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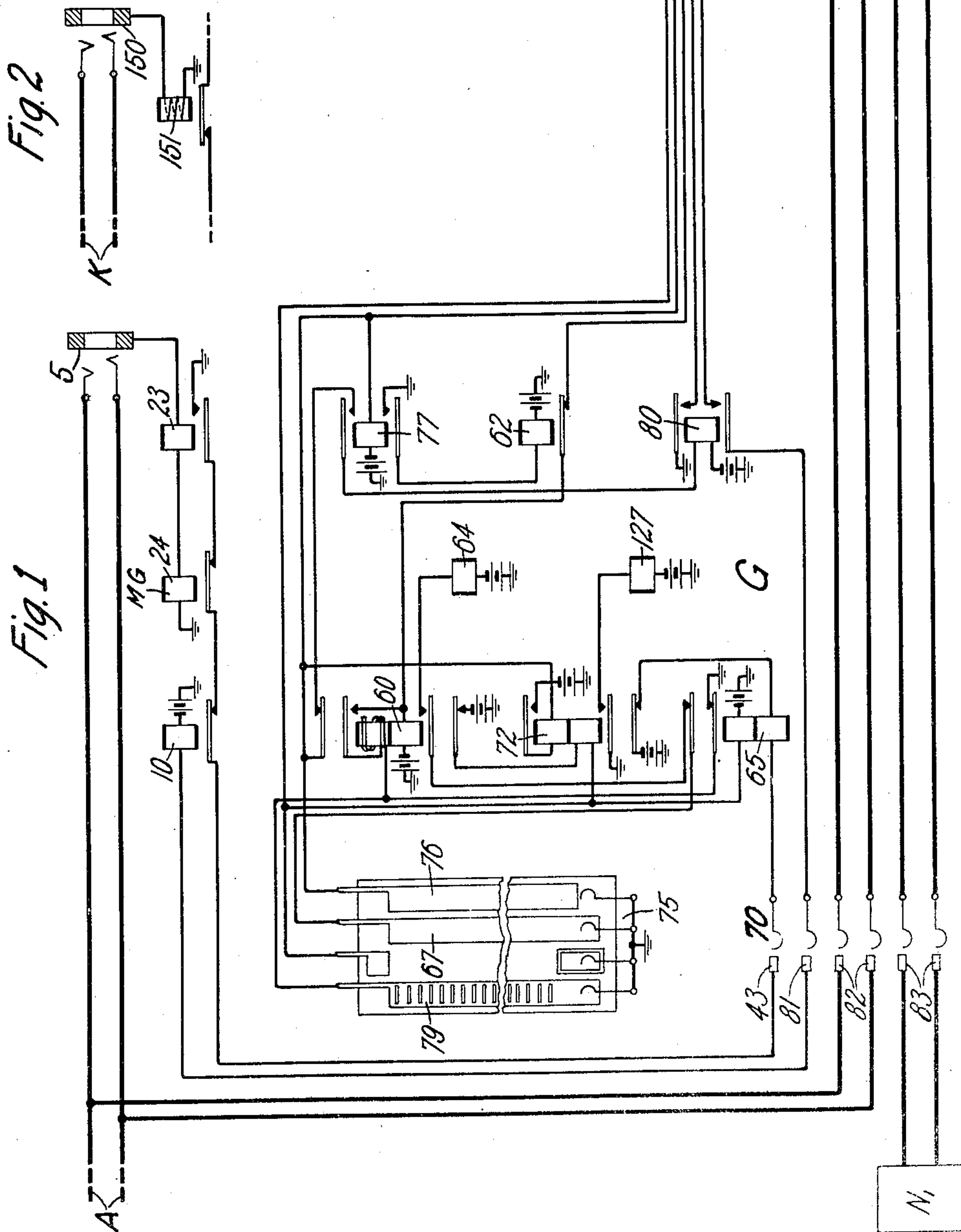
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L. L. GLEZEN ET AL.

