F. LUBBERGER.

TELEPHONE TRUNKING SYSTEM.

APPLICATION FILED JUNE 10, 1909. RENEWED MAR. 26, 1917.

1,243,747.

Patented Oct. 23, 1917.

4 SHEETS—SHEET 1.

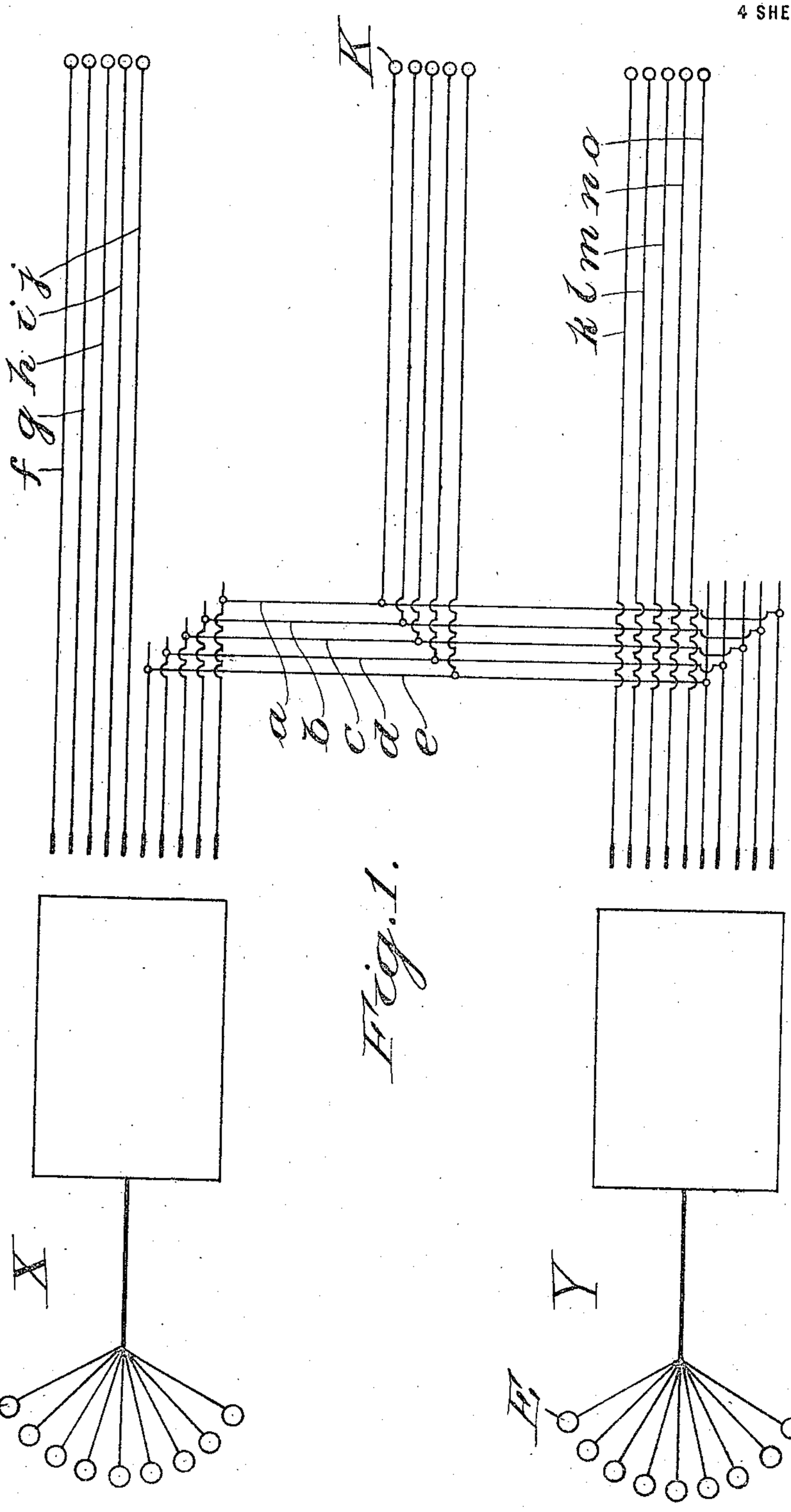

Fig. 1.

