May 14, 1929. E. O. SYMONDS 1,712,739

TELEGRAPHIC AND OTHER ELECTRICALLY OPERATED DEVICE

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Fig. 1.

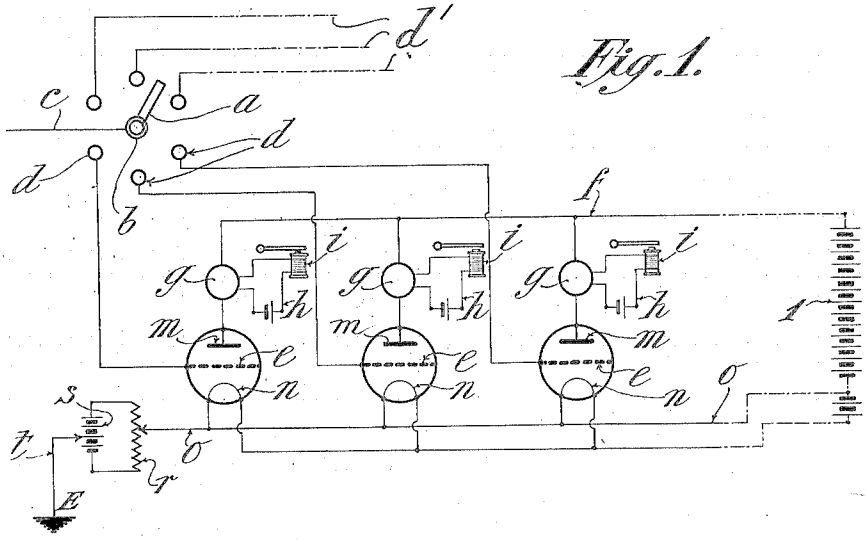
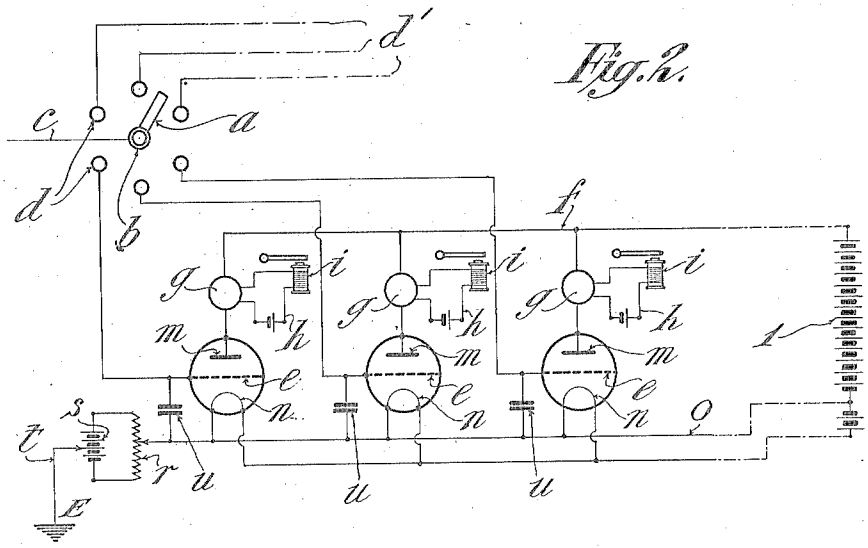


Fig. 2.



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Fig. 3.

