Nov. 18, 1924. 1,515,735

C. L. GOODRUM ET AL

MACHINE SWITCHING TELEPHONE SYSTEM

Filed July 21, 1921 2 Sheets-Sheet 1

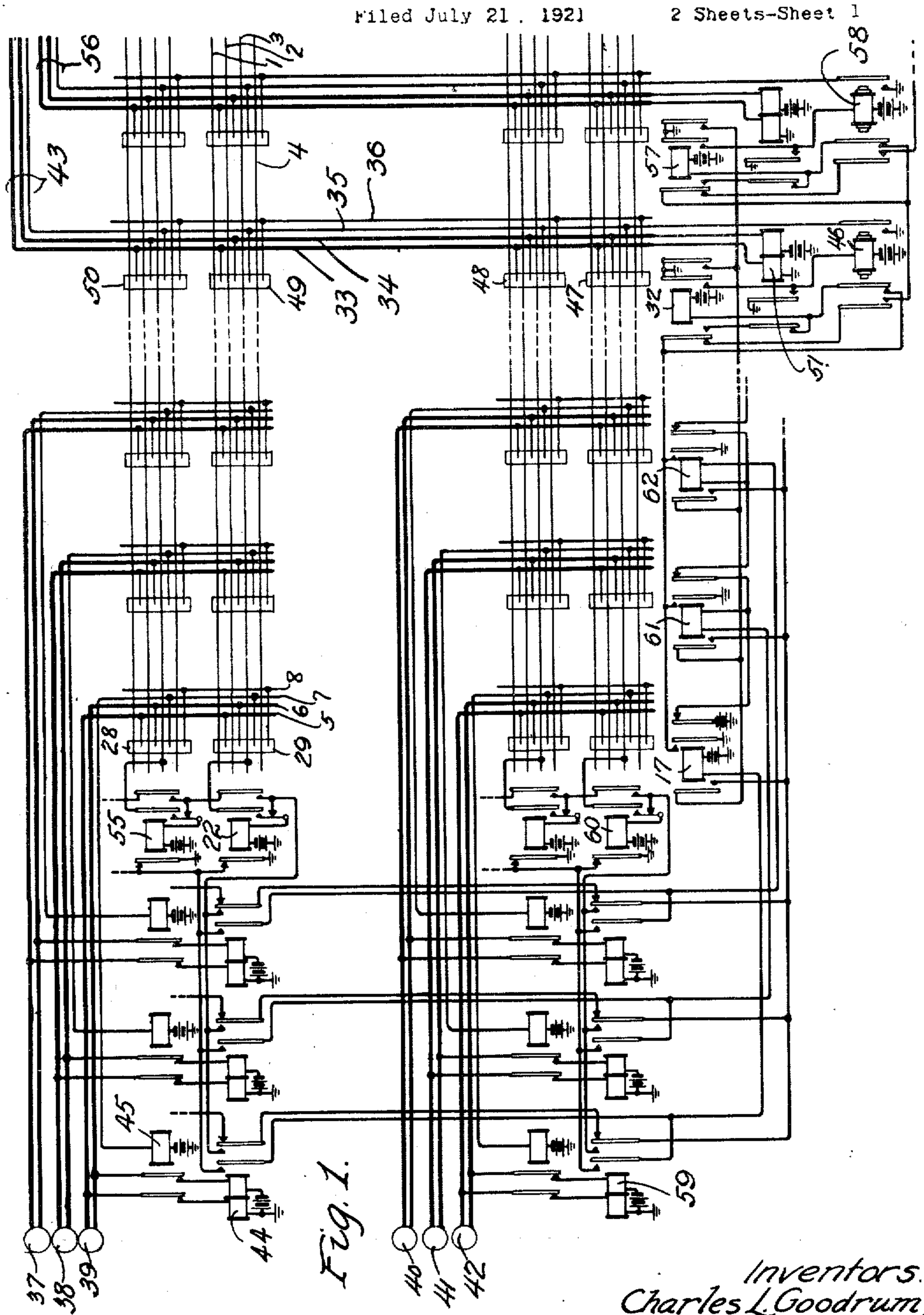

Fig. 1.

