

Oct. 29, 1946.

G. DEAKIN

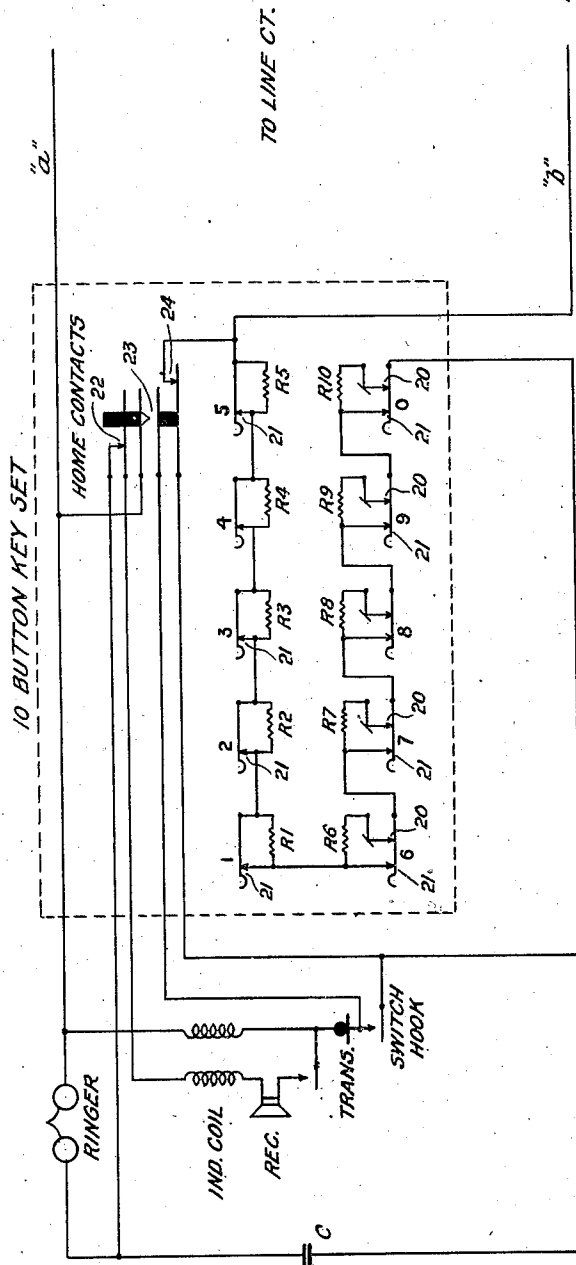
2,410,050

TELECOMMUNICATION SWITCHING SYSTEM

Filed April 21, 1944

4 Sheets-Sheet 1

Fig. 1.



