C. R. AUSTIN.

SEMI-AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED APR. 30, 1907.

975,105.

Patented Nov. 8, 1910.

3 SHEETS—SHEET 1.

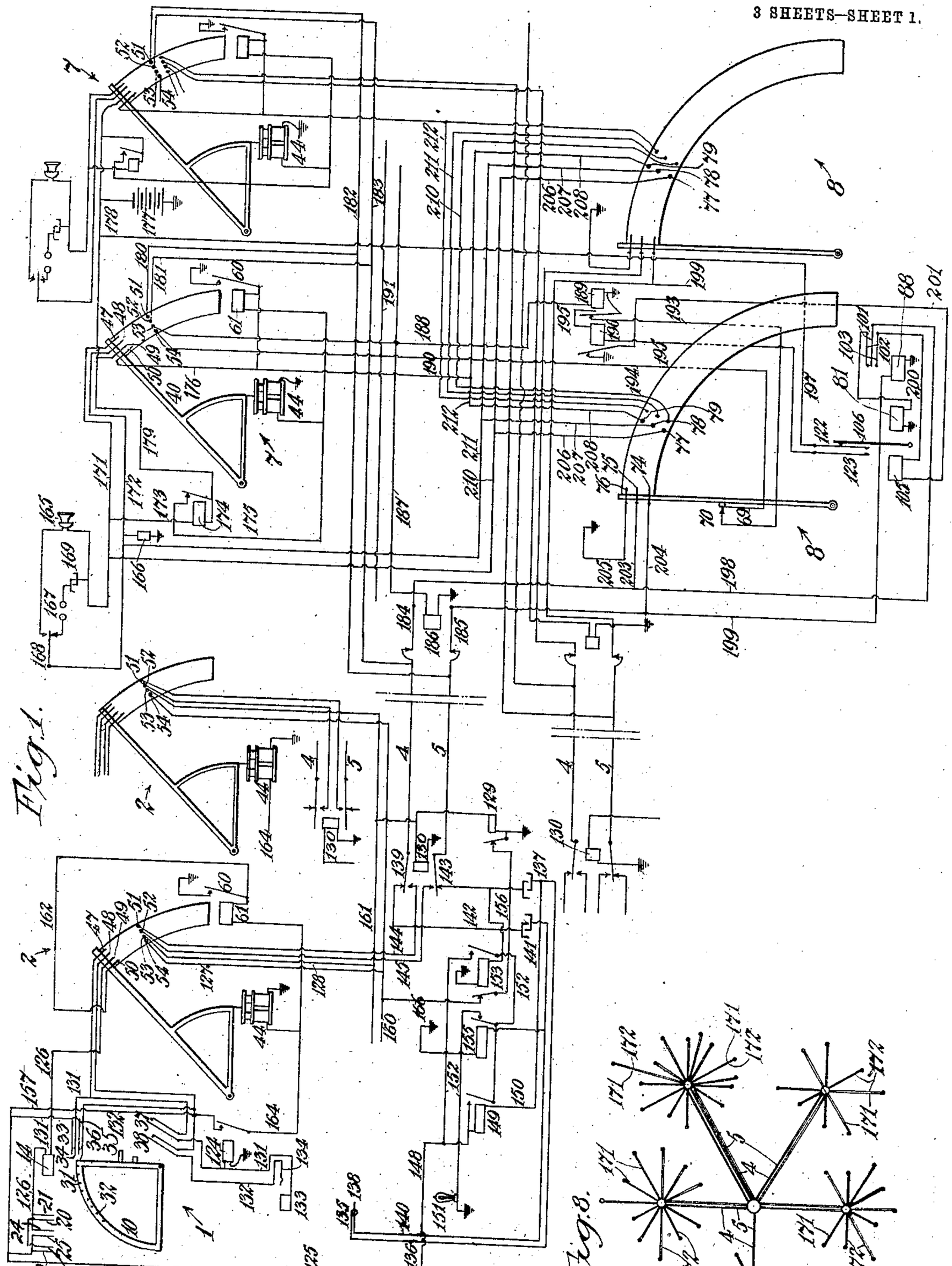

Fig. 1.

Fig. 8.

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3 SHEETS—SHEET 2.

Fig. 5.

