

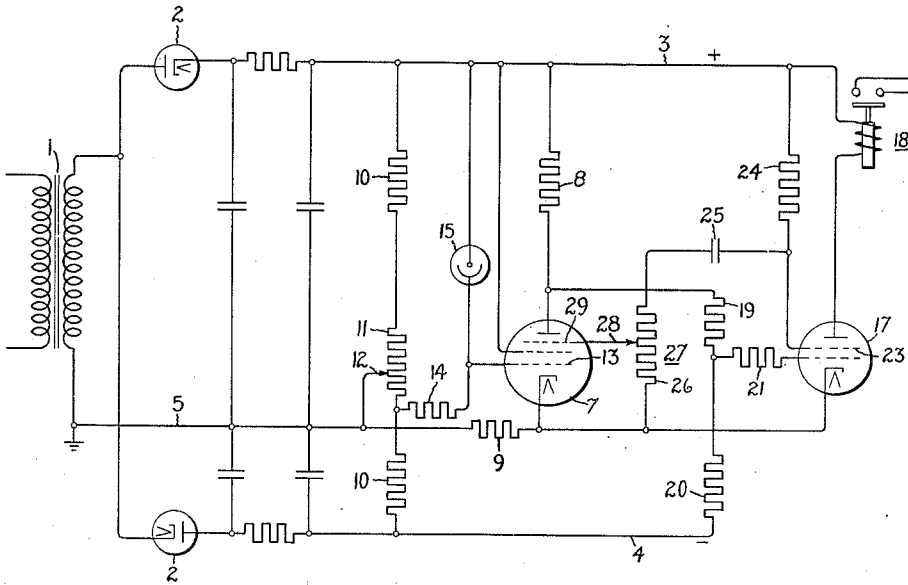
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RELAY APPARATUS

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## RELAY APPARATUS

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My invention relates to relay apparatus and particularly to relay apparatus of the type employing electron discharge amplifying means. Such apparatus often is employed to control an electro-magnetic relay of some common, inexpensive form. It sometimes happens that where the apparatus is required to respond to impulses of very short duration the time constant of the electromagnetic relay employed is too great to enable the relay to respond to the impulses. If the impulses are not too short, a special form of high speed relay may be successfully used; however, the additional cost of such a relay is an important consideration in many cases and there is a limit to the shortness of the impulses to which even such relays will respond.

It is the object of my invention to provide improved relay apparatus from which one may operate an ordinary inexpensive form of electromagnetic relay or other responsive device which apparatus will cause the operation of the relay in response to impulses, no matter how short, received by the apparatus. In accordance with my invention, I have devised a form of relay apparatus having improved means for so lengthening each received impulse that an ordinary, inexpensive relay or responsive device can be successfully used therewith.

My invention will be better understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

In the single figure of the drawing which is a circuit diagram of one embodiment of my invention, the transformer 1 whose primary may be energized from a 115 volt 60 cycle lighting circuit is shown feeding through the rectifiers 2 a well known form of two stage direct current amplifier circuit having the positive side 3, the negative side 4 and the neutral or ground side 5. The electron discharge amplifier 7 has its anode connected through the resistor 8 with the positive side 3 and its cathode connected through the resistor 9 with the ground lead 5. A voltage divider comprising the two resistors 10 and the potentiometer 11 connects between 3 and 4, the adjustable arm 12 of the potentiometer being connected with the ground side 5. A negative bias is supplied to the control grid 13 of the amplifier 7 from the lower or negative end of the potentiometer through the resistor 14. In the form of my invention which I have chosen to illustrate, the impulse to be amplified is obtained from the photo-electric device 15 connected between the side 3 and the

grid 13. As so arranged, as long as the photo-electric device is illuminated the negative bias is opposed and the amplifier 7 passes current.

The electron discharge amplifier 17 has its anode connected with the side 3 through the winding of the electromagnetic relay 18, which may be of inexpensive construction and not particularly fast in operation. The cathode of this amplifier connects with the cathode of the amplifier 7, the two amplifiers thereby having the common cathode resistor 9 whereby I am able to obtain quicker closing and opening of the relay. I am able to operate the two amplifiers in cascade with the two cathodes at the same potential in as much as I use a voltage divider comprising the resistors 19 and 20 between the anode of 7 and the side 4 to which divider the control grid of 17 connects through the resistor 21.

