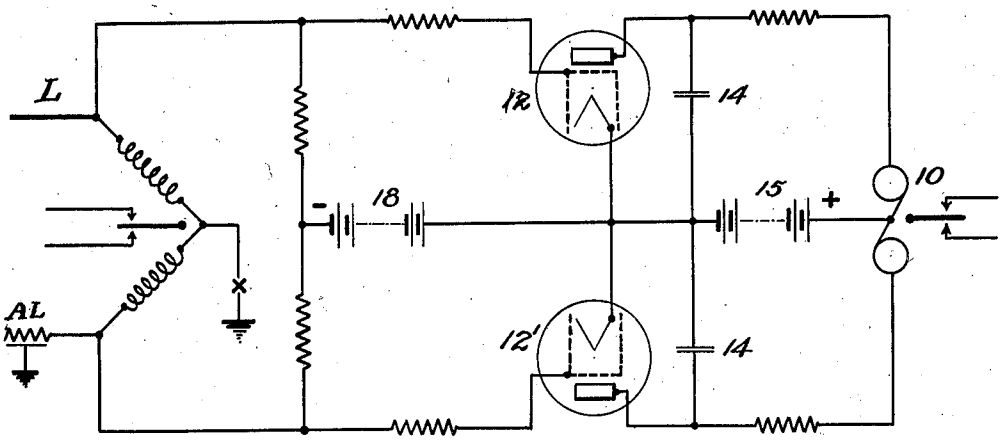
Oct. 22, 1935. P. L. WATTS ET AL 2,018,102

OSCILLATORY GRID CONTROLLED DETECTOR OR RELAY

Filed Dec. 20, 1933

Fig. 1.



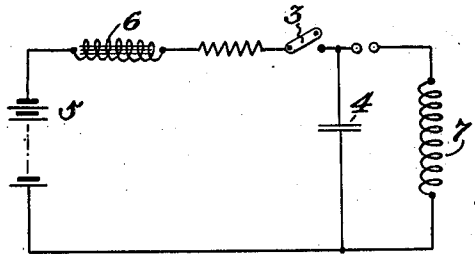


Fig. 2a

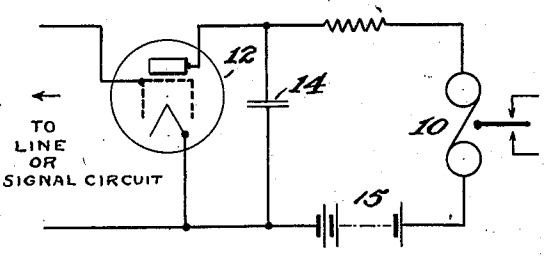


Fig. 2b

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OSCILLATORY GRID-CONTROLLED DETECTOR OR RELAY

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Application December 20, 1933, Serial No. 703,270

5 Claims. (Cl. 178—70)

This invention relates to circuits employing gaseous grid-controlled electron tube relays and is particularly adapted for carrier current telegraph systems, although it may also be used in other signaling circuits.

Communication circuits, particularly in wireless telegraphy or radio practice, have employed an oscillatory circuit as a generator of high frequency oscillations. In such circuits a spark-gap is associated with a condenser and an inductance in a manner well understood. While the spark-gap has usually been in air or in an atmosphere of hydrogen, it has sometimes been located in an enclosed space containing a gas at a comparatively low pressure. Geissler and violet ray tubes have been employed for this purpose. It is characteristic of such circuits that the current through the inductance is substantially constant, since a current path is continuously operative either through the condenser or across the gap.

One of the objects of our invention is to provide an oscillatory circuit which may be controlled by statically controlling the functioning of the gap.

Another object is to provide a circuit arrangement employing a gaseous arc tube as a detector for carrier current signals.

Other objects will appear from the following description of our invention, in connection with the accompanying drawing, in which—

Figure 1 is a circuit diagram illustrating one embodiment of our invention;

Figures 2*a* and 2*b* are explanatory diagrams to illustrate certain fundamental principles underlying our invention.

Before describing the invention it may be well to briefly refer to the well-known fundamental oscillatory circuit illustrated in Fig. 2*a*. Upon closing the switch 3, the condenser 4 is charged by the battery 5 at a rate controlled by the inductance 6. When the potential across the condenser becomes sufficient to break down the resistance of the gap, a spark occurs which short-circuits the condenser through the coil or translating device 7, thereby allowing the potential to drop to a low value, near or below the ionizing potential of the gas at the gap, and thus interrupting the circuit. The action is then repeated to produce an interrupted current. The frequency of this repetition depends upon the relative sizes of the condenser and inductance and upon the length and break-down character of the spark-gap and the rapidity with which the arc can be extinguished. When used as a generator of high frequency oscillations, it is usual to include a circuit tuned to the desired high frequency in series with the gap. By shock excitation, the interrupted current produces oscillations of high frequency in the tuned circuits.

