

March 9, 1948.

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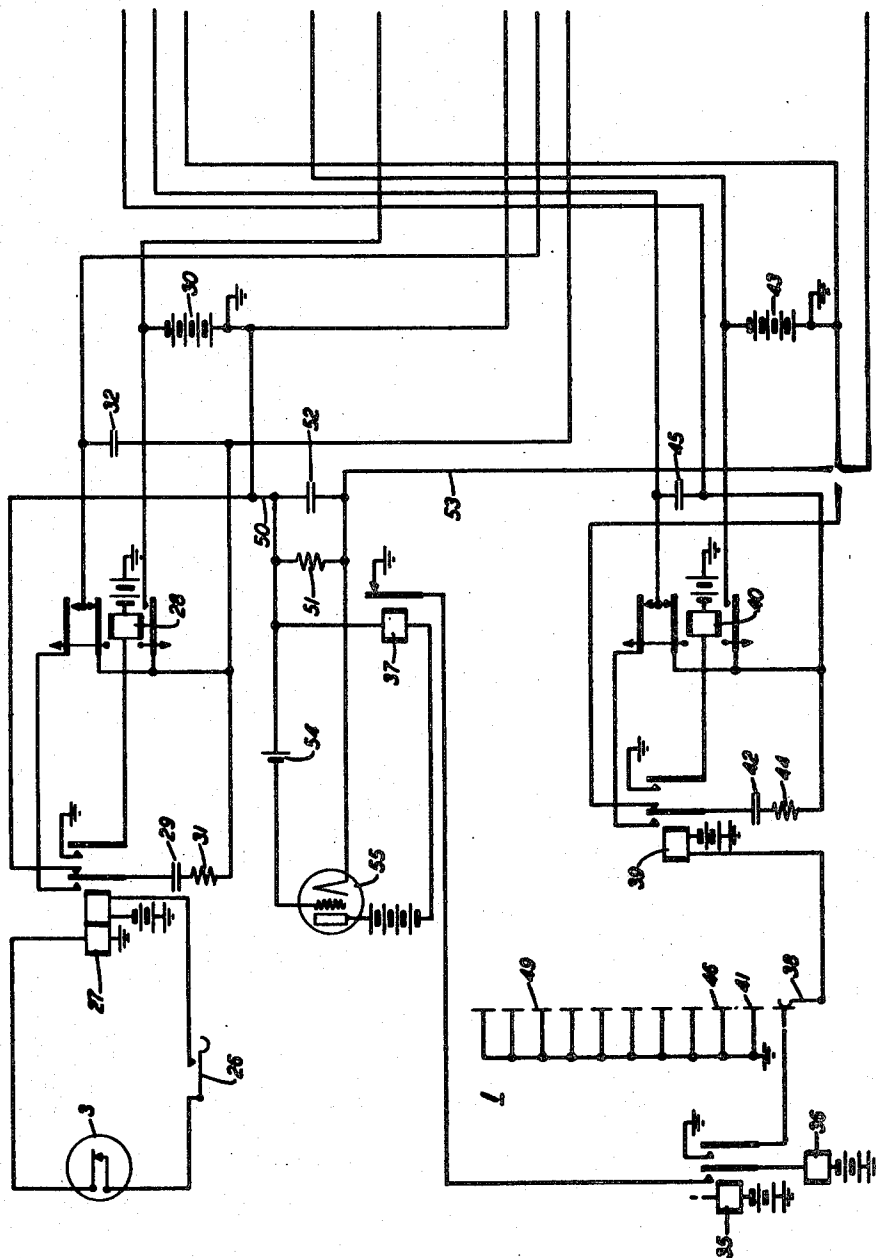
2,437,266

