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ELECTRONIC SWITCH

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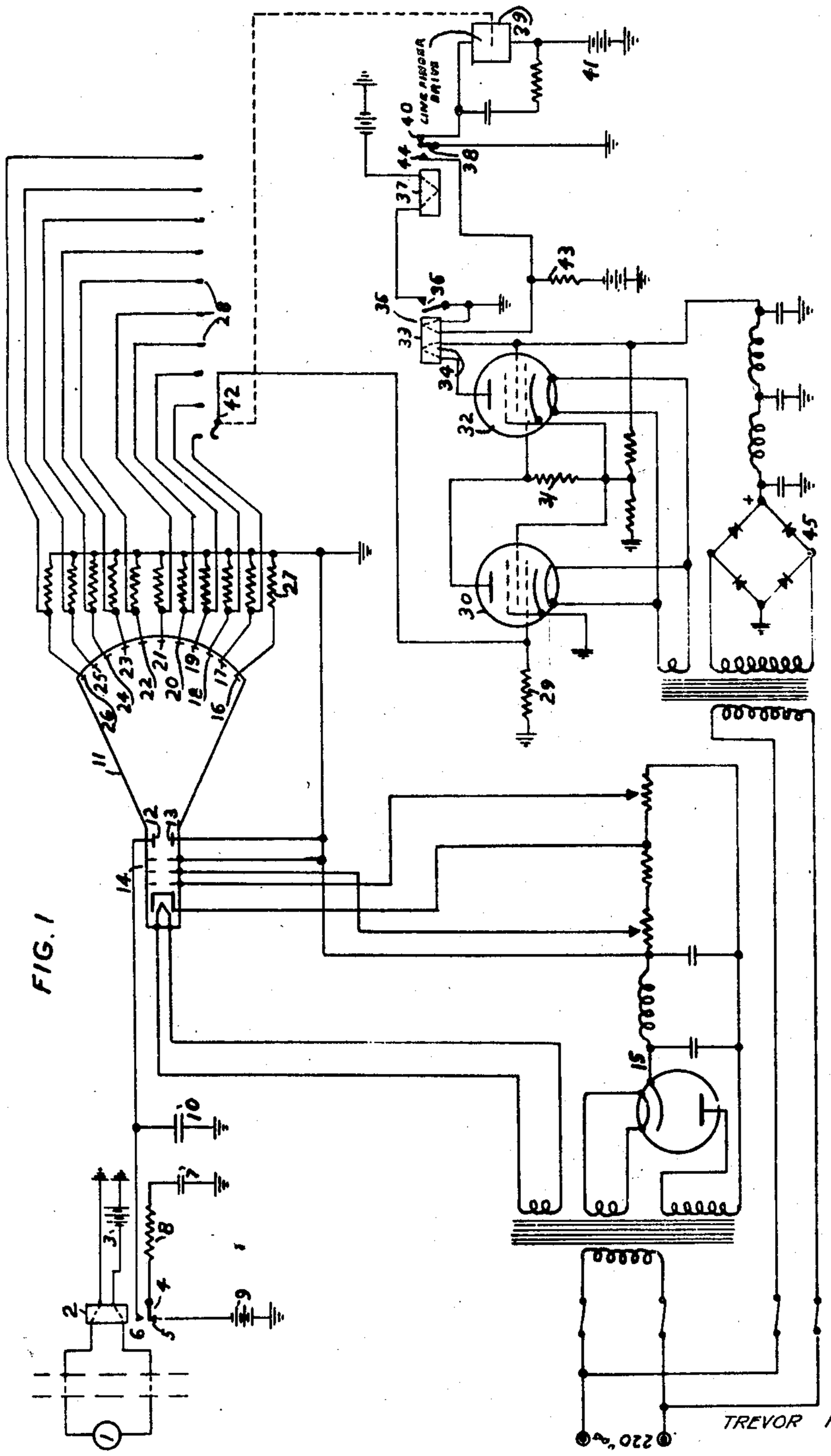