NOTE: CONTACTS 21 OPEN FULL LENGTH OF RETURN OF KEY
CONTACTS 20 OPEN ONLY AT START OF RETURN

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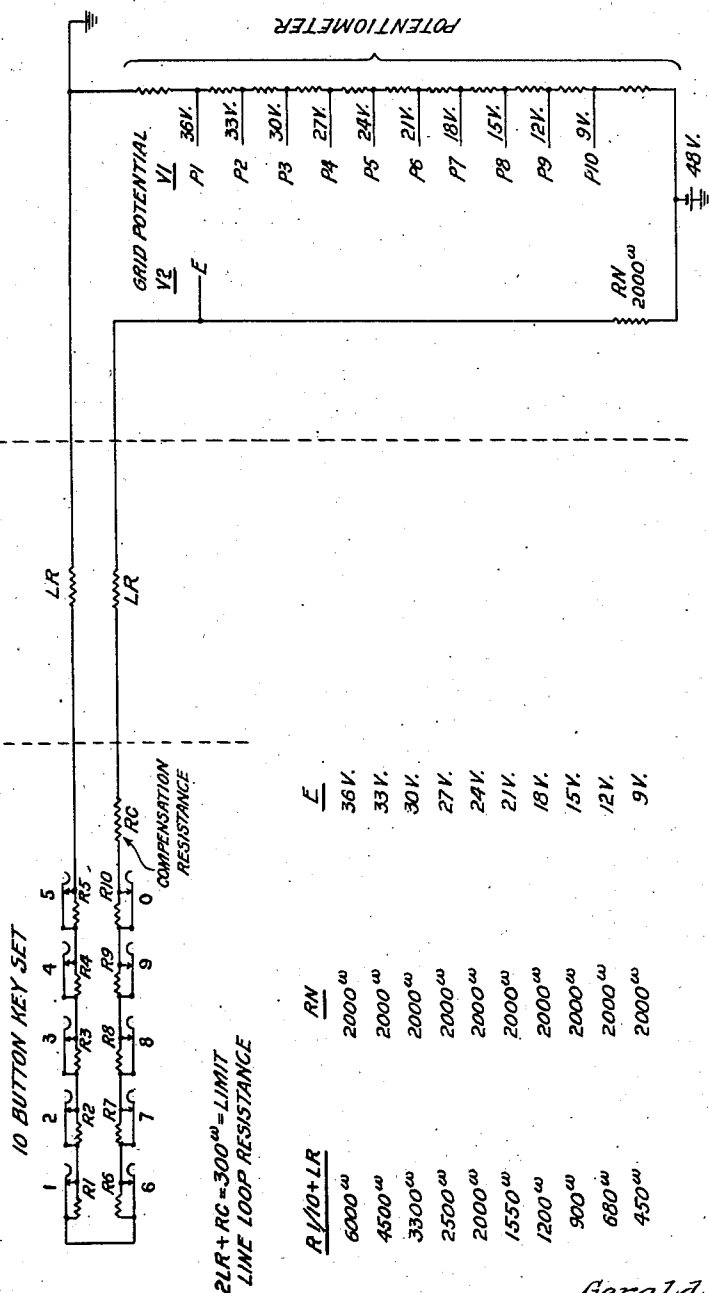
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4 Sheets-Sheet 2

Fig. 1a.



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Fig. 2.

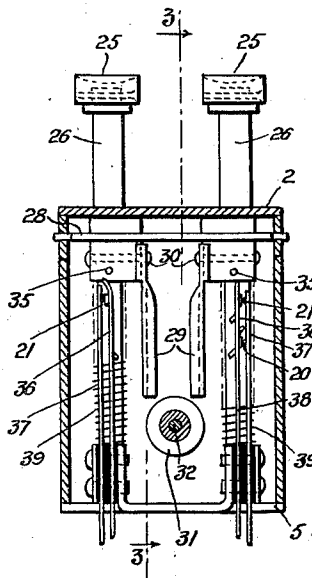


Fig. 3.

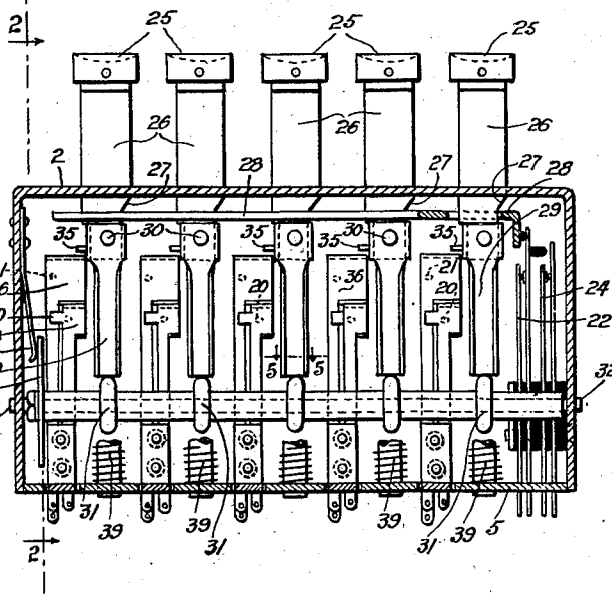


Fig. 5.

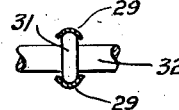


Fig. 4.