TRANSLATING DEVICE

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FIG. 1



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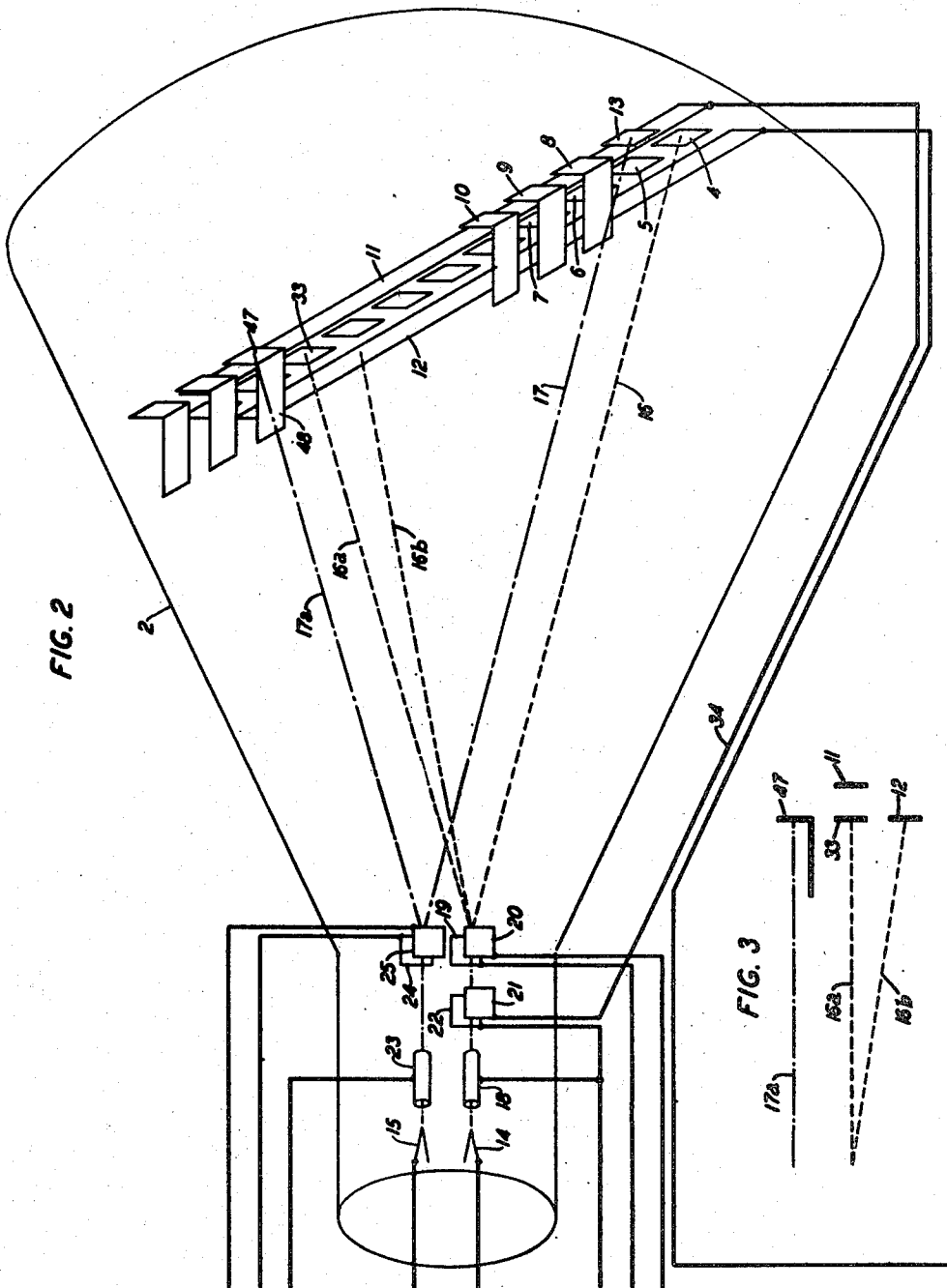
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TRANSLATING DEVICE

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7 Claims. (Cl. 177-353)

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This invention relates to electrical translating devices and particularly to those of the electron-beam type.

