June 28, 1938. R. F. DIRKES ET AL 2,122,367

TELEGRAPH SWITCHING SYSTEM

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FIG. 1

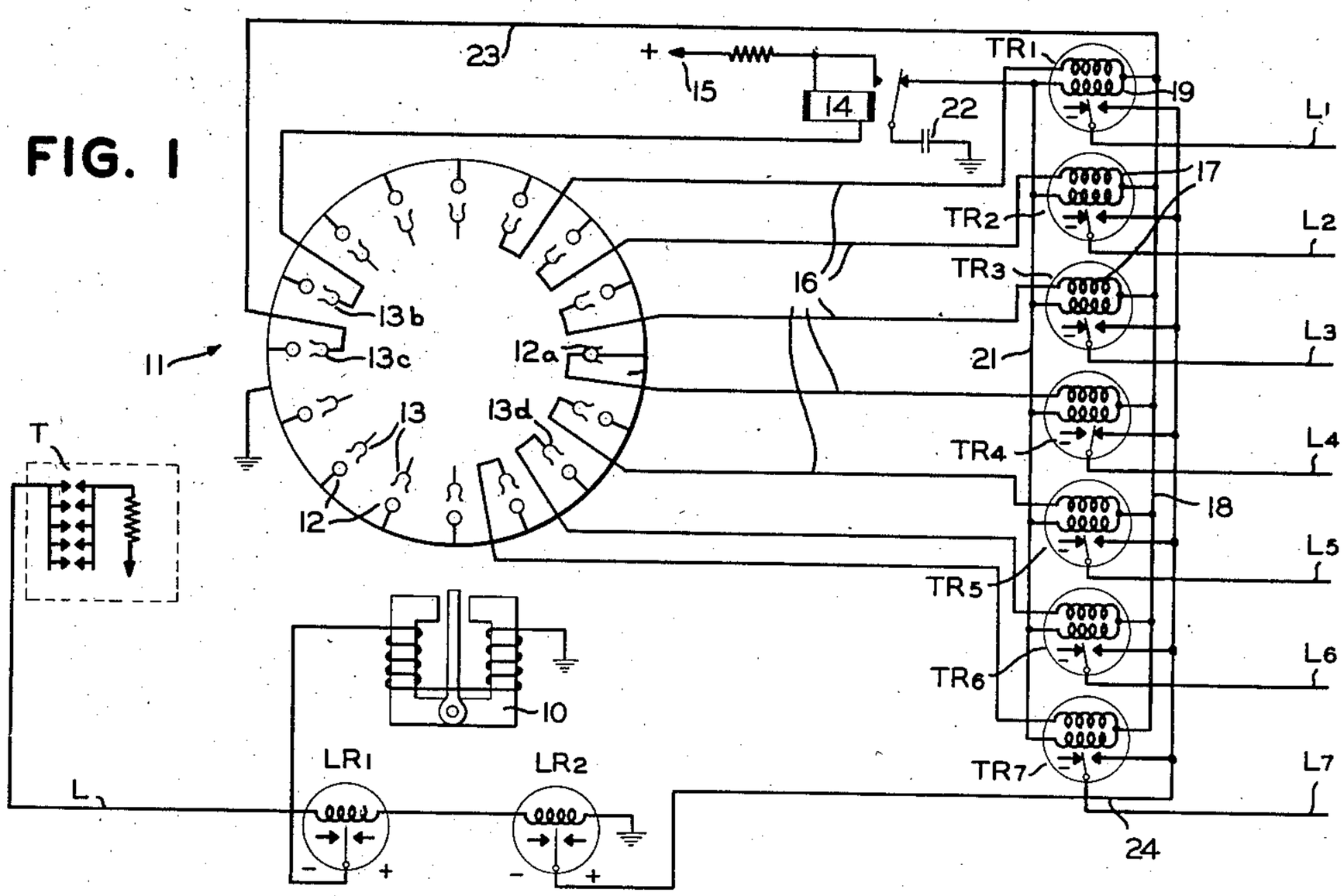
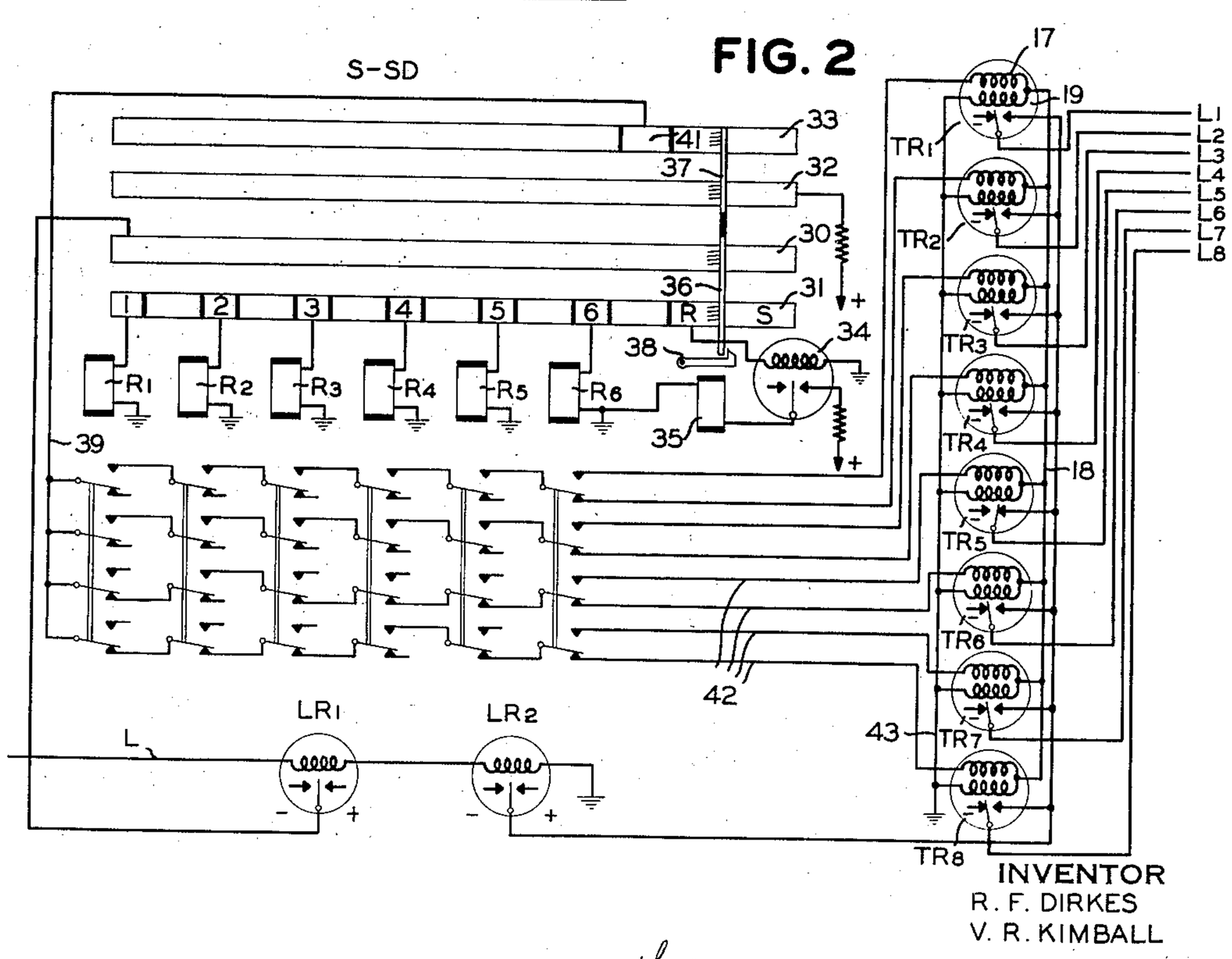