The screen grid 23 of the amplifier 17 connects with the side 3 through the resistor 24 which may have a resistance of 5000 ohms. Connected between the screen grid 23 and the ground side 5 is the capacitor 25, which may have a capacitance of 0.25 mfd., and the resistor element 26, which may have a resistance of 0.5 meg., of the potentiometer 27. The adjustable arm 28 of the potentiometer connects with the suppressor grid 29 of the amplifier 7. Thus it will be seen that I have provided a feed back circuit from the screen grid of the second amplifier to the suppressor grid of the first amplifier.

The operation of the apparatus illustrated briefly is as follows: When the photo-electric device is illuminated the amplifier 7 carries current but the amplifier 17 does not, at least does not carry sufficient current to operate the relay 18. Should a sudden reduction occur in the illumination lasting for only a short interval, shorter even than that normally required for the operation of the relay 18, the amplifier 7 by having its impedance increased ceases to conduct and the amplifier 17 by having its impedance decreased by reason of its coupling therewith accordingly is made to conduct. This lowered impedance of 17 results in an increase in the current passing to the screen grid 23 thereof through the resistor 24 and because of the potential drop through that resistor a reduced voltage is applied to the capacitor 25. The freed negative charge on that plate of the capacitor which connects with the suppressor grid 29 swings that grid sufficiently negative to produce a high impedance condition in the amplifier 7 regardless of the control grid 13 which now has

lost control. This condition of high impedance of 7 and accordingly low impedance of 17 continues until the former higher charge on the capacitor has had time to reduce by discharging through the potentiometer 26 and amplifier 17 to the new lower value. The length of this time may be very materially longer than the length of the impulse of reduced light and is sufficient to permit the operation of the relay 18. When the charge on the capacitor in reducing finally reaches a fixed or nearly fixed value the suppressor grid 29 returns substantially to cathode voltage whereupon the grid 13 regains control restoring the amplifier to its original low impedance or conducting condition. Amplifier 17 consequently is returned to its original high impedance condition and the relay 18 is deenergized.

It will thus be seen that an extremely short impulse applied to the control grid of the first amplifier produced, for example by a correspondingly short interruption or decrease in light affecting the photo-electric device by cumulative action causes a current impulse to be supplied to the relatively slow load device of ample length to insure the proper operation thereof. An advantage of using the voltage obtained from the screen grid rather than from the anode of the second amplifier for effecting the change in capacitor charge is that its load is pure resistance whereas the anode load is largely inductive and as such is more influenced by ripples in the rectified direct current supply, etc. By varying the position of the potentiometer arm 28 I may vary the length of the output impulse of amplifier 17 made in response to a given short input impulse to amplifier 7.

While I have shown and described the photo-electric device as connected in a manner to operate the relay 18 in response to a brief light decrease it will be obvious to one skilled in the art that it may be rearranged if so desired to operate the relay in response to a brief light increase instead.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Relay apparatus comprising a first electron

discharge amplifier having a control grid and a suppressor grid, a second electron discharge amplifier connected in cascade with said first amplifier and having a screen grid, a resistance supply connection to said screen grid, a load device in the output circuit of said second amplifier, means by which an impulse may be applied to the control grid of said first amplifier of a length shorter than that required for the actuation of said load device, a resistance connection between the suppressor grid and the cathode of said first amplifier and a capacitor connection between said suppressor grid and said screen grid.

2. Relay apparatus comprising a first electron discharge amplifier having a control grid and a suppressor grid, a second electron discharge amplifier connected in cascade with said first amplifier and having a screen grid, a resistor in the supply connection to said screen grid, a load device in the output circuit of said second amplifier, means by which an impulse may be applied to the control grid of said first amplifier of a length shorter than that required for the actuation of said load device, variable resistance means between the suppressor grid and the cathode of said first amplifier and a capacitor connected between said suppressor grid and said screen grid.

3. Relay apparatus comprising a first electron discharge amplifier having a control grid and a suppressor grid, a second electron discharge amplifier having its control grid connected with the output circuit of said first amplifier and having a screen grid, a resistor in the supply connection of said screen grid, an electro-magnetic load device in the output circuit of said second amplifier, a photo-electric device for applying an impulse of short duration to the control grid of said first amplifier, a potentiometer having its arm connected with the suppressor grid of said first amplifier and one end connected with the cathode thereof and a capacitor connected between the other end of said potentiometer and the screen grid of the second amplifier.

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