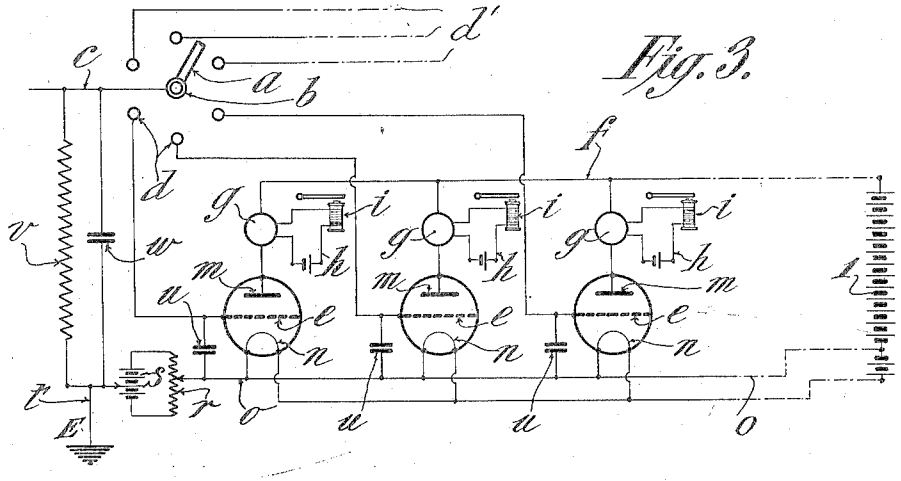


Fig. 4.

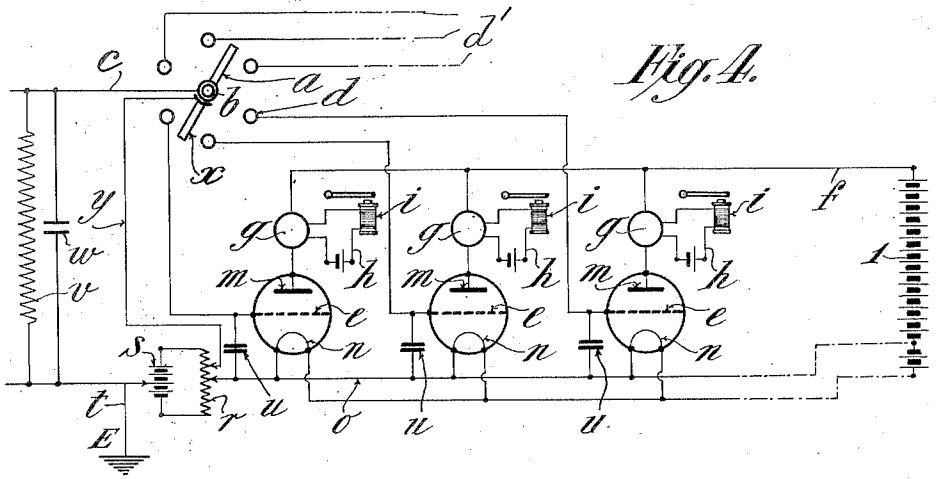
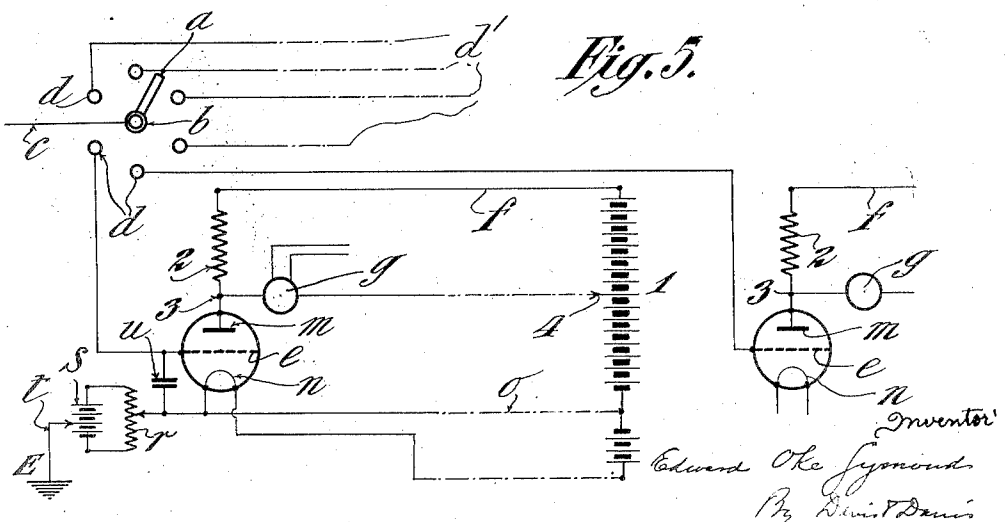


Fig. 5.