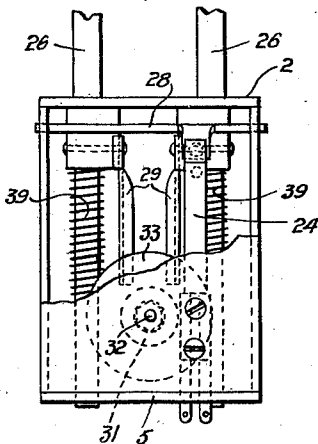


Fig. 6.

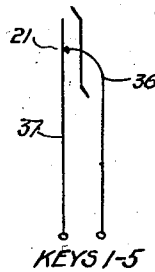
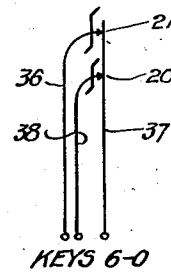


Fig. 6a.



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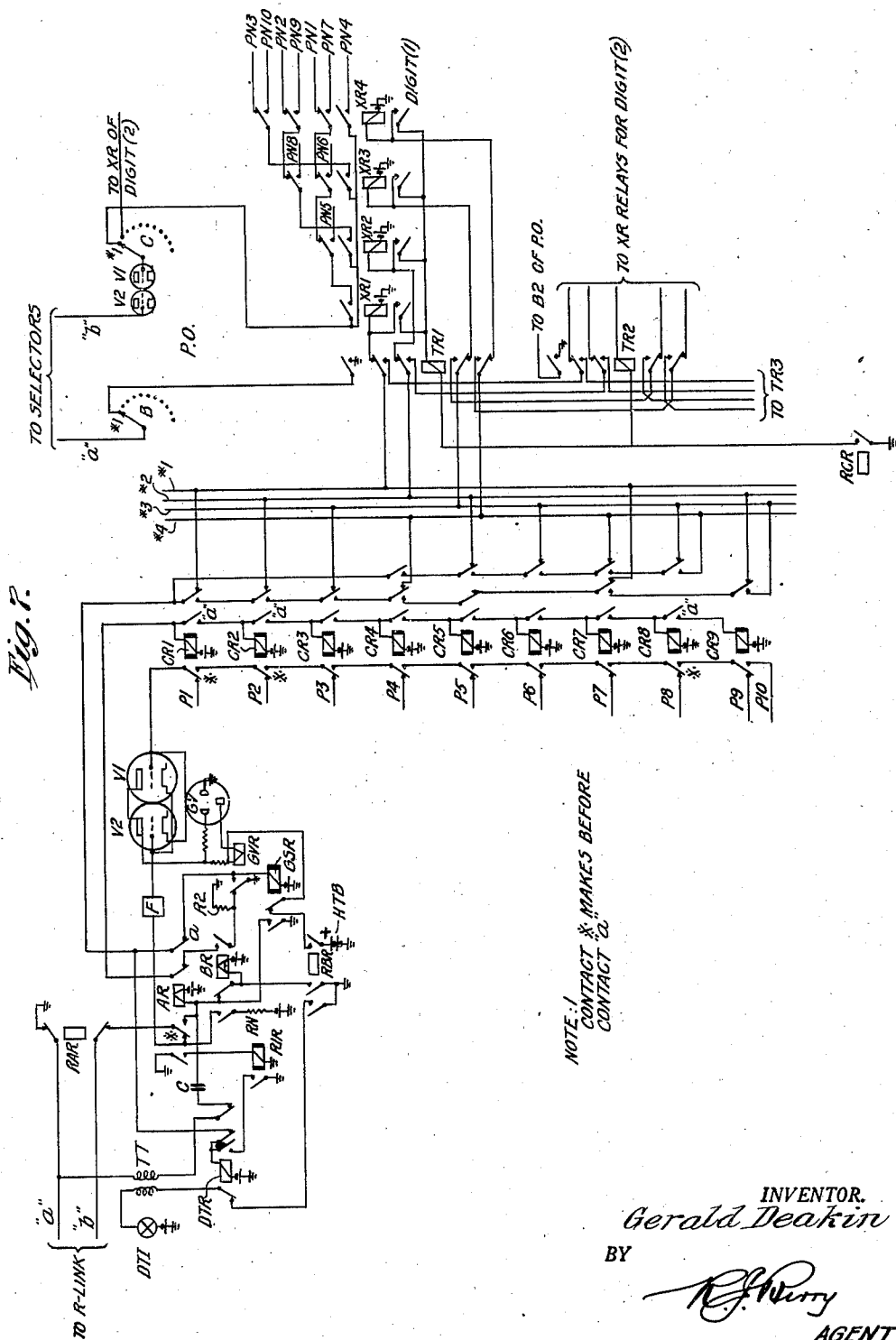
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TELECOMMUNICATION SWITCHING SYSTEM