FIG. 2



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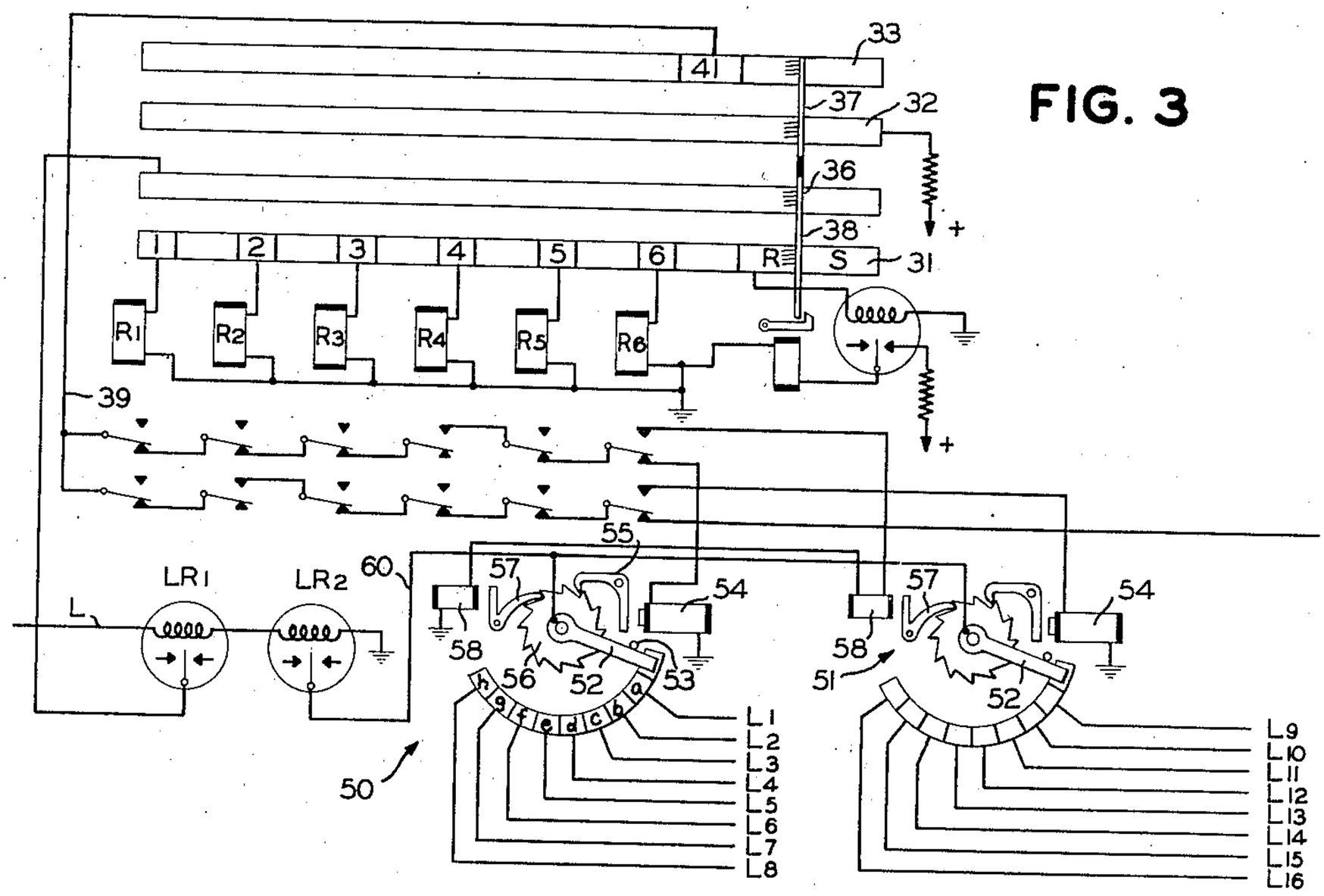

