Dec. 10, 1935. R. E. HERSEY 2,023,589

SWITCHING MECHANISM

Filed May 26, 1934 3 Sheets-Sheet 1

FIG. 1

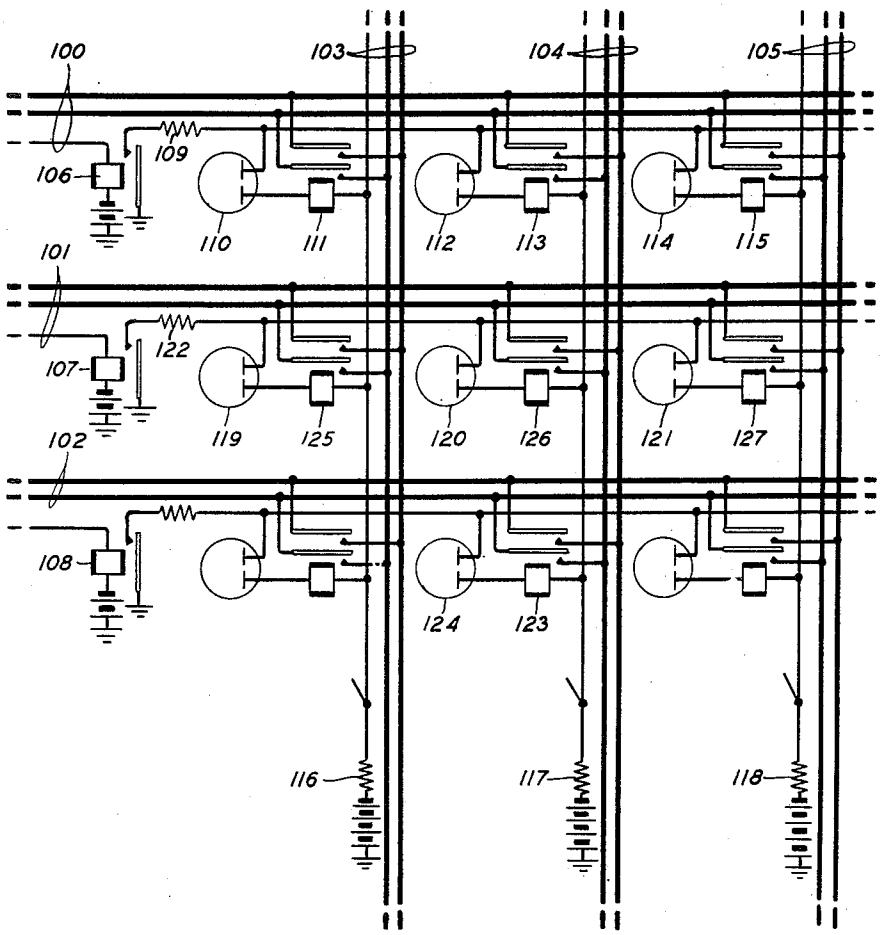

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FIG. 2

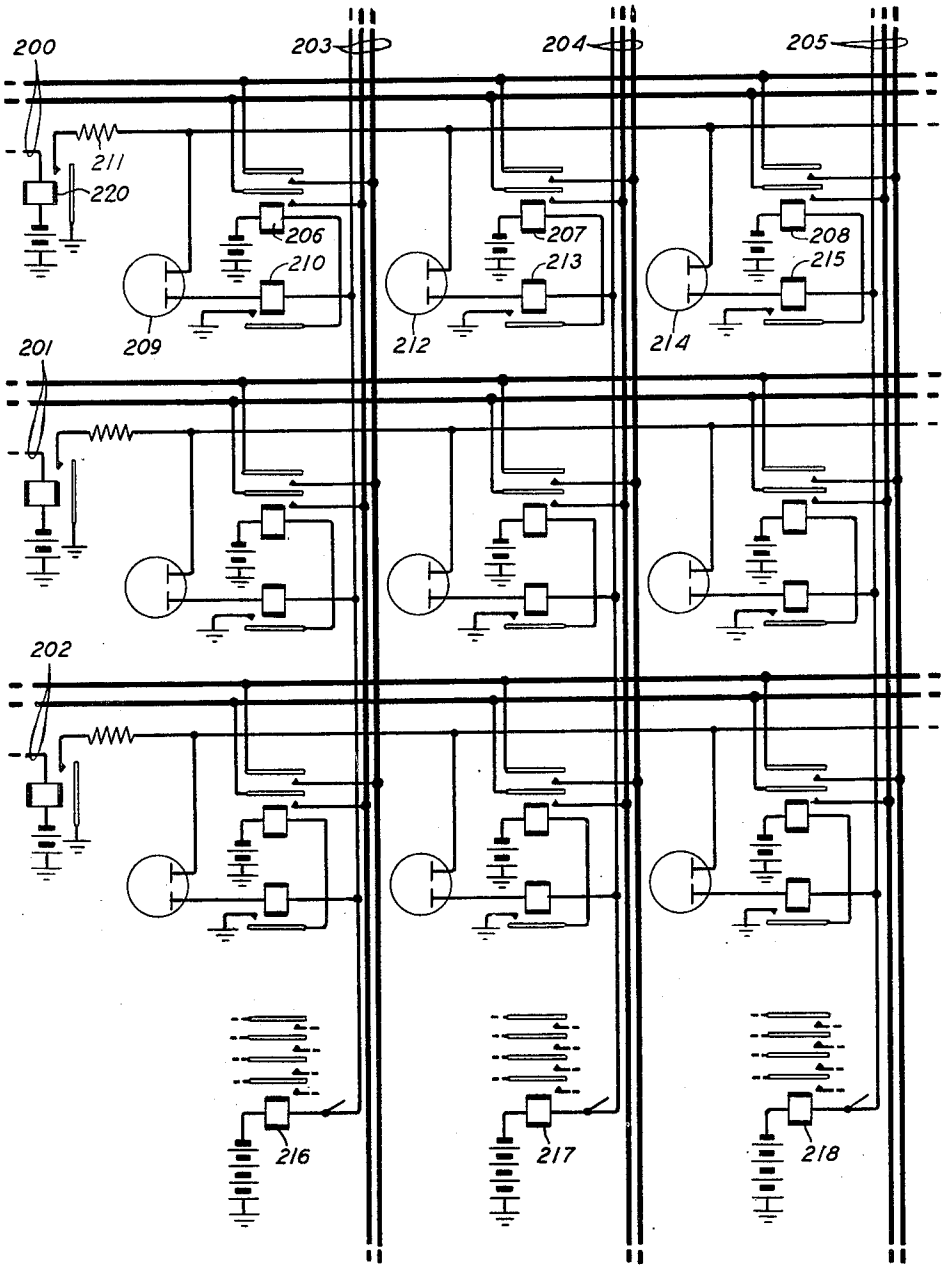

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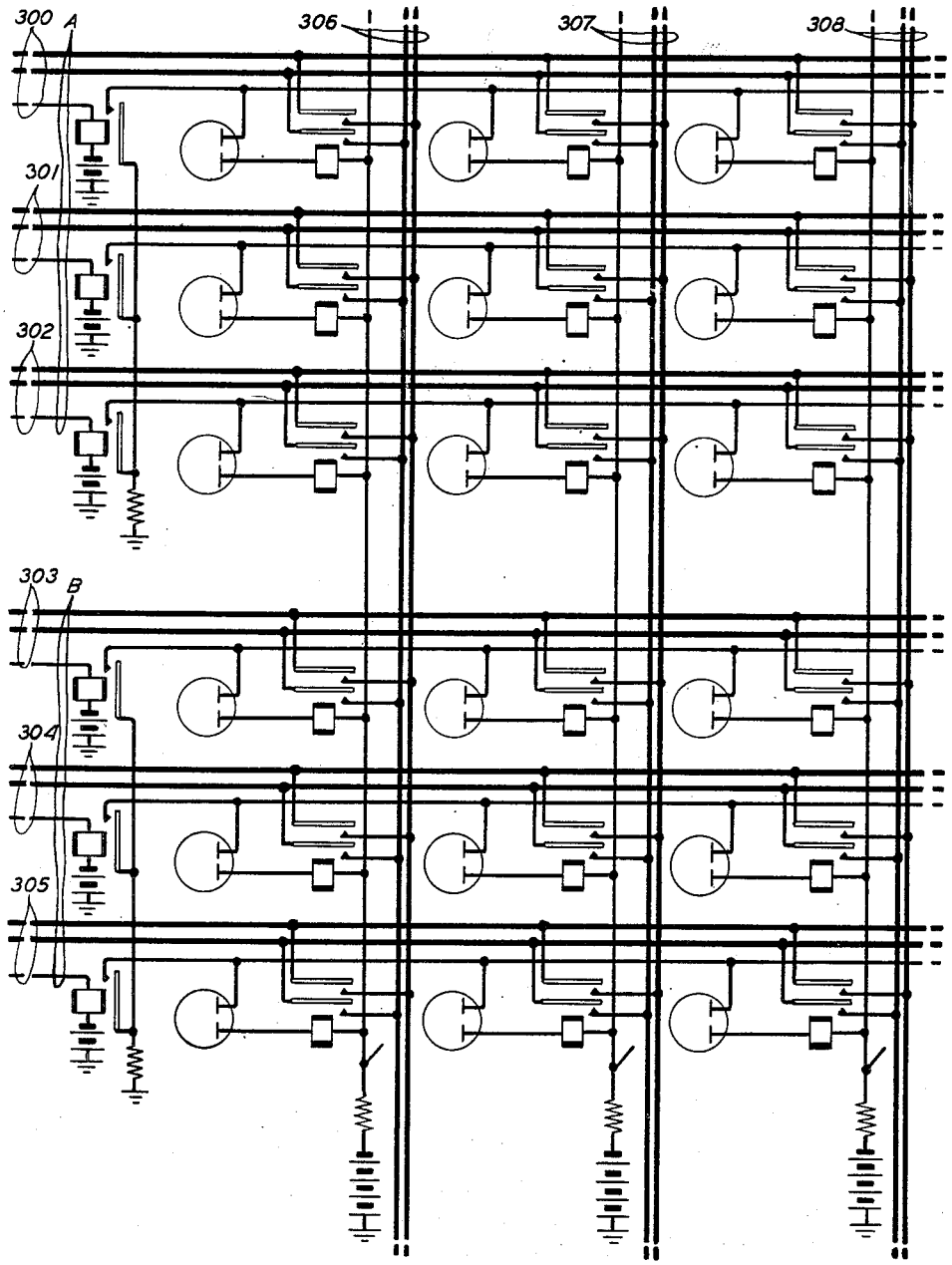
FIG. 3



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UNITED STATES PATENT OFFICE

2,023,589

SWITCHING MECHANISM

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Application May 26, 1934, Serial No. 727,603

13 Claims. (Cl. 179—18)

This invention relates to selective switching mechanism and particularly to such mechanism when used for interconnecting electrical circuits, such as telephone lines or trunks.

The objects of this invention are to increase the speed of operation of selective switching mechanisms, to simplify the apparatus used in effecting connections through these mechanisms, to simplify and improve the means for determining the idle and busy condition of the circuits undergoing selection, to eliminate as far as possible all moving parts, and to otherwise improve switching mechanisms of this character.