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UNITED STATES PATENT OFFICE

2,410,050

TELECOMMUNICATION SWITCHING
SYSTEMGerald Deakin, New York, N. Y., assignor to Inter-
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Application April 21, 1944, Serial No. 532,143

20 Claims. (Cl. 179—18)

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This invention relates to new and useful improvements in switching systems and, more particularly, to systems of the type disclosed in my copending application, Serial No. 532,142, filed April 21, 1944.

The object of the present invention is to simplify the switching system in which a set of ten keys are used for controlling a plurality of successive selecting operations.

In said application a key-sending system is disclosed in which six tube circuits are connected permanently in the register, each to a separate potential. Such register recording circuit is almost instantaneous in operation.

In accordance with the present invention a set of ten keys controls a single tube circuit in a register. This circuit, when operated, applies a series of ten potentials to the grid of a triode in rapid succession, and causes it to operate when the proper potential is reached. The return to normal of the depressed keys is controlled by a governor, and the speed of operation is limited to about four digits per second. The arrangement is particularly useful for P. A. B. X's having short lines of about 300 ohms.

In the drawings, Fig. 1 is a circuit diagram of a substation equipped with a key set utilizing the features of the present invention;

Fig. 1a is a diagram by means of which the theory of operation of the system will be elucidated;

Figs. 2-6a illustrate the mechanical details of the key set; Fig. 2 being a cross section along lines 2-2 of Fig. 3, Fig. 3 a cross section along lines 3-3 of Fig. 2, Fig. 4 an end view with parts broken away, Fig. 5 a detail of the contact actuating mechanism, Figs. 6 and 6a illustrating diagrammatically the contact arrangements controlled by keys 1-5 and 6-0, respectively, and

Fig. 7 shows as much of a register controller as is necessary for an understanding of the present invention.

Subscriber's set circuit (Fig. 1)

First the electrical and then the mechanical details of the key set will be explained.

When any one of the buttons 1 to 5 is depressed, a resistor R1 to R5 is cut in on the return stroke of the key plunger which opens contact 21. When any one of key buttons 6 to 0 is depressed, the circuit is momentarily opened on the return of the plunger at contacts 20 and 21. Shortly after the start of the return, contact 20 closes and cuts in resistor R6 to R10, as the case may be.

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When any button is depressed, the home contact nest operates, first opening the receiver circuit at 22, then short-circuiting the transmitter circuit at 23, and finally removing the short-circuit from the key set at 24.

Key set assembly (Figs. 2-6a)

The key set assembly mounts in the subscriber's set. When any key button 25 is depressed, plunger 26 forces with its inclined surface 27, a sliding bar 28 to the right, thus opening home contacts 22 and 24, as above-described. Part 29, attached to the plunger by rivet 30, engages friction wheel 31, molded or otherwise attached to a rotatable shaft 32, carrying a friction disc 33, rubbing against spring 34. This friction control serves no useful purpose on the downward stroke.

Shortly after the home contacts operate, a pin 35 of the depressed key engages the upper lip of a spring 36, forcing it still further against spring 37. After the key is about three-quarters depressed, pin 35 engages the upper lip of spring 38, forcing this spring also against 37. When the plunger is all the way down, the pin 35 is free of the lower lip of spring 38. It will thus be seen that when a key is depressed, only the home contact spring nest operates.

When a key button is released, it is raised by coiled spring 39, and pin 35 engages first the lower lip of spring 38, forcing it away from spring 37 and breaking contact at 20. At the same time a lug 40 on 38 (Fig. 3) forces spring 36 away from spring 37, thereby breaking the contact 21 between springs 37 and 36, and thus momentarily opening the line circuit. When the plunger has returned about one-fourth of the distance, pin 35 slips off the upper lip of spring 38, which returns and makes contact with spring 37, but spring 36 is now engaged by pin 35, and contact 21 is held open to introduce the resistor in the circuit until the plunger commences to restore the home contact to normal.

