

COPPER OXIDE RECTIFIERS

1. GENERAL

- 1.01 Copper oxide rectifiers are made up of discs of copper on which layers of copper oxide have been formed. Such a combination offers a low resistance to current flowing from the copper oxide to the copper but a high resistance to current flowing from the copper to the copper oxide. This characteristic makes the unit available as a valve to pass current in one direction only. Its principal application is in converting alternating current to direct or pulsating current.
- 1.02 At present copper oxide rectifiers are used for charging batteries in Private Branch Exchanges and Central Offices, and as a filament and plate power supply in small repeater installations. The copper oxide rectifier valve is used in the grid potential supply for four-wire echo suppressors in large repeater installations.
- 1.03 The copper oxide rectifier may be a single rectifying element, combination of elements, or a complete rectifier unit made up of a combination of all or part of the following:
- Rectifying Elements
 - Transformer (with primary and secondary taps to vary the output).
 - Resistances
 - Retardation Coil
 - Fuses or Safety Switches
 - Case and Mounting

2. DESCRIPTION OF APPARATUS

Rectifying Elements

- 2.01 A rectifying element consists of a disc of copper on which a layer of copper oxide has been formed. Good electrical contact is made with the exposed surface of the oxide layer by means of a terminal member of soft lead. The copper discs and terminal members are made in the form of washers and assembled on a bolt so that they can be clamped tightly together, thereby establishing the necessary pressure to secure good electrical contact. It is very important that the pressure be within certain limits—500 to 2000 pounds per square inch.

If the pressure is below 500 pounds per square inch, the current in the conducting direction is not maximum and if the pressure is over 2000 pounds per square inch, the reverse resistance breaks down and the leakage current increases so that the rectifying element is permanently injured. Any number of individual elements may be assembled in series and parallel arrangements into rectifier groups for any desired value of current and voltage or for full and half wave rectification. The current density that may be used is increased by the use of fins for dissipating the power loss (heat) generated in the rectifying elements.

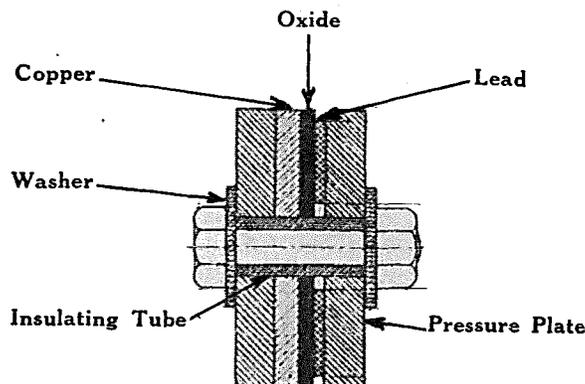


Fig. 1.—Rectifying Element Arrangement.

- 2.02 A rapid decrease in the amount of current which the discs will pass, or aging occurs within the first three or four months of service, or in a slightly longer time if the elements are placed in storage without being used. This decrease in initial output does not generally amount to more than twenty-five percent of the rated output and is anticipated in the design of the rectifier. Part of this aging is due to contact resistance at the outer junction and part is due to internal changes. It has been found that plating the lead washers with tin and graphiting the contact surface of the oxide reduces the contact aging and resistance. The rapidity of aging is a function of the temperature, aging increasing with the increase of temperature. If current is drawn during this time, the aging is more rapid and greater. Also, a washer which initially is particularly good will age more rapidly and to a greater extent than an average washer, so that after a time, the characteristics of different washers will vary less

2.02 (Continued)

than initially. Present tests indicate that after initial aging rectification takes place with little apparent electrolytic action or other physical or chemical changes. To avoid rapid deterioration of the discs the current output should not be allowed to exceed the nameplate rating. Overloading the discs will result in overheating, thus aging the discs more rapidly and in some cases destroying the rectifying action of the discs.