We have devised an oscillatory circuit of the above type capable of transmitting a large volume of current and which can be operated with precision under electrostatic control. This circuit arrangement is shown in Fig. 2*b*. We employ as the gap device, a grid controlled gaseous tube of the type which is in effect an electrostatically controlled arc rectifier and briefly consists of a gas filled envelope containing an electron emitting cathode, a surrounding grid and an anode, the geometry of the tube, nature and pressure of the gas and electron emissivity of the cathode being such that with the proper positive potential applied to the anode, the grid will interpose a high starting resistance to the tube but if the potential of the grid is raised to a critical value by a feeble current, the tube will break down and due to the arc discharge then occurring, will allow a large amount of current to flow from the anode to the cathode. One form of this type of tube is described in an article by Dr. Hull entitled "Gas filled thermionic tubes," published in the "Transactions of the A. I. E. E." July, 1928, at pages 761 to 763.

The translating device, indicated by the relay 10 is in the plate circuit of the tube 12. Oscillations occur in the condenser and tube circuit at a frequency depending upon the size of the condenser 14, the structure of the tube 12 the nature of the gas and the resistance of the battery circuit 15. It is evident that when the circuit is oscillating, a substantially constant current flows through the relay, thus holding it in an operated position. These oscillations, and likewise the relay current, will continue as long as the anode-cathode gap within the tube is conductive. We have found, however, that if a sufficiently negative potential is placed on the grid of the tube while the circuit is oscillating, the oscillations will cease. The negative potential impressed upon the grid increases the resistance of the gap between the anode and cathode of the tube to such an extent that the tube cannot re-start following a low potential period of the condenser. By the arrangement described, an oscillatory circuit may be interrupted at the rate of several hundred or more times per second, depending upon the type of tube and gas employed, the moment of interruption being under the electrostatic control of the grid circuit. The current through the relay, flowing at practically constant value, can thus be

started and stopped with great precision in accordance with the grid variations in the potentials.

In Fig. 1 we have shown an arrangement of our invention employing two tubes 12, 12', of the type referred to, having their grids connected across the terminals of a duplex telegraph line L to operate on polar signals. A stabilizing battery 18 connected to the grids through suitable resistance maintains a proper negative potential thereon to hold the tubes inactive when no signals are received over the line L. It will be evident that the tubes will respond alternately to the plus and minus impulses of the telegraph signals. If the contacts of the relay 10 are connected as for dash and dot relays in cable practice, this arrangement will operate to receive three element signals.

It will be apparent from the foregoing description of the operation of our oscillatory circuits embodying the gaseous tube relay that we may employ the same as a detector for carrier current signals. The plate current is initiated by the first positive half cycle of the incoming carrier wave and although it would tend to cease during the first negative half cycle, it is re-started continuously by the positive half cycles. The inductance of the circuit prevents these high frequency oscillations of relatively small amplitude from affecting the operation of the relay.

In carrier telegraph systems, where the number of cycles of carrier current per telegraph dot signal does not exceed six or seven cycles, some signal loss is suffered when half wave detectors are used, due to the fortuitous loss of the initial and final half cycles of the incoming carrier signal. In addition to the above described loss, some loss may be experienced with the gas tube detector, due to fortuitous interaction of the carrier frequency and the gaseous tube oscillation frequency. Hence a preferred arrangement for low frequency carrier current systems would be to employ a double wave detector or rectifier of a well known type in advance of the gaseous tube detector. Such a two-element detector in conjunction with a gaseous tube relay is disclosed in the application of J. R. Hyneman, Ser. No. 638,965.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a signaling system employing three-element code signals, a receiving apparatus embodying a relay comprising a pair of gaseous arc discharge tubes having input circuits connected to receive positive and negative impulses respectively, a polar translating device connected to the output circuits of both tubes, and electrostatic means connected to said input circuits to render both tubes inert when no signals are received.

2. In a signaling system employing three-element code signals, a receiving apparatus embodying a relay comprising a pair of gaseous arc discharge tubes having input circuits connected to receive positive and negative impulses respectively, a polar translating device connected to the output circuits of both tubes, and means operating to impress a potential upon said input circuits adapted to render both tubes inert when no signals are received.

3. In a signaling system wherein the signals comprise groups of current oscillations, a receiving apparatus having a detector comprising an electrostatically controlled gaseous arc discharge tube provided with anode, cathode and grid-controlling elements having an input circuit connected to receive said signals and an oscillatory output circuit including translating means.

4. In a carrier current telegraph system wherein the signals comprise groups of current oscillations, a receiving apparatus having a detector comprising an electrostatically controlled gaseous arc discharge tube provided with anode, cathode and grid-controlling elements having an input circuit connected to receive said signals and an oscillatory output circuit, a translating device in said output circuit and means to impress a potential adapted to stop the operation of said tube when no signals are received.

5. In a carrier current telegraph system wherein the signals comprise groups of current oscillations, a receiving apparatus having a detector comprising an electrostatically controlled gaseous arc discharge tube having an input circuit connected to receive said signals, and an oscillatory output circuit having a resistance and a current source in series relation shunted by a condenser, and a translating device connected in said output circuit in series with said current source.

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