An object of the invention is to enlarge the usefulness of electron-beam tubes and similar discharge devices in electrical switching and controlling systems.

Another object is to utilize an electron-beam device as a variably operable register capable of storing information and later making such information available for some specific use.

Another object is to utilize an electron-beam device to register information, such as the magnitude of a signal, and to exercise a corresponding control over an operating movement, such as the motion of a selecting switch.

The use of electron-beam tubes has been proposed heretofore for a wide variety of purposes in electrical systems particularly where sensitivity of control and high speed of operation are essential requirements. Among other proposals these tubes have been suggested for use as selectors and connectors in which the variable incoming signal currents serve to control the movement of a beam to select a desired one of a plurality of electrodes to which suitable work circuits are connected. Another known use for these tubes is to perform the functions of a distributor, the movement of the beam over the object electrodes serving to distribute the incoming signals to the proper outgoing circuits connected to said electrodes.

According to the present invention applicant has devised an electron-beam device that is capable of registering or storing certain information and then using the stored information to measure or determine the extent of some external motion. More specifically a tube is provided with means for producing and controlling two separate beams of electrons. One of these beams is made to advance in response to incoming signals until it engages a predetermined one of the objective anodes. The beam is held in this position for any desired length of time to store or remember the information represented by said incoming signals. Later, when it becomes desirable to do so, the signal beam may be advanced in synchronism or in any desired relation with respect to the movement of an external object, such as a moving switch, until said signal beam reaches a definite position relative to the said position of the first beam, at which time one or the other of said beams becomes effective to accelerate, retard, terminate or otherwise affect said movement.

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A feature of the invention is an electron device provided with means for producing a plurality of separately movable beams and in which the influence of one beam on another is utilized in the performance of useful functions.

The foregoing and other features of the invention will be discussed more fully in the following detailed specification.

In the drawings accompanying the specification:

Figs. 1 and 2 disclose a system in which an electron-beam tube is used for controlling the movement of a switch; and

Fig. 3 is a detailed view showing the disposition of the electrodes in the beam tube.

The signaling and controlling system illustrated in Figs. 1 and 2 includes a selector switch 1, the movement of which is to be controlled, an electron-beam tube 2 that is capable of registering a number or designation and utilizing the registration to determine the extent of movement of the switch 1, and sending means, such as an impulse transmitter 3, for transmitting the number to the tube for registration.

The tube 2 is provided with two sets of anodes arranged in parallel rows for engagement by the electron beams. One of these sets, the primary set, consists of a series of small rectangular target anodes, 4, 5, 6, 7, etc., arranged in a row and uniformly spaced with respect to each other. The other set, the secondary set, consists of a corresponding series of L-shaped anodes 8, 9, 10, etc., each of which has a target portion and a charge-accumulating portion. The arrangement of the primary and secondary sets of anodes is such that each primary anode lies beneath the corresponding secondary anode. There may be any suitable number of anodes in each set, ten being a convenient number since it facilitates the use of the decimal system of counting. In addition to the ten primary anodes 5, 6, 7, etc., corresponding respectively to the ten numerical values of a digit the first anode 4 in the series serves as a target for the beam when in its normal position. The secondary set of anodes is likewise provided with a normal-position target 13 on which the associated beam normally rests. A common auxiliary electrode 11, consisting of a band or strip of any suitable conducting material, lies directly behind the series of primary anodes and serves to intercept the beam when it is not fully masked by one of the primary anodes. A second common electrode 12, also consisting of a strip of suitable material, is disposed in parallel

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relation to electrode 11 and lies below the series of primary anodes.