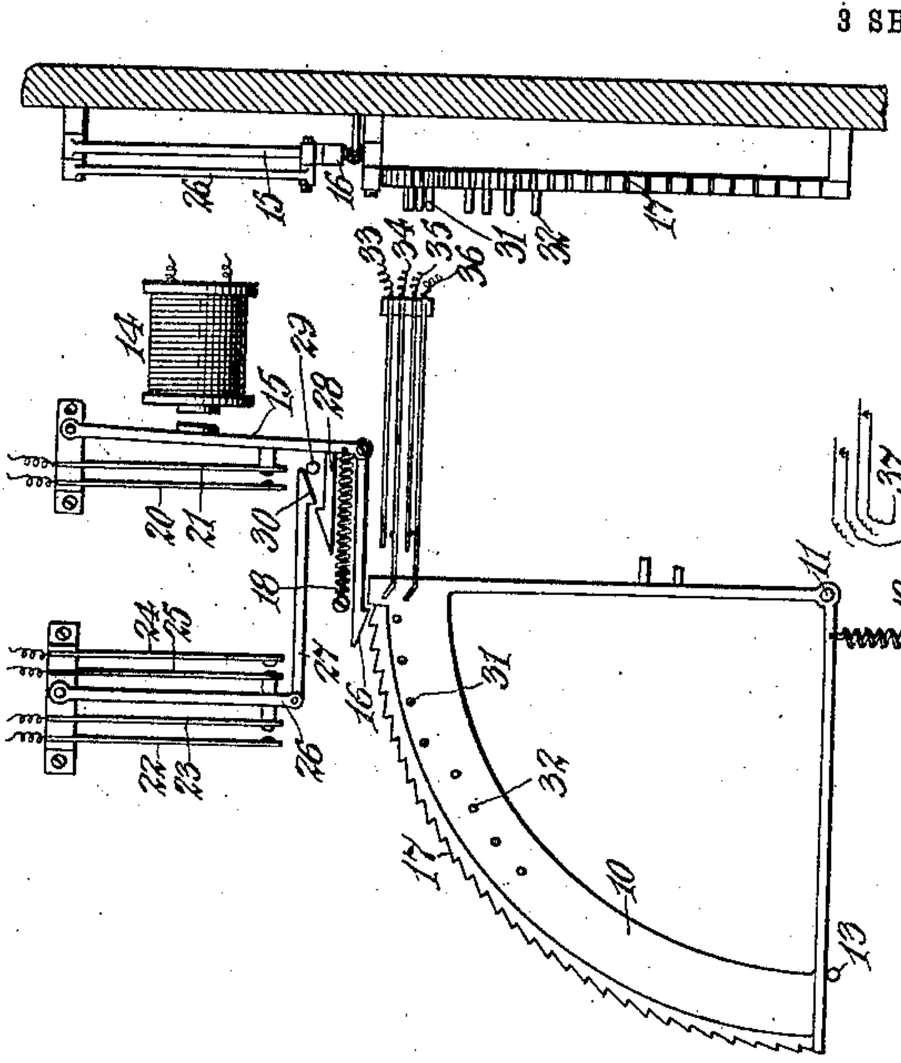


Fig. 4.

Fig. 3.

