Aug. 17, 1937. D. E. NOBLE 2,090,224

CONTROL APPARATUS

Filed Feb. 20, 1936

FIG. 1.

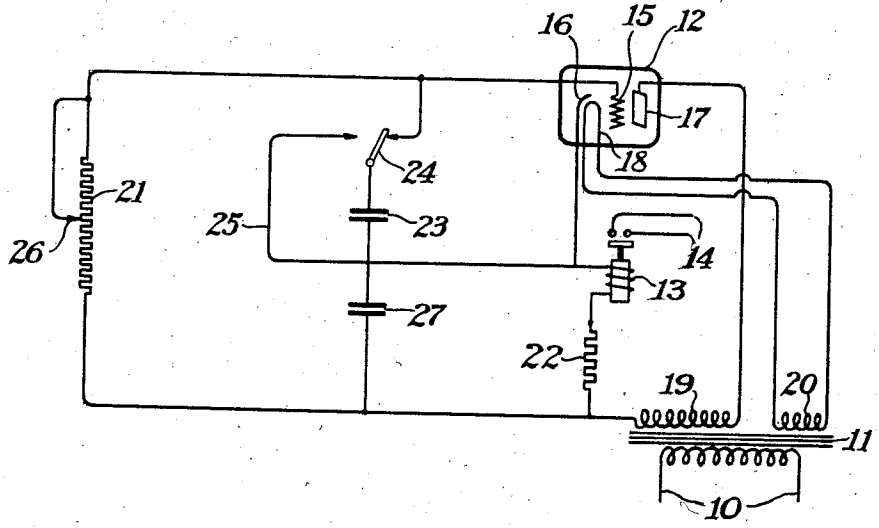
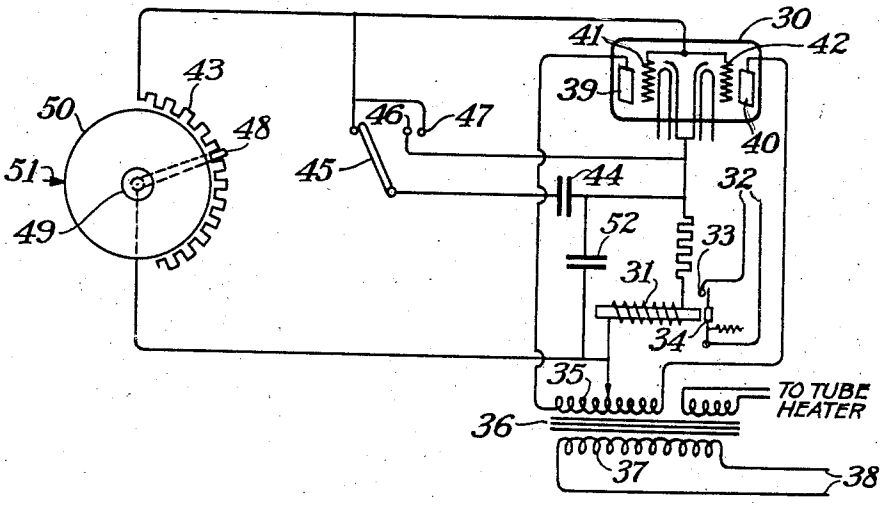


FIG. 2.



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CONTROL APPARATUS

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4 Claims. (Cl. 250—27)

My invention relates to control apparatus and has for its principal object the provision of an improved limited impulse electronic relay wherein an adjustable part controls the action of an electric valve to energize for a predetermined time interval the coil of a relay or other control device.

It is frequently desirable to have available an apparatus which will perform a control action either mechanical or electrical for a predetermined period, which period is adjustable in advance. Such apparatus is especially useful in making photographic exposures where a wide range of predetermined time intervals is needed and where an operator should be able to select such intervals with great accuracy.