TELEPHONE SYSTEM

Filed Aug. 6, 1926

3 Sheets-Sheet 1



Lee L. Glezen
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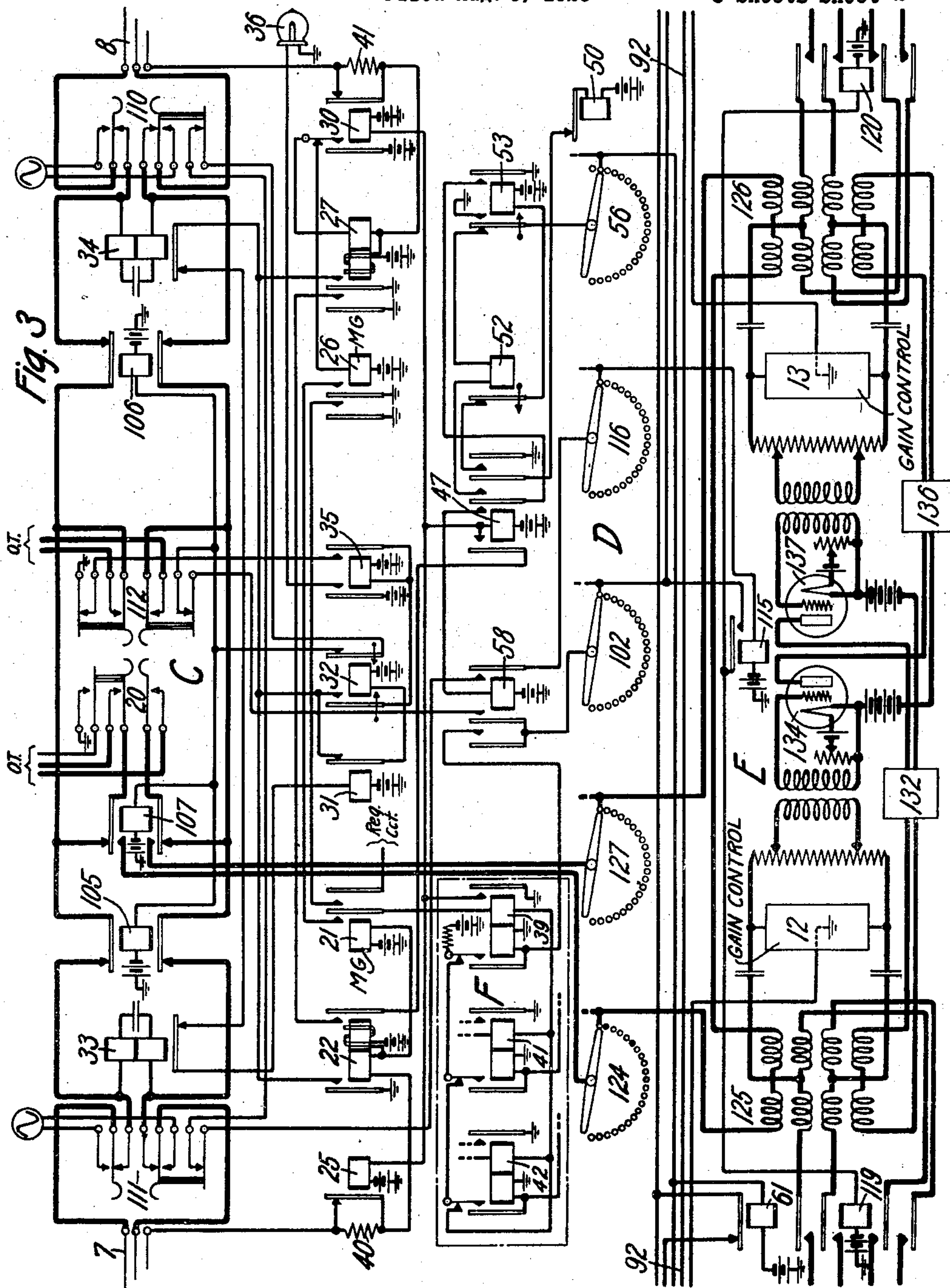
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3 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed August 6, 1926. Serial No. 127,500.

This invention relates to telephone systems, and more particularly to the automatic selection and insertion of speech amplifying apparatus in toll lines.

5 Speech amplifying apparatus, generally referred to as telephone repeaters, have heretofore been inserted in toll lines by manual means, and the gain control apparatus usually required in circuit connections of this
10 type has also heretofore been controlled manually. It is evident that such control may be subject to errors that may affect the transmission efficiency.

15 The invention has been applied to a system similar to that disclosed in the copending application of Edward Vroom and Joseph Krecek, Serial No. 39,882, filed June 27, 1925, in which toll cord circuits are employed at "through positions" at interconnecting stations. These cord circuits are arranged for interconnecting ordinary toll lines and also toll lines requiring a telephone
20 repeater without requiring any special operation on the part of the toll operator. This arrangement is such that an automatic discrimination is made between lines that do not require the addition of a repeater and those that do require this addition.

25 According to the present invention a system is provided whereby when a repeater is required a discriminating apparatus functions to start the automatic selection and connection of a repeater and gain control apparatus between two toll lines.

30 It should be understood that this invention is not limited in its use to the particular system employed to illustrate this application in practice, but may readily be used in any systems in which two lines require the
40 addition of a repeater.