FIG. 1

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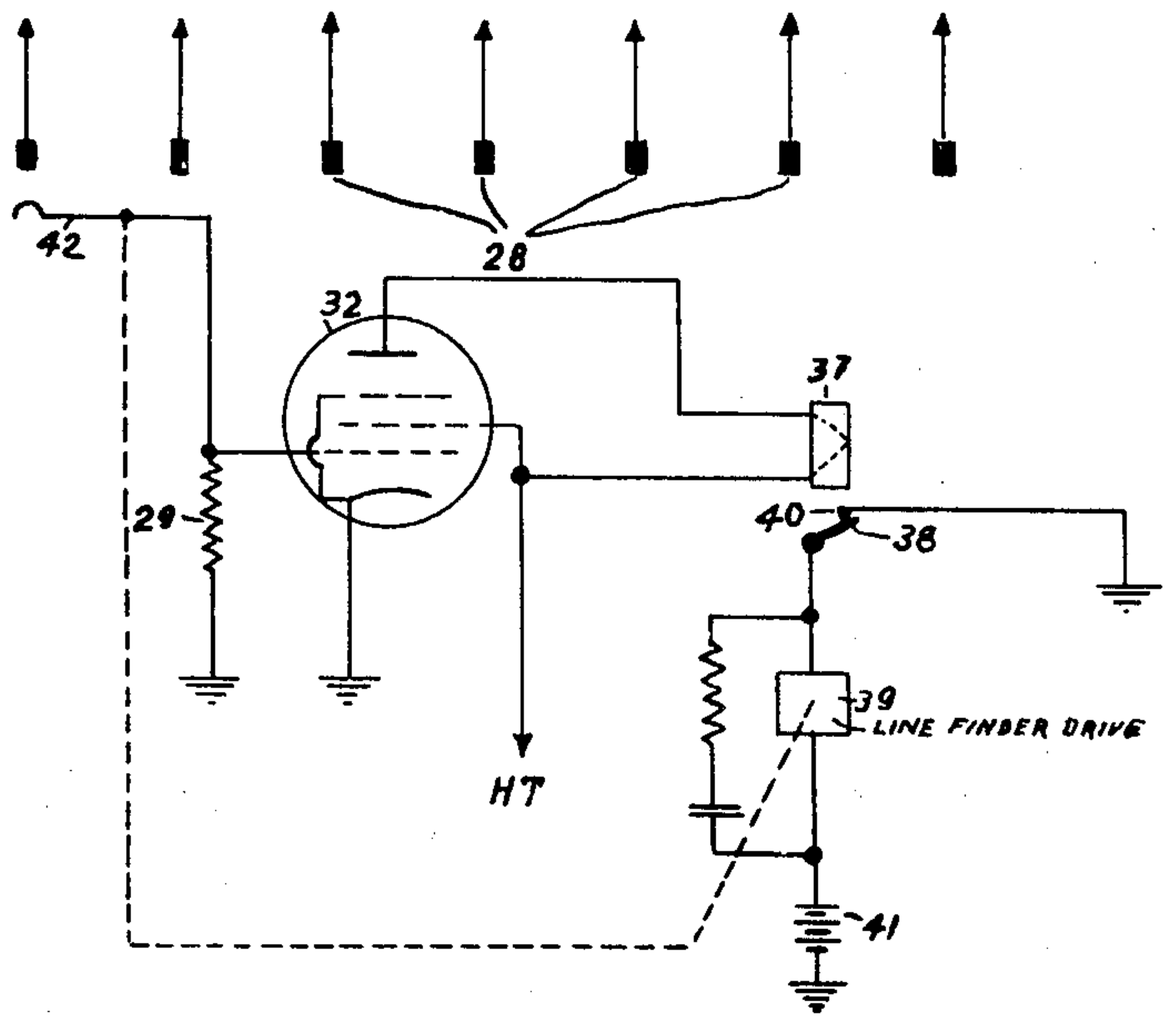
FIG. 2.



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ELECTRONIC SWITCH

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6 Claims. (Cl. 177—353)

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The present invention relates to control or switching devices employing electronic apparatus.

In automatic telephone or remote control systems, etc. devices are employed registering the signals transmitted by the operator or by the user. In numerous cases this is obtained by means of mechanical switches, for example, the so-called step-by-step switches which receive the impulses generated by a dial or by a remote control device, translate them, and control various members carrying out the desired operations.

This mechanical execution has the drawback of being relatively slow in operation, and moreover, the mechanical parts wear and require regular supervision and replacement of parts.

One of the objects of the present invention is the provision of an improved switch, particularly one which performs the function of the mechanical step-by-step switch and which preferably has other features such as being capable of operation at high speed requiring no periodic impulses, and lessening the requirement for replacement of parts.

The above-mentioned and other features and objects of this invention will become more apparent and the invention itself though not necessarily defined by said features and objects will be best understood by reference to the following description of an embodiment of the invention taken in connection with the accompanying drawings, wherein:

Fig. 1 is a schematic diagram of a switching arrangement embodying the present invention as applied to an automatic telephone system; and

Fig. 2 is a schematic diagram of a modification of a portion thereof.

The embodiment shown is the application of the invention to an automatic telephone system, but it is clear that the invention is not restricted to such an automatic telephone system, and may be applied to any remote control system employing current or voltage impulses as a means of connection between the control stations and the controlled apparatus.

Referring to Figure 1, the index 1 represents an impulse generating device, this impulse generator may be a telephone dial or any other arrangement producing impulses of such a character that they cause the relay 2 to operate.

