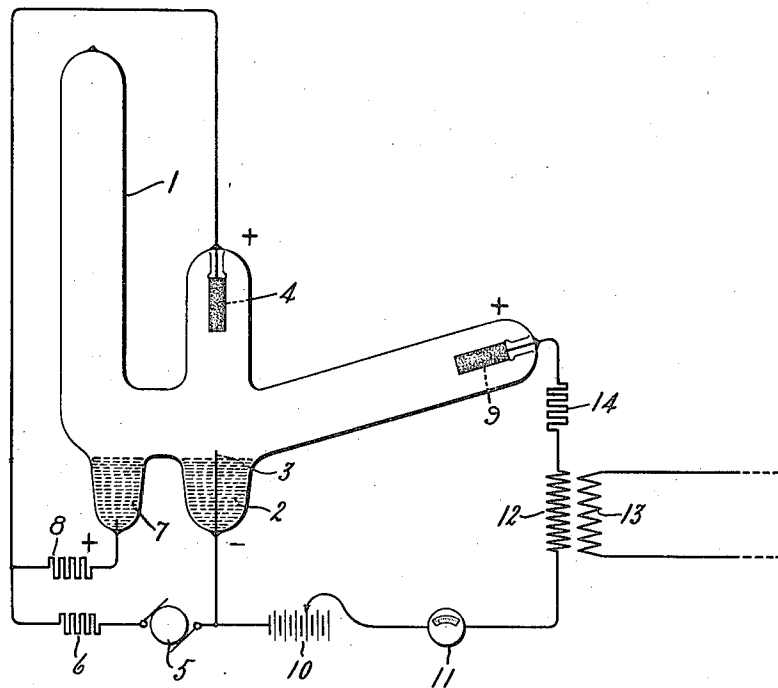


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 AMPLIFYING CURRENT VARIATIONS.
 APPLICATION FILED NOV. 26, 1907.

1,041,210.

Patented Oct. 15, 1912.



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UNITED STATES PATENT OFFICE.

EZECHIEL WEINTRAUB, OF SCHENECTADY, NEW YORK, AND MARIUS C. A. LATOUR, OF PARIS, FRANCE, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

AMPLIFYING CURRENT VARIATIONS.

1,041,210.

Specification of Letters Patent.

Patented Oct. 15, 1912.

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To all whom it may concern:

Be it known that we, EZECHIEL WEINTRAUB, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, and MARIUS C. A. LATOUR, a citizen of France, residing at Paris, France, have invented certain new and useful Improvements in Amplifying Current Variations, of which the following is a specification.

In the arts of telephony, telegraphy, wireless telegraphy, and in fact in any situation where weak signals or current impulses are to be registered or detected, it is desirable to have means which will amplify these current impulses or signals to produce amplified variations of current responsive to the signal currents.

Our present invention aims to provide a receiving device or system which will operate in response to small current variations to produce very greatly magnified currents or impulses. The principle of our invention depends upon the fact that in the neighborhood of the polarization voltage of a mercury arc or similar device, a small increase of impressed electromotive force causes the leakage current, or discharge, in such a device to change into the form of an arc with a corresponding enormous increase in current. As is well-known, an arc discharge is characterized by a comparatively low potential drop at the electrodes, and by a high current value. By thus utilizing the signal currents or other weak impulses of current, the voltage in the local circuit, which voltage is normally adjusted in the region of the polarization voltage of the lamp, is caused by the superposed voltages due to the variable currents to exceed the polarization voltage and to produce arc discharges with correspondingly large current variations. These large current variations may readily be observed by the flashes of light in the mercury vapor device, or may be utilized to operate a recording device, or for any other desired purpose.

The features of novelty which characterize our invention are set forth with particularity in the appended claims. The invention itself, however, will be better understood by reference to the following description taken in connection with the accompanying drawings which represent diagrammatically one embodiment of our invention.

From what we have already said it will be evident that our new receiving device or current amplifying device, taking advantage as it does of the sensitive condition of the mercury vapor lamp or tube at or about the polarization voltage, must be such a form of device as will produce an arc discharge as distinguished from a leakage or sort of Geissler tube discharge, immediately the polarization voltage of the tube is sufficiently overcome. For this purpose we may use any one of a large variety of forms of apparatus. We have, however, indicated in the drawings, for purposes of illustration, a form of mercury arc device suitable for the purpose. This may consist of a highly evacuated glass envelop or container 1. This container is provided with electrodes which form the seats, respectively, of two current paths, one a continuously maintained auxiliary arc, and the other a leakage or discharge path through the instrumentality of which the desired current variations are produced. For these two discharge paths a negative electrode 2 of mercury is provided as a common cathode. A platinum wire projects above the surface of the electrode at 3 in order to render the cathode spot of the arc stationary, and also to permit the current in the container to be run at a low value. An electrode 4 of suitable material, such as artificial graphite, is located above the cathode 2, and between it and the cathode an arc is constantly maintained from some suitable source of current, in this case a direct current generator or battery indicated conventionally at 5. This source of current 5 may be connected through a resistance 6 with the electrode 4.

In order to start the arc an auxiliary electrode 7 of mercury, located adjacent to the cathode 2, is provided, and is connected also to the source 5. When the tube or container 1 is shaken so that the mercury of the electrodes 2 and 7 forms a temporary connection, an arc is thus started and this arc then starts the main arc to the electrode 4. A resistance, such as 8, is provided so as to cause the arc between 7 and 2 to go out as soon as the main arc between 4 and 2 starts, though a switch may be used in place thereof if desired.