FIG. 3

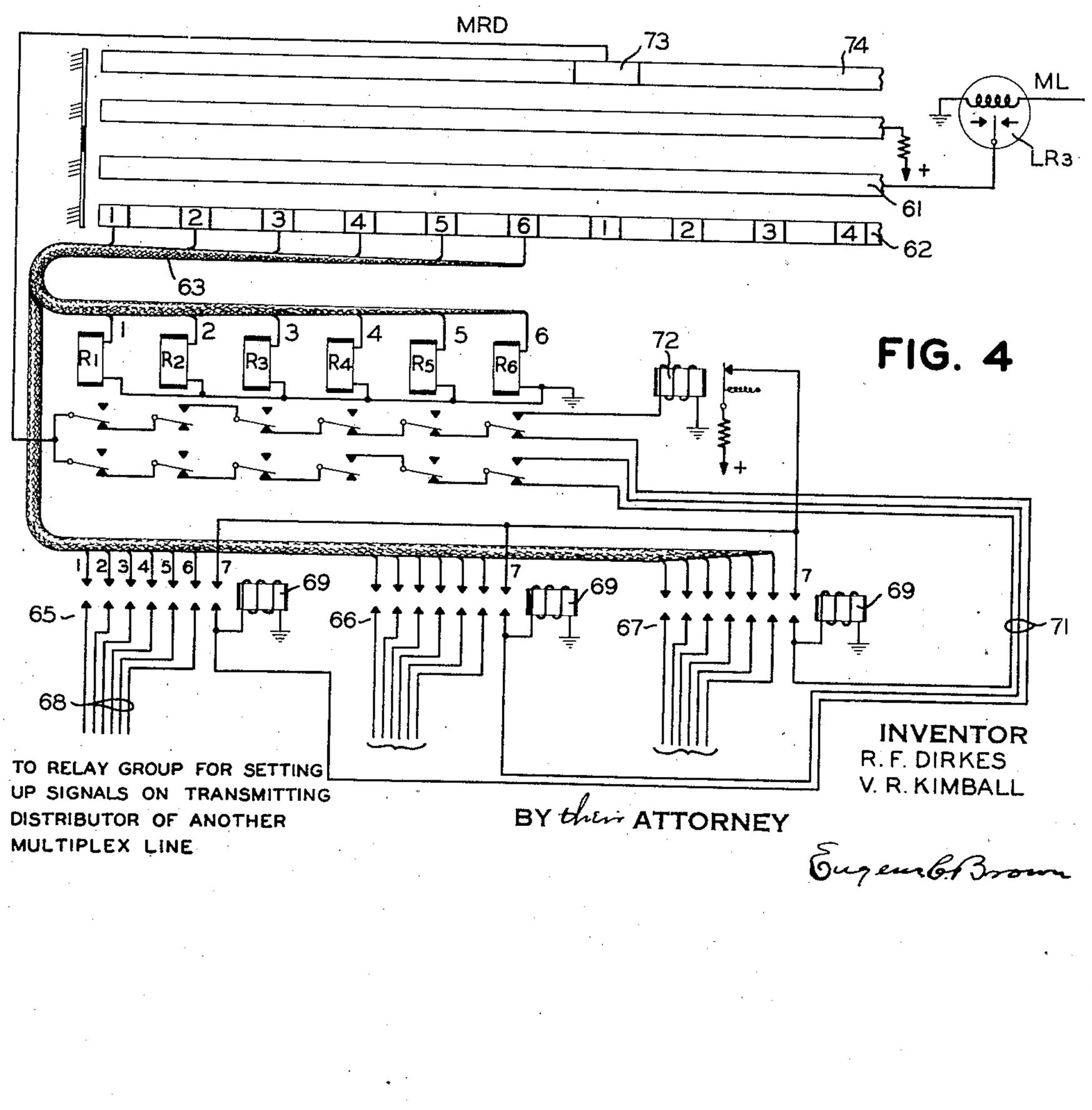

FIG. 4

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3 Sheets-Sheet 3

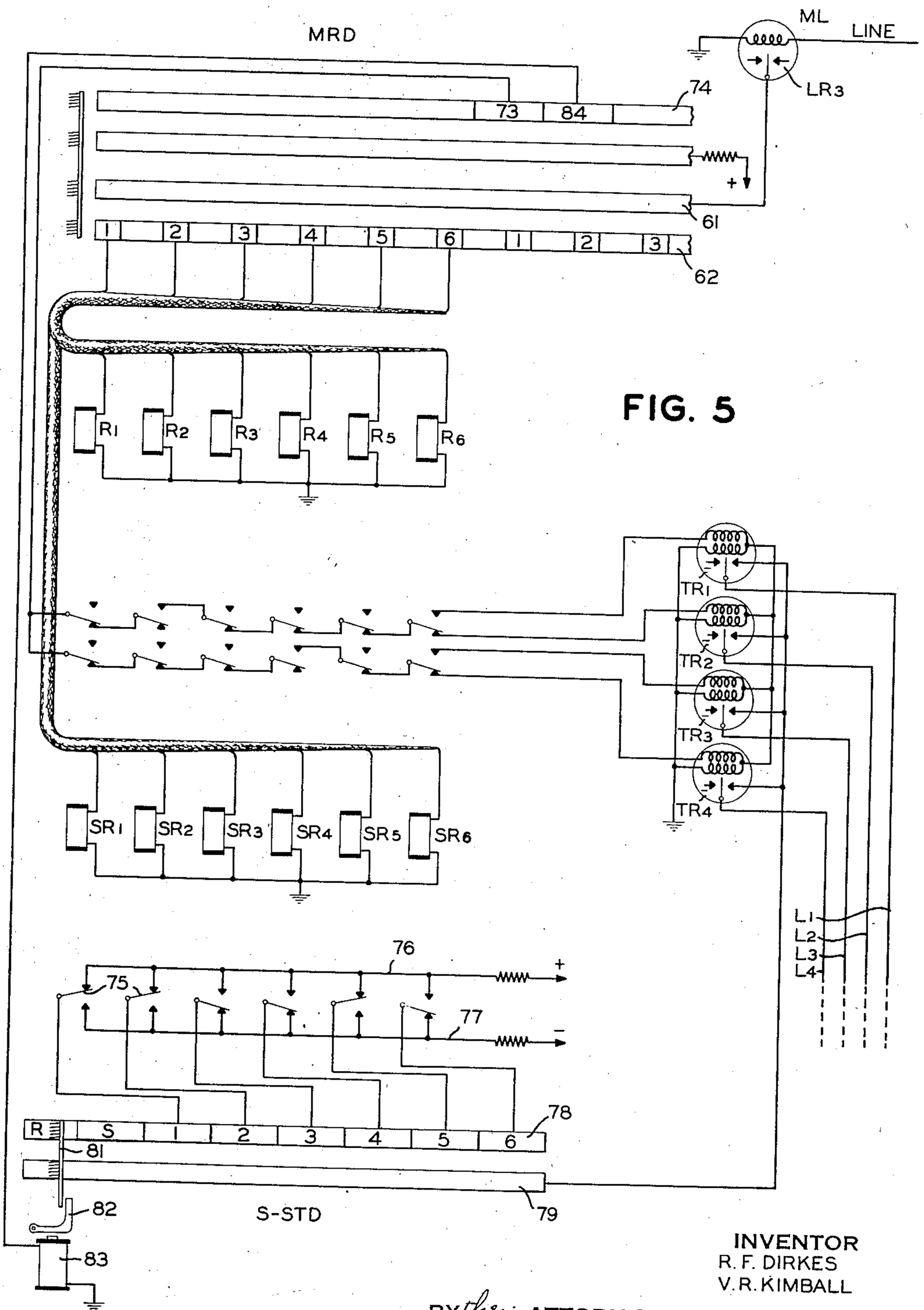

FIG. 5

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TELEGRAPH SWITCHING SYSTEM

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Application January 8, 1932, Serial No. 585,582

12 Claims. (Cl. 178—2)

This invention relates to printing telegraph systems and more particularly to a telegraph switching system.

There is at the present time a tendency towards the creation of telegraph exchange systems in which individual subscribers are equipped with printing telegraph sending and receiving apparatus of the ordinary start-stop type. The present invention relates to a telegraph exchange system of this nature, one of the objects being to provide facilities whereby the printing telegraph subscriber may extend his line automatically to a second subscriber located within the same or in a distant city.