Inventors:
Charles L. Goodrum,
John N. Reynolds,

by E. R. Rowlan Att'y

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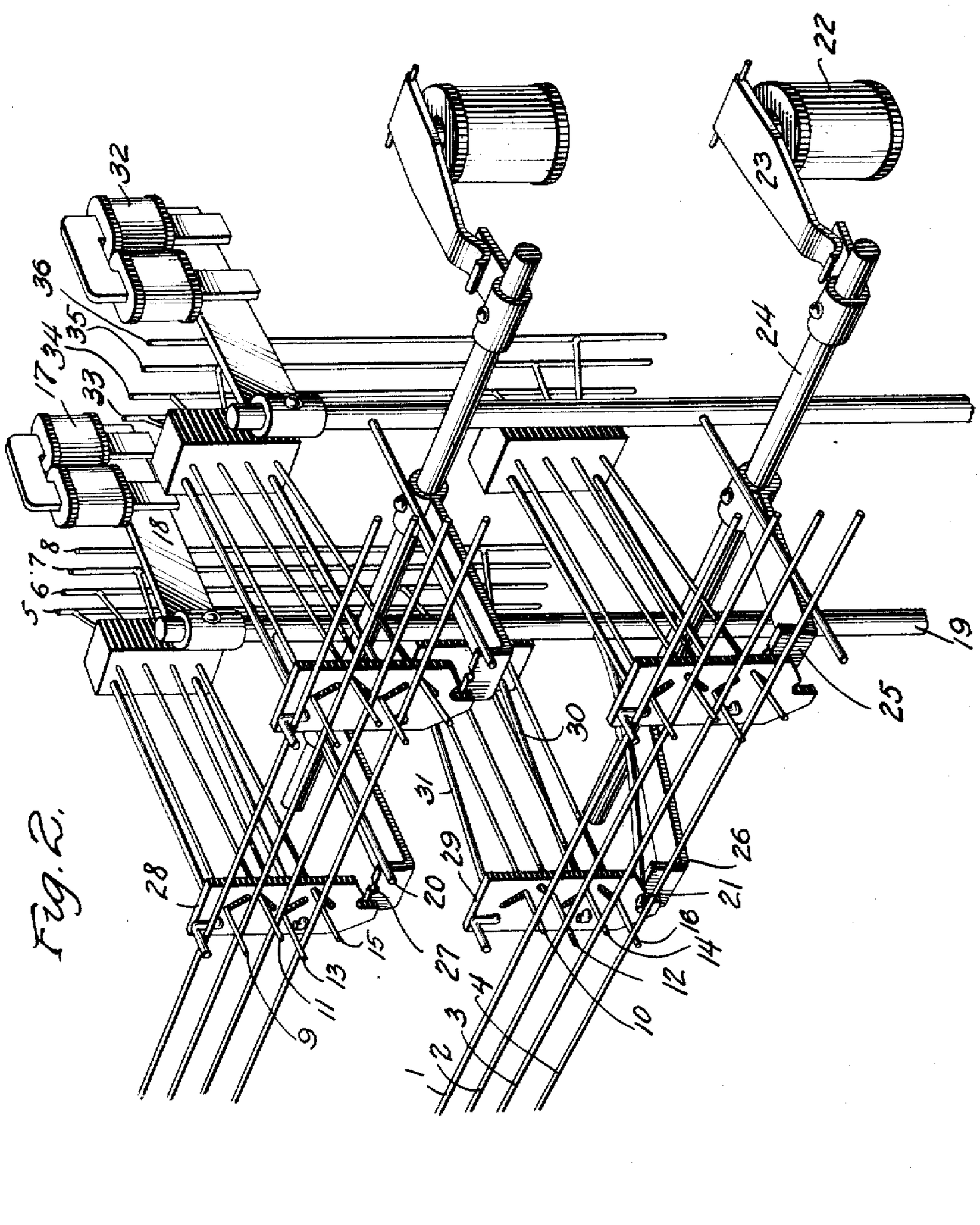

Fig. 2.

Inventors
Charles L. Goodrum,
John N. Reynolds,
By E. R. Nourse Att'y.

Patented Nov. 18, 1924. 1,515,735

UNITED STATES PATENT OFFICE.

CHARLES L. GOODRUM, OF NEW YORK, N. Y., AND JOHN N. REYNOLDS, OF GREENWICH, CONNECTICUT, ASSIGNORS TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

MACHINE-SWITCHING TELEPHONE SYSTEM.

Application filed July 21, 1921. Serial No. 486,442.

To all whom it may concern:

Be it known that we, CHARLES L. GOODRUM and JOHN N. REYNOLDS, citizens of the United States, residing at New York, in the county of New York, State of New York, and Greenwich, in the county of Fairfield, State of Connecticut, respectively, have invented certain new and useful Improvements in Machine-Switching Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to a coordinate switch particularly useful in automatic telephone circuits, and especially to a unitary coordinate switch wherein an array of individually operable switching devices is employed for connecting incoming and outgoing lines.