The tube 2 is also provided with cathodes 14 and 15 for producing two separate beams of electrons, the primary beam 16 and a secondary beam 17. The primary beam 16, after passing through the accelerating anode 18, comes under the influence of the deflector plates 19-20 and 21-22. The plates 19 and 20 serve to advance the primary beam 16 selectively over the objective anodes 5, 6, 7, etc., of the primary set; and the plates 21 and 22 serve to correct the position of the beam with respect to a desired one of said primary anodes. The secondary beam 17 after traversing the accelerating anode 23 passes between the deflector plates 24 and 25, which serve to advance said beam over the anodes 8, 9, 10, etc., of the secondary set.

To consider now one of the many possible useful applications of the beam tube disclosed herein, assume that it is desired to establish the registration of a number or other designation and subsequently to control the movement of some operating mechanism, such as a selector switch, in accordance with the registered designation. To this end a sending device, such as the dial 3, is manipulated to transmit a series of eight impulses, the key 26 having first been closed to cause the preparatory operation of the impulse relay 27. The operation of relay 27 closes an obvious operating circuit for slow-release relay 28. On the first opening of the dial contacts relay 27 releases, but relay 28, being slow, maintains its armatures in the attracted position. A charging circuit for condenser 29 may now be traced from the positive grounded pole of battery 30, back contacts of relay 27, condenser 29, contact-protective resistor 31, front contacts of relay 28 to the negative pole of battery 30. A definite predetermined charge is accumulated on condenser 29 during the open period of the impulse. At the end of the first open period the dial contacts close, and relay 27 reoperates. The charged condenser 29 is now connected to the larger condenser 32 for the purpose of transferring its charge thereto. The circuit for this transfer may be traced from the upper terminal of condenser 29 through the front contact of relay 27, front contact of relay 28, condenser 32, resistor 31 to the lower terminal of condenser 29. Upon the next opening of the dial contacts relay 27 releases and condenser 29 is recharged for the second impulse. When the dial contacts close at the end of the second impulse, relay 27 reoperates, and the charge of condenser 29 is transferred to condenser 32 where it is added to the charge representing the previous impulse. In like manner each of the succeeding impulses results in the addition of an incremental charge to the condenser 32.

It will be noted that the condenser 32 is connected across the control plates 19 and 20, wherefore the increasing charges applied to the condenser cause the application of increasing voltages to said control plates. Each of these voltage increments is just sufficient to advance the electron beam 16 from one anode to the next. That is to say, the voltage applied to plates 19 and 20 in response to the first impulse causes the beam 16 to move from the normal anode 4 to the No. 1 anode 5, the increased voltage resulting from the second impulse causes the beam to move from anode 5 to the No. 2 anode 6, and likewise for each succeeding impulse until the beam 16 is finally brought to rest on the No. 8

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anode 33. In this set position the primary electron beam 16 is illustrated by the dotted line 16a.

By careful design it is possible to derive voltage values which will bring the beam 16 into accurate relationship with the successive anodes 5, 6, 7, etc. However, it is sometimes desirable to permit tolerable variations in manufacturing the apparatus, and it is also well known that condenser charges have a tendency to leak away with the passage of time. With these considerations in mind it will be seen that the beam 16 may not always occupy a fully centered relationship with respect to the objective anode to which it has been driven. Assume for example that the charge on condenser 32 that drives the beam to the objective anode 33 gradually becomes diminished as a result of leakage. As the charge diminishes the beam 16 slowly returns toward its normal position and in so doing impinges to some extent on the back electrode plate 11. A circuit may now be traced from the positive pole of battery 30, deflector plates 22 and 21, conductor 34, electrode 11, thence over the beam 16 and cathode 14 to the negative pole of battery 30. The voltage applied to plates 21 and 22 in this circuit is of such a polarity that it opposes and prevents further drift of the beam toward its normal position and thus prevents it from wandering off anode 33. In this manner the beam is held on the anode to which it is driven until the registration thus established is no longer required.

