

June 24, 1930.

R. S. OHL

1,765,607

AMPLIFYING DEVICE

Filed April 26, 1928

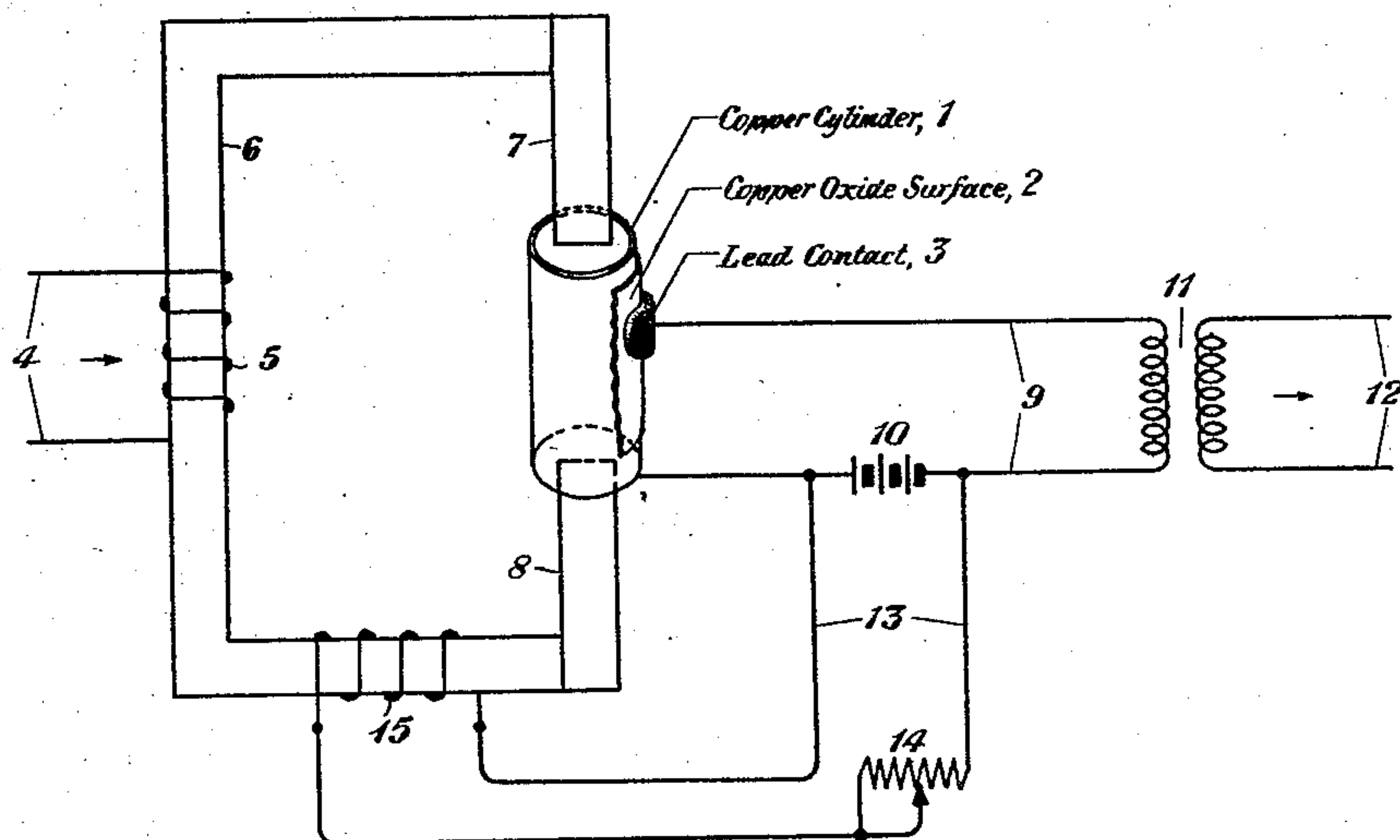


Fig. 1

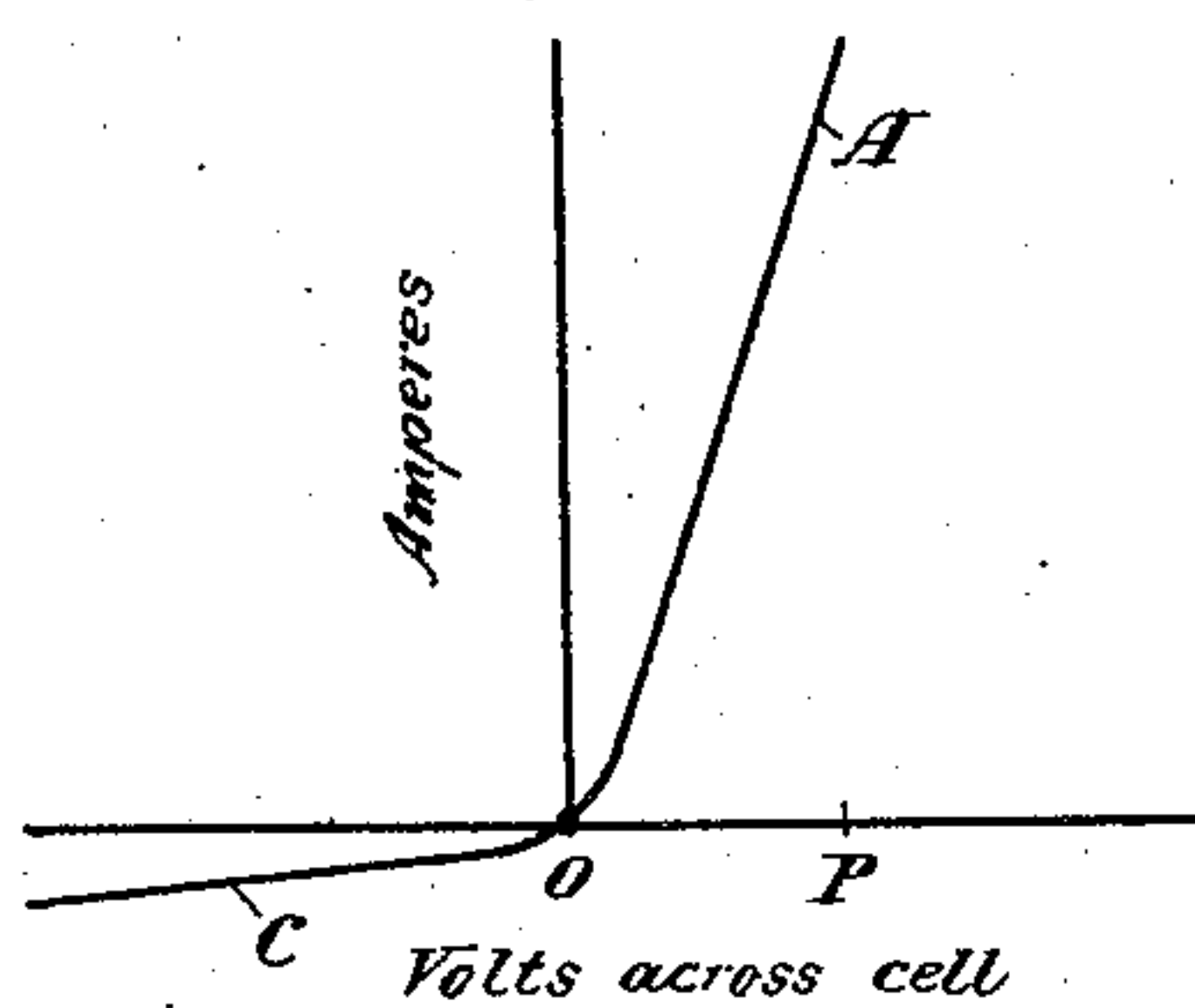


Fig. 2

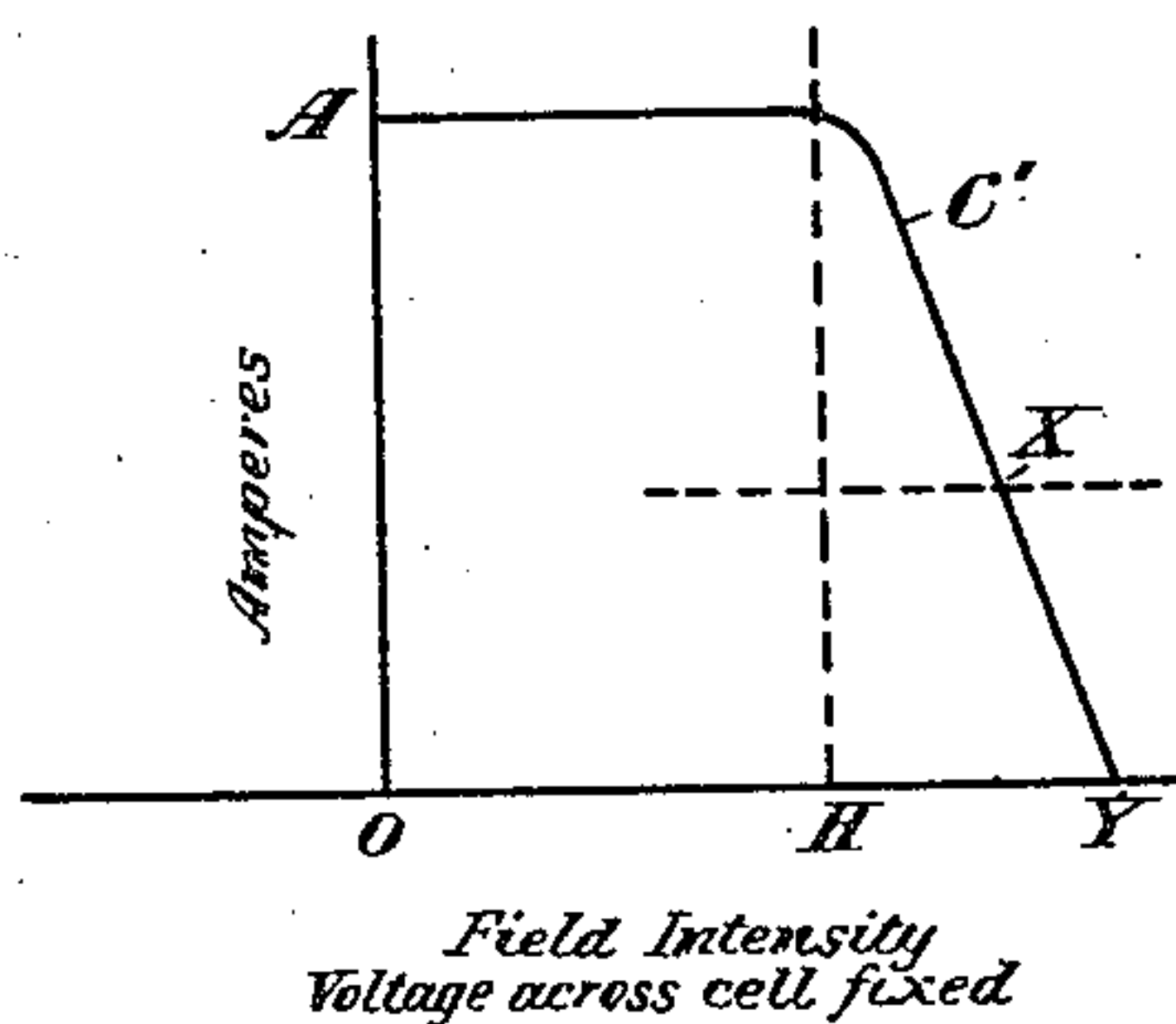


Fig. 3

INVENTOR
R. S. Ohl
 BY *g. r. y. o. n.*
 ATTORNEY

UNITED STATES PATENT OFFICE

RUSSELL S. OHL, OF CLIFFWOOD, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE
AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK

AMPLIFYING DEVICE

Application filed April 26, 1928. Serial No. 272,885.

This invention relates to improved arrangements for amplifying and repeating the variations in an electrical current.

It is known that when a copper disk is given a coating of copper oxide and a voltage is applied to the copper member and to the oxide member of the combination, an electron flow takes place between the copper and copper oxide. It has been found that such electron flow under certain conditions will be substantially unidirectional and, accordingly, the combination may be utilized as a rectifier of electrical currents. For a more detailed description of the contact type rectifier reference may be had to the Patent No. 1,640,335, issued August 23, 1927, to L. O. Grondahl. In the arrangements of the present invention there is provided a method of and means for controlling the electron flow in a device similar to the contact type rectifier by means of variations in an electrical current so that the device will function as an amplifier or repeater of such electrical variations.

In the arrangements of the invention the electron flow and attendant space charge existing in a device similar to the contact type rectifier may be controlled by means of a magnetic field applied at right angles to the direction of motion of the electrons. The field intensity may be controlled by the variations in the incoming electrical current. In an alternative arrangement the electron flow might be controlled by means of an electrostatic field produced by an electrode similar to the grid of a vacuum tube. Further objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description, together with the accompanying drawing, in the Figures 1, 2 and 3 of which the invention is illustrated. Fig. 1 is a circuit diagram embodying a preferred form of the invention. In Figs. 2 and 3 are shown curves graphically illustrating principles of operation of the invention. Similar ref-

erence characters have been utilized to denote like parts in all of the figures.