45 The invention contemplates the use of a selecting mechanism associated with each of a plurality of cord circuits. These selectors are adapted to automatically hunt for and connect the cord circuit with an idle repeater equipment, a plurality of which are provided for the common use of said cord circuits. When a cord circuit has been connected between two toll lines requiring a repeater and
50 the associated selector has found an idle repeater this repeater is immediately made busy to all other repeater selectors. There

is also provided a lock-out arrangement whereby only one repeater selector at a time is permitted to hunt for an idle repeater. 55 Each repeater is equipped with two line finder switches so arranged that as soon as a repeater has been engaged by a cord circuit one of the corresponding line finders begins to hunt for one of the toll lines connected
60 with the cord circuit and when this toll line has been found the other line finder begins to hunt for the other toll line connected with the cord circuit. As soon as the two toll lines are found by the respective line finders 65 the lines are made busy to other line finders, associated with other repeaters, that later may begin hunting for engaged toll lines. When all of these selections for inserting a
70 repeater between two toll lines are completed the lock-out arrangement is actuated to permit repeater selection by another cord circuit to take place.

When a call is completed over a connection of this type between two toll lines, the
75 repeater selector used is not actuated to return to any normal position, but remains with its brushes on the terminals of the repeater last employed, whereas the associated line finders are returned to normal. 80

In the above mentioned system employed to illustrate this invention, means is also provided for adjusting the gain control apparatus associated with each repeater to the
85 net gain required by the two toll lines connected with a repeater. The function of this adjusting means is automatic and controlled by certain transmission equalizing resistances associated with each line requiring a repeater. 90

Referring now to the drawings, Fig. 1 illustrates the incoming end of a toll line requiring a repeater and terminating in a jack and in the terminal bank of a line finder arranged to hunt over this bank. Fig. 2 illustrates the incoming end of a toll line that
95 does not require a repeater. Fig. 3 shows a cord circuit equipped for use with either of the above types of toll lines and is provided with a selector switch whereby an idle
100 repeater may be selected. This figure also shows one of the repeaters suitable for insertion between the toll lines. Fig. 4 shows the incoming end of another toll line re-

quiring a repeater terminating in a jack and in the terminal bank of another line finder arranged to hunt over this bank. The line finders in Figs. 1 and 4 are associated with the repeater equipment shown in Fig. 3. Fig. 5 illustrates the incoming end of another toll line that does not require a repeater.

In general the apparatus and functions of the systems shown are as follows: Assuming, for example, that the line A in Fig. 1 and the line B in Fig. 4 are to be interconnected. As these lines require the addition of a repeater for speech amplification, they are equipped with special discriminating resistance units in the sleeve circuits of the respective jacks 5 and 6, so that when the plugs 7 and 8 of the cord circuit C shown in Fig. 3 are inserted, respectively, in jacks 5 and 6, certain functions are effected in the cord circuit resulting in the selection and insertion of a repeater such as E between these two lines. The first effect in the cord circuit is that the repeater selector D starts to hunt for an idle repeater. This selector may be of any well known type of rotary step-by-step switches having a stepping magnet and a series of brushes actuated thereby to travel over circular terminal banks. One of the repeaters indicated with the letter E has been shown associated with the terminals of the five banks of the selector D. It should be understood that a plurality of repeaters such as E are associated with the terminal banks of the selector D and are connected in multiple to corresponding terminal banks of other repeater selectors individual to other cord circuits.

When an idle repeater such as E has been found it is immediately made busy to other repeater selectors. Also, all the cord circuits and their associated repeater selectors are so arranged in a common lock-out circuit arrangement, indicated at F, that only one repeater selector at the time can hunt for an idle repeater. When the repeater selector D finds an idle repeater such as E, circuit operations are immediately initiated to start the line finder G to hunt for the line A, a hunting terminal of this line A having been marked at the time the selector D started to hunt for a repeater. The line finder G is arranged to stop its brushes on the terminals of the line A when found. When the connection of line A through the line finder G is completed through to the repeater E, circuit changes will take place to start the line finder H of the repeater E to hunt for the line B. As the corresponding hunting terminal of this line is marked at the same time as the hunting terminal of line A is marked, line finder H will stop on the terminals of the line B when found. The line finders G and H may be of any well known panel type construction in which a set of brushes are moved by

the actuation of an up and a down magnet over a vertical bank of terminals and in which the control of the finders is regulated by a set of brushes traveling over a series of commutator segments. At this time, that is, when the lines A and B are connected through the repeater E, the lock-out arrangement F operates to permit another cord circuit and its associated repeater selector to function to select an idle repeater. It should be noted that the line finders G and H also connect balancing networks N^1 and N^2 through the repeater E to the lines A and B, respectively. These lines A and B are also arranged with certain resistance values of the windings of relays 10 and 11, these values depending upon the transmission equivalents of the lines. Associated with the repeater E are gain control units 12 and 13 illustrated merely by boxes. These gain control units may consist, as is well known in the art of combinations of marginal relays that may be operated in different combinations when battery through the windings 10 and 11 is connected thereto. The operation of such different combinations of relays may affect various impedance elements in the units to adjust the gain of the repeater. Thus, each toll line, according to the particular value of its associated resistance adjusts the gain of the repeater to the net gain required by the transmission characteristics of the corresponding line.