A feature of the invention is a selective switch comprising a field of electrical cross-points, each of which is provided with an electromagnet or relay and a space-discharge device for selectively connecting incoming lines or circuits to outgoing lines or circuits. According to this feature an incoming line may obtain connection with one of a number of outgoing lines by placing an electrical condition on the discharge devices at the connecting points between said incoming line and the outgoing lines. This causes current to flow through one of the discharge devices to operate the associated relay, which in turn completes the desired connection between the incoming and outgoing lines. By this arrangement, the speed of establishing a connection is greatly increased, the parts are simplified, and, except for relay contacts, all moving elements are eliminated.

Another feature is a circuit arrangement whereby the operation of the discharge device at the connecting point between a given incoming line and a given outgoing line affects the electrical condition of all other discharge devices associated with said incoming line and also affects the electrical condition of all other discharge devices associated with said outgoing line. In this way no other discharge device is permitted to operate to effect a connection of the incoming line to a second outgoing line; nor can any other discharge device associated with the selected outgoing line be operated subsequently by some other incoming line to effect a second connection to such outgoing line. In accordance with this feature, the flow of current through a given discharge device, representing a given incoming and a given outgoing line, lowers the potential on all other devices associated with said incoming line and also on all devices associated with said outgoing line. Thus a calling incoming line is prevented from seizing more than one idle outgoing line, and all busy outgoing lines are guarded against selection by a calling line.

These and other features of the invention will be more fully described in the following specification, taken in connection with the accompanying drawings, and also in the appended claims.

Referring now to the drawings, Fig. 1 shows a selective switch of the cross-point type comprising a group of incoming circuits 100, 101 and 102; a group of outgoing circuits 103, 104 and 105; incoming line relays 106, 107 and 108, which respond, when the associated incoming line is seized; and a relay and a space-discharge device, such as 111 and 110 respectively for each electrical cross or connecting point for selectively connecting any one of said incoming circuits to any one of said outgoing circuits.

Fig. 2 is similar to Fig. 1, except that an auxiliary relay such as 206 is employed for each electrical cross or connecting point for connecting any one of incoming circuits 200, 201 and 202 to any one of outgoing circuits 203, 204 and 205.

Fig. 3 is also similar to Fig. 1, except that groups of incoming circuits, such as A and B, are common to the outgoing circuits 306, 307 and 308.

The space-discharge devices shown herein may be of any suitable construction, such as the discharge tubes well known in the electrical art. They may if desirable contain any suitable gas, such as neon.

The operation of the circuits shown in the drawings will now be described in the following order: First a detailed operation of the circuits of Fig. 1, followed by a somewhat general description of the circuits of Figs. 2 and 3.

Assume that the incoming circuit 100 has been seized by a selective means (not shown) for the purpose of obtaining a connection with one of the idle outgoing circuits 103, 104 or 105, and that the line relay 106 associated with said incoming circuit has been operated. Relay 106 closes a circuit from ground at its front contact through resistance 109, thence in parallel; one path extending through space-discharge device 110, relay 111 and through resistance 116 to battery; a second path extending through space-discharge device 112, relay 113 and through resistance 117 to battery; and a third path extending through space-discharge device 114, relay 115 and through resistance 118 to battery. Since the potential applied by relay 106 is equally impressed across the electrodes of space-discharge devices 110, 112 and 114, if the ionization characteristics of said space-discharge devices are identical, with respect to the applied potential, simultaneous ionization of said devices might cause double connections. This can be prevented by

selecting space-discharge devices for each incoming circuit whose ionization characteristics are sufficiently different, with respect to the applied potential, so that the space-discharge device requiring the minimum potential will be the first to ionize. Let it be assumed then that, preferentially, the space-discharge device 110 ionizes and thereby becomes sufficiently conductive to allow current to flow through resistances 109 and 116, and through relay 111 in the aforementioned circuit. This current causes the operation of relay 111 and effects a potential drop across resistances 109 and 116. The operation of relay 111 connects the conductors of the incoming circuit 100 to the conductors of the outgoing circuit 103. The potential drop across resistance 109, which is common to the space-discharge devices associated with the incoming circuit 100, reduces the potential across the electrodes of said discharge devices. This reduced potential prevents the space-discharge devices 112 and 114 from functioning but device 110, having ionized as aforementioned, continues to function at this reduced potential and the further reduction caused by the potential across resistance 116. (The characteristics of the space-discharge devices are such that ionization will continue at a potential somewhat below the initial ionizing potential.) Resistance 116 is common to all of the space-discharge devices associated with the outgoing circuit 103 and the potential developed at said resistance causes a reduction of potential at the electrodes of said discharge devices, upon the seizure of associated incoming circuits, thereby preventing the busy outgoing circuit 103 from being reseized as will now be explained.

