60 cycle, 110- or 220-volt supply. Furnished for 25 or 100 cycles, if specified.
6. For **a portable emergency charger.** Supplied with a carrying handle, snap-on connectors.	**BQX Portable Emergency Charger**	Size 432—Up to 6 lead cells—59.4 watts Not rated for continuous service. Primary winding provided with strap connectors for 110-220-volt, 25- to 60-cycle supply. Furnished for 100 cycles, if specified.
7. For **charging large ampere-hour capacity batteries,** such as at interlocking towers. Panel to control charge rate; switches and fuses for a-c. and d-c. circuits; d-c. ammeter; four plug jacks and 15-point rotary switch connected to transformer secondary, 60 possible charge rate adjustments.	**BP**	Size 248—Up to 65 lead cells— 90 watts Size 448—Up to 110 lead cells—180 watts Size 648—Up to 80 lead cells—270 watts Size 848—Up to 110 lead cells—360 watts Size 1248—Up to 110 lead cells—540 watts Size 1648—Up to 65 lead cells—720 watts 110- or 220-volt, 25- or 60-cycle supply. Furnished for 100 cycles, if specified.
When ordering, give complete information about the type of battery, number of cells, maximum charging current, characteristics of battery load, frequency and voltage of a-c. supply.		
B. RECTIFIERS TO OPERATE WITH D-C. RELAYS		
1. To operate a **d-c. track relay on a a-c. track circuit.**		
(a) on **short track sections,** steam road, where there is no foreign current. Rectifier connected directly to rails. Has no regulating means.	**B½**	Any frequency. Output watts 1.8 max.
(b) on steam road **track circuits subject to foreign current.** An insulating transformer is built-in as part of the rectifier assembly. Connected between the rectifier and the rails.	**BQ½**	25- or 60-cycle, 2, 2.25 volts a-c. on track and 0.5 watt d-c. output. For 4-ohm and other resistance d-c. relays.
(c) on electric road, d-c. propulsion, **single rail track circuits** using balancing impedance. The built-in transformer has a center-tapped primary winding.	**BQA½**	25- to 100-cycle. See Section B1 (b).
When ordering, give length of track circuit; kind of ballast, wet and dry resistance per 1000 feet of track; kind of bonding; weight of rail; resistance, working current, and type of relay; frequency of signaling current; maximum and average d-c. propulsion current per rail; propulsion voltage.		
2. To operate **d-c. line relays direct from a-c. source.**		
(a) where **a suitable step-down transformer is already available.**	**B**	See Section A1.
(b) where only **110- or 220-volt a-c. supply is available.** Rectifier-transformer assembly; tapped primary and secondary windings. 25- or 60-cycle, 110- or 220-volt a-c. supply.	**BQ**	Size 116—d-c. output 12 volts 4.2 watts Size 132—d-c. output 30 volts 8.4 watts Size 232—d-c. 12 and 30 volts 16.8 watts Size 432—d-c. 10 and 30 volts 33.6 watts