Witnesses.
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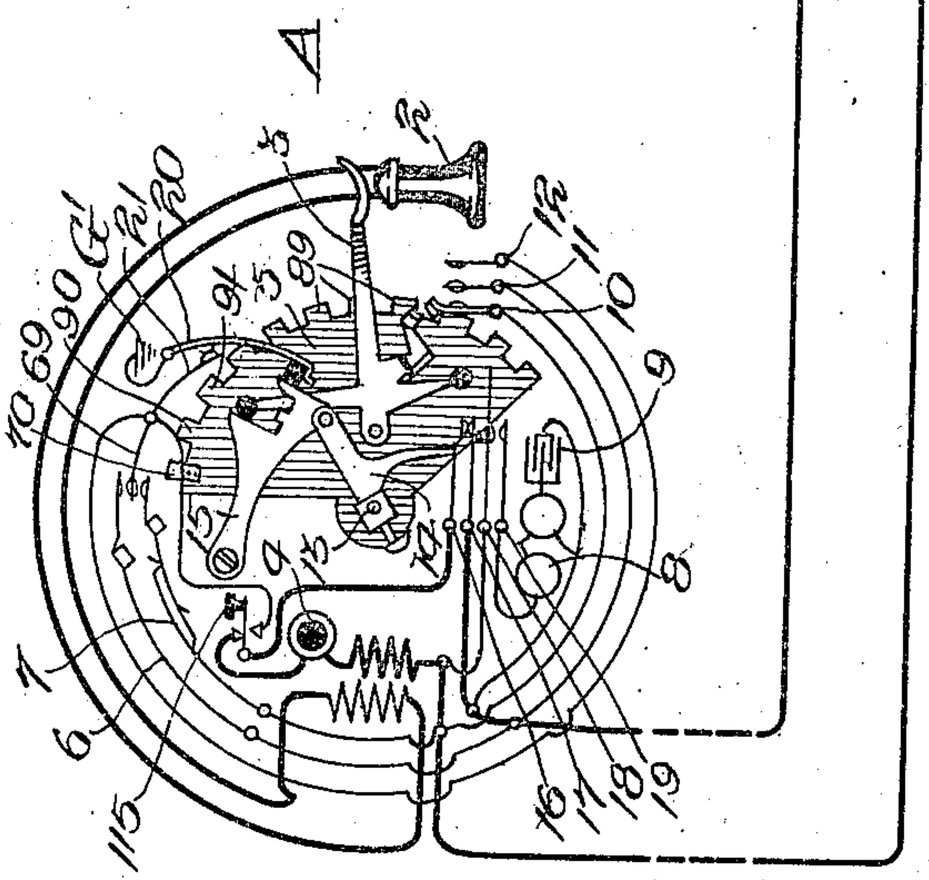
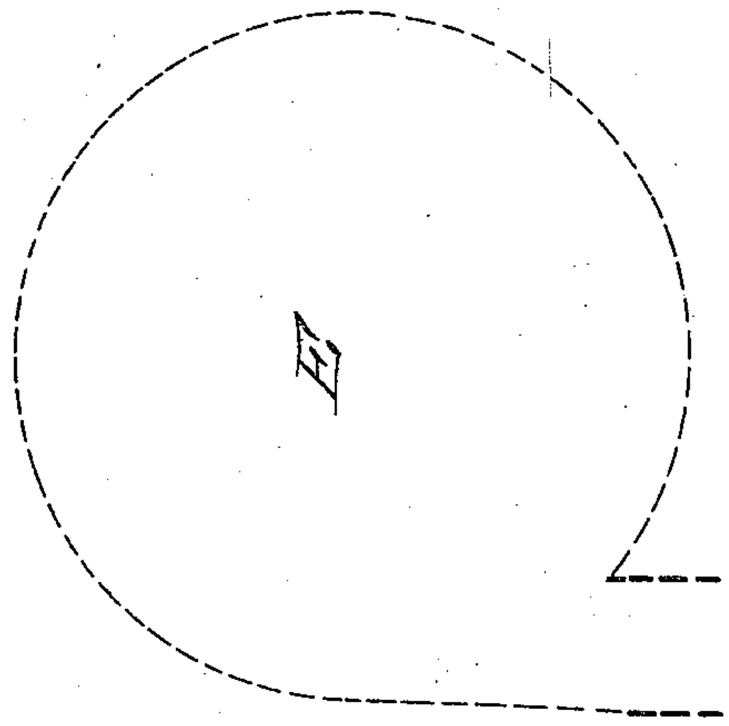


Fig. 2.



Witnesses.
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4 SHEETS—SHEET 3.