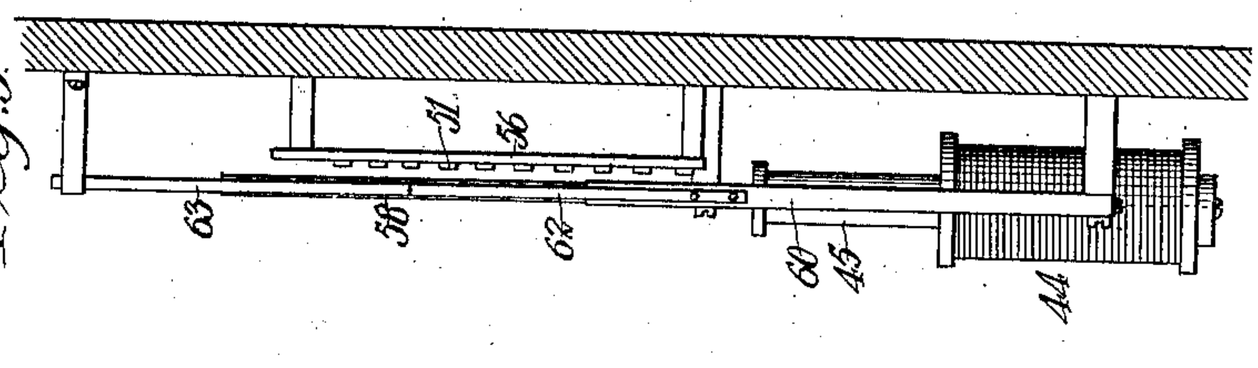
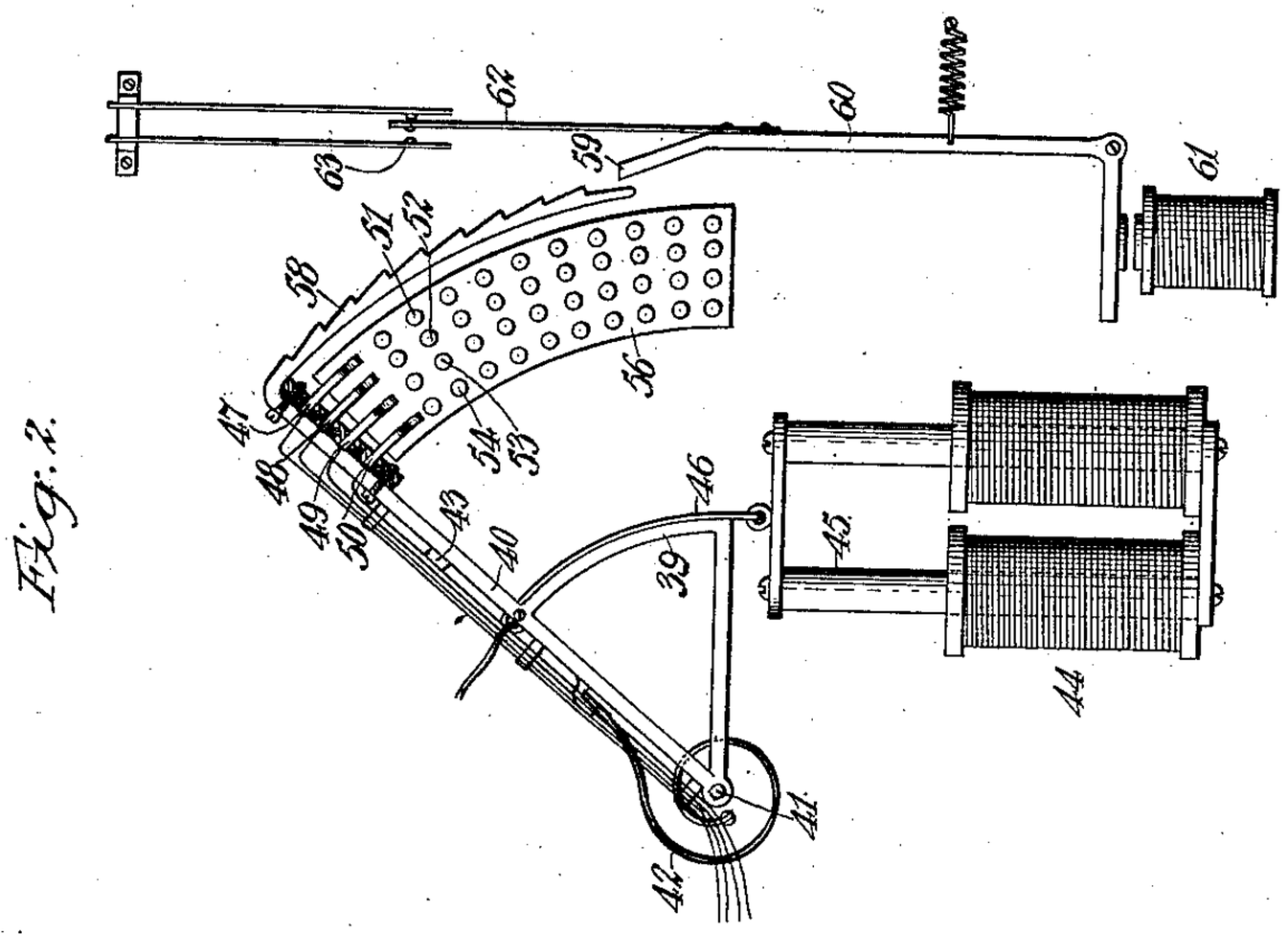


Fig. 2.



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3 SHEETS—SHEET 3.