NEED	TYPE	GENERAL INFORMATION
(c) with **primary-battery reserve and "cut-in" relay.** Rectifier-transformer assembly; tapped primary and secondary windings. Voltmeter, ammeter, and fuses on panel.	**BPA**	Size 248—d-c. output 16 volts 4.5 amps. 25- or 60-cycle, 110-volt a-c. supply.
When ordering, give complete information about the number of relays, type, resistance, and working current, whether in series or multiple or special combinations of series-multiple, maximum and minimum load, d-c. voltage and allowable voltage variation, a-c. voltage and frequency, and if line wires are in cable carrying a-c.		
3. To obtain **selective operation** of such devices as d-c. relays, lamps, or other indicators, on a d-c. polarized line. Half-wave rectifiers.	**B¼**	When ordering, give line voltage, current required by indicating device, also describe the device.
4. To make a **d-c. relay slow-release** by connecting half-wave rectifier across coils. Approximately quarter-second slow release effect on 6, 8, 10, or 12 volts d-c.	**B¼**	When ordering, give resistance and working current, and type of relay; slow release time desired.
5. To operate **a "light-out" relay on a-c. or d-c.** in series with a signal lamp. The rectifier is designed for mounting across coils of G-R-S Type W Class E Relay.	**B¼**	When ordering, give resistance and type of relay, rated voltage and wattage of lamp, supply voltage, single or double filament, wattage of each filament, whether relay should release if one filament burns out.
6. To **reduce radio interference** by flashing relays. Center-tapped rectifier for mounting across coils of relay.	**B¼**	When ordering, give type of relay, resistance, and operating voltage.
7. To operate **a "light-out" relay on primary side** of lighting transformer.	**BR½**	Satisfactory operation depends upon a proper combination of transformer primary impedance and relay resistance. Give line voltage and frequency, length of line circuit, lamp voltage and wattage, kind and size of line wire.
C. RECTIFIERS TO SHARE LOAD		
1. To **prolong the life of track and line primary batteries** by sharing the load.		
(a) by connecting, in multiple, **a full-wave automatic rectifier.** 115-volt 60-cycle supply. This rectifier increases its output as the load increases.	**BBY**	Track circuit 1 volt 1.4 amp. d-c. Line circuit 14.5 volt 0.30 amp. d-c.
(b) by connecting, in multiple, a **non-automatic rectifier.**	**BQX**	See Section A-5.
(c) by connecting a non-automatic **rectifier without a transformer** to an existing low voltage supply.	**BX**	See Section A-3.
When ordering, give a-c. voltage and frequency, type of cell, ampere-hour capacity, number in series or multiple, approximate maximum and minimum current, characteristics of load.		
D. RECTIFIERS TO SNUB MOTORS		
1. For **snubbing semaphore signal motors.** Half-wave rectifiers.	**BS**	8-, 10-, 20-, and 110-volt motors. Give type and voltage of signal mechanism.
E. RECTIFIERS FOR SPECIAL APPLICATIONS		
1. To operate intermittently a single **d-c. switch machine** at an outlying point. 110-volt d-c. A-c. should be connected to the rectifier only when the switch machine is operating. Separate transformer necessary.	**BA**	Size 456—150 volts a-c. 90 volts 8 amps. d-c., for 10 seconds. When ordering, give type of machine, operating voltage, length and size of line wire.
2. To operate intermittently switch machine **master controllers.** 110 volt d-c. Separate transformer necessary.	**BA**	Size 472—150 volts a-c. 110 volts 2 amps. d-c. for 10 seconds.
3. To operate a single **automatic stop.**	**BA**	See Section E1.
4. In **continuous train control territory,** to prolong the life of primary battery. Half-wave rectifier or valve connected in multiple with one primary cell.	**BB**	1-volt, 1-amp. d-c. output.
5. To obtain **high shunting sensitivity** and **quick drop-away** on track circuits. A rectified half-wave track circuit.	**B**	Size 132—max. 12 volts a-c. 2.4 amp. d-c.
When ordering rectifiers for No. 4 and No. 5, give length of track circuit; kind of ballast, wet and dry resistance per 1000 feet of track; kind of bonding; weight of rail; resistance, type, and working current of relay; frequency of signaling current.		
6. Small rectifiers for **valves in special d-c. circuits.**	**B**	When ordering, give total voltage of circuit, current, sketch and description of circuit, and describe the result desired.
7. Rectifiers to furnish **d-c. direct to load** without any battery standby.	**BBY**	See Section C-1 (a). When ordering, give a-c. voltage and frequency, d-c. voltage and current and load characteristics.

GENERAL RAILWAY SIGNAL COMPANY
New York Chicago ROCHESTER, N. Y. St. Louis A-1327

Printed in U. S. A.