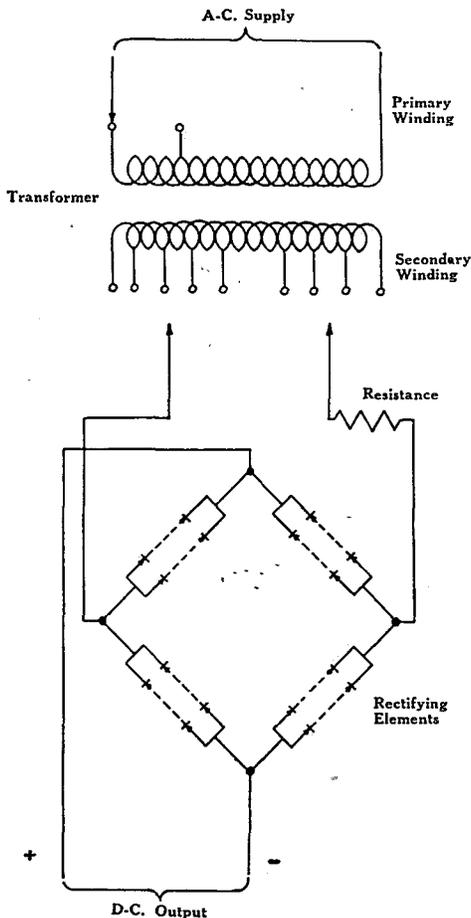


Fig. 2—Schematic Wiring Diagram.

Transformer

2.03 Transformers in various types of rectifiers are used to step down the service potential, usually 105 to 125, 180 to 210 or 210 to 250 volts, to the potential required in the service for which the rectifier is designed. Removing the case or cover exposes the transformer with its primary taps and input cord connection, the terminal panel on which are mounted the jacks,

the plugs connected to the secondary winding taps and fuse mounting (when furnished).

2.04 In the smaller 0.5 Ampere—8 Volt Rectifier, the output is varied by the use of a rheostat in the transformer secondary circuit. The output may be approximately doubled for emergency charging by shifting a movable link from a position marked "Low" to a position marked "High" (short circuiting the variable resistance).

2.05 In the other rectifiers the output is varied by changing the number of turns on the secondary winding of the transformer. This is accomplished by the use of 3 or more coarse secondary taps and 5 or more fine secondary taps which terminate on jacks mounted on the terminal panel. Connection is established to the secondary winding by means of suitable plugs attached to flexible leads.

2.06 The primary winding of the transformer is connected to a flexible cord and separable polarized plug for attaching the rectifier to the source of power. The primary winding is provided with one or more taps for use in increasing the output of the rectifier when, due to aging, the output falls below the normal rating of the rectifier.

Resistances

2.07 Resistances are provided in some cases to compensate for variations in the rectifier output due to manufacturing variations or variations of line regulation, for example; a change in line voltage causes a change in the output current and voltage. Under these conditions a resistance inserted in the circuit tends to reduce the rate at which the output drops due to aging thus lengthening the period within which a readjustment of the charging rate is required. The resistances on the rectifiers so provided are adjusted at the factory.

Retardation Coil

2.08 In some cases the d-c. output from the rectifying element is passed through a retardation (choke) coil to smooth out the rectified current before it reaches the battery or other power supply circuit. This reduces the noise in the associated telephone circuit.

Fuses and Door Type Switches

2.09 In some cases fuses are provided in the

2.09 (Continued)

secondary a-c. circuit to protect the transformer and primary circuit in the event of a breakdown of the rectifying elements, due to an overload. The secondary d-c. circuit is generally provided with a polarized plug or connector, and in the case of the 0.5 Ampere—8 Volt Rectifier, a fused distributing panel is provided. Safety switches (door type) are provided in the 0.08 Ampere—130 Volt Rectifiers in both the primary a-c. circuit and secondary d-c. circuit which open the circuit, when the cover is removed.

Case and Mounting

2.10 All rectifiers are enclosed in sheet metal cases equipped with removable covers. The 0.2 Ampere—30/75 Volt; 0.4 Ampere 30/75 Volt; 0.08 Ampere—130 Volt; and 0.5 Ampere—17 Volt rectifiers have two brackets attached to the rear of the rectifier case for wall and relay rack mounting. The 0.5 Ampere—8 Volt rectifier, has the

rectifier and battery mounted in the same case.

2.11 The 6 Ampere—10 Volt Rectifier is panel mounted, the panel fitting a standard power board framework. The ammeter, toggle switch and secondary pin jacks are mounted on the front of this panel, while the remainder of the rectifier is mounted on the rear of the panel.

Copper Oxide Rectifier Valve

2.12 The copper oxide rectifier valve is made up of a number of copper oxide rectifying discs assembled on a bolt and equipped with mounting details and connecting terminals. The valve is connected in series with a battery supply both being connected across the d-c. output of the copper oxide rectifier used as the grid potential supply for the four-wire echo suppressors. The valve is used to prevent current from passing through the battery supply with the rectifier in operation, and to carry the load current in case of the failure of the rectifier.