A more specific object is to eliminate auxiliary switching mechanism at the subscribers' offices and make connections by direct manipulation of the telegraph transmitting keyboard.

Still further objects are to enable the connections to be made between two simplex lines, between two multiplex channels, or between a multiplex channel and a simplex line.

Other objects and advantages of the invention will hereinafter appear.

In accordance with our invention we employ a switching device at the main station responsive to regular telegraph code signals transmitted over a line for transferring that line to another branch line extending to a second subscriber's office. Special code combinations, not used for regular intelligence communication, may be employed to effect the switching operation or the switching combination may, at least in part, consist of regular intelligence code groups. In either case they consist of code combinations of the same nature as those used for regular communication and are transmitted from the standard keyboard without the necessity of any special signaling equipment at the subscriber's office.

In order that the invention may be more fully understood, reference will be had to the accompanying drawings in which:

Fig. 1 is a diagrammatic showing at a central station, of one form of switching arrangement embodying the present invention, for connecting one simplex line to another;

Fig. 2 shows a modified arrangement for effecting such switching operations;

Fig. 3 shows a further modification employing stepping switches;

Fig. 4 shows an arrangement for transferring one channel of a multiplex circuit to a channel of another multiplex circuit; and

Fig. 5 shows an arrangement for transferring from one channel of a multiplex circuit to a simplex circuit.

Referring first to Fig. 1, we have shown a line L extending from a transmitter T at a branch or subscriber's office and terminating at a main office in a pair of serially arranged line relays LR1 and LR2. The tongue of relay LR1 is connected to the grounded winding of a magnet 10 controlling the operation of a multi-contact selector 11. The selector is of the type operating on a permutation code either of the five or six unit type, such as shown in our application Ser. No. 490,274, filed October 20, 1930. It is shown diagrammatically as having an annular row of grounded contact rods 12, normally held out of engagement with cooperating U-shaped spring contacts 13, but being movable into engagement therewith, as in the case of contact rod 12*a*, in response to a predetermined code permutation. Briefly the essential parts of the selector 11 comprise a notched code disk for each unit of the code, adapted to be moved into one of two positions under the control of the magnet 10, depending upon whether the associated code impulse is of marking or spacing character. With the code disks set up by a received code combination, a single row of notches will be arranged in alignment, allowing one of the code bars 12 to move inwardly under spring pressure into engagement with its associated contact 13. This type of selector is well known in the art and, therefore, has not been shown except diagrammatically.

One of the U-shaped contacts 13*b* is connected to one terminal of the winding of a charging relay 14, the other terminal of which is connected to a source of potential 15. The remaining contacts 13, with one exception, are connected by individual conductors 16 to one terminal of the operating windings 17 of a group of transfer relays TR_1 to TR_7. The opposite terminal of the windings 17 are connected together by a conductor 18 and also to one terminal of a restoring winding 19, provided for each of the relays. The opposite terminals of the windings 19 are connected together by a conductor 21 and to the back contact of the relay 14. The tongue of the relay 14 is grounded through a condenser 22 and the front contact thereof is connected to the source of potential 15. The contact 13*c* of the selector is connected by conductor 23 to the right hand side of the restoring windings 19.

The right hand contact of each of the transfer relays TR_1 to TR_7 is connected by a common conductor 24 to the tongue of the line relay LR2.

The left contacts of the relays TR_1 to TR_7 are connected to negative or marking battery and the tongues are individually connected to the outgoing lines L1 to L7, terminating at remotely arranged printers, which may be located in various subscribers' offices.

The operation of the system shown in Fig. 1 is as follows. Assuming the tongue of relay TR_4 to be on its right contact and the tongues of the remaining relays on their left or resting contacts, a circuit is completed from the line relay LR2 directly over the line L4. Consequently, signals received over the line L are repeated over the line L4. These signals are also set-up on the contacts of the selector 11 but, in the absence of a special code combination not used for regular intelligence communication, by which the contact 13*b* is grounded, the relays TR_1 to TR_7 do not respond and consequently the circuit through the line L4 is not interrupted. If the operator at the distant end of the line L desires to transfer to another subscriber, for instance, one at the end of line L6, he first transmits a special code combination which closes contact 13*b*, energizing the relay 14, which attracts its tongue, applying the source of potential 15 to the condenser 22 to charge the same. This signal group is followed by a second group representative of the line L6 and which may be a combination used for regular intelligence transmission. This latter combination effects a closing of contact 13*d*, applying ground to the operating winding 17 of relay TR_6. Contact 13*b* is released at this time, permitting the tongue of relay 14 to drop to its back contact and allowing the condenser 22 to discharge through the restoring windings 19 of all of the selecting relays, in parallel, and thence through the operating winding 17 of the single relay TR_6 to the grounded contact 13*d*. This discharge through the restoring windings 19 is in such direction as to bias all the tongues to their resting contacts and the discharge through the operating winding 17 is in a direction to move the relay tongue in the opposite direction. Since only a small part of the current passes through the restoring winding of relay TR_6 and the entire current passes through the operating winding of this relay, the latter winding predominates and the tongue is moved so as to complete the connection, from line relay LR2 to the branch line L6. The tongue of relay TR_4 is restored to its resting contact by the current through its restoring winding. The operator at line L may then carry on communication with the operator at line L6.