Assume that the incoming circuit 101 has been seized thereby operating relay 107. The operation of relay 107 closes a circuit from ground at its front contact through resistance 122, thence in parallel; one path extending through space discharge device 119, relay 125 and through resistance 116 to battery; a second path extending through space-discharge device 120, relay 126 and through resistance 117 to battery; and a third path extending through space-discharge device 121, relay 127 and through resistance 118 to battery. As aforementioned, the potential across the electrodes of space-discharge device 119 is reduced, due to the potential developed across resistance 116, thereby preventing the ionization of said device. However, the voltage impressed on the electrodes of space-discharge devices 120 and 121 is sufficient to cause the ionization of the device favored by its voltage characteristics as aforementioned. Assume then that space-discharge device 121 is preferentially ionized, thereby causing the operation of relay 127, which connects the conductors of incoming circuit 101 to the conductors of outgoing circuit 105. The potential developed at resistance 122, which is associated with all of the space-discharge devices associated with incoming circuit 101, reduces the potential for space-discharge device 120, thereby preventing its ionization. Likewise the potential developed at resistance 118, which is common to all of the space-discharge devices associated with the outgoing circuit 105, reduces the potential at the electrodes of said discharge devices, upon the seizure of associated incoming circuits, thereby preventing the busy outgoing circuit 105 from being seized. In like manner the seizure of incoming circuit 102 operates relay 108 which causes space-discharge device 124 to ionize and relay 123 to operate thereby connecting the conductors of said incoming circuit 102 to the conductors of the idle outgoing circuit 104.

When the selective means (not shown) frees the incoming circuit 100, relay 106 releases thereby opening the circuit in which is included resistance 109, space-discharge device 110, relay 111 and resistance 116. Relay 111 releases to disconnect the conductors of incoming line 100 from the conductors of outgoing line 103; the space-discharge device 110 deionizes; and the guarding potential at resistance 116 is removed thereby indicating that outgoing circuit 103 is again idle. In like manner any other outgoing circuit is disconnected from its associated incoming circuit when the line relay of said incoming circuit is released.

The circuit arrangement shown in Fig. 2 is similar to that of Fig. 1, except that auxiliary relays, such as 206, 207 and 208, are used at each cross or connecting point for the purpose of associating the incoming circuits with the outgoing circuits. Another difference between the two arrangements is the association of relays 216, 217 and 218 with the outgoing circuits 203, 204 and 205 respectively. Due to the similarity of the two circuits only a brief description is necessary.

Assume that the incoming circuit 200 has been seized by a selective means (not shown) in order to obtain a connection with one of the idle outgoing circuits 203, 204 or 205 and that the line relay 220 associated with said incoming circuit has been operated. Relay 220 operated closes a circuit from ground at its front contact through resistance 211 thence in parallel; one path extending through space-discharge device 209, relay 210 and through relay 216 to battery; a second path extending through space-discharge device 212, relay 213 and through relay 217 to battery; and a third path extending through space-discharge device 214, relay 215 and through relay 218 to battery. Here also the space discharge devices associated with the incoming circuits may have different voltage characteristics in order to prevent simultaneous ionization of said devices as hereinbefore mentioned. Assume that space-discharge device 209 is preferentially ionized and allows current to flow through resistance 211 and relays 210 and 216 in an aforementioned circuit, thereby causing the operation of said relays. Relay 210 operated causes the operation of relay 206 which associates the conductors of incoming circuit 200 with the conductors of outgoing circuit 203. Relay 216 may be used for switching purposes. Resistance 211 is common to all of the space-discharge devices associated with the incoming circuit 200 and the potential developed at said resistance causes a reduction of potential at the electrodes of said discharge devices preventing the ionization of devices 212 and 214. Relay 216 is common to all of the space-discharge devices associated with the outgoing circuit 203 and the potential at said relay, by virtue of current flowing through its winding, causes a reduction of potential at the electrodes of said discharge devices, upon the seizure of associated incoming circuits, thereby guarding busy outgoing circuit 203 against reseizure in a manner previously set forth. In like manner other incoming circuits such as 201 and 202 may be interconnected with outgoing circuits 204 and 205.