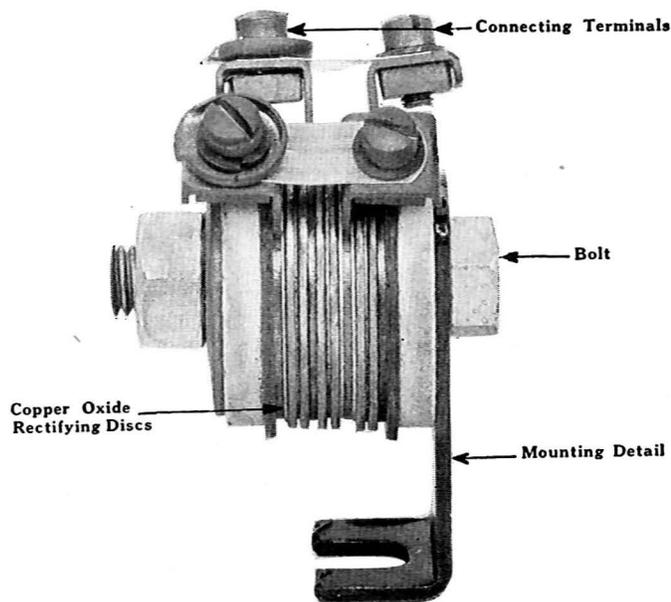


Fig. 3—Copper Oxide Rectifier Valve.

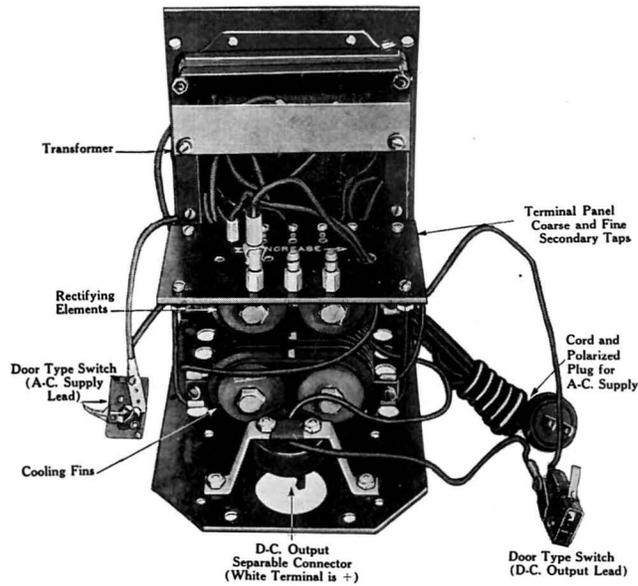


Fig. 4—0.08 Ampere—130 Volt Rectifier.

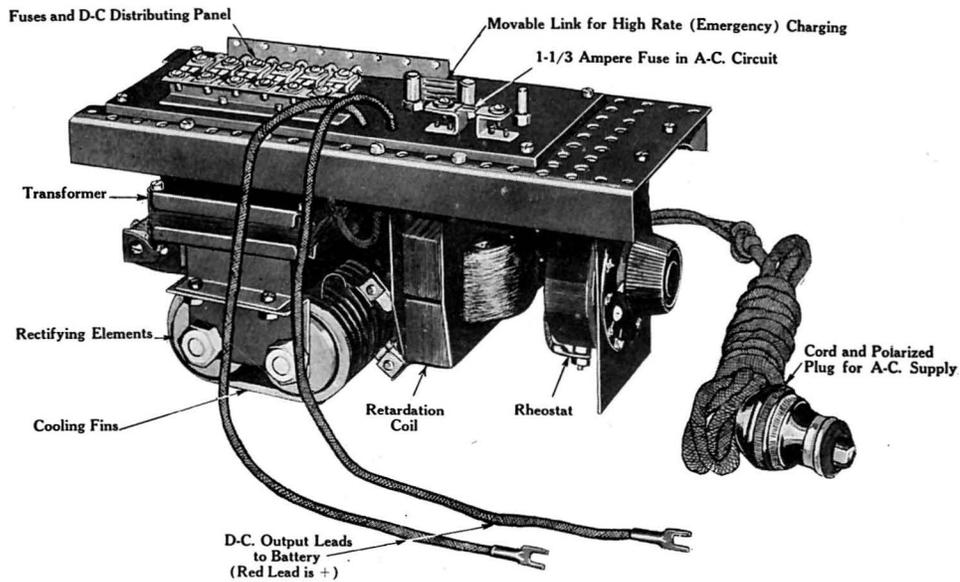


Fig. 5—0.5 Ampere—8 Volt Rectifier.