In Fig. 1 is shown a section 4 of an incoming line circuit terminating in a winding 5 on the core 6. The core 6 may be constructed of permalloy, if desired, and would have two pole pieces 7 and 8. Between the poles of this electro-magnetic device is located a copper cylinder 1 having a surface 2 of copper oxide in contact with the copper. A voltage is applied from the battery 10 by means of circuit 9 to the surfaces of the copper and copper oxide. Contact with the copper oxide may be made by lead or other soft metal coating, such as 3, under pressure to reduce the resistance of the contact. The copper cylinder and its oxide coating, together with circuit 9, is now substantially similar to the contact type rectifier and an electron flow will take place between the copper and the copper oxide elements. In series in the circuit 9 is the winding of a transformer 11 connecting circuit 9 to the output circuit 12. On the core 6 is provided an exciting winding 15 which is supplied with current over circuit 13 from the battery 10. The strength of the current in the exciting winding 15 may be adjusted by the resistance 14.

The operation of the invention may be more fully understood from a consideration of the curves of Figs. 2 and 3. In Fig. 2 is shown a curve C illustrating the current voltage characteristics of the contact type rectifier, such as the copper cylinder device of Fig. 1, when it is not subjected to magnetic control. When the voltage from the battery 10 is poled in one direction, such as toward the point P, the current will be very large, such as illustrated by the point A. However, when the voltage is poled in the other direction the current will fall to very small values. In other words, the arrangements will operate substantially as a unidirectional device. In Fig. 3 is illustrated the effect of a magnetic field in addition to the polarizing voltage. The polarizing voltage as supplied by the battery 10 will remain fixed so that the current flow will be at a desired point, such as A. The intensity

of the magnetic field between the pole pieces 7 and 8, as determined by the exciting winding 15, will be adjusted by the resistance 14. At low field intensities the current flow in the circuit 9 will remain at a constant value, such as A. In other words, at low field intensities, such as between the points zero and H, the current flow will remain substantially constant. However, at a certain intensity, such as H, the electron flow decreases to Y in nearly a straight line relation. The field intensity will now be adjusted to a desirable point, such as X, for example, close to the center of this straight part of the characteristic curve C'. Under such conditions any small changes in the field intensity due to currents in the line winding 5 will cause corresponding changes in the current through the rectifier device and the primary of transformer 11. These variations will be repeated into the circuit 12.

While the arrangements have been illustrated in certain specific forms which are deemed desirable, it is understood that they are capable of embodiment in many other forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A body consisting of a metal having an electronically conducting compound of the metal formed thereon and integral thereto, a circuit for applying a voltage to said metal and said compound whereby an electron flow will take place between said metal and said compound, and means for creating an electromagnetic field for controlling said electron flow.
2. A body consisting of a metal having an electronically conducting compound of the metal formed thereon and integral thereto, a circuit for applying a voltage to said metal and said compound whereby an electron flow will take place between said metal and said compound, means for creating an electromagnetic field in the vicinity of said body, and means for controlling the intensity of said electromagnetic field to control said electron flow.
3. A body consisting of a metal having an electronically conducting compound of the metal formed thereon and integral thereto, a circuit for applying a voltage to said metal and said compound whereby an electron flow will take place between said metal and said compound, an output circuit associated with said first circuit, an electromagnetic device in the vicinity of said body, and an incoming signaling circuit for varying the intensity of the field of said electromagnetic device whereby said electron flow will be correspondingly varied.
4. A copper cylinder having a surface of cuprous oxide formed thereon and integral

thereto, a circuit for applying a voltage to said metal and said oxide whereby an electron flow will take place between said metal and said surface, an electromagnet having its pole pieces so related to said cylinder that a magnetic field will be formed at right angles to said electron flow whereby the electron flow may be controlled by the intensity of said magnetic field, and a signaling circuit having a winding on the core of said electromagnet.

5. A copper cylinder having a surface of cuprous oxide formed thereon and integral thereto, a circuit for applying a voltage to said metal and said oxide whereby an electron flow will take place between said metal and said surface, an electromagnet having its pole pieces so related to said cylinder that a magnetic field will be formed at right angles to said electron flow whereby the electron flow may be controlled by the intensity of said magnetic field, means for regulating the intensity of said magnetic field, and a signaling circuit for varying the intensity of said magnetic field.

In testimony whereof, I have signed my name to this specification this 25th day of April, 1928.

RUSSELL S. OHL.

95

100

103

110

115

120

125

130