An object of the invention is to provide, in such a unitary switch, a wiring arrangement whereby any number of coexisting connections may be established by a common operating member.

This is accomplished by providing for the array of individually operable switches, which may be arranged in longitudinal and transverse rows, selecting mechanism which includes a common controlling element for the switches of each row, each longitudinal row being divided into sections serving separate and distinct line circuits, respectively.

More specifically, the invention relates to a switch of the type described which contains link circuits for connection between incoming and outgoing lines, whereby a plurality of coexisting line-link-line connections may be established with the economy of operation noted above.

A further feature of the invention is the provision, in such a unitary switch, of a wiring arrangement whereby interference between simultaneously calling incoming lines is prevented and the possibility of double connections between incoming lines and lines accessible thereto is obviated.

This is accomplished by providing operating circuits for the series of controlling elements serving incoming lines which are dependent for their continuity upon contacts controlled by other controlling elements of the series in such a manner that the operation of one controlling element renders the operating circuits of the remaining controlling elements temporarily ineffective.

In addition to the features above outlined such other features and advantages as are contemplated by the present invention will be clearly understood from the description given hereafter and from the appended claims.

The invention is shown in two figures, Fig. 1 of which is a circuit arrangement and Fig. 2 is a perspective view of one type of mechanical apparatus, which may be employed in such a circuit arrangement.

There are in the art a variety of mechanical switching structures involving cooperating switching members, each member controlling a plurality of circuit making contacts, which might be used in the system of this invention. An example of these numerous switching structures is shown in the patent to Roberts No. 1,143,998, issued June 22, 1915. The preferred form of switching mechanism for employment in a system of this character, which is shown in Fig. 2 of the drawing, was devised by J. N. Reynolds and is disclosed in the British patent to Western Electric Company, Ltd., No. 183,436, accepted August 23, 1923.

Considering first Fig. 2, the operation is as follows:

It is desired to establish a connection between the group of conductors 1, 2, 3 and 4 and the group of conductors 5, 6, 7 and 8. Conductor 5 is multipled at several points to spring wires such as 9 and 10; conductor 6 is multipled in the same manner to spring wires 11 and 12; conductor 7 is multiplied to spring wires 13 and 14, and conductor 8 is multipled to spring wires 15 and 16. Thus each group of conductors, such as conductors 5, 6, 7 and 8, are multipled to the movable contact sets forming a vertical row.

Associated with the group of conductors 5, 6, 7 and 8 is a magnet 17 which controls an armature 18 to rotate a bar or switching member 19. Secured to this bar and associated with each group of spring wires such as 9, 11, 13 and 15 and 10, 12, 14 and 16, are spring arms 20 and 21, respectively. When the magnet 17 is energized, all of the spring arms, such as 20 and 21, are moved in a clockwise direction through the rotation of bar 19.

Associated with the group of conductors 1, 2, 3 and 4 is a magnet 22 which, through an armature 23, controls a switching member or bar 24. Secured to this bar and associated with each group of conductors similar to the group 5, 6, 7 and 8 are arms such as 25 and 26. After the magnet 17 has become operated and the spring wire arm 21 has moved in a position above the arm 26, the magnet 22 may be operated whereupon the spring arm 21 will be moved upwardly. Each of the arms, such as 25 and 26, contains a notch 27 which is for the purpose of preventing the spring arm 21 from slipping when the magnet 17 is deenergized to return all of the spring arms, such as 20, back to their normal positions, leaving only the one, 21, in an operated position.

Associated with each group of spring wires, such as the group 9, 11, 13 and 15 and the group 10, 12, 14 and 16, is a piece of insulating material, such as hard rubber or fiber 28 and 29. The spring wires 10, 12, 14 and 16 project through slots cut in the insulating material 29. This insulating piece is so fashioned at its lower end that when the spring 21 has been moved in a clockwise direction and the arm 26 has been rotated upwardly, spring 21 will move the insulating piece 29 bodily upward, bringing the spring wires 10, 12, 14 and 16 into contact with conductors 1, 2, 3 and 4, respectively.