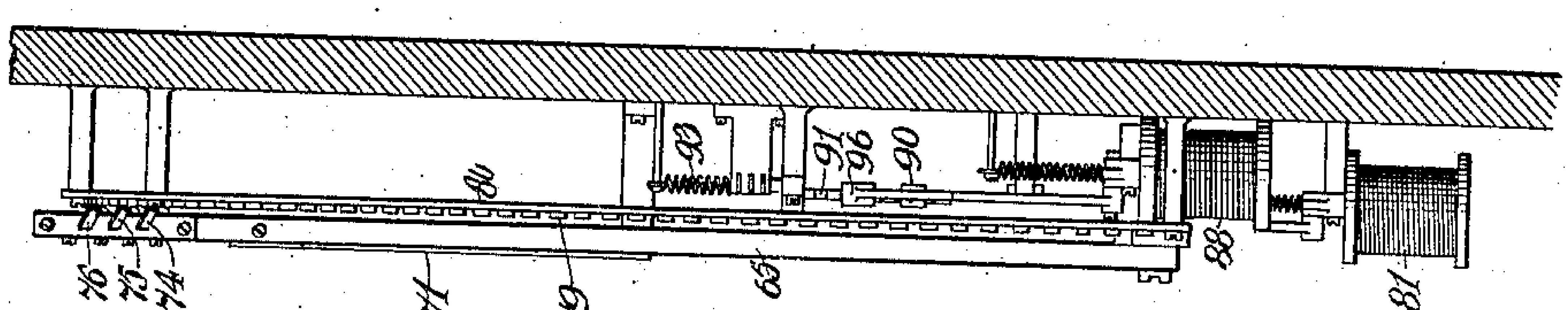
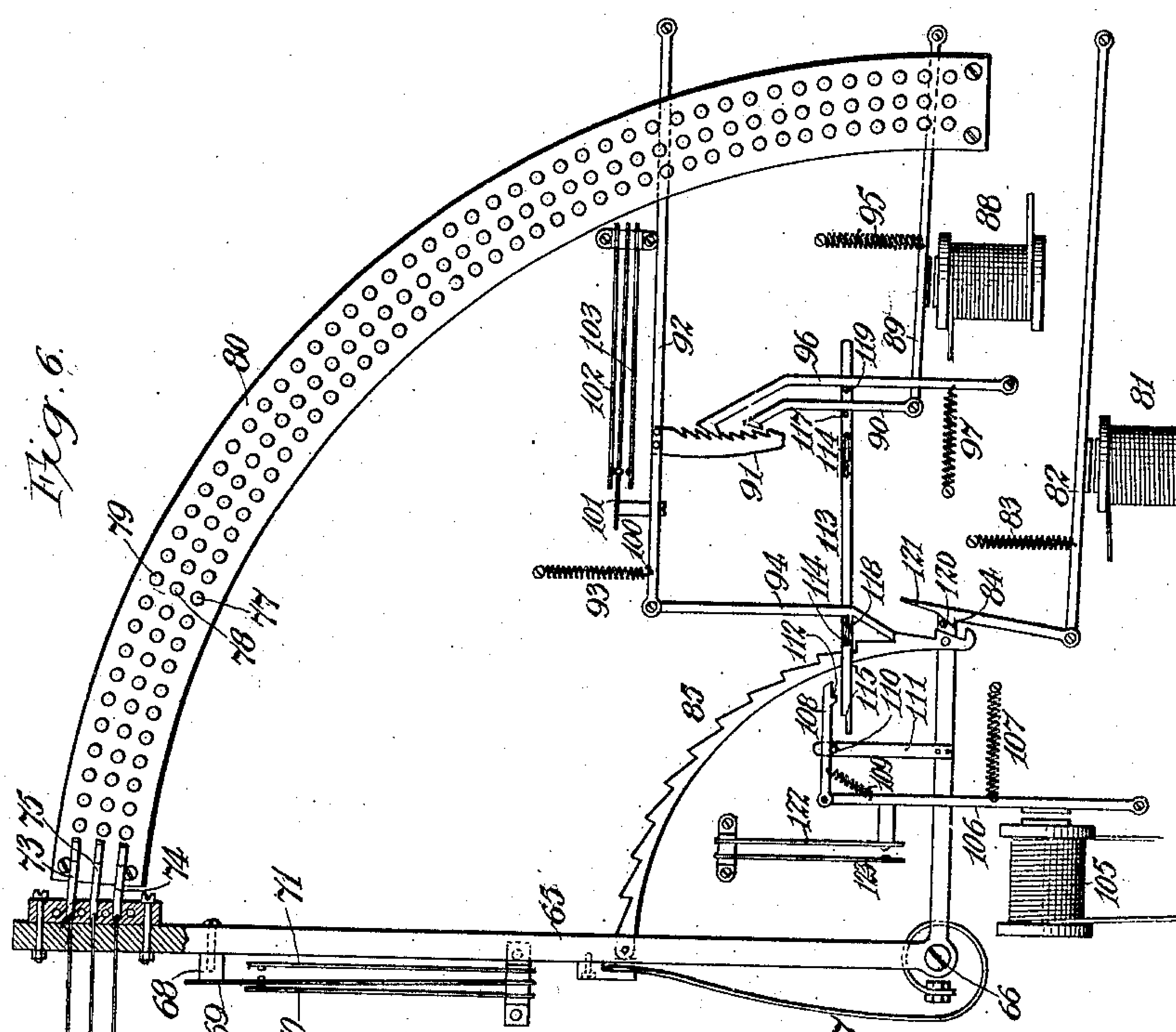


Fig. 7.