If the L line operator desires to disconnect his line entirely from any of the branch lines, he may do so by first sending a special charging code combination to close contact 13*b* and thereby operate relay 14 to charge the condenser 22, followed by a second special code combination to close contact 13*c*, so as to ground all of the restoring windings. The condenser 22 therefore discharges through all of the restoring windings in parallel, moving all of the relay tongues to their resting contacts and thereby disconnecting the line relay LR2 from all of the branch lines.

In Fig. 2 we have shown a modified switching arrangement in which the multi-contact selector is in the form of a start-stop distributor S—SD and a group of multi-contact coding relays R1 to R6. The start-stop distributor comprises a solid receiving ring 30, a segmented receiving ring 31, a solid local ring 32 and a segmented local ring 33. The tongue of the line relay LR_1 is connected to the solid ring 30 and the segments 1 to 6 of ring 31 are individually connected to the windings of coding relays R1 to R6. The distributor is shown with six segments, corresponding to a six unit permutation code, but obviously the number of units of the code may be varied by correspondingly changing the number of segments and the number of coding relays. The rest segment R of ring 31 is connected to ground through the winding of a brush releasing relay 34, one contact of which is connected to a source of potential and the tongue of which is grounded through the start magnet 35. The brushes 36 and 37 of the receiving and local rings respectively are normally held at rest by the latch 38.

Each of the relays R1 to R6 is provided with a plurality of contacts adapted to be closed in various combinations as the relays are energized, to complete a selected baffle circuit from the conductor 39, connected in common to the tongues of relay 1, to one of the contacts of relay 6. The conductor 39 is also connected to a segment 41 of the local ring 33 and the contacts of relay R6 are individually connected by conductors 42 to the operating windings 17 of the relays TR_1 to TR_8, for controlling the connection of the line L to the lines L1 to L8. The left hand terminals of the restoring windings 19, of relays TR_1 to TR_8, are connected by a common conductor 43 to ground.

In the operation of this system each of the relays TR_1 to TR_8 is selected by a special code combination not used for regular communication purposes. However, it is to be understood that the arrangement shown in Figure 1 for conditioning the selecting mechanism by a special code combination, so that it will respond to regular character code signals to effect a selection, may be used with the relay selector of Figure 2.

Since a six unit code is employed, the total number of available combinations is sixty-four, about three-fourths of which are necessary for operation of the receiving printers, the remaining combinations being available for selecting purposes. When it is desired to establish connection between the line L and any one of the lines L1 to L8, the combination representative of the desired line is transmitted. The start impulse of the group is repeated by the line relay LR_1 through the brushes 36 and rest segment R to the relay 34, which in turn applies a starting impulse to the magnet 35 to trip the latch 38 and start the brushes 36 and 37 into rotation. Brush 36 passes over segments 1 to 6 in synchronism with the received selecting impulses in the usual manner, operating the relays R1 to R6 in accordance with the received permutation. If line L2, for instance, is to be selected, relays R1 to R5 would be operated, completing a circuit through the top row of tongues and contacts of relays R1 to R5 and upper tongue and its lower contact, of relay R6, to the conductor 42 associated with relay TR_2. The relays R1 to R6 are of a type which retain their contacts in a set position until changed by the succeeding code combination. Consequently as the brush 37 engages segment 41, an impulse is transmitted from battery through ring 32, brush 37, segment 41, conductor 39, upper tongues and upper contacts of relays R1 to R5, upper tongue and lower contact of relay R6 to the operating winding 19 of relay TR_2, thence by conductor 18, to each of the restoring windings 19 in parallel and thence by conductor 43 to ground. All of the relays are thus restored to their resting con-

tacts with the exception of relay TR_2 which completes a circuit from the line relay LR2 to the line L2. Consequently subsequent signals transmitted over the line L will be repeated over the line L2.