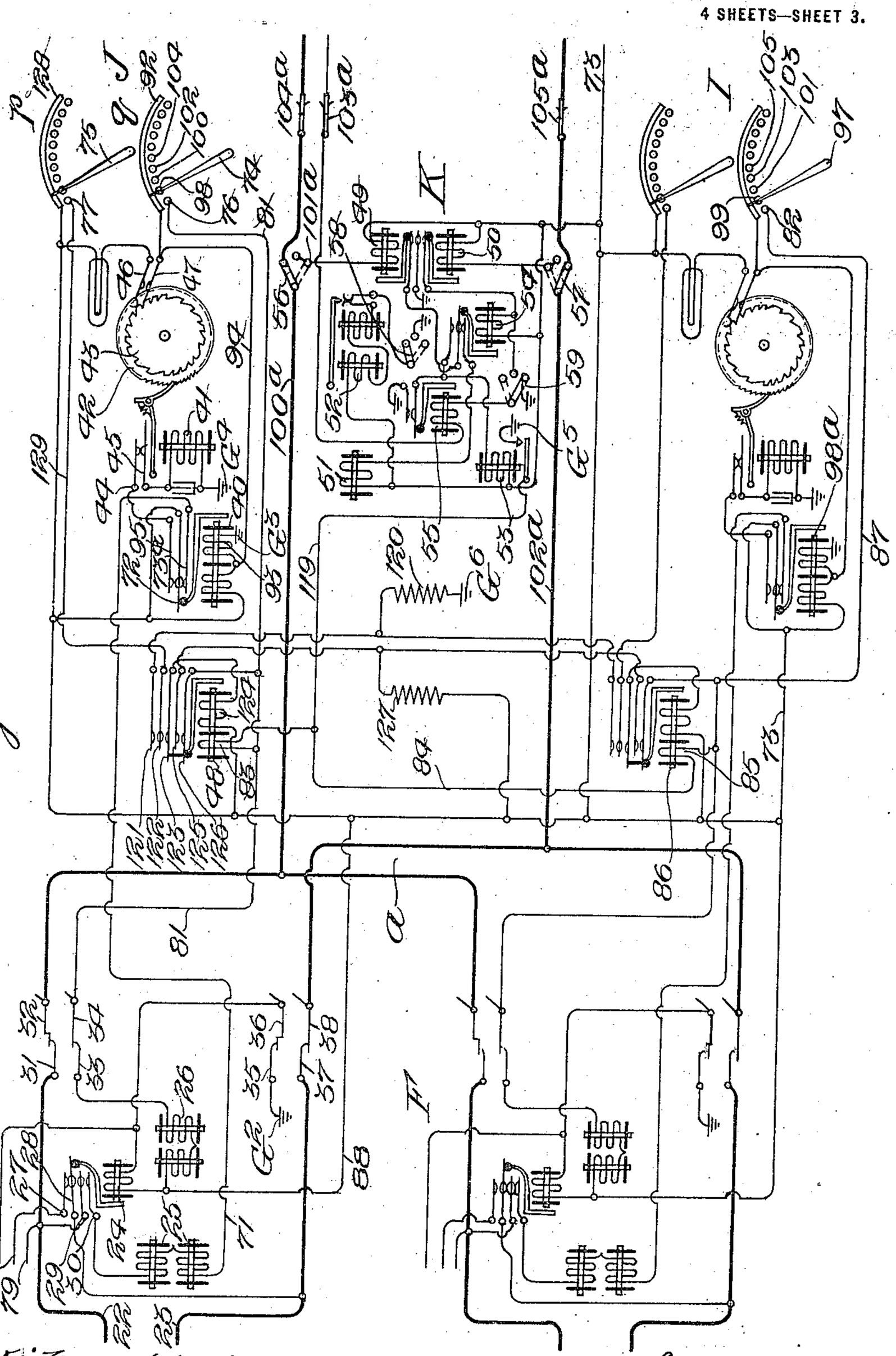

Fig. 3

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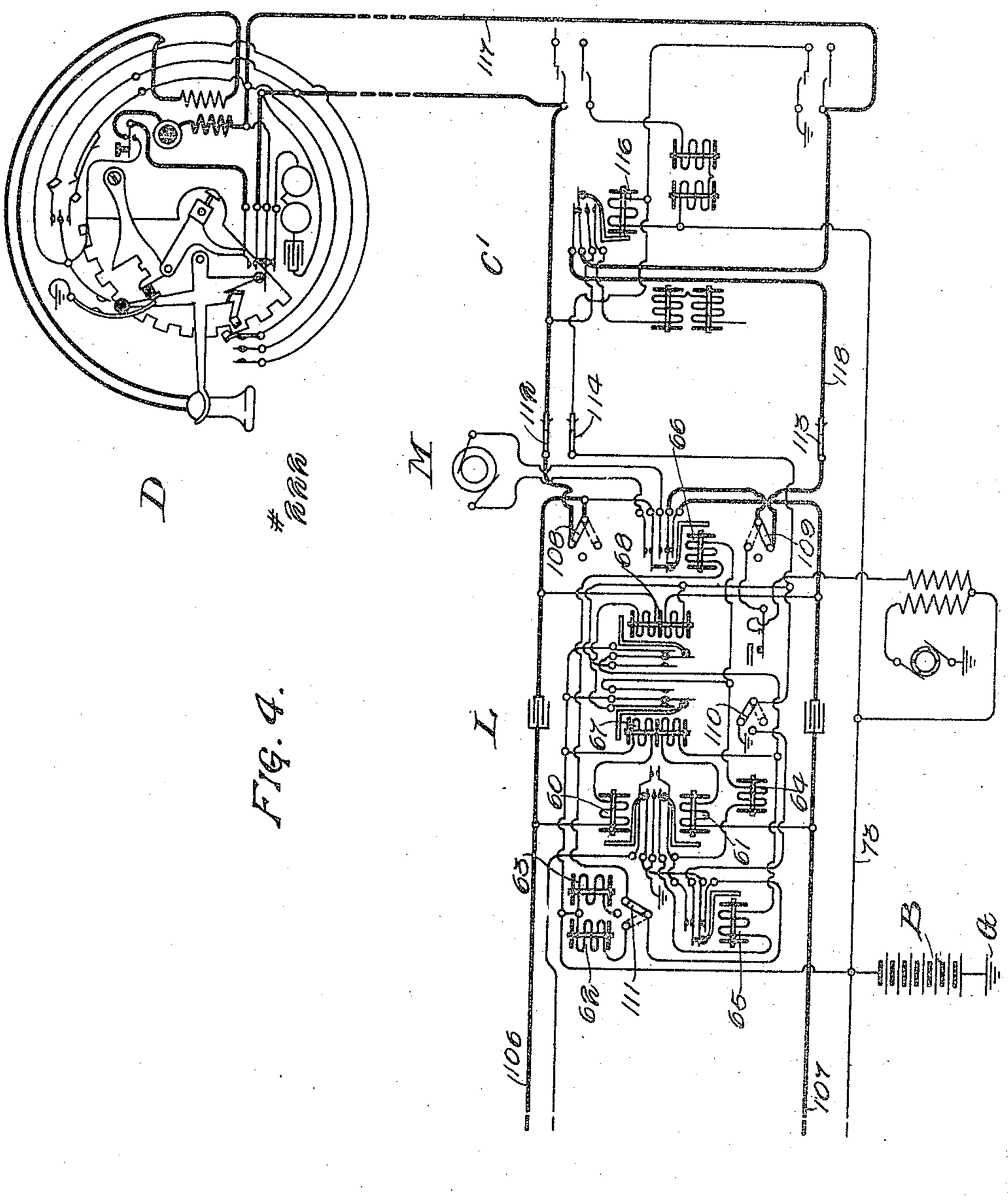

FIG. 4.

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UNITED STATES PATENT OFFICE.

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TELEPHONE TRUNKING SYSTEM.

1,243,747. Specification of Letters Patent. Patented Oct. 23, 1917.

Application filed June 10, 1909, Serial No. 501,258. Renewed March 26, 1917. Serial No. 157,585.

To all whom it may concern:

Be it known that I, FRITZ LUBBERGER, a subject of the Emperor of Germany, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Telephone Trunking Systems, of which the following is a specification.

My invention relates to telephone systems in general, but more particularly to telephone exchange systems employing means for extending calls either automatically or semi-automatically, depending upon whether service is afforded between manual and automatic subscribers, or entirely between automatic subscribers, and especially to systems in which trunking is necessary for extending calls between some or all of the subscribers thereof.

My invention contemplates, therefore, a system in which the subscribers' substations are divided into two or more groups, and in which some of the trunks leading thereto are common to all of the groups, while other trunks are individual to their respective groups, or to the divisions of a single group. For example, as herein disclosed, the subscribers of a sub-central station are divided into two groups, and while there are certain trunk lines leading thereto that are each individual to one of the two groups, still there are other trunk lines which are common to all of the subscribers of the two groups. Thus five trunks may be assigned to one group of subscribers and five trunks to the other group, and another five trunks will then be common to the two groups, whereby each subscriber of either group has access to any one of ten trunk lines. In other words, each subscriber has access to any one of five trunk lines which are individual to his group, and has access also to any one of five trunk lines that are common to the two groups. By this arrangement I find that increased efficiency is obtained, inasmuch as substantially the same character of service is afforded by a less number of trunks. It will be understood, of course, that this same arrangement may be applied to any number of groups of subscribers without departing from the principles of my invention.