The double springs 36 and 38 are required for keys 6 to 0 only (see Fig. 6a). For buttons 1 to 5, only spring 36 is required (Fig. 6).

The speed of the return of the plunger is controlled by friction washer 33 and spring 34 and the friction between rubber wheel 31 and part 30. This simple form of friction governor may, of course, be replaced by a more accurate type of governor, such as the worm governor used in the ordinary telephone dial. The system is arranged to allow the operation of three keys per second.

Operation of register circuit (Fig. 7)

The register circuit is of the same type as disclosed in my copending application, Serial No. 521,160, filed February 5, 1944, just as in the case of the register circuit described in said application, Serial No. 532,142, filed April 21, 1944. RAR falls away and RBR operates when the calling line is connected to the register. RBR operates AR, which locks up in series with the calling line, and immediately thereafter BR operates and opens the initial circuit. RBR applies high tension battery to the electrical discharge device comprising triodes V₁ and V₂ and gas valve GV, and closes the primary side of the dialing tone circuit, the secondary side of which is bridged across the calling line. AR operates slow releasing relay R₁R, which remains energized during the subsequent operation of the register circuit. The register circuit remains in this condition until the subscriber depresses a key button.

When a key button is depressed, no change in the register circuit takes place, but when the button is released, AR falls away due either to the momentary opening of the line circuit, in case any button R₅ to R₁₀ is operated, or to the high resistance of R₁ to R₅, in case any one of keys 1 to 5 is depressed. The value of the resistance which each key button cuts into the circuit on its return stroke is shown in Fig. 1a, as is the potential placed on the grid of V₂ when any key is depressed.

Assume now that button No. 3 is depressed. On the return stroke AR falls away since key 3 introduces resistor R₃, making the total loop resistance of the line 3300 ohms. AR is adjusted to fall off when the loop resistance is increased to approximately 1000 ohms. When AR makes its back contact, it connects the grid of V₂ and resistor R_a to the *b* wire. In this particular case the potential of the *b* wire at this point is reduced to 30 volts (P₃). At the same time, AR closes the starting circuit of a step-by-step operating device comprising a set of counting relays CR from ground, back GVR, front BR, back AR, winding CR₁ to battery. A few milli-seconds after, CR₁ operates CR₂, thus placing the potential P₃ normally on the back contact of CR₃ on the grid of V₁. The tube circuit now operates in the usual way, lights GV which energizes GVR. The starting circuit is opened before CR₃ has time to operate.

When GVR makes its front contact, it energizes the corresponding XR relay, circuit from ground, front GVR, back AR, front CR₁, front CR₂, back CR₃, back TR₁, winding XR₃ to battery. In parallel with this operation, GVR operates GSR. GSR operates AR and opens the high tension circuit, thereby releasing GVR and de-ionizing GV. AR locks up to the calling line and opens the operating circuit of XR₃ which now locks up over a front contact in series with TR₁ and front RCR. TR₁ operates and transfers the counting relay control to the next set of XR relays. AR opens the back contact circuit of GVR so that the counting relay circuit is not again energized when GVR makes its back contact.

All counting relays are made slightly slow-releasing so as to allow time for the energization of the XR relays. Resistor R₂ to ground at the back contact of GVR is provided to reduce sparking when the common counting relay holding circuit is opened. It is not sufficient to retain even one CR relay energized.

GSR is made slow enough to retain AR ener-

gized until the key plunger is restored to normal and the line circuit again closed.

F is a filter to prevent improper operation of the triodes by the dialing tone or the like.

When P. A. B. X stations are equipped for ten-button local calling, out-trunk calls may be made in one of two ways, either by installing an ordinary dial on the subscriber's set for those stations permitted to make out-trunk calls, or by adapting the P. A. B. X register circuit to convert ten-button pulses into dial or other types of pulse required to operate the central office equipment.