The relay 2 is actuated by the impulse transmitting system when the circuit comprising the battery 3, the relay 2, and the dial 1 is closed. In the non-actuated or normal position the armature 4 of the relay 2 closes a circuit comprising the

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battery 9, the contact 5, the armature 4, the resistance 8 and the condenser 7.

The resistance 8 is chosen sufficiently high to avoid the formation of sparks on the contacts, and yet sufficiently low for the condenser 7 to be charged at the potential of the battery 9 in a short time with respect to the time during which the circuit remains closed. When the relay 2 is actuated the circuit composed by the condenser 7, the resistance 8, the contacts 4 and 6, the condenser 10 and the deflecting plate 12, of the cathode ray tube 11 is closed. These circuits are well known both with regard to their construction and their operation.

It will only be recalled here that the potential on the terminals of the condenser 10 will be given by:

$$E_1=\frac{e}{N+1} \text{ for the first impulse}$$

where E_1 is the resultant potential on the terminals of the condenser 10, N is the ratio between the capacities of the condenser 10 and of the condenser 7, e is the potential of the battery 9:

$$E_2-E_1\frac{2N+1}{N+1} \text{ for the second impulse}$$

$$E_n-e\left[\left(\frac{N}{N+1}\,\frac{E_n-1}{e}\right)+\frac{1}{N+1}\right] \text{ for the } n\text{th impulse}$$

The charge on condenser 10 determines the deflection of the beam in the cathode ray tube 11. In automatic telephone circuits means are provided for discharging the condenser 10 when the telephone receiver is replaced on its hook or stand.

The deflecting electrode 12 forms a part of the cathode ray tube 11 which comprises a unit or electron gun 14 generating electronic beams, deflecting plates 12 and 13 and a system of target or electron receiving electrodes 16 to 26. The feed potentials of this tube are supplied by the rectified and filtered A. C. feed system 15. It is clear that the number of receiving electrodes may be increased or decreased as required.

The electronic beam generated by the system 14 is initially directed so as to be received by the electrode 16 when the potential on the terminals of the condenser 10 is zero. The remainder of the electrodes 17 to 26 are arranged so that the electronic beam progresses from one to the other in succession. The deflection of the cathodic beam being in proportion to the potential on the terminals of the condenser 10, if an impulse has been received the beam will arrive on the elec-

trode 17, if two impulses have been received the beam will arrive on the electrode 18, etc. . . . , and if 10 impulses have been received the beam will strike the electrode 26. The electrodes are dimensioned and arranged in accordance with the formula given above. The electronic current arrives on the earth or ground terminal which is the positive terminal of the source of supply, across one of the resistances 27 and consequently creates a potential difference across the terminals of that resistance which it passes through.

At 28 are shown diagrammatically 10 terminals of a mechanical switch, for example, of the well known clutch type, much used in the rotary automatic telephone systems and known by the name of "line finder." The clutch or driving mechanism of this switch is shown at 39. The contact 40 and the armature 38 are closed during the operation of the line finder, that is to say while the contacts 28 are searched by the brush 42, the clutch being supplied with the power from source 41. At the moment when the circuit of the armature 38 is opened the brush 42 stops.

When the circuit formed by one of the resistances 27, the corrsponding contact 28, the contact of the brush 42 and the resistance 29 is closed, a part of the current of the electronic beam will circulate in the resistance 29 and a potential will appear on the terminals of this resistance, the earthed end being positive. This difference of potential will be applied to the grid of an amplifier valve 30 which may be a valve of any type but preferably of the pentode type as shown in the drawing and in which the plate current is not zero when the grid potential is zero.

The resistances 27 and 29 are of such a value that when current flows through resistor 29, the resulting potential applied to the grid of the valve 30 decreases the plate current of valve 30 to zero or around zero. The resistance 29 may be chosen lower than the resistance 27, so that another line finder operating in parallel with the one illustrated in the drawings cannot stop on the same contact.

The plate current of the valve 30 passing across resistance 31, creates a difference of potential between the terminals of this resistance. This potential which is applied between the cathode and the grid of the second valve 32, is polarised, in such a way that the grid becomes negative with regard to the cathode during the passage of the current, and of such an amplitude that the plate current of the valve 32 is reduced to zero. However, when no current traverses the resistance 31, the control grid of the valve 32 is at the potential of the cathode and a strong current circulates in the plate circuit. This current goes through the winding 34 of the relay 33, a second current goes through the winding 35 of the same relay, and this current is regulated by means of the resistance 43, in such a way that the armature of the relay is attracted when no current circulates in the winding 34. The windings are arranged and connected in such a way that when they are carrying normal currents, the magnetic forces are opposed. Even a very weak current through the winding 34 causes the relay to overbalance and close the contacts 36.