In the accompanying drawings Figure 1 is a diagram of two groups of subscribers, in a system embodying the principles of my invention. Each group has access to certain trunks individual thereto, and both groups have access to a number of certain other trunk lines.

Figs. 2, 3 and 4 taken together illustrate a calling subscriber's station (Fig. 2) connected with a called subscriber's station (Fig. 4) through the medium of the central office switching apparatus of said system shown in Figs. 3 and 4, in which connection a trunk line common to the use of two groups of subscribers is used, which trunk, shown at the center of Fig. 3, terminates in a selector switch from which a trunk line is shown running to Fig. 4; and in Fig. 2 there is also indicated, by dotted lines, a subscriber's station belonging to a different group from that to which the calling subscriber already referred to belongs, both of which, of course, have access to the same trunk (Fig. 3) previously pointed out.

As thus illustrated, the subscriber's telephone, shown in full lines in Fig. 2, is of the general character disclosed in British Patent No. 26,301 of 1906, and comprises, therefore, the following parts: The receiver 2, switch-hook 3, transmitter 4, impulse wheel 5, impulse springs 6 and 7, a ringer 8, a condenser 9, release springs 10, 11 and 12, a dial (not shown) on the usual shaft 13, to which latter there is also rigidly attached the cam-finger 14 through the medium of which the dial is locked when in normal position by the locking cam 15. The switch-hook, of course, controls the usual springs 16, 17, 18, 19 and also the ground springs 20 and 21. It is understood, of course, that the dial is on the other side of the impulse wheel 5, opposite to that of the cam-finger 14.

The subscriber at the said station, which will be designated as station A, is provided with ground whereby current for operating purposes is derived from the central battery B (Fig. 4), one terminal of which is preferably grounded at G. The subscriber's station A is connected by the line conductors 22 and 23 with a line switch C. Each subscriber in the system is ordinarily provided with such a line switch, and it is individual to his line. The called subscriber D (Fig. 4), in accordance with this arrangement, is provided with his individual line switch C^1, while allotted to the station E there is the line switch F. In this system all of the line switches of the group to which the line

switch C belongs have allotted to them, as is usually the case, a controlling master switch, indicated at J, of the general and well-known character. Similarly, all of the line switches of the group to which the line switch F belongs are also provided with a corresponding master switch I. The master switch that controls the line switch C^1 is not shown. It could, however, very easily be the master switch J or the master switch I or some other master switch, depending on the group to which the line switch C^1 belongs. In Fig. 3 only one trunk line *a* of Fig. 1 is shown. It will be understood, however, that the line switch C has access to ten trunk lines, and that the said switch C is therefore provided with ten such terminals as are shown in Fig. 3, each of which represents one of the trunk lines *f*, *g*, *h*, *i*, *j*, *e*, *d*, *c*, *b*, *a* (Fig. 1). All of the other line switches of this group will have multiples to the same trunk lines. A similar arrangement is provided for the line switch F, the terminals of which will represent, of course, the trunk lines, *a*, *b*, *c*, *d*, *e*, *k*, *l*, *m*, *n*, *o* (Fig. 1). Each of the line switches in this system is provided with a bridge-cut-off relay 24, trip magnet 25 and release magnet 26. The bridge-cut-off relay 24, as shown, has under its control the springs 27, 28, 29 and 30, while the trip magnet 25 has under its control (through the medium of the usual plunger) the bank springs 31, 32, 33, 34, 35, 36, 37 and 38. Not only does the plunger operate these bank springs 31–38, but also nine other similar sets, which together make up the line switch bank of ten terminals to which reference has been made. The master switch J, like all of the other master switches, comprises a bank having two levels *p* and *q*, an operating relay 40 and a motor mechanism comprising a motor magnet 41, a ratchet wheel 42 and a circuit-closing cam wheel 43. The motor magnet 41 is provided with a couple of springs 44 and 45 in its energizing circuit, while the circuit-controlling cam 43 controls the springs 46 and 47 contained in the energizing circuit of the operating relay 40. Each one of the common trunks *a*, *b*, *c*, *d* and *e* is provided with one trunk relay 48 for each line switch group having access to the trunk. In this case, since two line switch groups C and F have access to the trunk *a*, there are provided two such trunk relays. Each of these relays is provided for the purpose of maintaining the trunk busy in case the calling subscriber should release the connection at any other time than when the plunger shaft is opposite the plunger. It is to be understood that in this system the master switch is provided with a particular form of shaft described in the *Western Electrician* of Chicago, Illinois, U. S. A., of January 11, 18 and 25, 1908—that is, when a subscriber makes a call he trips his line switch and drives the master switch shaft on one step. If a subscriber should then release, the plunger cannot return fully to normal position until the master switch has again returned to a position identical with that at which the plunger was released. Furthermore, if the same subscriber should again make a call before the master switch has reached such a position, he will operate his line switch as before, but will seize the same trunk line which he originally had. On account of this arrangement and construction it is necessary to maintain the trunk busy as long as the plunger is not fully restored to normal. Before the line switch releases, after having once seized the trunk, the trunk is maintained busy in the usual manner, without the assistance of the relay 48; but after the line switch is released, and until it regains its full normal position, it is the function of the relay 48 to keep the trunk busy until the master switch again arrives opposite the same trunk.

The selector K (Fig. 3) is of the general type disclosed in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson, and is provided with the usual line relays 49 and 50, the vertical magnet 51, the rotary magnet 52, the release magnet 53, the private magnet 54 and the back-release relay 55. As usual, this switch is provided with the side switch wipers 56, 57, 58 and 59. The connector switch L (Fig. 4) is of the general form of connector switch shown in United States Letters Patent No. 815,176, granted March 13, 1906, to Keith, Erickson and Erickson, but modified for common battery work, such as the connector switch in the British patent hereinbefore referred to. This connector switch comprises the line relays 60 and 61, the vertical and rotary magnets 62 and 63, the release magnet 64, the private magnet 65, the ringer relay 66, the differential relay 67 and the back-bridge double-wound relay 68.