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Fig. 6.

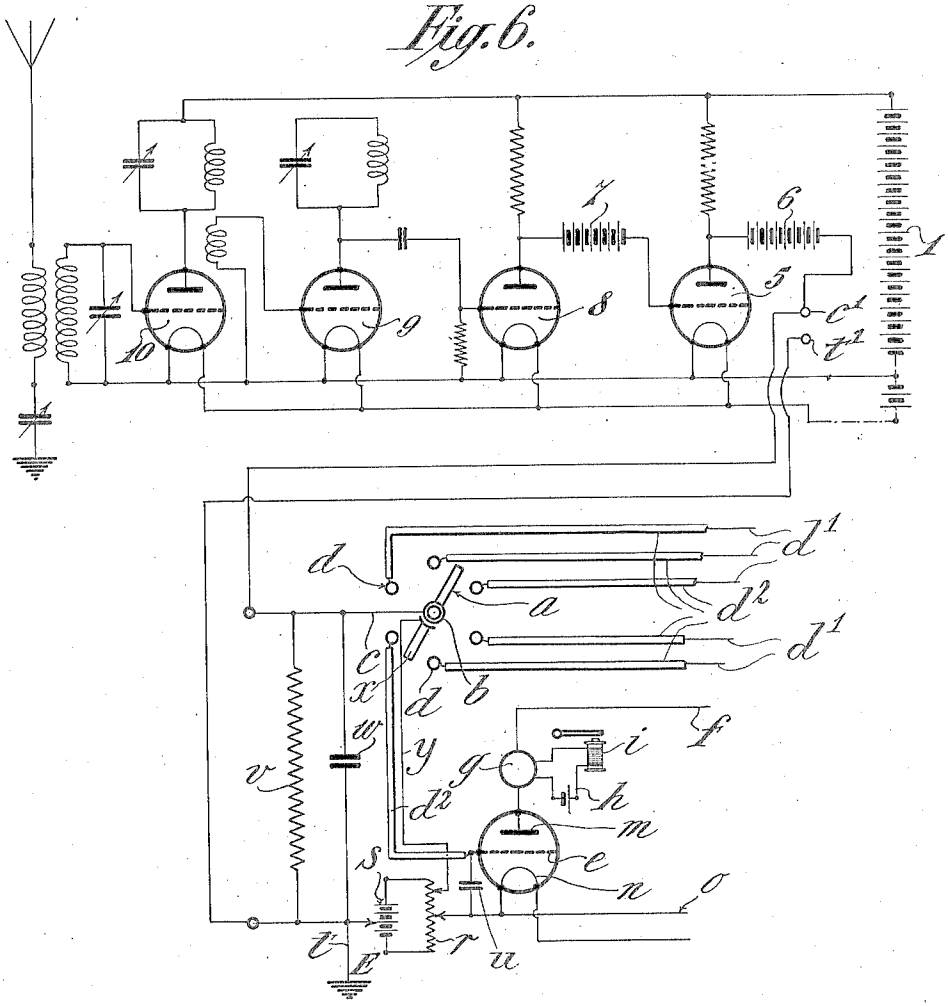
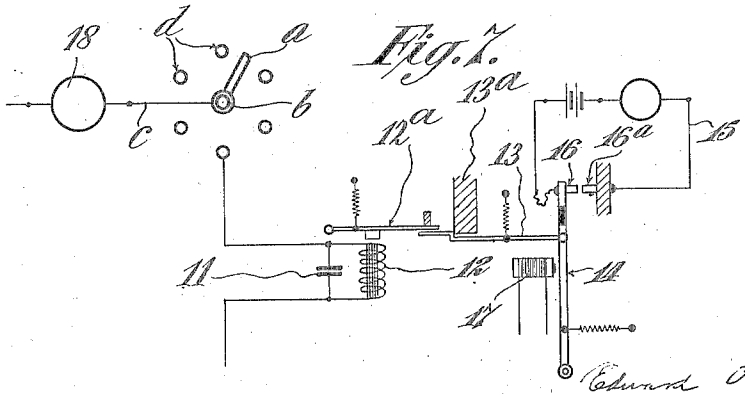


Fig. 7.