Fig. 6.



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UNITED STATES PATENT OFFICE.

CHARLES R. AUSTIN, OF LONGBEACH, CALIFORNIA.

SEMI-AUTOMATIC TELEPHONE SYSTEM.

975,105. Specification of Letters Patent. **Patented Nov. 8, 1910.**

Application filed April 30, 1907. Serial No. 371,188.

To all whom it may concern:

Be it known that I, CHARLES R. AUSTIN, a citizen of the United States, residing at Longbeach, in the county of Los Angeles and State of California, have invented a new and useful Semi-Automatic Telephone System, of which the following is a specification.

This invention relates to a telephone system wherein a central station is connected by trunk lines to a plurality of sub central stations serving different parts of the district, the subscribers' lines being grouped or radiating from the subcentral station.

The main object of the present invention is to provide for the supervision and control which is only obtainable by manual operation at the central station, and at the same time to eliminate expense of an operator at the sub central stations. By providing an automatic sub central station it is possible to provide a number of sub central stations to serve a given district with but little expense. Where an operator is required at a sub central station it is necessary to make the same serve a considerable district to pay the expense of the operator, but with an automatic sub central station the sub central station district may be made comparatively small and the service wires to the subscribers proportionately short, thereby greatly reducing the wire expense; moreover, an automatic sub central station serving a small district may be made so compact that it requires but little space and no special building or room is required, but it may be placed in a comparatively small box or inclosure on a pole or building.

Another object of the invention is to enable the subscriber to call central directly by the usual operation of removing the receiver from the hook, and to enable central to call subscriber by automatic selection at the sub central station.

Another object of the invention is to provide for sending over the trunk lines from central the necessary calling impulses to select any subscriber's line from the sub central station by the mere operation of the usual spring jack device at the central station switch board.

Another object of the invention in connection with a system indicating a plurality of trunk lines is to provide for switching the subscriber's line at the sub central station to a trunk line which is not in use.

Another object of the invention in connection with such a multiple trunk system is to provide for switching the calling device at central on to a trunk line which is not in use.

Another object of the invention is to provide for using the same trunks for the incoming calls that are used for the outgoing calls, thereby reducing the number of trunks necessary for a given number of subscribers' lines.

In this system each subscriber's circuit terminates at a sub central station from which calls are automatically trunked to the central station. At the central station the call is manually connected to trunk leading to sub central station at which called subscriber's line terminates and where the trunk is automatically connected to said called subscriber's line.

In the accompanying drawings: Figure 1 is a diagram of the system. Fig. 2 is a side elevation of a selecting switch which is provided both at the sub central station and at central station, being automatically operated at the sub central station by the subscriber's line and constituting a line switch and being automatically operated at the central station by the jack and constituting a jack switch. Fig. 3 is a side elevation of Fig. 2. Fig. 4 is a side elevation of a selector for automatically sending to the line selective sequences of impulses. Fig. 5 is an end elevation of Fig. 4. Fig. 6 is a side elevation of a trunk switch for connecting a call at the sub central station to the trunk line. Fig. 7 is an end elevation of Fig. 6. Fig. 8 is a diagram of a central station and a plurality of sub central stations, showing the general arrangement.

Referring to Fig. 1, the central station is provided with a switch board, having for each subscriber a selector 1 and a jack switch 2. The usual jack, relay and signal devices are also provided at the central station and any desired number of trunk lines 4, 5 lead to the sub central stations, there being as many trunk lines for each sub central station as are warranted by the business thereat. Each sub central station is provided with a line switch 7 for each subscriber's line and with a trunk switch 8 for each trunk line.