The line switch C^1 is the same as the line switch C.

The telephone D is the same as the telephone A.

Having thus described in general the system, and detailed the mechanical equipment, I will now give a still more detailed description of the circuits and the operations. In doing so it will be assumed that the subscriber A is calling the subscriber D, and every step in the operation will be described with sufficient minuteness for one skilled in the art. It will be assumed that the number of the subscriber D is 222 and that the subscriber at the station A operates his calling device accordingly. In doing so he pulls down his dial, first in accordance with the hundreds digit 2, then for the tens digit 2

and last for the units digit 2. As soon as the receiver is removed from the switch-hook, the springs 18 and 19, which are normally in contact and through which the ringer 8 is bridged across the line in series with the condenser 9, separate, thereby removing the said ringer 8 from the line. At the same time—that is, by the same operation of the switch hook—the springs 16 and 17 are brought into contact, thereby closing the line circuit through the transmitter 4. Also, the locking cam 15 is removed from behind the cam arm 14, thus unlocking the dial. The subscriber then, in operating for the hundreds digit 2, pulls down the dial and permits the ground springs 20 and 21 to come into contact, thus supplying ground to the ground post 69; and through the medium of the impulse wheel 5, or more particularly through the medium of the rotary impulse tooth 70 on said impulse wheel, the rotary impulse spring 7 is pressed on to the ground post 69, whereby an impulse is sent over the rotary line 23 for energizing the trip magnet 25 of the line switch C. This energizing circuit, it will be seen, extends from ground G′ through the springs 69 and 7 to the rotary line conductor 23, and through the trip magnet 25 to the conductor 71, thence through the springs 73^a and 72 to the battery B, and through said battery to ground G. The trip magnet 25 then permits the plunger to operate, which plunger, it is assumed, is at the time opposite the trunk *a*. That being the case, the master switch is in such a position that the wipers 74 and 75 are respectively engaged with the contact points 76 and 77. That being the case, the plunger, upon operating, presses the springs 31 and 32, springs 33 and 34, springs 35 and 36 and springs 37 and 38 into contact. By this operation of the line switch, and more particularly by the engagement of the springs 35 and 36, a guarding potential is provided at the private normal conductor 78 from ground G^2, which normal conductor 78 terminates in the private bank of all connectors through which the subscriber A may be reached. Of course, it is to be understood that the line normals, or normal line conductors 79 and 80 as they are known, are parallel with the private normal conductor 78 and have terminals in the same connector banks. By the same operation of the line switch, and more particularly by the engagement of the bank springs 33 and 34, a guarding potential is established in the master switch bank contact 76, by way of conductor 81, for preventing the master switch J from selecting the trunk *a* as long as the said trunk is busy. This guarding potential, it will be seen, is supplied by the non-grounded terminal of battery B over the battery lead 73, through the release magnet 26 of the line switch C. This release magnet 26 is of small resistance, something in the neighborhood of sixty ohms, which does not impair the effectiveness of the guarding potential. Not only is guarding potential provided at the bank contact 76 of the master switch J, but a guarding potential is simultaneously established from the same source to the bank contact 82 of the master switch I. This guarding potential, after passing through the release magnet 26 and reaching the conductor 81, passes through the winding 83 of the trunk relay 48 (which is likewise of small resistance, something in the neighborhood of two ohms) to the conductor 84, thence through the winding 85 of the trunk relay 86, which corresponds to the line switch F, to the conductor 87 and bank contact 82 of the master switch I. As soon as this guarding potential is established at the bank contact 76 of the master switch J, and since the wiper 74 is resting on said contact, thereby connecting said contact with the segment 92, an energizing circuit is established through the winding 93 of the motor relay 40, said circuit extending from ground G^3 through said winding 93, conductor 94, segment 92 and contact 76, through the conductor 81, thence through the release magnet 26 to the battery lead 73. As soon as this circuit is closed the motor relay 40 energizes and presses the springs 72 and 95 into contact (which springs said relay 40 controls), thereby establishing an energizing circuit for the motor magnet 41 from ground G^4 through the said magnet 41, through the springs 45 and 44, springs 95 and 72 to the battery lead 73. The magnet 41 energizes a number of times, and in so doing advances the wiper 74 from the contact 76 onto the next contact 98. It will be understood, of course, that the wiper 75 is similarly advanced. If the next contact is likewise provided with a guarding potential, like the contact 76, the master switch will not stop on this contact, but will continue to rotate, because the energizing circuit for the motor relay 40 is maintained. However, as soon as the wiper 74 leaves the last busy contact, the circuit through the motor relay 40 is, of course, broken, and the relay is, as a result, de-energized to break the energizing circuit of the motor magnet 41. Had the wiper 97 of the master switch I been resting on the contact 82, it is obvious that the motor relay 98^a of the master switch I would have energized in multiple with the motor relay 40 of the master switch J, and both master switches would have been advanced. This does not mean that both master switches J and I would necessarily continue to advance the same length of time, because, since all of the contacts of the master switches J and I are not in multiple, one master switch

might find a changed condition before the other, consequently stopping first.