To bring out more fully the features of this invention detailed descriptions will now be made of the two types of connections that may be established by means of cord circuit C. If a connection is desired between two toll lines requiring a repeater inserted between them, the first action on the part of the toll operator, after she has received indications through the usual indicating lamp (not shown) that a connection is desired over line A, is to insert plug 7 into jack 5 and to operate the talking key 112 to connect her telephone set (not shown) to the talking conductors of the cord C and line A. As the means for calling the toll operator's attention to toll line A does not form part of this invention and as any well known means may be employed therefor, it has not been illustrated. The toll operator may now communicate with the operator at the distant end of line A and receive the number of the wanted subscriber's line. As it was assumed that a repeater was required in this connection, it may be extended over toll line B to a distant station where the connection may be completed in any well known manner to the wanted subscriber's line. The toll operator will, therefore, restore her talking key 112 after receiving the desired information, and insert plug 8 into jack 6 of toll line B.

Functions will now take place to insert a

repeater in the connection as follows: On the insertion of plugs 7 and 8 into jacks 5 and 6, respectively, the following circuits are completed. One circuit for the operations of relays 21, 22, 23 and 24 may be traced as follows: battery, winding of relay 21, left hand winding of relay 22, armature and back contact of relay 25, tip terminals of plug 7 and jack 5, windings of relays 23 and 24 in series to ground. Due to the comparatively low resistance of the windings of relays 23 and 24, relay 21 operates in series with relay 22, the operation of relay 21 indicating that the cord circuit is connected to a line requiring the insertion of a repeater. A similar circuit is prepared for the operation of relays 26, 27, 28 and 29. This circuit may be traced from battery through the winding of relay 26, make-before-break contacts of relay 30, right hand winding of relay 27, right hand armature and back contact of relay 30, sleeve terminals of plug 8 and jack 6, windings of relay 28 and 29 to ground. The operation of relay 26 in this instance indicates that toll line B is one requiring the insertion of a repeater. The operation of relays 22 and 27 causes the operation of relay 31 over the following circuit: battery, winding of relay 31, armatures and back contacts of ringing relays 33 and 34 to the left hand armature and front contact of relay 22 to ground and left hand inner armature and front contact of relay 27 to ground. It will be noted that these last mentioned connections to ground also provide a circuit for relay 32 through the armature and back contact of relay 31, but as relay 31 is faster in its operation than relay 32, this latter relay will not operate and, consequently, not close a connection for relay 35 that would cause the lighting of lamp 36. The circumstances under which lamp 36 became lighted will be explained later.

Provided the lock-out arrangement indicated at F is not in use by another cord circuit at this time the ground connection due to the operation of relays 21 and 26 will now cause the operation of relay 39 over a circuit as follows: battery, make-before-break contacts of relay 39 and the corresponding contacts of other similar relays individual to other cord circuits, such as relays 41 and 42 in the lock-out circuit, through the right hand winding of relay 39, inner right hand armature and front contact of relay 21 and inner left hand armature and front contact of relay 26 to ground. The operation of relay 39 opens the connection to battery through its make-before-break contacts for the other relays in the lock-out circuit and thus prevents any other cord circuit from functioning to select the repeater. In other words, only one of the lock-out relays may be operated at a time and when a relay once

becomes operated it remains operated as long as the associated cord circuit is in process of interconnection. Relay 39 in operating provides a locking circuit for itself through its left hand winding and also closes a circuit for the operation of relays 25 and 30 over an obvious circuit.

These latter relays in operating insert resistances 40 and 41 in the respective sleeve circuits of plugs 7 and 8 to cause the corresponding relays 24 and 29 to release. The release of relay 24 causes a connection to ground to be made for the hunting terminal 43 of line finder G and the release of relay 29 causes a ground to be connected to a hunting terminal 45 of line finder H. The terminals of lines A and B in the terminal banks of line finders G and H are thereby marked for hunting. On the operation of relay 30, relay 26 is released and a connection for the maintenance of relays 27 and 28 operated is now extended through the left hand armature and front contact of relay 30. The ground for the operation of relays 25 and 30 also causes the operation of relay 47 as follows: battery, winding of relay 47, right hand armature and front contact of relay 39 to ground. Relay 47 in operating provides a locking circuit for itself through its left hand armature and front contact, through the right hand armature and front contact of relay 22 and outer left hand armature and back contact of relay 27 to ground. The operation of relay 47 closes a circuit for the stepping magnet 50 for the starting of the repeater selector D, provided the brushes thereof do not rest on the terminals of an idle repeater. If they rest on the terminals of an engaged repeater, a circuit will be completed for the stepping magnet 50 as follows: battery, through the winding, armature and back contact of magnet 50, middle right hand armature and front contact of relay 47, winding of relay 52, left hand armature and back contact of relay 53, through the brush of the terminal bank 56, through the connected terminals of this bank, the corresponding terminal and brush of the repeater selector engaged with a repeater and the ground at the armature and front contact of the relay corresponding to relay 53 in the engaged cord circuit. In this case relay 52 will operate as it is faster in its operation than relay 53, which, it will be noted, has a circuit completed through the outer right hand armature of relay 47 and armature and front contact of relay 52. As relay 52 is always slow to release, it will remain operated while the magnet 50 will step the brushes of the repeater selector D until they come in contact with the terminals of an idle repeater, at which time it will find no ground on the corresponding terminal of bank 56. Relay 52 will now release and permit the operation of relay 53. Relay 53 in