The selecting impulse transmitter, see Figs. 4 and 5, comprises an arc 10 mounted to turn on an axis 11 and drawn by spring 12 to turn on said axis in a given direction, the motion of this direction being limited by a stop 13. Means are provided for operating said arc in the opposite direction, step by step, said means comprising a magnet 14 whose armature lever 15 is normally retracted by a spring 18 and carries a pawl 16 engaging a ratchet rack 17 on the said arc or member 10. This magnet is in a local circuit controlled by the jack in the switch board as hereinafter described, and this circuit also includes a pair of contacts 20, 21 operated by the armature lever 15, and two other pairs of contacts 22, 23, 24, 25 operated by an arm 26, carrying a hook 27 to engage a hook 28 on the armature lever. The pair of contacts 22, 23, as well as the contacts 20, 21, are closed when the armature is fully retracted, and the pair of contacts 24, 25 is closed by the hook means 28, 27 when the armature means starts to move forward, the contacts 22, 23 being broken at the same time, thus establishing a circuit for a magnet independent of the back contacts 20, 21. A fixed pin 29 is provided to engage an incline 30 on the hook 27 when the armature is fully attracted, to raise said hook, releasing it from the hook 28, whereupon the member 26 springs back to normal position, opening this auxiliary circuit and putting the magnet again under control of the main contacts 20, 21, 22, 23, which are not closed until the armature is fully retracted. By this means a definite length of stroke is given to the armature. The armature lever of magnet 14 is adjusted for such rapid operation by the magnet and the retractive springs thereof, that at each retraction the pawl 16 is moved back to engage with the next tooth of rack 17 of member 10, before the said member 10 has time to move back appreciably under the influence of its spring 12. The inertia of member 10 is such as to prevent it from moving back rapidly enough to interfere with the operation as described.

The arc member 10 is provided with a plurality of series of projections or pins 31, 32, the pins of series 31 operating on one of a pair of spring contacts 33, 34, and the pins of series 32 operating on one of a pair of contacts 35, 36. One of the contacts, as 34, 36 of each pair has an inclined end portion to be engaged by the pin 31 or 32, to close the contact on the other one of the pair, when the arc member 10 is being operated as above stated, the pair engaging on the other side of the flange when the arc member is returning, so that the contacts are not closed in such return. These pairs of contacts are connected to send impulses to the line on the two sides of the metallic circuit as hereinafter set forth, and the number of pins in the respective series determines the selection effected at the other end of the line. Two pairs of contacts 37, 38 are closed by the pressure of member 10 when in fully operated position. A selective impulse transmitter such as above described, is provided for each subscriber's line, and the spring jack devices of the switch board are individually connected to the operating means for said transmitters, so that manual operation of the spring jack selects one of the impulse transmitters for operation.

The line switch (description of which will also serve for the jack switch) comprises an arm 40 mounted to turn on an axis 41 and drawn by spring means 42 in a given direction, its motion in that direction being arrested by a stop 43, said arm being operated in the other direction by a magnet or solenoid 44, whose core or armature 45 is connected to a strap 46 operating over a segment 39 connected to said arm. Said arm carries two pairs of contacts 47, 48, 49, 50, passing, in the operation of the arm, respectively over four rows of contacts 51, 52, 53, 54, arranged on an insulating plate 56 in concentric relation to the axis of motion of the arm 40. Said arm is also provided with a ratchet rack segment 58 to be engaged by a stop 59 on an armature 60 of a magnet 61. This armature lever carries a contact 62, coöperating with a fixed contact 63, to control connections to the line switch as hereinafter set forth.

The trunk switch, see Figs. 6 and 7, comprises an arm 65 mounted to turn on an axis 66 and drawn by a spring 67 in a given direction, its motion in that direction being arrested by a lug 68 on the arm engaging a contact spring 69 which thus normally makes contact with a fixed contact spring 70 and is held away from another fixed contact spring 71. Said arm 65 carries three contact springs or brushes 73, 74, 75, adapted in the movement of the arm to pass respectively over three segmental rows of contacts 77, 78, 79, arranged concentrically with the axis 66 and carried by an insulating plate 80. Said arm is operated step by step in this movement by a plurality of electromagnetic selecting devices, operating in sequence to move the arm, first by large steps, passing over several contacts at a time, and then by smaller steps, passing over one contact at a time. These two operations are performed in sequence by two magnets 81, 88. The armature lever 82 of magnet 81 is retracted by a spring 83, and carries a pawl 84 to engage, in the attraction of the armature, a ratchet rack segment 85 on arm 65. The secondary step by step operating means comprises a magnet 88 whose armature lever 89 has a retracting spring 95 and a pawl 90 engaging a ratchet rack segment 91 on a carrying a pawl 94 engaging the ratchet