For the purpose of description the group shown in Fig. 1 to which the subscriber A is allotted will be designated as group X, and the group to which the subscriber E is allotted will be designated as group Y. To these groups, of course, as already stated, the trunks *a*, *b*, *c*, *d* and *e* are common, and the master switches J and I are so wired that the master switch bank contacts 76 of the master switch J and 82 of the switch I are connected through the winding 83 of the trunk coil 48 and the winding 85 of the trunk coil 86. In a similar manner the bank contacts 98 and 99 will be connected through windings of the trunk *b* similar to the windings 83 and 85 of the trunk *a;* likewise the bank contacts 100 and 101 through similar windings of the trunk *c;* and in the same manner the contacts 102 and 103 are connected through the coils of the trunk *d*, and the contacts 104 and 105 through the coils of the trunk *e*. Now if the wipers 74 and 97 of the master switches J and I are resting on the contacts 76 and 82, corresponding to the trunk *a*, and a subscriber calls, as the subscriber A of group X is explained to have called, both master switches are advanced, the master switch J onto contact 98 and the master switch I onto the contact 99. It will be evident that in this operation all of the plungers that are in engagement with the plunger shafts of the X and Y groups will be advanced opposite the trunk *b*. Now, should the subscriber E of the group Y make a call, the line switch F will, of course, seize the trunk *b* and both master switches J and I will be advanced one step onto the contacts 100 and 101 corresponding to the trunk *c*. In this way, if five subscribers in the groups X and Y successively make calls, the master switches J and I will be advanced until their wipers 74 and 97 are driven beyond the contacts 104 and 105, respectively. If only five trunks, *a*, *b*, *c*, *d* and *e*, are common to the groups X and Y, as shown in Fig. 1, and the remaining trunks shown in said figure are individual to either one or the other of these groups, then the sixth subscriber of the groups X and Y that makes a call under the conditions supposed will not affect both master switches. He will only affect the master switch of the group to which he belongs, because there is no connection between such trunks, and because the trunks *f*, *g*, *h*, *i*, *j*, *k*, *l*, *m*, *n* and *o* are not provided with trunk relays such as the relays 48 and 86. Now, by this operation of the line switch C, and more particularly as a result of the engagement of the bank springs 31 and 32 on the one side, and the springs 37 and 38 on the other, the line conductors 22 and 23 of the station A are extended to the first selector K. The selector must be in position to receive the impulses of the hundreds digit 2 as soon as the subscriber releases the dial. However, before the impluses are transmitted to the selector K, the bridge-cut-off relay 24 is energized, whereby the springs 28, 29 and 30 are operated for removing a short-circuit normally maintained through these springs across the line conductors 22 and 23, and at the same time disconnecting the trip magnet 25 from the line. The energizing circuit for this bridge-cut-off relay 24, it will be seen, is controlled by the bank springs 35 and 36, and may be traced from ground G^2 through said springs to the bridge-cut-off relay 24, thence through said bridge-cut-off relay to the conductor 88 and to the battery lead 73, over which battery B and ground G are found. As soon as the dial is released after having been pulled forward, as originally explained, the first two vertical impulse teeth, particularly designated as 90 and 91, operate to press the vertical impulse spring 6 onto the ground post 69 twice, thereby sending two impulses over the vertical line conductor 22. These impulses are passed through the vertical line relay 49 of the selector K over the following circuit: from the substation ground G′ to the springs 20 and 21, to the ground post 69, vertical impulse spring 6, vertical line conductor 22, line switch bank springs 31 and 32 (Fig. 3), vertical trunk conductor 100^a, selector side switch wiper 56, contact point 101^a, vertical line relay 49 to the battery lead 73, and thence through battery to ground. The vertical line relay 49 then operates in the usual manner to raise the shaft of the selector switch K. In this particular instance the said shaft is raised two steps in accordance with the two impulses transmitted. Each time the line relay 49 energizes, of course, it closes the energizing circuit for the vertical magnet 51, which magnet 51 is the one that raises the shaft. After the vertical impulse teeth 90 and 91 have operated, as described, the rotary impulse tooth 70 then presses the rotary impulse spring 7 onto the ground post 69 once. This impulse, of course, passes over the rotary line conductor 23 to the exchange over the rotary trunk conductor 102^a (Fig. 3), through the rotary line relay 50. More particularly this circuit extends from ground G′ to the impulse spring 7, thence to the rotary line conductor 23, line switch bank springs 37 and 38 (Fig. 3), to the rotary trunk conductor 102^a, thence through the rotary line relay 50 to the battery lead 73. The shaft having been raised to the second level, as previously explained, the operation of the rotary line relay 50 energizes the private magnet 54 for the purpose of tripping the side switch of the first selector K from first to second position. By this operation of the side switch

the side switch wipers are all advanced from the first to the second position. By this operation, and more particularly by the engagement of the side switch wiper 59 with the second side switch contact, the private magnet 54 is placed in temporary connection with the private wiper 103[a]. At the same time the side switch wiper 58, in passing to the second contact, establishes a temporary energizing circuit through the rotary magnet 52. As soon as this energizing circuit for the rotary magnet is closed, said magnet energizes, rotating the switch shaft one step, thereby placing the switch shaft wipers 103[a], 104[a] and 105[a] in engagement with the first trunk line. If this first trunk line is busy, the private wiper 103[a] will, as usual under the same conditions, find a circuit to ground over which the private magnet 54 is reënergized for maintaining the side switch in second position until an idle trunk line is found. In this case, however, it is assumed that the first trunk is idle, and therefore the private magnet 54 does not reenergize, and the rotary magnet 52 only energizes once. In so doing, the rotary magnet, through the medium of its armature, in turn operates the armature of the private magnet 54 to switch the side switch from second to third position, and thereby disconnecting the switch K from the trunk line conductors 100[a] and 102[a] and cutting the subscriber's line through to the connector switch L (Fig. 4). The calling subscriber having operated his dial once for the hundreds digit 2, now operates the same the second time for the tens digit 2, thereby as in the first instance sending two impulses over the vertical line conductor to the exchange and in this particular instance through the vertical line relay 60 and one of the windings of the differential relay 67 of the connector L; and also sending, after the vertical impulses are completed, the rotary impulse over the rotary line conductor 23, through the rotary line relay 61 and through another of the windings of the differential relay 67 of the connector. It will be seen, of course, that the impulses delivered over the vertical line conductor 100[a] pass to the connector switch through the side switch wiper 56 of the first selector K, and also through the vertical line wiper 104[a] to the vertical trunk conductor 106. In a similar manner the rotary impulses, in reaching the connector, pass from the rotary trunk conductor 102[a] (Fig. 3) through the side switch wiper 57 of the selector switch K, and through the rotary line wiper 105[a] to the rotary trunk conductor 107. Each time that the vertical line relay 60 of the connector energizes it closes an energizing circuit through the vertical magnet 62, provided the side switch is in first position. This being the case when the impulses for the tens digit are transmitted, the vertical magnet 62 operates to raise the switch shaft. In this particular instance the shaft is raised two steps, thereby carrying the wipers 112, 113 and 114 thereon opposite the group of subscribers in which the subscriber #222 is situated. The rotary impulse that follows upon operating the rotary line relay 61 energizes the private magnet 65, whereby the side switch is tripped from first to second position. By this operation the side switch wipers 108, 109, 110 and 111 are carried from the first to the second side switch position. This puts the rotary magnet 63 under the control of the vertical line relay 60 in place of the vertical magnet 62. Therefore, when the subscriber subsequently operates his dial for the units digit 2 the rotary magnet 63, by the operation of the vertical line relay 60, rotates the shaft and wipers until the latter are carried into engagement with the line desired, namely the line #222. The last rotary impulse that comes in operates the rotary line relay 61, whereby the private magnet 65 is again energized for tripping the side switch from second to third position, thus connecting the calling and called subscribers' lines. Having established connection with the desired line, the calling subscriber presses his signaling button 115, thereby grounding the vertical line conductor 22 and as a result energizing the vertical line relay 60, as well as the differential relay 67 in the connector switch. The side switch being in third position, the combined operation of the vertical line relay 60 and the differential relay 67 closes an energizing circuit for the ringer relay 66, whereby ringing current is thrown out on the called line from the ringer generator M for signaling the called subscriber. Had the called line been busy, the last rotary impulse, instead of placing the two lines in connection, would have caused the release of the connector switch upon the energizing of the private magnet 65, since when the said private magnet energizes, the private wiper 114 is placed in connection with the release magnet 64, and since, if the line is busy, the contact engaged by said private wiper is grounded, an energizing release circuit for the magnet 64 is completed. When the called subscriber answers he energizes the back-bridge relay 68, which operates to shift the connection of the lower winding of the differential relay 67 from the non-grounded to the grounded terminal of the battery, thereby furnishing the calling subscriber with talking battery current. Of course, as soon as the connector side switch passes to third position after connection has been established with a called line, the ground potential is supplied at the private wiper 114, whereby the bridge-cut-off relay 116 of the called line is energized for removing the