For holding the piece of insulating material 29 in position, two springs 30 and 31 are provided which are threaded through the insulating material and bent over in a manner to locate the piece 29. The spring wire 31 after being threaded through the insulation is also bent upwardly and then outwardly so that when the group of spring wires 10, 12, 14 and 16 are at rest, they will be preventel from moving downwardly a sufficient distance to contact with the conductors of the group 1, 2, 3 and 4.

It will be seen from this arrangement that, if two magnets 17 and 32 are simultaneously energized and then magnet 22 is energized, a connection will be established from conductor 5 to conductor 1 and thence to conductor 33 and in the same manner conductors 6, 7 and 8 will be connected through conductors 2, 3 and 4 to conductors 34, 35 and 36. The group of spring wires, together with the conductors with which they cooperate, thus forms a field of switches arranged in vertical or longitudinal rows and horizontal or transverse rows, which collectively may be considered a switchboard.

Considering now the circuit arrangement shown in Fig. 1, the operation is as follows:

There are shown two groups of three incoming lines each, the upper group containing lines 37, 38 and 39 and the lower group containing lines 40, 41 and 42.

Let it be assumed that the subscriber on line 39 wishes to establish a connection. The circuits in Fig. 1 show how upon the removal of the receiver on the line 39, it will be automatically connected to trunk 43.

A calling subscriber on line 39 removing his receiver from the switchhook establishes a circuit for the energization of the line relay 44. This circuit extends from ground, left-hand winding of relay 44, back contact and outer left-hand armature of cut-off relay 45, over the closed loop of line 39, the inner left-hand armature and back contact of cut-off relay 45, right-hand winding of line relay 44, to battery and ground. This establishes a circuit from ground, the left-hand armature and back contact of link magnet 22, the front contact and inner right-hand armature of relay 44, winding of magnet 17, to battery and ground. Magnet 17 rotates the line bar 19 and prepares to move the insulating piece 29, or any of the others shown on the vertical line above the magnet 17, Fig. 1. The insulating piece 29 controls the connection of line 39 to the first link 1, 2, 3 serving this subgroup of lines and insulating piece 28 controls the connection of said line to the second link. While only two links per subgroup are shown, any desired number may be provided and the first idle one is utilized. Magnet 17 in attracting its armatures closes a circuit from ground, inner right-hand armature and front contact of magnet 17, back contact and inner left-hand armature of slow releasing relay 46, winding of trunk bar magnet 32, to battery and ground. This magnet 32 causes the rotation of a bar similar to 19 and prepares for the operation of the insulating pieces 47, 48, 49 and 50 common to the trunk 43 and respectively individual to the several links. Magnet 32 in attracting its armatures locks itself in a circuit from ground, inner right-hand armature and front contact of magnet 17, left-hand armature and front contact of magnet 32, outer armature and contact of relay 51, winding of magnet 32, to battery and ground. This locking circuit is necessary because upon the energization of magnet 32 a circuit is established from ground, inner right-hand armature and front contact of magnet 32, winding of slow releasing relay 46, to battery and ground, causing the energization of this latter relay and the opening of the original energizing circuit of magnet 32. Magnet 32 also closes a circuit from ground, the outer right-hand armature and front contact of magnet 32, left-hand armature and front contact of magnet 17, the outer right-hand armature and back contact of relay 59, the outer right-hand armature and front contact of line relay 44, the normal contact of the inner right-hand armature of magnet 22, winding of magnet 22, to battery

and ground, assuming the first link 1, 2, 3 serving the group of lines 37, 38, 39, etc. to be idle. Magnet 22 becomes energized in this circuit and by means of the arms 26 and 25 causes the movement of insulating pieces 29 and 49, whereupon a circuit is established from conductors 5, 6, 7 and 8 through the link conductors 1, 2, 3 and 4, respectively, to trunk conductors 33, 34, 35 and 36, respectively. A circuit is now established from ground, front contact and right-hand armature of relay 46, conductor 35, conductor 3, alternate contact of the right-hand armature of magnet 22, winding of magnet 22, to battery and ground and in parallel therewith through conductor 7, winding of cut-off relay 45, to battery and ground. Magnet 22 is locked in this circuit and relay 45 is energized in this circuit. Cut-off relay 45 becoming energized opens the circuit for line relay 44 which retracts its armatures and opens the circuit for magnet 17 and magnet 17 opens the original energizing circuit of magnet 32. Magnet 17 deenergizes provided no other line served by the switching bar 19 is calling at this time. Simultaneously with the energization of cut-off relay 45, which is as soon as the line 39 is extended to trunk 43, a circuit through the windings of relay 51 is completed over the loop of the substation and this relay remains energized during the establishment of the connection. Relay 51 opens the locking circuit of magnet 32 so that if magnet 17 has not become deenergized by this time magnet 32 will be restored and will release its associated switching bar. Relay 51 also maintains relay 46 energized by placing a ground on the winding of relay 46 as a substitute for the ground placed there by the inner right-hand armature of magnet 32. The connection between the line and trunk is maintained by the continued energization of magnet 22 which controls the link bar 24.