rack segment 85 on the switch arm 65. A retaining pawl 96 is provided for holding the rack 91 from back movement, this pawl being pressed toward the rack by a spring 97. Lever 92 operates, by an insulating lug 100, a contact spring 101 normally held back against a contact 102 and away from a contact 103, the said contacts controlling the operating circuit of the resetting means. The resetting means comprises a magnet 105 whose armature lever 106 is retracted by a spring 107 and carries a pawl 108 which is drawn downwardly by a spring 109 and normally rests on a pin 110 extending from an arm 111 on the segment 85, so that a shoulder 112 at the outer end of said pawl is normally above a slide 113 mounted to move longitudinally on fixed pins 114, said slide having a shoulder 115 adapted to be engaged by the aforesaid shoulder 112 on the pawl when the said pawl is allowed to drop by movement of the segment 85 as hereinafter set forth. The said slide 113 has pins 117, 118, 119 adapted to release the respective pawls 90, 94, 96 aforesaid when the slide moves back on release of armature of magnet 105. Pawl 84 is released from rack 85 by a fixed pin 120 acting on an incline 121 on the pawl when the latter is retracted. Armature 106 of magnet 105 presses contact spring 122 against a contact spring 123 when magnet 105 is energized. A connection 198 leads from the armature 184 for trunk line 4 through switch contacts 101, 102, and through the first operating magnet 81 of the trunk switch to ground, and another connection 199 leads from the armature 185 for the other side 5 of the trunk line through the second operating magnet 88 of the trunk switch to ground, closure of said contacts being controlled by said magnet 88. The other contact, 103, whose connection is controlled by the said magnet 88 is connected by wire 200 to relay 105, whence a connection 201 is made to the armature of relay 196, the back contacts of said relay being connected to ground. The wires 198, 199 connected to the armatures 184, 185 for the respective sides of the trunk line 5, 4, are connected by wires 203, 204 to the respective contact brushes 74, 75 on the arm 65 of the trunk switch, the other contact brush 76 thereof being connected to ground by wire 205. The fixed contacts 77, 78, 79 of the trunk switch are connected by connections 206, 207, 208 to respective multiple lines 210, 211, 212, which are multipled to corresponding contacts in the different trunk switches, there being as many trunk switches as there are trunk lines.

The local operating circuit for the selecting impulse transmitter is from ground through battery 99, wire 125, and a circuit 126, including the contacts 20 to 25 of transmitter operating magnet 14 to brush 49 of the jack switch. Contacts 53, 54 of the jack switch at central are connected by wires 127, 128 to wires 160, 161 which are multipled to similarly located contacts on all of the jack switches. Wire 161 is connected to ground through magnets 130 and 129. A circuit leads from movable contact 50 which coöperates with the series of contacts 54 through the armature and front contact of stop magnet 61 of the jack switch to ground. This connection serves as a trial ground.

The trunk line wires 4, 5 are connected to two armatures 139, 143 of a magnet 130, whose front contacts are connected by wires 144, 145 to the contacts 51, 52 of the jack switch. Movable contacts 47, 48 coöperating with these fixed contacts 51, 52 are connected respectively to circuits 131, 132 of the selecting impulse transmitter, the circuit 131 including contacts 33, 34, 37, and circuit 132 including contacts 35, 36, 38. Battery wire 125 is also connected by wire 157 to front contact of relay 124, the armature of said relay being connected by wire 164 to magnets 44 and 61 of the jack switch. The selecting impulse transmitter is adapted to send impulses over the two sides, viz., the sleeve and tip sides of the line, sequentially, contacts 33, 34 operated by the first series 31 of pins being connected through circuit 131 and contacts 37 to the jack sleeve 133 and the contacts 35, 36 operated by the second series of pins 32 being connected by circuit 132 and contacts 38 to the jack tip 134. Plug sleeve 135 is connected by wire 136 through a condenser 137 to the back contact of an armature 143 of the relay 130. Plug tip 138 is connected by wire 140 to condenser 141, whence a wire 142 leads to the back contact of another armature 139 of relay 130. A connection leads from battery wire 125 through wire 148, relay 149 and wire 150 to wire 136 leading to the plug sleeve 135. The circuit 152 for signal 151 leads from wire 148 to front contact and armature of relay 153, and back contact and armature of relay 155. Relay 153 is in a ground connection from wire 143. Relay 155 is in a ground connection from wire 140.