operating its left hand armature connecting it to ground makes the repeater selector D busy and by operating its right hand armature causes the operation of relay 58 over a circuit as follows: battery, winding of relay 58, inner right hand armature and front contact of relay 47, right hand armature and front contact of relay 53 to ground. It will be noted that the ground on the selected terminal of bank 56 will now be supplied from the left hand armature and front contact of relay 53 and it is such a ground that caused stepping magnet 50 to operate and make this particular repeater busy.

This ground on the selected terminal of bank 56 now also causes the operation of relays 60 and 61 over circuits as follows: battery, lower winding of relay 60, armature and back contact of relay 62, through bank 56 to ground at the left hand armature and front contact of relay 53 and from battery through the winding of relay 61 to the same ground. Relay 60 in operating closes a locking circuit for itself to its inner upper armature and front contact and upper winding to the upper inner armature and front contact of relay 65 to ground. This relay 60 now causes the line finder G to function by closing a circuit for up-drive magnet 64 as follows: battery, up-drive magnet 64, inner, lower armature and front contact of relay 60, upper outer armature and back contact of relay 65, commutator segment 67 and the cooperating brush of the group 75 as shown to ground. Line finder brushes 70 will now be moved up over the terminal bank associated with this line finder G and hunt for the terminals of line A. When the upper brush of group 70 comes in contact with terminal 43 of line A the ground applied to this terminal causes the operation of the relay 65 over a circuit as follows: battery, outer lower armature and back contact of relay 72, lower winding of relay 65, upper brush of the group 70, terminal 43, armatures and back contacts of relays 10 and 24, and armature and front contact of relay 23 to ground. As soon as the line finder starts upward to hunt for the line A, a ground is connected through brush group 75 to the commutator segment 76. This ground causes the operation of relay 77 over a circuit as follows: battery, winding of relay 77, commutator segments 76 and the right hand brush of the group 75 to ground. Relay 77 in operating closes an obvious circuit for the operation of relay 62.

To arrest the upward movement of brushes 70 and 75 at the proper time, the connection from the commutator segment 67 is placed under control of relay 65, so that when this relay operates the up-drive magnet 64 is deenergized. The operation of relay 65 opens the locking circuit for relay 60 previously traced through the contact of

relay 65. A second locking circuit for relay 60 is established through the commutator segment 79. The momentum of the switch brush mechanism usually carries the brushes a short distance above the center of the terminals on which they are intended to be brought to rest. When the brushes have overthrown in this manner the commutator brush is associated with a conducting segment of commutator 79. During the time that the commutator brush is associated with this conducting portion of commutator 79, the aforementioned locking circuit is established for relay 60. Relay 60 will therefore be energized until the brushes 70 have centered directly on the terminals of line A in a manner well known in the art. When the brushes have been properly centered the left hand brush of the group 75 is resting on an insulated portion of segment 79 so that relay 60 releases. This relay in releasing causes the operation of relay 80 over a circuit as follows: battery, winding of relay 80, upper armature and front contact of relay 77, upper outer armature and back contact of relay 60, commutator segment 76 to ground.

Relay 80 in operating causes the operation of relay 10 over a circuit as follows: battery, winding of relay 10, terminal 81 and the associated brush of the group 70, lower armature and front contact of relay 80 to the automatic gain control circuit 12, where this circuit may find a connection to ground through a series of marginal relays. As hereinbefore mentioned, any well known type of gain control circuit may be used and it is evident that the particular resistance value of the winding of relay 10 will cause proper adjustment of the gain control circuit 12 to suit the requirements of the line A. As the gain control circuit itself does not form a part of this invention, no description of its operation will be made. Gain control circuits such as are disclosed in the copending application of H. J. Fisher, Serial No. 95,582, filed March 18, 1926 are of the type that may be adapted for use in the repeater employed in this circuit. The only change that would have to be made is that the relays for controlling the gain would be marginal and connected to the control circuit established by the operation of relay 80. The operation of relay 10 removes the ground from the hunting terminal 43, thus making the line A busy to other line finders. The line A and the network N¹ are now associated with one side of the repeater selected through the terminals 82 and 83 and the corresponding brushes of group 70.