Assume now that at any suitable time following the registration by the beam tube 2 the switch 1 is set in operation. To this end a relay 35 may be operated to close an energizing circuit for the magnet 36. This circuit extends through the front contacts of relay 35 and the normal contacts of relay 37. Relay 35 also closes a circuit from ground through its front contacts, brush 38 on its normal position contact, winding of relay 39 to battery. Relay 39 closes an obvious operating circuit for slow-releasing relay 40.

In any well-known manner the magnet 36 causes the brushes of the switch, including the brush 38, to move over their associated contacts. In passing from the normal-position contact to the first working contact 41 the brush 38 opens the circuit of relay 39, which releases its armatures. Relay 40, however, being slow to release, maintains its armatures attracted during the release time of relay 39. When relay 39 releases, it closes a circuit for charging the small condenser 42, the circuit being traceable from the positive pole of battery 43, back contacts of relay 39, condenser 42, contact-protective resistor 44, lower front contacts of relay 40 to the negative pole of battery 43. A predetermined charge is impressed on condenser 42 during the time relay 39 is released. When brush 38 reaches the work contact 41, relay 39 reoperates and closes a circuit for transferring the charge on condenser 42 to the larger condenser 45. This circuit may be traced from the upper terminal of condenser 42, front contacts of relay 39, front contacts of relay 40, condenser 45, resistor 44 to the lower terminal of condenser 42. As the brush 38 passes from contact 41 to contact 46, relay 39 again releases, and condenser 42 is recharged. When brush 38 reaches contact 46, relay 39 reoperates, and the charge on condenser 42 is transferred to condenser 45 where it is added to the previous charge. In like manner incremental charges are added to condenser 45 as the brush 38 passes from one contact to the next.

Since the condenser 45 is connected across the

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deflector plates 24 and 25 the increasing charges impressed on said condenser by the movement of the switch 1 cause the application of increasing voltages to said deflector plates. These increasing voltages cause the secondary beam 17 to move progressively over the secondary anodes 8, 9, 10, etc., in synchronism with the movement of the switch 1. The impingement of the secondary beam 17 on the target areas of the anodes 8, 9, 10, etc., establishes momentarily a negative charge on each one of these successive anodes. It will be noted that the larger portion of each one of these anodes extends at right angles to the target area and lies in a plane substantially parallel to the plane formed by the sweep of the primary beam 16 over the primary anodes. A negative charge, therefore, is established on each of the secondary anodes in close proximity to the path traversed by the primary beam 16. Accordingly, when the secondary beam 17 reaches the target portion of the No. 8 anode 47, the portion 48 of said anode, immediately beneath which lies the positioned primary beam 16a, acquires a momentary negative charge. The effect of this charge is to repel the beam 16a from its position on anode 33 to the position 16b where it now engages the electrode 12. At this instant the switch 1 has reached its No. 8 position, and the brush 38 is engaging the contact 49.

The deflection of the primary beam from 16a to position 16b results in the closure of a circuit from the positive pole of battery 30, conductor 50 through resistor 51 and condenser 52 in parallel, conductor 53, electrode 12, beam 16b, cathode 14 to the negative pole of battery 30. The voltage developed across resistor 51 and condenser 52 opposes the biasing battery 54 and permits the tube 55 to conduct. Current flowing in the anode-cathode circuit of tube 55 operates relay 37, which opens the circuit of magnet 36 to stop the movement of the switch 1.

At any suitable time the key 26 may be opened to release the relay 27, and relay 35 may be released to open the circuit of relay 39. Also in any convenient manner the switch 1 may be restored to its normal position. The release of relay 27 is followed in a short time by the release of relay 28, which closes an obvious discharge circuit for the condenser 32. Similarly the release of relay 39 is followed by the release of relay 40, and a discharge circuit is closed for condenser 45. The removal of the charges from condensers 32 and 45 permits the beams 16 and 17 to return to their normal position anodes 4 and 13, respectively.