In Fig. 3 we have substituted a group of stepping magnets 50 and 51 for the transfer relays TR_1 to TR_8 of Fig. 2. Each stepping relay consists of a contact arm 52, normally urged toward a stop 53 by a spring, not shown, and movable over a series of contacts *a* to *h* by means of a magnet 54, pawl 55 and ratchet wheel 56. A locking latch 57 is provided for holding the contact arm in each set position and is adapted to be retracted by a release magnet 58 to allow the contact arm to be restored to its initial position. The release magnets 58 are included serially in circuit with the uppermost contact of relay R6. The operating magnets 54 are included in circuits individual to the remaining contacts of relay R6. With this system when it is desired to connect the line L with one of the lines L1 to $L1_6$, a special release code combination is first transmitted of such nature as to operate magnets R4 and R6 and thus complete a circuit from the segment 41 over conductor 39, upper tongues and lower contacts of relays R1 to R3, upper tongue and upper contact of relay R4, upper tongue and lower contact of relay R5 and upper tongue and upper contact of relay R6 to the release magnets 58, which are energized thereby withdrawing the locking pawls 57 to restore all of the contact arms 52 to their insulated contacts and thereby interrupting the circuit from line relay LR2 through the contact arm 52 to the lines L1 to $L1_6$. Following this a code combination representative of one of the stepping switches 50 or 51 is transmitted. This combination must be one not used for regular communication purposes. If line L4 is to be selected, the combination representative of switch 50 will be repeated four times, thus operating the tongues of the selecting relays in such an arrangement as to complete the circuit from segment 41 through the magnet 54 each time the brushes of the distributor revolve. With the arm 52 of switch 50 locked on contact *d* by the locking pawl 57, a circuit is completed from the line relay LR_2, by means of conductor 60 and contact arm 52, directly to the line L4.

All of the foregoing systems have been arranged for connecting one simplex line to another simplex line. In Fig. 4 we have shown an arrangement for connecting one channel of a multiplex circuit to one of a plurality of multiplex printers or to a channel of another multiplex circuit operating at the same speed. The incoming multiplex line ML is connected to a line relay LR_3, which repeats the signals to the solid ring 61 of the multiplex receiving distributor MRD, which may have a number of channels, one only of which is shown complete. The segments 1 to 6 of segmented ring 62 are connected through a cabled conductor 63 to the windings of a group of code relays R1 to R6, arranged as shown in Figs. 2 and 3. These segments are also connected to the contacts 1 to 6 of each of a plurality of gang switches 65, 66 and 67. The opposing contacts of each gang switch are connected by conductors 68 to the selecting magnets of a multiplex printer or to a group of storage relays, not shown, for applying the code combinations to one channel of a transmitting multiplex distributor associated with another multiplex line, not shown. Each of the switches 65 to 67 is provided with an operating magnet 69, having one terminal grounded and the other terminal connected by one of the conductors 71 to the individual contacts of the relay R6. The upper contact of relay R6 is connected in series with a release relay 72, having its back contact connected to one contact 7 of each of the switches 65 and 66.

The operation of this system is as follows. Each of the gang switches 65 to 67 is represented by special code combinations not used for communication purposes and when it is desired to select one of the switches to connect the incoming channel to one channel of another multiplex circuit, a code combination is first transmitted to operate relays R2 and R6, thereby to complete the baffle circuit to relay 72 from the local segment 73 of the local multiplex ring 74, through the tongue of relay R1 and its lower contact, tongue of relay R2 and its upper contact, tongues of relays R3, R4 and R5, and their lower contacts and tongue of relay R6 and its upper contact, to the winding of relay 72 and thence to ground. Relay 72 thus opens its contact, removing battery from the contact 7 of each of the switches, thereby interrupting the circuit to any of the operating magnets 69, the switch contacts of which are closed. With all of the switches open a second code combination is transmitted representative of the particular gang switch to be operated, thus, for instance, if switch 65 is to be selected, selecting magnet R2 only would be operated, completing the baffle circuit from local segment 73 through the upper tongue and lower contact of relay R1, upper tongue and upper contact of relay R2, upper tongue and lower contacts of relays R3 to R6 and thence by one of the conductors 71 to the winding 69 of relay 65. This impulse closes the gang switch 65 and completes a locking circuit for coil 69 from battery at the tongue of relay 72 through the contact 7 of the gang switch. With the switch 65 closed, the signal combinations received over one channel of the multiplex circuit are repeated over the conductors 68 to the segments of the multiplex transmitting distributor associated with the other multiplex circuit or to an associated multiplex printer. Obviously both multiplex distributors must be operated at the same speed and any of the various arrangements for maintaining such synchronism and phase relation as are known in the art may be employed for this purpose.

In Fig. 5 we have shown means for transferring from one channel of a multiplex system to any one of a number of simplex circuits. In this arrangement each of the contacts of the code relay R6 is connected to the operating winding of an individual transfer relay TR_1 to TR_4 in the same manner as shown in Fig. 2. The relays TR_1 to TR_4 control the switching of the multiplex channel to one of the simplex lines L1 to L4. The contacts 1 to 6 of the multiplex receiving distributor MRD are also individually connected to a group of six storing relays SR_1 to SR_6, the contact tongues 75 of which play between marking and spacing bus bars 76 and 77 respectively. The tongues 75 are connected to segments 1 to 6 of a start-stop transmitting distributor S—STD, segmented ring 78 of which is also provided with a start segment S and a rest segment R. Solid ring 79 of the distributor is connected to the right hand contacts of the transfer relays TR_1 to TR_4. The brush 81 is normally held in rest position by a latch 82, controlled by a magnet 83, energized when the multiplex brush passes across local segment 84.