A similar arrangement is disclosed in my copending application, Serial No. 533,466, filed May 1, 1944, of which application, Serial No. 540,946, filed June 19, 1944, is a continuation, in which the keys are locked until the register responds and control the register by a combination of potential and polarity changes.

What I claim is:

1. In a switching system, a controller having a plurality of operating positions, a source of current, a multi-electrode discharge device, means for establishing a connection between said controller and said device, a relay, means for operating said relay when potentials applied to two electrodes of said device bear a predetermined relationship to one-another, means including said connection for applying a different potential to one electrode in each position of the controller, means actuated by the controller for applying various potentials to the second electrode, and switching means variably operable under the control of said relay and the last-mentioned means.

2. The system according to claim 1, and means for operating the relay when the same potentials are applied to the two electrodes.

3. In a switching system, a controller having a plurality of operative positions, a source of current, a responsive device, means for applying a different potential to the responsive device in each position of the controller, step-by-step means for applying different potentials to the responsive device, means for operating the step-by-step means when the controller is actuated, a relay operated when the potentials applied to the responsive device bear a predetermined relation to one-another, and switching devices variably operable under the control of said relay and step-by-step means.

4. The switching system according to claim 3, and means for operating the relay when the two potentials applied to the responsive device are the same.

5. The switching system according to claim 3, and in which the step-by-step means comprises a set of counting relays having contacts for applying said potentials.

6. The switching system according to claim 3, and in which the controller is arranged to apply ten different potentials, and the step-by-step means comprises a set of nine counting relays, having contacts for applying said ten different potentials.

7. The switching system according to claim 3, and in which the controller comprises a plurality of keys and a corresponding number of resistances, one for producing each operating position, and means responsive to the association of any key for starting the step-by-step means to operate.

8. The switching system according to claim 3, and in which the controller comprises a plurality of keys and a corresponding number of resistances, one for producing each operating posi-

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tion, and means responsive to the actuation of any key for starting the step-by-step means to apply one potential after the other.

9. In a switching system, a controller having a plurality of operating positions, a current source, a pair of triodes, means for establishing a connection between said controller and said triodes, a relay, means for operating said relay when the potentials applied to the grids of the two triodes bear a predetermined relationship to one-another, means for applying a different potential to the grid of the first triode in each position of the controller, step-by-step means controlled by said relay for applying different potentials to the grid of the second triode, means actuated by the controller for starting the operation of the step-by-step means, and a plurality of digit storage devices variably operable under the control of said relay and step-by-step means.

10. In a switching system, a controller comprising a set of keys, one for each operating position of the controller, a current source, a pair of triodes, means for establishing a connection between said controller and said triodes, a resistance for each key switched into the connection when the key is operated, a relay, means for operating said relay when the same potentials are applied to the grids of the two triodes, means including said resistances for applying a different potential to the grid of the first triode in response to the operation of each key, step-by-step means controlled by said relay for applying said different potentials, one after the other, to the grid of the second triode, means actuated by the controller for starting the operation of the step-by-step means, and a plurality of storage devices variably operable under the control of said relay and step-by-step means.

11. In a switching system, a controller having a plurality of operating positions and operable in accordance with successive digits of a number, a D. C. source, a pair of triodes, a relay, means for operating said relay when the same potentials are applied to the grids of the two triodes, means for applying a different potential to the grid of the first triode in each position of the controller, means including a set of counting relays controlled by said relay for applying said different potentials, one after the other, to the grid of the second triode, means actuated by the controller for starting the operation of the counting relays, and a storage device for each digit variably operable under the control of said relay and counting relays.

12. In a switching system, a normally inactive controller comprising a set of ten keys operable in accordance with a plurality of successive digits, a D. C. source, a pair of triodes, a two-wire circuit connecting the controller with the triodes, a relay, a gas valve for operating said relay when the same potentials are applied to the grids of the two triodes, a different resistance switched into the circuit by each key for applying ten different potentials to the grid of the first triode, means including a set of counting relays controlled by said relay for applying said ten different potentials, one after the other, to the grid of the second triode, means actuated by the actuated key for starting the operation of the counting relays, and a storage device for each digit variably operable under the control of said relay and counting relays.