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UNITED STATES PATENT OFFICE.

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TELEGRAPHIC AND OTHER ELECTRICALLY-OPERATED DEVICE.

Application filed December 31, 1926, Serial No. 158,270, and in Great Britain January 21, 1926.

This invention consists of improvements in or relating to telegraphic and other devices which are operated by impulses or variations of a very small electric current. For the sake of brevity, the word "impulse" will be used in this specification to denote any current or variation of current which is received by the apparatus and is required to operate it.

In electrical devices which are to be operated by very small impulses of current, it is usual to arrange that the impulses control or operate an electrical relay, which in turn controls another circuit which effects the desired operation, but a disadvantage of this arrangement is that when the impulses are very small or very short, the relay itself must be a very delicate and sensitive mechanism in order that it may respond to feeble and short impulses. Moreover, the rate at which impulses may succeed one another, to give successive operations, is limited by the time required for the operation of the relay.

It is an object of the present invention to provide an improved apparatus in which the rate at which the impulses can be received for utilization is substantially higher than has heretofore been possible, and in which ample power will nevertheless be available for the operation of any desired device or devices.

For the purposes of the invention there is provided, for connection to the transmission line whereby the impulses are received, a synchronized distributing device, such as a switch arm, adapted to sweep over a series of separate contacts and connect the line momentarily to the separate contacts in turn in synchronism with the impulses, so that each impulse is delivered to a separate contact, and associated with each contact is a "trigger circuit", such for example, as a suitably arranged thermionic valve, or combined condenser and thermionic valve, or combined condenser and winding, adapted, when released or activated by an instantaneous impulse imparted through the distributing device, to give a sustained output of energy to it, to operate any desired device.

In a preferred form of apparatus according to the invention, each of the contacts of the distributing device is connected to one pole of a condenser and to the grid of a corresponding thermionic valve, the other pole of the condenser being connected to the filament of the valve, and the relay or other device to be operated is arranged in the anode circuit of the valve in any desired manner.

The invention also comprises the combination with a transmission line, of a synchronized distributor, whereof each of the separate contacts has a condenser associated with it for the purpose of storing each of the very short impulses received, a thermionic valve so connected with each condenser as to be modulated by the charge thereof, and means for automatically discharging each condenser after the valve-circuit has been operated. Preferably, the discharging of the condenser is effected by an auxiliary contact-member carried by the synchronous distributor.

Any known or suitable means of synchronizing the motor used for actuating the distributor arm may be employed, such for example as an extra line signal distributed to two extra synchronizing contacts on the distributor and adapted to regulate the speed of the said motor.

Apparatus adapted to receive and utilize electric impulses in the manner hereinbefore set forth can be constructed in various forms.

In the accompanying drawings, Figs. 1 to 7 inclusive, show, diagrammatically, and by way of example only, several forms of apparatus embodying the invention.

In Fig. 1, the synchronized impulse distributing device comprises a rotary contact or switch arm a connected, as through a stationary contact b, to a telegraph or other signal transmission line c and arranged to sweep over an annular series of separate stationary contacts d in such manner that successive impulses are delivered to successive stationary contacts. To each contact d is connected by a conductor d^1, the grid e of a thermionic valve in the anode circuit f of which is arranged an electrical device g for actuating or controlling any desired device. Such device g may, for instance, be an electric relay, adapted to respond to variations of current strength set up in the said anode circuit and to control for instance a second electric circuit h for actuat-

ing an electro-magnet device i of any desired kind for effecting some useful purpose. m is the usual anode and n the filament of the thermionic valve. The filament n may be connected by a conductor o to any desired point in a potentiometer r connected to the terminals of an electric battery s, a suitable point of the battery being connected by a conductor t to earth E. In this example it is assumed that the natural capacity of each grid will be sufficient to hold the charge transmitted to it for a sufficient time to enable the corresponding relay g to be actuated.