When the subscriber on line 39 replaces his receiver on the switchhook and opens the loop of this line, relay 51 becomes deenergized and shortly thereafter relay 46 retracts its armatures, removing ground from conductor 35 and allowing magnet 22 and relay 45 to become deenergized whereupon the connections are restored to normal.

When the magnet 22 is energized, say in one connection, the starter wire from the front contact and outer right-hand armature of relay 44 is extended through the front contact and outer right-hand armature of magnet 22 to the link bar magnet 55, so that another call coming in, say from line 37 or 38, may be extended over the link circuit shown just above the one comprising conductors 1, 2, 3 and 4.

While trunk 43 is busy, relay 46 is energized so that a second call initiated in any subgroup of lines will seize trunk 56 through a circuit extending through the left-hand armature and back contact of magnet 32, the outer left-hand armature and front contact of relay 46, the back contact and inner left-hand armature of relay 58, winding of magnet 57, to battery and ground.

Certain general features of this system which should be pointed out are as follows: First, the lines in a vertical or longitudinal row above magnet 17 form one digital subgroup, and second, the lines in a horizontal or transverse row to the right of magnet 22 form another digital subgroup.

These two subgroups may be said to be in the two principal directions of a two-coordinate systetm and hence in a one hundred line main group, there will be twenty digital subgroups, ten of which will be characterized by the tens digit and the remaining ten will be characterized by the units digit.

It is not, of course, necessary that the actual number of the lines be placed in any particular order, the above described grouping being arranged through the connections of the contacts and armatures of the line relays.

All of the link circuits have access to the trunks such as 43 and 56. The link circuits are, however, divided into groups and each group of link circuits is individual to a particular group of lines in one direction of the two-coordinate system. Thus, the group of link circuits comprising conductors 1, 2, 3 and 4 is individual to the particular subgroups of lines 37, 38 and 39 and forms a row of contact sets, one before each line and trunk bar. It should be noted that each of these links is available to each of these lines and the same is true of other links with respect to the lines of their respective groups.

It should be noted that the subgroup magnets are not rendered individual through the act of establishing a connection. The magnet 17, for instance, after assisting in the extension of line 39, through a link circuit comprising conductors 1, 2, 3 and 4 to trunk 43, may thereafter assist in the extension of line 42 or in the extension of any corresponding line in other subgroups.

It should be further noted that magnet 17, upon energizing, opens its outer right-hand armature contacts and removes battery potential from the windings of all other magnets corresponding to magnet 17, such as magnets 61, 62, etc., serving other lines of the same or other subgroups, as, for example, lines 37, 38, 40 and 41, so that should a call be simultaneously initiated upon other lines served by such other magnets, no interference will result and the possibility of double connections to the same link circuit

is obviated. Similarly, the remaining magnets 61, 62, etc. disconnect battery potential from all other magnets succeeding them in order in such a manner that it is not possible for two such magnets to remain energized at the same time, the magnet nearest the source of potential being given the preference.

Should two lines in different subgroups, for example, lines 39 and 42, both served by the same magnet 17, call simultaneously, the connection of both lines to the same trunk circuit through different link circuits is prevented since it is not possible for link bar magnets, such as 22 and 60, serving, respectively, the subgroups of lines in which lines 39 and 42 terminate to become simultaneously operated. The circuit for the magnet 22 is open at this time at the back contact of the line relay 59 of line 42 and cannot be closed until after line 42 has become extended to a trunk line and line relay 59 is released.

What is claimed is:

1. The combination in a switching system of incoming circuits, link circuits, outgoing circuits, contact sets, a plurality of switching bars movable independently of and cooperating with each other for actuating said contact sets to connect an incoming circuit to a link circuit and to connect such link circuit to any outgoint circuit, and means for maintaining the established connection with a single one of said bars.

2. The combination in a switching system of line circuits, link circuits, trunk circuits, contact sets, line bars serving said lines, link bars serving said links, a trunk bar for each of said trunks, said bars being movable independently of said contact sets, means for causing the joint operation of a line bar, a link bar and a trunk bar, said bars cooperating with each other for actuating said contact sets to connect a line to a link and to connect such link to a trunk, and means whereby the link bar maintains the established connection.