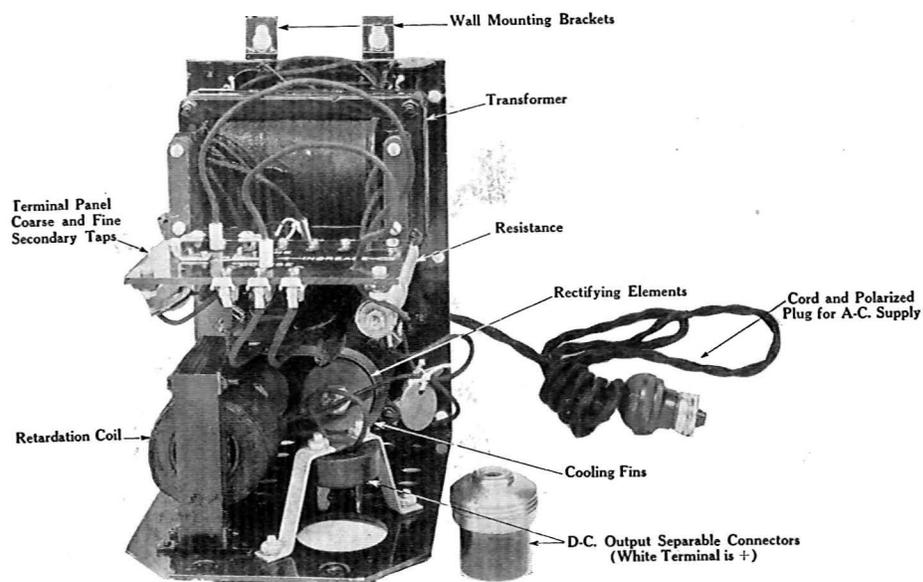


Fig. 6—0.5 Ampere—17 Volt Rectifier.

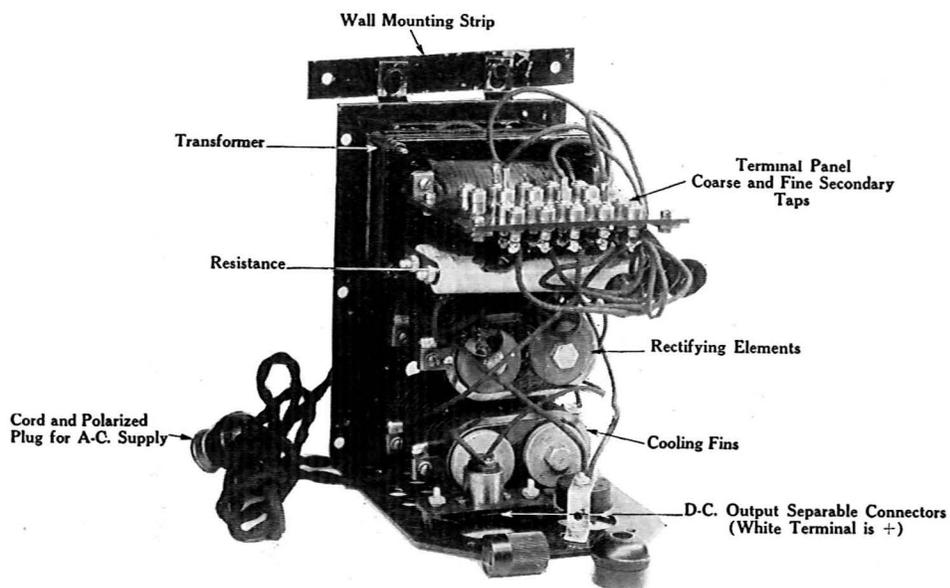


Fig. 7—0.2 Ampere—30/75 Volt Rectifier (List No. 1).

NOTE: The 0.4 Ampere—30/75 Volt Rectifier is similar in general appearance to the 0.2 ampere—30/75 Volt Rectifier.



Fig. 8—0.75 Ampere—6 Volt Rectifier.