13. The switching system according to claim 12, and in which nine counting relays have contacts for applying the ten different potentials.

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14. In a switching system, a controller having ten operating positions and comprising a key for each position and movable from a normal to an actuated position and return to normal, a two-wire line circuit, ten different resistances, one for each key, in series in the circuit, a first contact for each key and a second contact for five of the keys, the contacts of each key normally short-circuiting the associated resistance, means controlled by each key for opening its first contact substantially throughout its return movement, means controlled by said five keys for opening their second contacts only during the beginning of the return movement, a device connected with the line circuit and comprising a first means responding once to the actuation of any key, a second means variably operated dependent on the key actuated, and a switching device jointly controlled by the first and second means.

15. The switching system according to claim 14, and in which the first means comprises a relay actuated upon the opening of a contact by any relay.

16. The switching system according to claim 14, and in which the first means comprises an electric discharge device having an electrode connected with the circuit and responding once during the return movement of each key.

17. The switching system according to claim 14, and in which the second means comprises a set of counting relays.

18. In a telephone switching system, a receiver and a transmitter, a controller having ten operating positions and comprising a key for each position and movable from a normal down to an actuated position and return up to normal, means for governing the speed at which said keys move, a two-wire line circuit, ten different resistances, one for each key, in series in the circuit, a first contact for each key and a second contact for five of the keys, the contacts of each key normally short-circuiting the associated resistance, a home contact set, means operative upon the actuation of any key and while any key is off-normal first to open the circuit of the receiver, then to short-circuit the transmitter, and then to remove a short circuit around all the keys, means controlled by each key for opening its first contact substantially throughout its return movement, means controlled by said five keys for opening their second contacts only during the beginning of the return movement, a device connected with the line circuit and comprising a first means responding in the same manner in response to the actuation of any key, a second means variably operated dependent upon the key actuated, and a switching device jointly controlled by the first and second means.

19. In a telephone switching system, a controller having a plurality of operating positions and comprising a key for each position and movable from a normal to an actuated position and return to normal, a line circuit, a plurality of different resistances, one for each key, in series in the circuit, a first contact for each key and a second contact for some of the keys, the contacts of each key normally short-circuiting the associated resistance, a contact set, means operative upon the actuation of any key and while any key is off-normal to remove a short-circuit around all the keys by operating the contact set, means controlled by each key for opening its first contact substantially throughout its return movement, means controlled by said some keys for opening their second contacts only during

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part of the return movement, a source of D. C. for the line circuit, a responsive device connected with the line circuit and comprising a first relay bridged across the line circuit and adapted to be de-energized when the circuit is opened in the two contacts of any of said some keys and also when connected in series with any one of the resistances associated with the other keys, an electric discharge device, a path closed to the device over a back contact of said relay from said circuit, a step-by-step means, a potentiometer across said source having a plurality of taps, contacts controlled by the step-by-step means for connecting a different tap with the device, a starting circuit for said step-by-step means controlled by said relay, a second relay operated when the same potentials are applied to the device, and an impulse storing device controlled by the second relay and the step-by-step means.

20. In a telephone switching system, a controller having ten operating positions and comprising a key for each position and movable from a normal down to an actuated position and return up to normal, means for governing the speed at which said keys move, a two-wire line circuit, ten different resistances, one for each key, in series in the circuit, a first contact for each key

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and a second contact for five of the keys, the contacts of each key normally short-circuiting the associated resistance, a contact set, means operative upon the actuation of any key and while any key is off-normal first to open in said contact set the short-circuit around all the keys, means controlled by each key for opening its first contact substantially throughout its return movement, means controlled by said five keys for opening their second contacts only during the beginning of the return movement, a source of D. C. for the line circuit, a responsive device connected with the line circuit and comprising a first relay operated when the circuit is opened in the two contacts of any of said five keys and also when connected in series with any one of the resistances associated with the other keys, an electric discharge device, a path controlled by said relay to said circuit from said device, other means controlled by said relay for applying different potentials one after the other to said device, a second relay operated when the potentials applied to the device bear a predetermined relationship to one-another, and a switching device controlled by the second relay.

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