3. The combination of a switching system of line circuits, link circuits, trunk circuits, contact sets, line bars serving said lines, link bars serving said links, a trunk bar for each of said trunks, means for causing the joint operation of a line bar, a link bar and a trunk bar, said bars cooperating with each other for actuating said contact sets to connect a line to a link and to connect such link to a trunk, means for releasing the line and trunk bars, and means controlled by the link bar for maintaining the established connection.

4. The combination in a switching system of lines divided into sub-groups, a group of links for each sub-group of lines, trunks serving all of said links, line switching members each serving a line in each subgroup, link switching members individual to said links, trunk switching members individual to said trunks, and means for causing the joint operation of one of each of said switching members to connect a line to a link and to connect such link to a trunk.

5. In a switching system, a plurality of link circuits, a plurality of lines intersecting all of said link circuits, a second plurality of lines severally arranged to intersect a portion only of said link circuits, switching means at each point of intersection, the switching means at each point of intersection being operable independently of particular switching means at other points of intersection, and means for operating said switching means in pairs whereby a line of one group is connected to a line of the other group through one of said link circuits.

6. The combination in a switching system of a plurality of sets of contacts arranged in a row and divided into groups, a plurality of incoming lines, each connected in multiple to the sets of contacts comprising one of said groups, another plurality of sets of contacts arranged in rows, a plurality of outgoing lines, each connected in multiple to the sets of contacts comprising one of said other rows, a plurality of sets of link conductors, each associated individually with a set of contacts of said first mentioned row and with a set of contacts in each of said last mentioned rows, and means operable to establish a connection between a set of contacts associated with one of said incoming lines and its associated set of link conductors and simultaneously operable to establish a connection between a set of contacts associated with one of said outgoing lines and said set of link conductors.

7. The combination in a switching system of incoming lines, outgoing lines, contact sets for said incoming lines, contact sets for said outgoing lines, an operating mechanism common to said incoming lines, an operating mechanism individual to each outgoing line, other operating mechanisms associated in common with said first and second mentioned operating mechanisms, the conjoint operation of one of each of said first, second and third mentioned operating mechanisms being effective to actuate the contact sets of said incoming and outgoing lines to establish a connection between one of said incoming and one of said outgoing lines, said first mentioned operating mechanism being operable in conjunction with other of said second and third operating mechanisms to establish connections between other incoming and outgoing lines co-existing with the connection already established.

8. In a telephone system, a group of lines arranged on a two coordinate basis and divided into subgroups, a group of trunks for serving said lines, link circuits for inter-

connecting said lines and said trunks, said link circuits being divided into groups, each group of link circuits being individual to a subgroup of said lines in one coordinate direction, independently operable contact arrangements each for connecting one of said lines to one of said links, independently operable contact arrangements each for connecting one of said links to one of said trunks, and means for simultaneously operating a plurality of said contact arrangements to extend one of said lines to any one of said trunks.

9. In a switchboard, the combination with conductors for two groups of lines, one group divided into subgroups, of a plurality of connecting links each provided with a plurality of switches comprising one switch for a line in each of said subgroups of one of the groups of lines and one for each of the lines of the other group, and mechanism for the common control of all the switches and adapted to operate the said switches of any connecting link in pairs independently of the condition of the switches of all other connecting links, said mechanism including three cooperating sets of elements, one set for the selection of lines by subgroups in one of said groups of lines, another set for the selection of individual lines in the other group, and the third set for the selection of individual connecting links.

10. In a switchboard, the combination of line conductors, a plurality of connecting links, each provided with one switch for the conductors of one line in each of several subgroups of one group of lines and one switch for the conductors of each line of another group, and mechanism for the common control of all the switches and adapted to operate one pair of said switches after another in the several connecting links, said mechanism including three cooperating sets of elements, one set for the individual selection of subgroups in one of said groups of lines, another set for the individual selection of lines in the other group, and the third set for the individual selection of connecting links.

11. In a switchboard, the combination of a group of line conductors arranged in subgroups, link conductors forming with said line conductors an array of independently operable switches divided into switching sets each inclusive of one line circuit only in each of the subgroups thereof and collectively adapted to establish interchangeable connections for the said line conductors to the connecting links, and mechanism adapted to operate the switches individually including two cooperating sets of members, each of one set for the common control of all switches serving a subgroup of line conductors and each of the other set for the common control of all switches of a switching set.