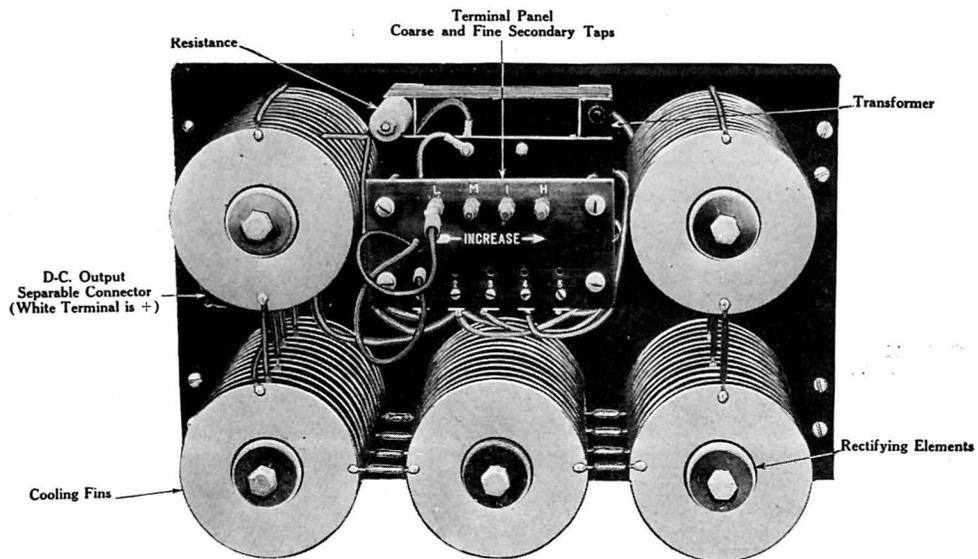


Fig. 9—2.25 Ampere—30 Volt Rectifier.

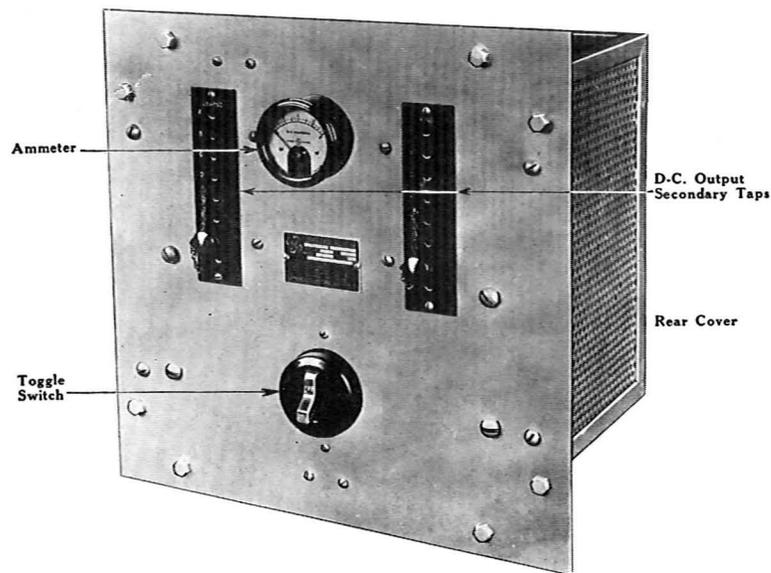


Fig. 10—6 Ampere—10 Volt Rectifier (Front View).

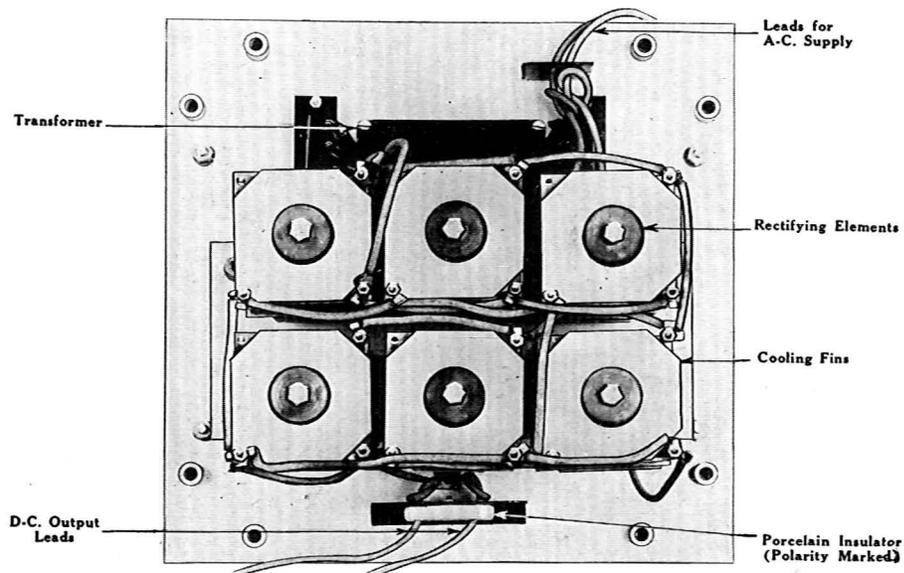


Fig. 11—6 Ampere—10 Volt Rectifier (Rear View).

APPROVED:
 Bell Telephone Laboratories, Inc.
 Department of Development and Research

AEP 9- 5-30
 RLY 9-18-30