short-circuit from across the said line and closing the connection between the rotary line conductor 117 and the rotary normal 118. When the calling subscriber hangs up his receiver he grounds both lines simultaneously by pressing the release springs 10, 11 and 12 into contact. By grounding both sides of the line at the same time the differential relay 67 energizes, which in turn breaks the energizing circuit of the back-bridge relay 68, thus permitting the line relays 60 and 61 to become energized at the same time with the differential relay 67, thereby energizing the release magnet 64 in series with the back-release relay 55 of the selector K. Of course, if the called subscriber had not answered, the line relays 60 and 61, as well as the differential relay 67, would have energized in the first instance, regardless of the back-bridge relay 68. As soon as the release magnet 64 is energized the connector switch is released, and as soon as the back-release relay 55 of the selector K is energized and then deënergized, said selector is likewise released. It will be seen that when the release magnet 53 is energized by the back-release relay 55, another circuit is closed by the said release magnet 53 for releasing the line switch C. This circuit extends from ground G^5 over the conductor 119, through the winding 83 of the bridge coil 48 to the trunk-release conductor 81, thence through the line switch bank springs 34 and 33, through the release magnet 26, through the conductor 88 and through battery lead 73. When this circuit is established the release magnet 26 of the line switch C energizes in series with the trunk coil 83. The line switch C is released, whereby the bank springs 31 and 32 are opened, as well as the springs 33 and 34, springs 35 and 36 and springs 37 and 38. Ordinarily this would remove the guarding potential from the conductor 81 which, in this case, is connected as already stated with the bank contacts 76 and 82 of the master switches J and I, respectively. The plungers of the line switches C and F are not always fully restored when their release magnets are energized, as described particularly in connection with the line switch C, because it is very seldom that the master switch has returned to the position where the line switch was tripped by the time that the subscriber that is using the line switch is ready to release. Obviously, then, if the subscriber to whom the line switch C is allotted should make another call before the master switch J has arrived at the position aforesaid, the line switch C will seize the same trunk line, which in this case terminates in the switch K. The foregoing, together with the fact that the master switches J and I do not run synchronously, makes it possible, unless special provision is made, for the switch F to trip in to the trunk that terminates in the first selector K while the line switch C is in its semi-released position. If the line switch F has tripped in, it is obvious that, unless some other provision is made, the subscriber to whom the line switch C is allotted may make a call before the master switch J has permitted the plunger of the line switch C to fully restore, and in that case the line switch C would plunge in onto the trunk already occupied by the line switch F. A provision by which this interference is obviated is as follows: When the release circuit for the line switch C is closed by the release magnet 53, as already explained, the trunk relay 48, upon energizing, establishes a locking circuit for itself in order that it may remain energized after the bank springs 33 and 34 of the line switch C separate. This energizing circuit, it will be seen, extends from ground G^6 through the resistance coil 120, through the springs 121, 122 and 123, through the winding 124 of the relay 48 to the battery lead 73. This relay being thus locked maintains the springs 125 and 126 in contact, whereby the guarding potential is maintained at the bank contacts 76 and 82 of the master switches J and I. This guarding potential, it will be seen, is provided at the contact 76 over the conductor 81, through the said springs 126 and 125, and through the resistance coil 127 to the battery lead 73; and at the contact 82 the guarding potential is provided over the conductor 87, through the winding 85 of the coil 86, through the winding 83 of the coil 48, and through the springs 126 and 125 and the resistance coil 127 to the battery lead 73. By this provision it will be seen that a guarding potential is maintained at the contact points 76 and 82 as long as the line switch C remains in its semi-released position. Eventually, when the master switch J arrives in its course on the first contact again, the coil 48 is short-circuited by the wiper 75, whereby the said coil 48 may be restored and the guarding potential removed from the contacts 76 and 82 at the same time that the line switch C regains its full normal released condition. The circuit over which the said coil 48 is short-circuited is as follows: From the battery lead 73 to the common segment 128 of the master switch J, thence through the wiper 75 to the bank contact 77, conductor 129, through the springs 122 and 123, through the coil 124 back to the battery lead 73. By this means the locking circuit for the coil 48 is broken. It will be obvious that what has been described in connection with the line switch C, coil 48 and the master switch J is likewise true of the line switch F, coil 86 and the master switch I.