The operation is as follows. When it is desired

to select one of the lines L1 to L4 a special code combination representative of such line is transmitted to complete a baffle circuit to the contacts of the relay group R1 to R6 and as the multiplex distributor brush passes on to segment 13 an impulse is transmitted over this baffle circuit to the selected transfer relay, operating the same and restoring the other relay tongues to their resting contacts. The succeeding signals then serve to set up the storage relays SR_1 to SR_6 so as to apply the code combination to the segments of the start-stop transmitting distributor and as the multiplex brush passes local segment 84, the start magnet 83 is energized, releasing the brush 81 to complete one revolution and thereby transmit the code combination over the selected line. The transmission of the signal impulses proceeds from the start-stop distributor, of course, during the time of the reception of the corresponding signal impulse of the succeeding signal group. It will be understood, of course, in this modification that the signal combinations used to operate the selecting relays TR_1 to TR_4 must not be used for regular communication purposes.

It is obvious, of course, that numerous changes may be made in the various systems proposed and that other systems will be apparent from the information given herein. Accordingly, we do not desire to be limited to the exact details shown, except as required by the terms of the appended claims.

What we claim is:

1. A printing telegraph switching system comprising a line, means for transmitting code signals over said line, a plurality of associated lines, a selecting relay for each of said associated lines arranged to connect said first line thereto and means controlled by certain of said code signals for operating a predetermined relay to connect said first line with a desired one of said associated lines.

2. A printing telegraph switching system comprising a line, means for transmitting code signals over said line, a plurality of associated lines, a selecting device for each of said associated lines, arranged to connect said first line thereto and means controlled by certain of said code signals transmitted over said first line for operating a predetermined selecting device to connect said first line with a desired one of said associated lines and means controlled by other code signals transmitted over said first line for disconnecting said first line from said associated lines.

3. A printing telegraph switching system comprising a line, means for transmitting code signals over said line, a plurality of associated lines, a selecting relay for each of said associated lines arranged to connect said first line thereto, an operating winding and a restoring winding for each relay and means responsive to certain code combinations for energizing the operating winding of the relay associated with a predetermined one of said associated lines and the restoring windings of the remaining relays whereby to connect said first line to said predetermined associated line and disconnect it from the remaining associated lines.

4. A printing telegraph system comprising a line, means for transmitting a succession of code signals over said line, a plurality of associated lines, a selecting circuit for each of said associated lines, a condenser associated with said selecting circuits and means responsive to a predetermined code combination for discharging said condenser through a predetermined selecting circuit to effect a connection between said first line and the associated line controlled by said predetermined selecting circuit.

5. A printing telegraph system comprising a line, means for transmitting a succession of code signals over said line, a plurality of associated lines, a selecting circuit for each of said associated lines, a condenser associated with said selector circuits, means responsive to a special code combination for charging said condenser and means responsive to a succeeding code combination for discharging the condenser through a predetermined selecting circuit to effect a connection between said first line and the associated line controlled by said predetermined selecting circuit.

6. A printing telegraph switching system comprising a line, means for transmitting a succession of permutation code signals over said line, a plurality of associated lines, means for connecting said first line selectively to any one of said associated lines and means whereby said first mentioned means is made responsive to a single predetermined permutation code signal transmitted over said first line.

7. A printing telegraph switching system comprising a line arranged to transmit permutation code signals, a main office at which said line terminates, a plurality of associated lines also terminating at said main office, means for simultaneously connecting said line to a predetermined associated line and disconnecting it from any of the remaining associated lines to which it may have been connected and means whereby said first mentioned means is made responsive to a single permutation code signal received over said first line.

8. A printing telegraph switching system comprising a line arranged to transmit permutation code signals, a main office at which said line terminates, a plurality of associated lines also terminating at said main office, a rotary distributor at the main office, a group of coding relays associated therewith, selecting circuits controlled by said coding relays, means included in said selecting circuits for connecting said first line selectively to one of said associated lines and means for applying predetermined code signals, received over said first line, to said rotary distributor to operate said coding relays.

9. A printing telegraph switching system comprising a plurality of multiplex lines terminating at a main station and a selector mechanism common to said lines, said selector mechanism being responsive to predetermined code signals received over a channel of one multiplex line for connecting said channel to one channel of another multiplex line.

10. A printing telegraph switching system comprising a plurality of multiplex lines terminating at a main station, a switching mechanism for completing connections between a channel of one multiplex line and a channel of another multiplex line, said switching mechanism being responsive to predetermined signal combinations received over a channel of one multiplex line for interrupting its existing connections and connecting said channel to a different multiplex channel.

11. A printing telegraph switching system comprising a multiplex line terminating at a main station, a plurality of simplex lines terminating at said station and means responsive to predetermined code combinations received over one channel of the multiplex line for effecting con-

nections selectively between said channel and one of said simplex lines whereby the succeeding signals received over said channel will be repeated over said selected simplex lines.

12. A printing telegraph system comprising a plurality of multiplex channels, and a plurality of simplex channels terminating at said station, and means for completing connections between predetermined multiplex and simplex channels for repeating signals therebetween, said means being responsive to code signals received over one of said channels for varying the connections between said multiplex and simplex channels.

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