When the contacts 36 close the relay 37 is then actuated and the circuit 40 opened. This interrupts the current in the clutch 39 and the finder is stopped. The whole of the operation takes place so rapidly that the contact of the brush 42 is stopped near the centre of the contact 28

corresponding to the receiving electrode of the tube 11 on which the electron beam rests.

It should be noted that the sweeping of the beam across various targets produces transient currents through resistors 27 of such small value that, if brush 42 is on the corresponding contact of the resistor 27 through which said small current is flowing, the resultant current flow through resistor 29 is insufficient to cause tube 30 to be blocked and thereby operate the system. When, however, the beam comes to rest on one of the targets and the line finder brush 42 touches the corresponding contact the resulting current through resistor 29 causes tube 30 to be blocked which in turn causes tube 32 to conduct whereby current flows through winding 34 closing contact 36 and energizing relay 37 which draws armature 38 from contact 40 and stops the line finder clutch 39.

The relay 33 is a relay with quick release quickly closing contacts and slow operation slowly opening contacts so that the line finder is maintained in position even if the contact 42–28 is momentarily broken or if the potential on the terminals of the resistance 29 momentarily falls below the value necessary to maintain at zero the plate current of the valve 30.

The potentials necessary for the operation of the valves 30 and 32 are supplied by the source of supply 45 which may be a part of the current supply system 15.

The bias current of the relay 33 passing through the winding 35 is reduced to zero, when the relay 37 operates since the armature 38 makes contact with the contacts 44 and short circuits the winding 35. This insures proper operation as the finder cannot operate before the bias current of the relay 37 has been cut off.

Figure 2 represents a modification of the system described in Figure 1 in which the brush 42 is directly connected in the grid circuit of the second valve 32 and in which only the relay 37 is utilised.

Tube 32 is normally conductive causing current to flow through relay 37 and armature 38 to touch contact 40 thereby supplying energy to the clutch 39 and causing the brush 42 to continuously and cyclically sweep the contacts 28. When the brush 42 touches the contact 28 connected to the target electrode on which the beam is resting, current will flow through brush 42 and resistance 29. The potential across resistance 29 blocks tube 32 deenergizing relay 37 whereupon the armature 38 swings away from contact 40 deenergizing clutch 39 and holding the line finder, with brush 42 resting on its proper contact.

The speed of operation of the circuit of Figure 2 will be slightly greater than that of the arrangement on Figure 1, in view of the fact that it is possible to obtain a greater speed of operation for a single relay than for two relays in series. A relay can be connected in parallel with the clutch 39 so that the clutch circuit cannot be actuated again.

While I have described above the principles of my invention in connection with specific apparatus, and particular modifications thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the score of my invention.

What is claimed is:

1. A control arrangement comprising a cathode ray tube including beam forming means, beam deflecting means, and a plurality of target electrodes arranged so that the particular elec-

trode impinged upon by the beam is determined by the beam deflection, means for producing a selected number of pulses, means controlling the beam deflecting means and responsive to said pulses for deflecting the beam to a degree determined by the number of pulses, a line finder including a movable brush, a plurality of contacts each connected to a separate one of said electrodes and adapted to pass a portion of the electron beam current impinging upon said electrode to said movable brush, a driving mechanism for moving said brush over said contacts successively and means responsive to the flow of current from one of said contacts through said brush for deenergizing said driving mechanism to thereby halt said brush.

2. A control arrangement according to claim 1 wherein said controlling means includes a condenser and means for applying the pulses to said condenser to charge it to a level determined by the number of said pulses, and means for applying the charge on said condenser to the beam controlling means.

3. A control arrangement according to claim 2 wherein said beam deflecting means comprises electrostatic plates to which the charge on said condenser is applied.

4. A control arrangement according to claim 2 wherein the pulse producing means includes a source of pulses, a relay actuated by each one of said pulses and having contacts, a second condenser arranged to be charged through said contacts when the relay is in deenergized condition and arranged to distribute part of its stored energy to the first-mentioned condenser through said contacts when the relay is energized.

5. A control arrangement according to claim 1 wherein the deenergizing means includes a normally conductive electron tube, a relay arranged in the output circuit thereof and energized by

current flowing through said tube, a source of power for said driving mechanism, and a set of contacts, forming part of the relay, in series between said source of power and said driving mechanism and arranged to be closed while said relay is energized.

6. A control arrangement according to claim 1 wherein said deenergizing means includes a first relay adapted upon energization thereof to open the circuit energizing said driving mechanism, a second relay having its contacts in series in the circuit supplying energy to said first relay, said second relay having a first winding normally connected to have current flow therethrough to thereby maintain its associated contacts in open position, and a second winding, and means responsive to the flow of current through the movable brush for producing a current flow through said second winding in a direction opposite the current flow of the first winding whereby the contacts of said second relay close, thereby energizing said first relay and deenergizing the driving mechanism.

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