From the foregoing it will be seen that by my invention I provide an arrangement

whereby each subscriber has access to any one of a number of trunks that are individual to his group, and also has access to any one of a number of trunks that are common to the subscribers of the two groups—that is to say, to the subscribers of the two divisions of the group of subscribers whose lines terminate at the sub-central station. The trunk lines then lead to the central station, at which place first selectors and second selectors, and even third selectors if they are necessary, are employed for trunking the calls through the exchange to the trunk lines that lead to the sub-central stations of the called subscribers. As explained, these trunk lines leading to the sub-central stations of the called subscribers terminate in connectors, and it is by means of these connectors that certain lines are seized leading to the substations of the called subscribers. Each subscriber of a sub-central station has access to certain trunks that are not accessible to other subscribers of the same sub-central station. In addition, however, each subscriber has access to certain trunks that are common to all of the subscribers of that sub-central station. Thus each subscriber has access to any one of ten trunk lines, so that as far as each subscriber is concerned the trunking is practically on a ten per cent. basis. Suppose, however, that there are one hundred subscribers in the group X and one hundred subscribers in the group Y, making two hundred subscribers in all. Ordinarily a ten per cent. trunking would require twenty trunk lines for such a group of two hundred subscribers, but with my improved arrangement practically a ten per cent. trunking is obtained with only fifteen trunk lines. Other advantages will be obvious to those skilled in the art.

What I claim as my invention is:—

1. In a telephone exchange system, a group of subscribers' stations, another group of subscribers' stations, a set of trunks for one group, a set of trunks for the other group, a third set of trunks common to both groups, a master switch and trunking switches controlled thereby for use by the subscribers of one group, and a master switch and trunking switches controlled thereby for use by the subscribers of the other group, whereby the trunks that are common to the two groups are subject to automatic selection by more than one master switch, each master switch operating independently of the other.

2. In a telephone exchange system, a group of subscribers' stations, another group of subscribers' stations, a set of trunks for one group, a set of trunks for the other group, a third set of trunks common to both groups, a master switch and trunking switches controlled thereby for use by the subscribers of one group, a master switch and trunking switches controlled thereby for use by the subscribers of the other group, whereby the trunks that are common to the two groups are subject to automatic selection by more than one master switch, each master switch operating independently of the other, a first selector at the end of each trunk.

3. In a telephone exchange system, a group of subscribers' stations, another group of subscribers' stations, a set of trunks for one group, a set of trunks for the other group, a third set of trunks common to both groups, a master switch and trunking switches controlled thereby for use by the subscribers of one group, a master switch and trunking switches controlled thereby for use by the subscribers of the other group, whereby the trunks that are common to the two groups are subject to automatic selection by more than one master switch, each master switch operating independently of the other, a first selector for each trunk, and connectors for finding the called subscribers.

4. In a telephone exchange system, a group of subscribers' stations, another group of subscribers' stations, a set of trunks for one group, a set of trunks for the other group, a third set of trunks common to both groups, a master switch and trunking switches controlled thereby for use by the subscribers of one group, a master switch and trunking switches controlled thereby for use by the subscribers of the other group, whereby the trunks that are common to the two groups are subject to automatic selection by more than one master switch, each master switch operating independently of the other, and means having vertical and rotary motion to extend connection from the said trunks.

5. In a telephone system, subscribers' lines divided into a plurality of groups, trunk lines common to a number of said groups, and trunk relays controlling a busy test for said trunks, the number of such relays depending upon the number of groups to which said trunks are common.

6. In a telephone system, subscribers' lines divided into a plurality of groups, a set of trunk lines for each group, trunk lines common to a number of said groups, and trunk relays for said common trunks, the number of such relays depending upon the number of groups to which said trunks are common.

7. In a telephone system, subscribers' lines divided into a plurality of groups, a set of trunk lines for each group, a set of trunk lines common to a plurality of groups, a master switch and trunking switches controlled thereby for each group for use by the subscribers of that group, said trunking switches comprising a plunger and a bank

of contacts into which said plunger is adapted to be thrust, means for partially withdrawing said plunger and then completely withdrawing the same, and means whereby a busy test is maintained upon a selected trunk until said plunger is completely withdrawn, substantially as described.

8. In a telephone system, subscribers' lines divided into a plurality of groups, a set of trunk lines for each group, a set of trunk lines common to a plurality of groups, a master switch and trunking switches controlled thereby for each group for use by the subscribers of that group, and means whereby said trunk-selecting means place said trunks in condition to test busy.

9. In a telephone system, trunk-lines, a trunk-selecting switch which returns to normal position, and means whereby said switch maintains the selected trunk in a busy condition until it is fully restored to normal position, substantially as described.

10. In a telephone system, subscribers' lines divided into a plurality of groups, a set of trunk lines for each group, a set of trunks common to a plurality of groups, and a line switch individual to each line for selecting an idle trunk, said line switch comprising a plunger and contacts associated therewith, and means for making a trunk busy not only when the plungers are in the bank, but until said plungers are fully restored to normal position, substantially as described.

11. In a telephone system, a group of trunk lines, a group of switches for selecting one of said trunk lines, a relay for controlling a busy test for a selected trunk, and a locking winding for said relay whereby said busy test may be maintained after the release of the selecting switch.

12. In a telephone system, a group of trunk lines, a group of switches for selecting one of said trunk lines, a trunk-release circuit for said switches, a relay having a winding included in said circuit, a busy test controlled by said relay, and a locking winding for said relay whereby said busy test may be maintained after the release of the selecting switch.

Signed by me at Chicago, Cook county, Illinois, this 3 day of June, 1909.

FRITZ LUBBERGER.

Witnesses:
EDWARD D. FALES,
ARTHUR J. RAY.