The modified arrangement shown in Fig. 2 is similar to that shown in Fig. 1 except that there is associated with each contact d and corresponding thermionic valve, a condenser u in such manner as to increase the capacity of the grid circuit. For this purpose one pole of the condenser u is connected to the grid e, the other pole being connected to the filament of the valve. The effect of a current impulse received through a contact d on the associated condenser u is to charge it and thereby ensure that a potential difference shall be applied to the grid e and maintained after the synchronously operated distributor arm a has left the contact, even though the duration of contact between the arm and contact, or the time during which the condenser receives its charge, is very small. In this case each condenser u will remain charged until the distributor brush a in its next rotation charges it to the same or a different potential.

Fig. 3 shows another modified arrangement in which a resistance v, say of the order of 10,000 ohms, is connected between the line c and earth E. This ensures that a current, positive or negative, flows from the said line. In some cases it may be advantageous to connect a condenser w across the resistance v. This condenser should be larger than the grid condensers u when these are used. Its effect is to act as a reservoir from which the grid condensers u are charged up. This process of charging up will be nearly instantaneous and in consequence, the contacts d of the distributor can be made exceedingly short.

In some cases it is important that no accumulation of charges on a condenser should obtain. To attain this end, the synchronous distributor shown may be provided with means for discharging each condenser to any desired potential after a suitable interval of time. Fig. 4 shows an arrangement of apparatus similar to that shown in Fig. 2 but wherein means are provided for automatically discharging each condenser in turn to any desired potential after its corresponding valve circuit has been operated. For this purpose, in the example shown, the distributor is provided with an auxiliary contact arm x mounted independently of the main distributor arm a and arranged to sweep over the contacts d so as to connect each condenser in turn to earth E through a conductor y, the potentiometer r and battery s.

The relay g or other device to be operated may be connected in the anode circuit of the thermionic valve in different ways and various arrangements may be used. Thus, for example, the said device g may be arranged in series with the anode m and high tension battery 1, as in the arrangements hereinbefore described and shown in Figs. 1, 2, 3 and 4. Or, as shown in Fig. 5, a resistance 2 may be connected in series with the anode m of the valve and the high tension battery 1. The relay g or other device may then be connected between the common point 3 of the said resistance and the anode of the valve and a suitable point 4 on the high tension battery 1, giving a bridge arrangement in which the relay g or other device is operated by the out-of-balance distribution of potential of the arrangement set up when an impulse is transmitted to the valve.

In cases where the impulses received are comparatively strong, the transmission line may be connected directly to the synchronous distributor, as in the examples hereinbefore described, but in cases, where the impulses are very weak, or where carrier wave transmission is used, any desired amplifying arrangement may be interposed so as to amplify the impulses which are imparted to the synchronous distributor, suitable batteries or potentiometers being used when necessary, to ensure the correct distribution of potential throughout the apparatus.

Fig. 6 shows one arrangement of means for amplifying weak electric impulses, for instance wireless impulses, before they are imparted to the synchronous distributor and associated parts hereinbefore described and which are unchanged, the terminal c^1 corresponding to the transmission line c and t^1 being connected to the earth connected conductor t of Figs. 1 to 5 hereinbefore described. In this example, 5 is a low frequency magnifying thermionic valve, which may be a rectifying valve, preceding the impulse distributor hereinbefore described. The high frequency oscillations can be received, amplified and applied to the said rectifying valve in the usual way and by any known circuit.

In the example shown, the anode of the rectifying valve 5 is connected through a battery 6 to the terminal c^1, and the grid of the valve is connected through a battery 7 to the anode of the next preceding rectifying valve 8. Valves 9 and 10 are tuned anode high frequency valves connected up in known manner. The low frequency coupling shown is that known as battery cou-

pling but any other kind of coupling may be used. The method of rectification shown is that known as "grid leak rectification."

For carrier wave work any other suitable high frequency circuits can be used. The arrangement can be duplexed by any suitable circuit, such as a bridge circuit, formed by resistance, or by a split inductance, or by other methods, suitable precautions being taken to ensure proper symmetry.