G-R-S RECTIFIERS

The basic principle of the copper-oxide rectifier is the peculiar property of a copper disk with a coating of copper-oxide on one face imposing high resistance to an electric current in one direction and offering low resistance to a current in the opposite direction. The reason for this phenomenon has not been definitely determined, but it is a well known fact that, when copper-oxide has been formed on one face of a copper disk by special heat treatment, current flows more readily from copper-oxide to copper than in the opposite direction. Each disk, therefore, serves as an efficient electrical valve which allows current to flow in one direction and prevents its flow in the opposite direction. The valve action or rectification takes place at the junction of the copper and copper-oxide, and numerous tests in laboratory and field show conclusively that the action is entirely electronic without any chemical action or decomposition of the rectifier elements.

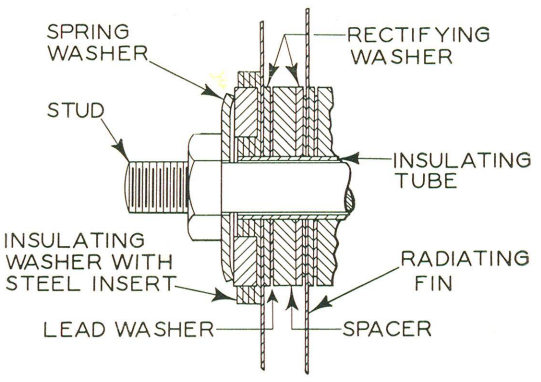


Figure 1. Make-up of Rectifier Unit

Each rectifier unit comprises copper-oxide disks or washers, lead washers, brass radiating washers or cooling fins, spacer and insulating washers assembled on an insulating tube over a bolt as shown in Figure 1. The number of copper-oxide disks and their connection in series or multiple depends upon the output voltage and current for which a particular rectifier is designed. In order to secure full-wave rectification the disks in most of the rectifiers are connected to form a wheatstone-bridge circuit.

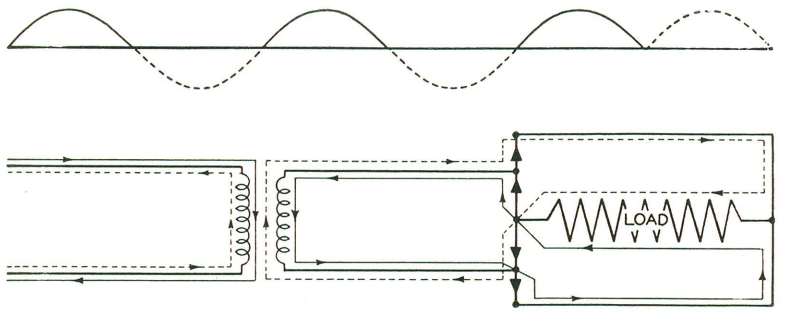


Figure 2. Flow of current in full-wave Rectifier

Figure 2 shows the manner in which the flow of current is directed by the valve action of four rectifying disks connected in a wheatstone-bridge circuit so that current from both halves of the a-c. wave flows through the load in the same direction.

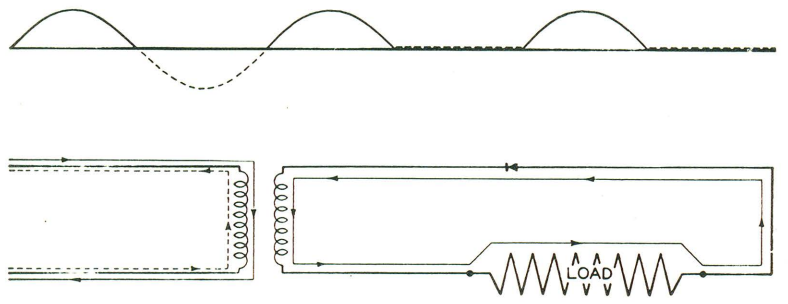


Figure 3. Flow of current in half-wave Rectifier

Figure 3 shows the circuit arrangement of a half-wave rectifier which prevents the flow of current in one direction so that current from only one-half of the a-c. wave flows through the load.

SELECT THE PROPER RECTIFIER FROM CHART ON OTHER SIDE
HANG CHART ON WALL FOR FUTURE REFERENCE