When the selective means (not shown) frees the incoming circuit 200, relay 220 releases thereby deionizing space-discharge device 209 and releasing relays 210 and 216. Relay 216 released releases 206 thereby restoring the circuit to normal.

The circuit arrangement shown in Fig. 3 is also similar to that shown for Fig. 1, except that the incoming circuits 300, 301, 302, 303, 304 and 305 are arranged in groups, such as group A and group B. The selective means (not shown) for seizing said incoming circuits is so arranged that when any one circuit is seized the entire group is made busy. The method of associating an incoming circuit, such as 301, with an outgoing circuit, such as 306, is the same as described for the circuit of Fig. 1.

In case it is desirable to connect an incoming line to two or more outgoing lines simultaneously, this can be done, as suggested herein, by selecting for these outgoing lines discharge devices having the same ionization characteristics.

What is claimed is:

1. In combination, an incoming line, a plurality of outgoing lines, separately operable contact sets for connecting said incoming line to the respective outgoing lines, a plurality of space-discharge devices, one for each of said contact sets, means for changing the electrical condition of all of said devices to cause one of them to discharge, and means responsive to the discharge of one of said devices for operating the associated set of contacts.

2. In combination, an incoming line, a plurality of outgoing lines, a plurality of space-discharge devices, one for each outgoing line, a circuit for each of said devices, a source of potential, means for applying said source to all of said devices for causing one of them to discharge and permit the flow of current in the circuit thereof, and means responsive to the flow of current in said circuit for connecting the incoming line to the outgoing line corresponding to the discharged device.

3. In combination an incoming line, a plurality of outgoing lines, a plurality of space-discharge devices, one for each outgoing line, a circuit for each said devices, relay windings, one in each of said circuits, a source of potential, means for applying said source to all of said devices to cause current to flow through one of them and energize the relay winding in the circuit thereof, and a set of contacts responsive to the energized winding for connecting the incoming line to the corresponding outgoing line.

4. In combination, an incoming line, a plurality of outgoing lines, separately operable contact sets for connecting said incoming line to the respective outgoing lines, a plurality of discharge tubes, one for each of said contact sets, means for marking all busy outgoing lines, means for placing an electrical condition on all said tubes to cause the discharge of one of them corresponding to an idle outgoing line, and means responsive to the discharge of the tube for operating the associated set of contacts.

5. In combination, an incoming line, a plurality of outgoing lines, a plurality of space-discharge tubes, one for each outgoing line, a circuit for each of said tubes, a source of potential, means for applying said source to said tubes to cause any one of them to discharge and permit the flow of current in its circuit, means in the circuit of the discharged tube for connecting the incoming line to the corresponding outgoing line, and means for preventing any other one of the said tubes from discharging.

6. In combination, an incoming line, a plurality of outgoing lines, a plurality of gas-filled discharge tubes, one for each outgoing line, a circuit for each of said tubes, a source of potential, means for applying said source to said tubes to cause one of them to discharge and permit the flow of current in its circuit, means in the circuit of the discharged tube for connecting the incoming line to the corresponding outgoing line, and means for altering the potential on all other tubes to prevent another one of them from discharging.