Relay 80 in operating also causes the operation of relay 90 over a circuit as follows: battery, lower winding of relay 90, armature and back contact of relay 91, lead 92, upper armature and front contact of relay 80 to ground. Relay 90 operates and pro-

vides a locking circuit for itself through its upper inner armature, front contact and upper winding to the upper inner armature and back contact of relay 94. The operation of relay 90 starts the line finder H to hunt for the toll line B and the operations of this line finder are similar to the operation of line finder G. That is, on the operation of relay 90 the up-magnet 95 of this line finder will be energized over a circuit that receives ground from the commutator segment 96. As the brushes 97 move from normal over the commutator a circuit is completed for the operation of relay 98 from ground and segment 140. The operation of relay 98 causes the operation of relay 91 and the operation of relay 91 opens the original energizing circuit for relay 90 which, however, is not released until the brushes 100 of line finder 1 are centered on the terminals of line B. The operation of relay 94 opens the energizing circuit for up-drive magnet 95 to arrest the upward movement of the switch brushes. The operation of relay 94 also opens one holding circuit for relay 90. When the switch brushes are properly centered the holding circuit through the centering commutator for relay 90 is opened and this relay releases. The brushes 100 of line finder H are now, therefore, centered on the terminals of line B and this line and the associated network N^2 are associated with the opposite end of repeater E. On the release of relay 90, relay 101 operates to close a connection for the operation of relay 11 and the adjustment of the gain control circuit 13 in the same manner as the operation of relay 10 was effected and the gain control circuit 12 was adjusted.

The operation of relay 101 completes a circuit to ground at its upper armature and front contact. This ground is applied to a terminal of bank 102 of the repeater selector D through the associated brush to the left hand armatures of relay 58. The ground applied at the outer left hand armature and front contact of relay 58 short circuits the left hand winding of relay 39 so that this relay will not now release and restore the chain circuit to battery through the corresponding relays such as 41 and 42 of other cord circuits, permitting another cord circuit to actuate its repeater selector to hunt for an idle repeater. The release of relay 39 does not effect the release of relays 25 and 30 which are now held up over the circuit completed to ground at the outer left hand armature and front contact of relay 27 through the left hand armature and front contact of relay 47. The ground applied to the inner left hand armature and front contact of relay 58 causes the operations of the relays 105, 106 and 107, as follows: battery through the windings of relays 105, 106 and

107 through the lower closed contacts of talking key 112, through the inner left hand armature and front contact of relay 58. This ground applied at the inner left hand armature and front contact of relay 58 also causes the operation of relay 115 over a circuit as follows: battery, winding of relay 115, a terminal of bank 116 and the associated brush of the selector D, right hand armature and front contact of relay 58, lower closed contacts of ringing key 111, lower closed contacts of ringing key 110, right hand armature and back contact of relay 32, lower closed contacts of talking key 112 to the inner left hand armature and front contact of relay 58. The operation of relay 115 closes a circuit for the operation of relays 119 and 120 over circuits as follows: battery, windings of relays 119 and 120, armature and front contact of relay 115 to the ground at the upper armature and front contact of relay 101. Relays 105 and 106 in operating opens the connection between the two toll lines A and B through the cord circuit C and the operation of relay 107 connects the monitoring leads from the operator's telephone set to the repeater so that in case the operator decides to monitor on the connection she may do so at this time by operating key 20. A circuit for the operator's telephone set in this instance may be traced as follows: from the set through contacts of key 20, upper armature and front contact of relay 107, the brush and associated terminal of bank 124, a winding of hybrid coil 125, a winding of hybrid coil 126, a terminal of bank 127 and the associated brush, lower armature and front contact of relay 107 and lower contacts of key 20.