The apparatus of my invention is intended to work directly from an alternating current source of supply, without the interposition of any special rectifying means, and its time interval is determined by the charge of a condenser connected in the grid circuit of an electric valve through which current is supplied to the control device or relay.

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

Referring to the drawing,

Fig. 1 shows one suitable circuit arrangement for the apparatus of my invention and Fig. 2 shows a modified circuit arrangement of a similar apparatus.

In Fig. 1 is shown a circuit 10 for transmitting current from a suitable source through a transformer 11 and an electric valve 12 to an electro responsive device 13 which is shown as a relay coil adapted to control the connections of a circuit 14 which it is desired to control and which may comprise any desired apparatus such as a photographic printing lamp or shutter arrangement. The valve 12 comprises a grid 15 for controlling the flow of current between its cathode 16 and its anode 17 to the operating coil of the relay 13. The valve 12 may be of any suitable construction and is here shown as a heated cathode type in which a filament 18 is the heater element. The transformer 11 is provided with a secondary winding 19 for supplying the current to the anode circuit of the valve 12 and another secondary winding 20 for supplying heating current to the filament 18. It will be noted that the coil of the relay 13 and the secondary winding 19 are connected in series in the anode circuit of the valve 12 and that the grid 15 is connected through a resistance 21 to the junction between the serial combination of the relay coil 13 and the secondary winding 19 whereby a negative potential determined by the resistance of the coil 13 is impressed on the grid 15. The resistance 21 indicates any means suitable for regulating the impedance to the passage of a current therethrough such as a light sensitive cell or an ordinary adjustable resistance as shown. In the arrangement shown the potential impressed on the grid is, of course, the drop across the relay coil 13 and a suitable series resistance 22, the value of which is so selected that the potential applied to the grid 15 prevents the anode current from reaching a value sufficiently large to actuate the relay 13. It will be understood that the additional resistance 22 is only necessary when the resistance of the relay coil 13 does not supply the desired potential.

A condenser 23 is adapted to be connected directly across the cathode 16 and the grid 15 by means of a switch 24 when it is in the position shown in Fig. 1. This switch 24 is normally to the left so as to connect a lead 25 in shunt relation with the condenser 23 so that this condenser is drained of any charge.

The operation of the apparatus will be readily understood if it be assumed that the switch 24 has just been moved to the position shown. Under this condition, the condenser 23 immediately starts receiving a charge through the resistance 21 which decreases the potential on the grid 15 by an amount equal to the drop across the resistance 21 and a current flows in the anode circuit of the valve 12 which energizes the relay 13 to close the circuit 14. As the charge on the condenser 23 increases, the current through the resistance 21 decreases until the anode current of the valve 12 drops below the value at which the relay 13 will remain closed and, accordingly, the relay opens the circuit 14. The time interval during which the relay 13 is held closed depends upon the magnitude of the capacity of the condenser 23 and the value of the resistance 21 and very accurate regulation of this time interval is possible by varying the capacity of the condenser 23 or adjusting the value of the resistance 21 included in the charging circuit. In the present instance I have shown the resistance 21 as being variable by means of an adjustable contact 26.

In the arrangement just described, it will be noted that the anode current flows through the relay coil 13 only during one half of each cycle of the alternating current, and, in order to elim-

inate any chattering of the relay 13, I connect a condenser 27 across the relay coil 13, as is well-known.