7. In combination, an incoming line, a plurality of outgoing lines, a plurality of gas-filled discharge tubes, one for each outgoing line, a circuit for each of said tubes, a source of potential, means for applying said source to said tubes to cause one of them to discharge and permit the flow of current in its circuit, means in the circuit of the discharged tube for connecting the incoming line to the corresponding outgoing line, and means effective as a result of current flow through the discharged tube to so alter the potential on the other tubes as to prevent any one of them from discharging.

8. In combination, an incoming line, a plurality of outgoing lines, a plurality of gas-filled discharge tubes, one for each outgoing line, a circuit for each of said tubes, a source of potential, means for applying said source to said tubes to cause one of them to discharge and permit the flow of current in its circuit, means in the circuit of the discharged tube for connecting the incoming line to the corresponding outgoing line, and a resistance in circuit with the discharged tube for changing the potential on the other tubes to prevent another one of them from discharging.

9. The combination with a plurality of incoming lines and a plurality of outgoing lines of a switching mechanism comprising a plurality of sets of switching contacts, the several contact sets being separately operable for the purpose of connecting any incoming line to any outgoing line, space-discharge devices, one for each contact set, means for altering the electrical condition of all devices conjointly associated with an incoming line and the several outgoing lines to cause the discharge of some one of said devices, and means responsive to such discharge for operating the contact set associated therewith.

10. The combination with a plurality of incoming lines and a plurality of outgoing lines of a switching mechanism comprising a plurality of sets of switching contacts, the several contact sets being operable for the purpose of connecting any incoming line to any outgoing line, space-discharge devices, one for each contact set, means for applying an electrical condition to all devices conjointly associated with an incoming line and the several outgoing lines to cause the flow of current through one of said devices, means responsive to the flow of current through one of said devices for operating the contact set associated therewith, and means effective as a result of such current flow for altering the electrical condition of all other devices associated with said incoming line to prevent the discharge of another one thereof.

11. The combination with a plurality of incoming lines and a plurality of outgoing lines of a switching mechanism comprising a plurality of

sets of switching contacts, the several contact sets being operable for the purpose of connecting any incoming line to any outgoing line, discharge tubes, one for each contact set, means for applying a potential to all tubes conjointly associated with an incoming line and the several outgoing lines to cause current to flow through one of said tubes, means responsive to such current flow for operating the corresponding set of contacts to connect the incoming line to the corresponding outgoing line, and means effective as a result of such current flow for changing the potential of all other tubes associated with said incoming line and of all other tubes associated with the seized outgoing line.

12. The combination with a plurality of incoming lines and a plurality of outgoing lines of a switch mechanism comprising a plurality of sets of switching contacts, the several contact sets being separately operable for the purpose of connecting any incoming line to any outgoing line, discharge tubes, one for each contact set, means for applying a potential to all tubes conjointly associated with an incoming line and the several outgoing lines to cause current to flow through one of said tubes, means responsive to such current flow for operating the corresponding set of contacts to connect the incoming line to the corresponding outgoing line, and means effective as a result of such current flow for altering the potential of all other tubes associated with the seized outgoing line to mark such line as busy to other incoming lines.

13. The combination with a plurality of incoming lines and a plurality of outgoing lines of a switching mechanism comprising a plurality of sets of switching contacts, the several contact sets being operable for the purpose of connecting any incoming line to any outgoing line, space-discharge tubes, one for each contact set, a circuit for each of said tubes, means for applying a potential to all tubes conjointly associated with an incoming line and the several outgoing lines to cause the discharge of one of said tubes, means in the circuit of the discharged tube responsive to the flow of current therein for operating the corresponding set of contacts to connect the incoming line with the corresponding outgoing line, a resistance in the circuit of the discharged tube for altering the potential on all tubes conjointly associated with the incoming and the several outgoing lines to prevent connection to a second outgoing line, and a second resistance in the circuit of the discharged tube to mark the seized outgoing line as busy to all other incoming lines.

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