The operation of relays 119 and 120 cause connections from the lines A and B and networks N^1 and N^2 to be completed to the repeater E. The circuit from line A may be traced through terminals 82 and the associated brushes of line finder G, the upper two armatures and front contacts of relay 119, windings of hybrid coil 125, lower armatures and front contacts of relay 119 to the terminals 83 through the associated brushes to network N^1 . Similarly, line B is connected through terminals 130 and associated brushes of line finder H, upper armatures and front contacts of relay 120, winding of hybrid coil 126, lower armatures and front contacts of relay 120, lower brushes and terminals 131 to the network N^2 . The hybrid coil 125 is connected through any well known input circuit under control of the gain control circuit 12 to the vacuum tube amplifier 134, the output circuit of which is connected to any well known filter arrangement 136 to windings of hybrid coil 126. This constitutes the circuit for transmission from line A to line B. The circuit for transmission from line B to line A is completed

from the hybrid coil 126 through any well known input circuit controlled by the gain control circuit 13 and connected to the vacuum tube amplifier 137, the output circuit of which is connected to any well known filter arrangement 132 and windings of hybrid coil 125. As the type of repeater is immaterial, as far as this invention is concerned, no further description of its construction or operation will be made. It should be understood that any repeater arrangement well known in the telephone art may be employed in circuits of this general character. Conversation through the repeater E from line A to line B or from line B to line A may now take place, although, of course, the connection has to be extended from line B at the distant station to the wanted subscriber before such conversation can actually take place.

When such a connection is completed in any well known manner and conversation between the parties connected through lines A and B is ended, the toll operator may receive suitable indications to this effect and to break up the connection she will remove plugs 7 and 8 from jacks 5 and 6. This causes the release of relays 23, 28, 22, 21 and 27. The release of relays 22 and 27 causes the release of relay 47. The release of this relay causes the release of relays 25, 30 and 53. The release of relay 53 causes the release of relays 61 and 58 and the release of this latter relay causes the release of relays 105, 106, 107 and 115. The release of relay 115 causes the release of relays 119 and 120, so that the repeater E is now disconnected from the lines A and B and the cord circuit is thereby restored to normal. The release of relay 61 causes the operation of relays 72 and 135. The circuit of relay 72 may be traced as follows: battery, lower outer armature and back contact of relay 60, lower winding of relay 72, armature and front contact of relay 61, commutator segment 76 to ground. Relay 72 provides a locking circuit for itself through its upper armature, front contact and upper winding to the ground on commutator segment 76 and closes an obvious circuit for down-magnet 127. When the line finder G has returned completely to normal the circuit for relay 72 is opened as the brush associated with commutator segment 76 leaves this segment. Relay 72 in releasing, stops the down-magnet 127. Similarly, on the operation of relay 135 a circuit is completed for this relay through the commutator segment 140 and the operation of this relay closes an obvious circuit for down-magnet 142 for the release of line finder H to normal. Relay 135 is locked through the commutator segment 140 until the line finder is completely returned, when this relay is released and the down-magnet 142 is released to step the line finder in normal posi-

tion. All relays held in an operated position through the agency of commutator segments 76 and 140 are released when the brushes 75 and 97 are restored to their normal positions. The cord circuit C', repeater E and line finders G and H are now in normal condition. It should be noted, however, that repeater selector D is not moved from the position in which its terminals are connected to the repeater E as there is no circuit for the stepping magnet 50.

If ringing current at either of the distant ends of line A or B is connected to these lines for supervision, a corresponding ringing relay 33 or 34 will operate to cause the lighting of lamp 36. For example, if relay 33 is operated, the circuit through the armature and back contact of relay 33 is opened. Relay 31 is thereby released to permit the operation of relay 32 over a circuit as follows: battery, winding of relay 32, armature and back contact of relay 31, left hand armature and front contact of relay 22 to ground. The operation of relay 32 closes an obvious circuit for the operation of relay 35. Relay 35 locks to ground at the upper contacts of talking key 112. Relay 35 in operating closes an obvious circuit for the lighting of lamp 36. Lamp 36 is extinguished by operating key 112. It should be noted that when key 112 is operated relays 105, 107 and 106 are released so that a talking connection is completed from line A to the operator's telephone set and on the operation of relay 32 the circuit for relay 115 is open so that this relay in releasing causes the temporary disassociation of the repeater from the line by the release of relays 119 and 120. This prevents the repeater from singing during the ringing interval. The operation of the talking key 112 will also release relays 115, 119 and 120 to eliminate the repeater during conversation.

If connection is desired between two lines that do not require a repeater, the following operations take place. In this case lines, such as the ones shown in Figs. 2 and 5 may be used. On the insertion of plug 7 into jack 150 of line K a circuit is completed from ground through the high resistance winding of the supervisory relay 151, sleeve terminals of jack 150 and plug 7, armature and back contact of relay 25, windings of relays 22 and 21 in series to battery. Due to the high resistance of the winding of relay 150, relay 21 does not operate but relays 150 and 22 do operate in this circuit. Relay 150 performs the usual supervisory functions in ordinary toll lines, as is well known in the art. Similarly, on the insertion of plug 8 into jack 155 of line L, a circuit is closed for the operation of relay 27 and the relay 157 having a high resistance winding. In this circuit relay 26 is not oper-

ated. On the operation of relays 22 and 27 a circuit is connected for the operation of relay 31 as previously traced. The operation of this relay prevents the operation of relay 32, so that lamp 36 is not lighted at this time. The fact that relays 22 and 26 are not operated at this time prevents the repeater selector D from functioning to include a repeater between lines K and L, and the cord circuit is now completed through from line K to line L. Talking connection between the toll operator and the lines K and L may be established by the operation of talking key 112 and ringing supervision of either of these lines may be established in the same manner as hereinbefore described by the lighting of lamp 36.