The path in which the desired current variations are produced is provided by means of an electrode or anode 9, located in a

branch of the tube or container 1, and it is between this electrode 9 and the cathode 2 that the phenomena take place which permit us to obtain greatly magnified current variations in response to weak signals or current fluctuations or pulsations. To secure the desired results, we provide a local circuit including the anode 9 and the cathode 2. This local circuit includes a battery or other source of readily adjustable electromotive force 10, a current-indicating device 11, which may be of any desired form, or may be omitted altogether, a secondary winding 12 of a transformer the primary 13 of which receives the weak signals, and a resistance 14 for limiting the current flow. The primary 13 of the transformer, as will be readily understood, receives the weak signal currents or the like from the appropriate source, as for example in a wireless telegraph system, from the antennæ or the like, and in the case of a telegraph or telephone system, from the transmission line or circuit.

In the operation of our new receiving device or current amplifier, the space between the anode 9 and the cathode 2 must always be in condition so that an arc will form as soon as the voltage impressed upon said electrodes is sufficient to maintain an arc. It is for this purpose, therefore, that an auxiliary arc is kept constantly in existence between the auxiliary anode 4 and the cathode 2 by means of current from the source 5. Under these conditions, the battery 10, or other source of current, will always produce a flow of current between the anode 9 and the cathode 2, but the character of this current flow will depend upon the magnitude of the voltage of the source 10. If the voltage of the source is such that the difference of potential between the anode 9 and the cathode 2 is substantially equal to or less than the polarization voltage, that is to say, the voltage at which the leakage discharge is about to change into an arc discharge, there will be merely a sort of leakage current between the anode 9 and the cathode 2 of relatively very small value.

When, now, a current pulsation or signal current is received by the primary 13 of the receiving transformer, a corresponding pulsation is produced in the secondary 12 and this is superposed, so to speak, upon the voltage of the battery 10. These voltage pulsations in the secondary 12, or at least those portions of the pulsations of the right polarity, being added to the voltage of the battery or source 10, produce a momentary voltage of a magnitude greater than the polarization voltage of an arc discharge in the tube 1, and thereby cause the leakage discharge, which continually takes place in the tube 1 between the anode 9 and the cathode 2, to change into an arc discharge. These

arc discharges, of course, are only momentary depending upon the duration of the voltage impulses in the secondary 12, but when they occur there is an enormous increase of current in the local circuit of the secondary due to the greatly decreased resistance of the tube 1 to the passage of current between the electrodes mentioned. These current impulses or amplified discharges in the tube 1 may be very readily observed by noting the flashes of light in the tube itself without any other indicating means being required. If desired, however, a receiving instrument 11, such as a galvanometer or other registering means may be employed.

Although in the foregoing description we have indicated our invention as embodying a receiver suitable for signal systems, it will be evident that its usefulness is not limited to the particular embodiment shown, but is capable of much wider variations. We therefore do not wish to be restricted to the precise details shown and described.

What we claim as new and desire to secure by Letters Patent of the United States, is,—

1. A current receiver consisting of an evacuated envelop, a cathode or negative electrode, means for constantly exciting said electrode, an anode cooperating with said cathode, means adjusted to normally impress between said anode and cathode a voltage less than the polarization voltage of an arc discharge, and means responsive to current variations for momentarily raising the voltage between said electrodes above the polarization voltage.

2. The combination of electrodes between which an arc may be produced, means for enabling such an arc to be produced whenever a voltage in excess of the polarization voltage of an arc is applied to said electrodes, means for impressing on said electrodes a voltage approximating the polarization voltage, a source of current variations, and means for augmenting said voltage in response to said current variations to raise the same above the polarization voltage and thereby produce an arc between said electrodes.

3. The combination of an evacuated envelop containing electrodes adapted to form the seat of an arc discharge, means for constantly exciting the cathode or negative electrode, means for impressing a substantially constant voltage on said electrodes, and means for superposing voltage impulses to produce corresponding arc discharges between said electrodes.

4. The method of amplifying current variations which consists in impressing upon electrodes a voltage just insufficient to produce an arc discharge, and augmenting said voltage at recurrent intervals to a value suf-

ficient to produce an arc discharge in response to the fluctuations of a variable current.

5 5. The method of producing amplified
current variations responsive to variable
currents or impulses, which consists in im-
pressing upon electrodes between which an
arc may be produced a voltage insufficient
10 to maintain such an arc, and recurrently
augmenting said voltage to the arcing volt-
age in response to the variable currents or
impulses to produce corresponding arc dis-
charges between said electrodes.

15 6. The method of amplifying current va-
riations which consists in maintaining nor-
mally between electrodes a weak discharge
or current flow of the nature of a leakage
current, and causing this leakage current
20 to change into an arc in response to signal
currents or other impulses.

7. The method of producing amplified
current waves or fluctuations responsive to
variable currents, which consists in main-
taining between suitable electrodes a dis-
charge normally of the nature of a leakage 25
current, and causing this leakage current to
develop into an arc in response to variable
currents or impulses.

In witness whereof, WEINTRAUB has here-
unto set his hand this 11th day of October, 30
1907, and LATOUR has hereunto set his hand
this 9th day of November, 1907.

EZECHIEL WEINTRAUB.
MARIUS C. A. LATOUR.

Witnesses to Weintraub:

HELEN ORFORD,

FRANK J. DORE.

Witnesses to Latour:

DEAN B. MASON,

ALMA DALMA MARSHALL.