It will be understood that many variations may be made in the details of the structures and circuits herein illustrated. Numerous variations in the shape and disposition of the anodes and their electrodes and also in other structural features will suggest themselves to those skilled in the art.

What is claimed is:

1. The combination in a translating device of a plurality of primary electrodes, means for producing a beam of energy for incidence upon said electrodes, a plurality of secondary electrodes, means for producing a second beam of energy for incidence upon said secondary electrodes, separate and mutually independent means for deflecting said first and second beams over said primary and secondary electrodes respectively, and means effective when a predetermined relation is established between the positions of said beams on said electrodes for causing a coactive displacement of one beam with respect to the other, and signaling

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means electrically connected to said device and rendered operative by said displaced beam.

2. The combination in a translating device of a plurality of primary electrodes, means for producing a beam of energy for incidence upon said electrodes, a plurality of secondary electrodes, means for producing a second beam of energy for incidence upon said secondary electrodes, means for causing said first beam to become incident upon a predetermined one of said primary electrodes, independent means for causing said second beam to pass over said secondary electrodes, means effective when said second beam reaches a predetermined one of said secondary electrodes for causing a coactive displacement of one of said beams with respect to the other of said beams, and signaling means electrically connected to said device and rendered operative by said displaced beam.

3. The combination in a translating device of a plurality of primary electrodes, means for producing a beam of energy for engagement with said electrodes, a plurality of secondary electrodes, means for producing a second beam of energy for engagement with said secondary electrodes, means for moving said first beam into engagement with a predetermined one of said primary electrodes, means for moving said second beam over said secondary electrodes, means effective when said second beam engages a particular one of said secondary electrodes for imparting an additional movement to said first beam, and means rendered operative in response to said additional movement of said first beam.

4. The combination in an electron device of a plurality of primary electrodes, means for producing a beam of energy for engagement with said electrodes, a plurality of secondary electrodes, means for producing a second beam of energy for engagement with said secondary electrodes, separate means for driving said first and second beams over said primary and secondary electrodes respectively, an auxiliary electrode, means responsive to one of said beams when a predetermined relation is established between the positions of said beams on said electrodes for moving the other of said beams into engagement with said auxiliary electrode, and means rendered effective by the engagement of said other beam with said auxiliary electrode.

5. The combination in a translating device of a plurality of primary electrodes, means for producing a beam of energy for engagement with said electrodes, a plurality of secondary electrodes, means for producing a second beam of energy for engagement with said secondary electrodes, means for moving said first beam into engagement with a predetermined one of said primary electrodes, means for moving said second beam into engagement with a predetermined one of said secondary electrodes and for establishing an electrostatic charge thereon, said electrostatic charge serving to cause a deflection of said first beam, and responsive means rendered operative by the deflection of said first-mentioned beam.

6. The combination in a translating device of means for producing a plurality of separate beams of energy, means responsive to incoming signals for driving one of said beams into a predetermined position where it remains as a registration of said signals, a driven member, means for operating said driven member, means for moving said second beam to measure the extent of motion of said driven member, and means effective when said second beam reaches a prede-

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terminated position relative to the position of said first beam for terminating the operation of said driven member.

7. The combination in an electron-beam tube of an enclosed envelope, a series of spaced primary electrodes, and a series of spaced secondary electrodes disposed within said envelope, means within said envelope for producing two separate beams of electrons, the first of said beams serving to sweep over said primary electrodes and the second of said beams serving to sweep over said secondary electrodes, means for driving said first beam into engagement with a predetermined one of said primary electrodes, means for driving said second beam over said secondary electrodes, an auxiliary electrode disposed within said tube and common to said primary and secondary electrodes, means for establishing an electrostatic

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charge when said second beam reaches a secondary electrode occupying a definite relation with respect to the primary electrode engaged by said first beam, said electrostatic charge serving to displace said first beam into engagement with said auxiliary electrode, and work means controlled by said auxiliary electrode when engaged by said first beam.

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