In some cases, it may be advantageous to have more than one thermionic valve for controlling each electro-magnetic device *g* in the arrangements shown in Figs. 1 to 5 inclusive hereinbefore described, for producing varying amplified currents corresponding to the variation in the received impulses. In general however, it will be best to effect any desired amplification before the distributor and relay circuits are reached, the reason being that in this way economy in valves and valve connections is possible.

With the arrangement hereinbefore described, the successive impulses received over the transmission line *c* may form parts of successive messages, so that each stationary contact, condenser, thermionic valve and associated parts then deals with the elements of a single separate message, the arrangement affording sufficient time for the corresponding electro-magnetic device *g* to deal with each successive element of the message which affects it. To enable this result to be attained, the contact arm must revolve at a rate in synchronism with the impulses corresponding to each message transmitted and received.

In each arrangement it will be advisable, as a practical precaution, to enclose each insulated conductor d^1 connecting a distributor contact *d* to the corresponding valve in an earthed metal tube indicated at d^2 in Fig. 6.

It may be desirable in each of the arrangements hereinbefore described that a negative potential be at all times applied to the grid of each valve. This condition is obtained by the electrical battery *s*.

Fig. 7 shows an arrangement in which the trigger device associated with each stationary contact *d* of the impulse distributor comprises a condenser 11 and a winding 12 adapted by the action of electric impulses imparted thereto, to act as a relay device. In the example shown, the winding 12 is arranged to attract a spring controlled armature 12^a and trip a spring controlled catch device 13 from a stationary holding device 13^a and permit a spring controlled lever 14, connected to the catch device, to close an electric circuit 15 between contacts 16—16^a, the lever 14 and catch device 13 being afterwards returned to the normal inoperative position shown, to open the circuit 15 by a resetting device 17 operated from the impulse distributor. The impulses transmitted to the distributor may advantageously be magnified by amplifying means such for example as those shown in Fig. 6 and indicated at 18.

What I claim is:—

1. In apparatus for the reception and utilization of electric impulses from a transmission line, a synchronized distributing device operative to connect a plurality of insulated contacts to line in rapid succession and, associated with each contact, impulse utilizing means and a trigger device for bringing such impulse utilizing means into action, said trigger device being designed to be activated by instantaneous connection to line through said distributing device and, after activation, to continue to deliver energy to said impulse utilizing means.

2. In apparatus for the reception and utilization of electric impulses from a transmission line, a synchronized distributing device operative to connect a plurality of insulated contacts to line in rapid succession and, associated with each contact, impulse utilizing means, a trigger device for bringing such impulse utilizing means into action, said trigger device being designed to be activated by instantaneous connection to line through said distributing device and, after activation to continue to deliver energy to said impulse utilizing means and means for de-activating each trigger device after a predetermined lapse of time.

3. In apparatus for the reception and utilization of electric impulses from a transmission line, a plurality of impulse utilizing devices for successive operation by line impulses, trigger means associated with each impulse utilizing device for receiving an instantaneous potential impulse from line and employing it to provide a sustained actuating force on the co-related impulse utilizing device, means for imparting line potential successively to the several trigger means and means for imparting another potential to each trigger means after lapse of a predetermined time.

4. In the device of claim 3, trigger means comprising a thermionic valve having in association with its grid circuit, capacity means for securing instantaneous activation by line impulses and subsequent sustained delivery of energy to the impulse utilizing means.

5. In the device of claim 3, trigger means comprising a thermionic valve and a condenser arranged in the grid circuit of said valve for securing instantaneous activation by line impulses and subsequent sustained delivery of energy to the impulse utilizing means.

6. In telegraphic apparatus for the reception and utilization of electric impulses, a rotary distributing device having an annular

series of stationary contacts, said distributing device being operative in synchronism with the received impulses to impart said impulses severally and in succession each to one of the annular series of stationary contacts, an impulse utilizing device associated with each contact, and trigger means interposed between each contact and its associated impulse utilizing device for receiving an activating impulse instantaneously from line and for supplying a sustained actuating force to the impulse utilizing device.