12. In a switchboard, the combination with conductors for two groups of lines one group divided into subgroups, of a plurality of connecting links collectively adapted to establish and maintain a plurality of independent connections between the lines of one group and the lines of another group, each such connecting link being provided with one switch for one line in each of several subgroups of one of said groups of lines and one switch for each of the lines in the other group, and mechanism for the common control of all the switches and adapted to actuate and release successively one pair of said switches after another in several connecting links and to hold the actuated switches in operation simultaneously, each such operation for any pair of switches in any connecting link being independent of the condition of the switches in all other connecting links, said mechanism including three cooperating sets of elements, one set for the individual selection of lines by subgroups in one of said groups of lines and adapted to condition for operation the switches associated with any such selected subgroup, another set for the individual selection of lines in the other group and adapted to condition for operation the switches associated with any such selected line, and the third set for the individual selection of connecting links and adapted to operate the particular pair of said switches of any such selected link which in each instance is conditioned for operation by the other two sets of elements.

13. A switchboard having rows of contacts forming terminals for one group of lines greater in number than said rows, other rows of contacts forming terminals for another group of lines equal in number to the last mentioned rows, connecting links crossing all of said rows and forming with each of said contacts a switching point, and controlling mechanism including a designating element common to a plurality of lines in the first mentioned group for each row and a holding element for each connecting link, whereby upon the joint operation of two designating elements and a holding element any line of one group may be extended to any line of the other.

14. In a switchboard, the combination with a field of switches arranged in longitudinal and transverse rows and mechanism adapted to operate any of said switches individually, including two cooperating sets of members, each of one set for the common control of all switches in a longitudinal row and each of the other set for the common control of all switches in a transverse row, of line conductors arranged in a longitudinal row and extending to separate portions, respectively, of one of said longitudinal rows of switches, and link conductors each extending to one of said transverse rows of

switches whereby the line conductors may be successively selected and separately connected to accessible link conductors.

15. In a switchboard, the combination with a field of switches arranged in longitudinal and transverse rows and mechanism adapted to operate any of said switches individually, including two cooperating sets of members, each of one set for the common control of all switches in a longitudinal row and each of the other set for the common control of all switches in a transverse row, of a series of line conductors arranged in a longitudinal row and leading to separate portions, respectively, of one of said longitudinal rows of switches, a single line conductor leading to another of said longitudinal rows of switches, and link conductors each leading to one of said transverse rows of switches whereby any line conductor in said series may be selected and connected to said single line conductor through a link conductor accessible to both.

16. A coordinate switch having rows of contacts forming terminals of one group of lines greater in number than said rows, other rows of contacts forming terminals of another group of lines equal in number to the last mentioned rows, connecting links for all of said rows and forming with each of said contacts an individually operable switching point, and controlling mechanism including a line member common to the switching points of each row, and a link member for each connecting link whereby upon the joint operation of a pair of line members and a selected link member any line of one group may be extended to any line of the other group.

17. In a switchboard, the combination of an array of individually operable switches arranged in longitudinal and transverse rows, and selecting mechanism including a common controlling element for the switches in each row, each longitudinal row being divided into sections for separate line circuits respectively, and each transverse row comprising a connecting group.

18. In a switchboard, the combination with an array of individually operable switches arranged in longitudinal and transverse rows and selecting mechanism including a common controlling element for the switches of each row, of conductors for separate line circuits leading to different switches, respectively, of each longitudinal row and a link circuit conductor joining the switches of each transverse row into a connecting group.

19. In a switchboard, the combination of an array of individually operable switches arranged in longitudinal and transverse rows, each longitudinal row comprising a plurality of sections for a corresponding plurality of separate line circuits, an individual line circuit conductor leading to each section of each longitudinal row of switches, an individual link circuit conductor joining the switches of each transverse row and forming therewith a connecting group, and selecting mechanism including a common controlling element for the switches in each row.

20. The combination in a switching system of incoming lines, link circuits and outgoing lines, with means for establishing line-link-line connections comprising a set of incoming line bars, a set of link bars and a set of outgoing line bars, and means for preventing the simultaneous operation of more than one bar of each of said sets.

21. The combination in a switching system of incoming lines, link circuits and outgoing lines, with means under the control of incoming lines for establishing line-link-line connections comprising a set of incoming line bars, a set of link bars and a set of outgoing line bars, and means to prevent interference between simultaneously calling incoming lines.