The embodiment of the invention illustrated in Fig. 2 is quite similar to the apparatus described in connection with Fig. 1 in that an electric valve 30 controls the current flow in a relay 31 connected in its anode circuit and which controls a separate circuit 32 by means of a contact 33 carrying an armature 34 adapted to be attracted upon energization of the relay 31. In the present instance, the valve 30 is of twin triode type which has its cathodes connected through the relay 31 to the center point of the secondary winding 35 of a transformer 36, the primary winding 37 of which is connected through leads 38 to any suitable source of alternating current. As is well known, the terminals of the secondary winding 35 are connected to the anodes 39 and 40 of the valve 30. The potential on the grids 41 and 42 of the valve 30 is determined by the potential drop across a resistance 43 due to the passage therethrough of a charging current for a condenser 44. A switch 45, when in the position shown in Fig. 2, connects the condenser 44 to be charged through the resistance 43 and, as was the case in the arrangement shown in Fig. 1, the potential on the grids of the valve 30 is reduced and the anode current increases to energize the relay 31 and thereby close the circuit 32 for a time interval depending upon the capacity of the condenser 44 and the value of the resistance 43. Although the valve 30 is of the self rectifier type, I prefer to shunt the relay 31 with a condenser 52 to insure quiet operation. When the switch 45 is moved to its middle position, that is, engaging contact 46, the condenser 44 is short circuited and the relay 31 remains open. If the switch 45 is moved to the extreme right so as to engage both the contact 46 and a contact 47 the cathode voltage is directly impressed on the grids of the valve 30 and the relay 31 holds the circuit 32 closed as long as the switch 45 remains in this position. It is thus evident that this arrangement makes it possible for the operator to obtain manually controlled time intervals.

For adjusting the time interval of the apparatus shown in Fig. 2, I have provided a sliding contact 48 which acts to include a greater or less amount of the resistance 43 in the charging circuit in accordance with the position of a dial knob 49 to which the contact 48 is secured. The knob 49 may be secured to a disk 50 provided with a time scale which cooperates with an index 51 to show the time interval for which the apparatus is adjusted.

In each arrangement described the adjustable resistance for regulating the rate at which the condenser is charged may take any desired form and may be adjusted either manually or automatically in accordance with any desired factor, such as the intensity of a light source, the transmission of a photographic record, or the like.

The embodiments of my invention which have been illustrated and described have been selected for the purpose of setting forth the principles involved. It will be obvious, however, that the invention may be modified to meet various conditions which may be met with in different specific uses and I, therefore, intend to cover by the appended claims all such modifications which fall within the spirit and scope of my invention.

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

1. Means for controlling the current in the output circuit of an electron discharge device having a cathode, anode, and control electrode, comprising an input circuit for said device, a source of potential in the output circuit, a resistance between the cathode and said source, a condenser one side of which is connected to the cathode, a resistance the value of which may be varied connected between the source of potential and the condenser so that the condenser is charged through said variable resistance, and means for impressing the potential drop across said variable resistance, due to the charging current, upon said control electrode.

2. In an electric timing device including a relay coil connected in the output circuit of an electron discharge device having an anode, a cathode, and a grid, the serial combination of a resistance and a source of potential between the cathode and the anode, the resistance being between said source and the cathode, a resistance the value of which may be varied connected to the junction between said source and said first-mentioned resistance and to the grid, a condenser, and means for connecting the condenser across the grid and the cathode whereby the condenser will be charged through the variable resistance at a diminishing rate until fully charged.

3. In a timing device including a relay coil, means for energizing the relay coil for a selected time interval comprising a three electrode thermionic valve, a source of potential and said coil connected in series across the cathode and anode of the valve so that said coil is between said source and the cathode, an adjustable resistance connected across the junction between said coil and said source and the control electrode of said valve, a condenser, a switch for connecting the condenser to be charged through said resistance, and means for impressing the potential drop across said resistance directly upon said control electrode, whereby when the switch is closed an increased current will flow between said anode and said cathode for an interval of time depending upon the capacity of the condenser and the magnitude of said resistance.

4. In a device of the character described including an electron discharge device having a cathode, an anode, and a grid, means for controlling the potential of the grid comprising a source of potential connected in series with a resistance across the cathode and the anode, the resistance being between the source of potential and the cathode, a variable resistance connected between the grid and the junction of the source of potential and the first-mentioned resistance, a condenser, and means for connecting said condenser across the grid and the cathode whereby the absolute value of the potential on said grid will be reduced temporarily and will increase until said condenser becomes charged through said variable resistance.

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