7. In telegraphic apparatus for the reception and utilization of electric impulses, a rotary distributing device having an annular series of stationary contacts, said distributing device being operative in synchronism with the received impulses to impart said impulses severally and in succession each to one of the annular series of stationary contacts, an impulse utilizing device associated with each contact trigger, means interposed between each contact and its associated impulse utilizing device for receiving an activating impulse instantaneously from line and for supplying a sustained actuating force to the impulse utilizing device and means operated by the rotary distributing device to de-activate the trigger means and restore the impulse utilizing device to an inoperative state after lapse of a predetermined time.

8. In telegraphic apparatus for receiving and utilizing electric impulses, a synchronized distributing device having a plurality of contacts for successive connection to a signal line, a relay associated with each contact and, interposed between each relay and its contact, trigger means for receiving energy instantaneously from line through such contact and delivering energy for a sustained period to said relay.

9. In apparatus for receiving and utilizing electric impulses, a synchronized distributing device having a plurality of contacts for successive connection to a signal line, a circuit controlling device associated with each contact and, interposed between each circuit controlling device and its associated contact, trigger means for receiving energy instantaneously from line through such contact and delivering energy for a sustained period to said circuit controlling means.

10. In apparatus for receiving and utilizing electric impulses, a synchronous distributing device having a series of contacts for successive connection to an impulse carrying line, a thermionic valve associated with each contact, each thermionic valve having capacity in its input circuit and receiving an instantaneous input through its associated contact, and an impulse utilizing device connected in the output circuit of each valve so as to receive therefrom sustained output energy resulting from the instantaneous input.

11. In apparatus for receiving and utilizing electric impulses, a synchronous distributing device having a series of contacts for successive connection to an impulse carrying line, a thermionic valve associated with each contact, each thermionic valve having capacity in its input circuit and receiving an instantaneous input through its associated contact, and circuit controlling means connected in the output circuit of each valve so as to receive therefrom sustained output energy resulting from the instantaneous input.

12. In apparatus for receiving and utilizing electric impulses, a synchronous distributing device having a series of contacts for successive connection to an impulse carrying line, a thermionic valve associated with each contact, each thermionic valve having capacity in its input circuit and receiving an instantaneous input through its associated contact and a relay associated with the output circuit of each valve, each relay being adapted to respond to sustained changes of current occurring in the associated valve output circuit when an instantaneous input of energy occurs on the input side of the valve.

13. In apparatus for receiving and utilizing electric impulses, a synchronous distributing device having a series of contacts for successive connection to an impulse carrying line, a thermionic valve so associated with each contact that the grid circuit of said valve is in permanent connection with such contact, each valve having capacity in its grid circuit and being adapted to receive a grid charge instantaneously from line, an impulse using device connected in the anode circuit of each valve to receive therefrom the sustained energy output resulting from the instantaneously received grid charge and means operative after a predetermined lapse of time to discharge the grid and thereby to arrest the output of energy to the impulse using device.

14. Apparatus according to claim 12 comprising means associated with the synchronous distributing means for earthing the grids of the trigger valves after a predetermined period has elapsed from the time of charging said grids.

15. In apparatus for the reception and utilization of electric impulses from a transmission line, a synchronized distributing device operative to connect a plurality of insulated contacts to line in rapid succession, and, associated with each contact, impulse utilizing means and a trigger device comprising capacity means designed to be activated by instantaneous connection to line through said distributing device and after activation to continue to deliver energy to

said impulse utilizing means and means for storing energy for the successive activation of the several trigger devices.

16. The device of claim 15 in combination with means for dissipating surplus energy from each trigger device after a predetermined lapse of time.

17. In apparatus for the reception and utilization of electric impulses from a transmission line, a synchronized distributing device operative to connect a plurality of insulated contacts to line in rapid succession, and, associated with each contact, impulse utilizing means and a trigger device comprising capacity means designed to be activated by instantaneous connection to line through said distributing device and after activation to continue to deliver energy to said impulse utilizing means and a storage condenser receiving energy from line and imparting energy successively to the trigger devices in response to movements of the distributing device.

18. The device of claim 17 wherein the capacity means is shunted by a high resistance.

Signed at Croydon, in the county of Surrey, England, this thirteenth day of December, 1926.

EDWARD OKE SYMONDS.