22. The combination in a switching system of incoming lines, link circuits and outgoing lines, with means for establishing line-link-line connections comprising a set of incoming line bars, a set of link bars, a set of outgoing line bars, operating magnets for said bars, said magnets having armature contacts and operating circuits for the magnets corresponding to the bars of one of said sets and dependent for their continuity upon said contacts.

23. The combination in a switching system of lines, circuits therefor, contact sets, a set of switching bars, a second set of switching bars, the bars of one set cooperating with the bars of the other set for connecting any line to any circuit, a series of operating magnets for each set of switching bars, said magnets having armature contacts, and an operating circuit for each of the magnets of one of said series, the operating circuit for each of the magnets of said series, except the first, extending through the contacts controlled by all preceding magnets in said series whereby the simultaneous operation of the switching bars of one of said sets is prevented.

24. A selector having rows of contacts multiply connected in groups numerically greater than said rows, other rows of contacts multiply connected in groups numerically equal to said other rows, links crossing all of said rows and forming with said contacts an individually operable switching device at each said crossing point, and controlling mechanism comprising conditioning elements associated with said rows and operating elements associated with said links.

25. In a telephone system, primary lines

arranged in coordinate groups, a line magnet for the lines of each group in one coordinate direction, a plurality of link magnets for each group of lines in another coordinate direction, a link circuit controlled by each of said last magnets, a plurality of secondary lines accessible to said link circuits, a secondary line magnet for each of said secondary lines, means for establishing a connection between a primary and a secondary line by initially energizing a primary line magnet and a secondary line magnet and thereafter an idle one of said link magnets, and means for maintaining said established connection by deenergizing said primary and secondary line magnets and maintaining said link magnet energized.

26. A selector having coordinately arranged individually operable switching points, mechanical means for operating said points and electrical means for controlling said mechanical means, said electrical means comprising a magnet for each row of points in one coordinate direction, said magnets being divided into groups, a circuit arrangement for selectively operating the magnets of one group and for automatically operating the magnets of another group, a magnet for each row of points in another coordinate direction, said last mentioned magnets being divided into groups and a circuit arrangement for selecting a group and automatically operating the magnets of said selected group.

27. In combination in a switching unit, rows of line and link contacts coordinately arranged, a single controlling element for each line row, a single controlling element for each link row, said line and link controlling elements cooperating to effect engagement between line and link contacts common to the intersecting line and link rows, a group of incoming lines, a group of outgoing lines, some of the lines of one of said groups appearing in a greater number of link rows than any line of the other group and each link row serving to connect a line in one group to any one of a plurality of lines in the other group.

In witness whereof, we hereunto subscribe our names this 20th day of July A. D., 1921.

CHARLES L. GOODRUM.
JOHN N. REYNOLDS.

DISCLAIMER.

1,515,735.—*Charles L. Goodrum*, New York, N. Y., and *John N. Reynolds*, Greenwich, Conn. MACHINE SWITCHING TELEPHONE SYSTEM. Patent dated November 18, 1924. Disclaimer filed February 8, 1927, by the patentees, assignee, *Western Electric Company, Incorporated*, consenting.

Hereby enter this disclaimer to the said claims of said Letters Patent which are in the following words, to wit:

"7. The combination in a switching system of incoming lines, outgoing lines, contact sets for said incoming lines, contact sets for said outgoing lines, an operating mechanism common to said incoming lines, an operating mechanism individual to each outgoing line, other operating mechanisms associated in common with said first and second mentioned operating mechanisms, the conjoint operation of one of each of said first, second and third mentioned operating mechanisms being effective to actuate the contact sets of said incoming and outgoing lines to establish a connection between one of said incoming and one of said outgoing lines, said first mentioned operating mechanism being operable in conjunction with other of said second and third operating mechanisms to establish connections between other incoming and outgoing lines co-existing with the connection already established.

"20. The combination in a switching system of incoming lines, link circuits and outgoing lines, with means for establishing line-link-line connections comprising a set of incoming line bars, a set of link bars and a set of outgoing line bars, and means for preventing the simultaneous operation of more than one bar of each of said sets.

"21. The combination in a switching system of incoming lines, link circuits and outgoing lines, with means under the control of incoming lines for establishing line-link-line connections comprising a set of incoming line bars, a set of link bars and a set of outgoing line bars, and means to prevent interference between simultaneously calling incoming lines."

[*Official Gazette March 1, 1927.*]