What is claimed is:

1. In a telephone system, lines, repeater equipments, means whereby any two of said lines may be interconnected, selecting apparatus, and means automatically operable in response to the interconnection of two of said lines to select an idle repeater equipment and interpolate said repeater equipment between said two lines.

2. In a telephone system, lines, repeater equipments, means whereby any two of said lines may be interconnected, switching apparatus for selecting an idle repeater equipment, other switching apparatus for interpolating a selected idle repeater equipment between two interconnected lines, and means automatically responsive to the interconnection of two of said lines for actuating said switching apparatus.

3. In a telephone system, lines, repeater equipments, a cord circuit for interconnecting any two of said lines, selecting apparatus, and means automatically operable in response to the interconnection of two of said lines to select an idle repeater equipment and interpolate said repeater equipment between said two lines.

4. In a telephone system, lines, repeater equipments, a cord circuit for interconnecting two of said lines, means in said cord circuit for the selection of an idle repeater equipment, and means operative upon the selection of a repeater equipment to connect each of said interconnected lines to the repeater equipment and to open the connection between said cord circuit and said lines.

5. In a telephone system, lines, repeater equipments, a cord circuit for interconnecting two of said lines, means in said cord circuit for the selection of an idle repeater equipment, automatic switching means associated with each of said repeater equipments for finding and connecting lines to the corresponding repeater equipment, and means for starting the operation of an automatic switching means responsive to the selection of the associated repeater equipment by said cord circuit to find and connect each

of said interconnected lines with said repeater equipment.

6. In a telephone system, lines, repeater equipments, a cord circuit, a switch associated with said cord circuit for selecting an idle repeater equipment, two switches associated with each repeater equipment for selecting lines, means responsive to the connection of the cord circuit between two of said lines for actuating the first mentioned switch to hunt for an idle repeater equipment, and means responsive to the finding of an idle repeater equipment for actuating the associated switches to hunt for the two lines associated with the cord circuit and connect the selected repeater equipment between them.

7. In a telephone system, lines, repeater equipments, a cord circuit, a switch associated with said cord circuit for selecting an idle repeater equipment, two switches associated with each repeater equipment for selecting lines, means responsive to the connection of the cord circuit between two of said lines for marking the terminals of said lines on the said switches of the repeater equipments and for actuating the first mentioned switch to hunt for an idle repeater equipment and means responsive to the finding of an idle repeater equipment for actuating the associated switches to hunt for the marked terminals of said two lines and to connect the selected repeater equipment between said terminals.

8. In a telephone system, lines, repeater equipments, a plurality of cord circuits, a switch associated with each cord circuit for selecting an idle repeater equipment, two switches associated with each repeater equipment, means responsive to the connection of a cord circuit with two of said lines for actuating the switch associated with said cord circuit to select an idle repeater equipment, means for thereafter actuating one of the switches associated with the selected repeater equipment to find one of the lines associated with the cord circuit, means for thereafter actuating the other of said switches associated with the selected repeater equipment to find the other of said lines, and means for thereafter connecting said selected repeater equipment between said two lines and for opening the connection established over the cord circuit between said two lines.

9. In a telephone system, lines, repeater equipments, a plurality of automatic means for connecting an idle repeater equipment between two of said lines, means for initiating the operation of any one of said automatic means, and means for preventing more than one of said automatic means from completing its function at a time.

10. In a telephone system, lines, repeater

equipments, a plurality of automatic means for connecting an idle repeater equipment between two of said lines, means for initiating the operation of any one of said automatic means, and means responsive to the actuation of any one of said automatic means for delaying the actuation of any one of the other of the automatic means until said first automatic means has completed its functions.

10 11. In a telephone system, lines, repeater equipments, a plurality of cord circuits, a switch associated with each cord circuit for selecting an idle repeater equipment, switching means associated with each repeater

15 equipment for selecting lines, means responsive to the connection of a cord circuit between two of said lines for actuating the switch associated with said cord circuit to select an idle repeater equipment, means responsive to the finding of an idle repeater equipment for actuating the associated switching means to find the two lines associated with the cord circuit and connect the selected repeater equipment therebetween, and means for preventing the establishing of more than one connection between two lines and a repeater equipment at a time.

In witness whereof, we hereunto subscribe our names this 2nd day of August A. D., 1926.

LEE L. GLEZEN.
SAMUEL P. SHACKLETON.
EDWARD VROOM.