The subscriber's apparatus, indicated in a general way at 7, includes the usual receiver and transmitter, herein termed the instrument 165, bell 167, hook switch 168 and condenser 169, connections being made from the instrument and from the hook switch to the subscriber's line 171, 172. Wire 171 is connected to contact brush 47 on the arm 40 of the line switch and is connected by wire 173 to relay 174, the other terminal of which is connected to its own armature, and the front contact of the relay being connected by wire 175 through the operating solenoid or magnet 44 to

ground, and also through the stop magnet 61 to the armature of said magnet. From said armature one circuit leads through the front contact 63 thereof to ground and another leads by wire 176 to the contact brush 50 on the arm 40 of the line switch. Subscriber's wire 172 is grounded through retardation coil 166 at the sub station and is connected to brush 48 of the line switch. The battery 177 at the sub station is connected by wire 178 to the armature of relay 174 and to the brush 49 of the line switch. Fixed contacts 51, 52 of the line switch are connected respectively by wires 180, 181 to two multiple lines 182, 183, which are connected respectively to two sides of a trunk line 4, 5. The said two sides of the trunk line are connected respectively to back contacts of two armatures 184, 185 of a relay 186 in a circuit 187, grounded at one end, and extending as a multiple line in the sub station. Each of fixed contacts 53 of the line switch is connected by a wire 188 through a relay 189 to ground, and each fixed contact 54 is connected by a wire 194 to a multiple line 191. The armature of relay 189 aforesaid is grounded and controls by its back contact a circuit 193 leading to the back contact 70 of the trunk switch, contact 69 of said switch being connected by wire 194 to the multiple line 191 aforesaid. The front contact of relay 189 is connected through wire 195 and relay 196 to contact 123, against which contact 122 is pressed by operation of trunk switch resetting magnet 105, said contact 122 being connected by wire 197 to battery wire 178.

The operation is as follows:—On the receiver being removed from hook 168 of subscriber's instrument, closing contacts of hook switch, current from battery 177 flows through relay 174 to sleeve side 171 of subscriber's line to instrument, through instrument to tip side 172 of line and to ground through retardation coil 166. This energizes relay 174 which, closing its contacts, causes current from battery 177 to pass through windings of solenoid 44 to ground. When brush 50 on arm 40 of line switch reaches a contact 54 which is grounded, battery current also flows through front contact of relay 174, through magnet 61, end brush 50 to contact 54 which connects to ground through wire 194, contacts 69, 70, wire 193 and armature of relay 189. The armature of magnet 61 on being attracted closes springs 62, 63 grounding the magnet at 63, and locking the arm 40 with brushes 47, 48, 49 resting on contacts 51, 52, 53 corresponding to contacts 54 with which contact has been made. Brush 50 being in advance of the others when the arm is locked, has passed over contact 54 and is on open circuit. Brush 49 on reaching contact 53 closes the circuit through wire 188 and relay 189 to ground, and current also flows through wire 187 to relay 186 to ground, opening contact at relay 189 and taking ground off contact 54, and also opening the connections through armatures 184, 185 to the trunk line. Contact 54 being multipled through a group of line switches, the ground is opened to prevent other switches from engaging on it while in use. The subscriber's line is now connected through brushes 47, 48, contacts 51, 52 and wires 180, 181, 182, 183, to trunk leading to central station, and relay 153 at central station is energized by current from battery 177, passing to tip side 5 of trunk and through armature 143 and relay 153 to ground, relay 153 then closing circuit 152 and lighting lamp 151 on main switch board.

The operator at the central station after ascertaining the number that calling subscriber desires, inserts plug in jack corresponding to that number, whereupon current from battery 99 passes through wire 148, relay 149 and wires 150, 137, to the sleeve of plug and jack and to ground through relay 124, which closes connection from battery wire 125 for energizing solenoid 44 of jack switch, the current then passing from wire 125 through wire 157, armature of relay 124 and wire 164 to the solenoid 44, and the solenoid being energized, the jack switch selects a trunk, not already engaged, to a subcentral station, in the following manner: As the long contact 50 of the jack switch passes onto any contact 54 it will, if the trunk corresponding thereto be not busy, close the circuit as follows: from battery 99 through wires 125, 164 as above traced, thence through magnet 61 and wire 162 to contacts 50, 54, and wires 127, 160, 166, through contact of relay 153, wire 150 and back contact of relay 129 to ground; magnet 61 being thereby energized operates its armature to stop the motion of the jack switch, the contact 50 meanwhile moving off the contact 54, and contacts 47, 48, 49, coming onto the corresponding set of contacts 51, 52, 53. As contact 50 leaves contact 54, the ground connection just traced is broken, but before this takes place magnet 61 has closed a ground for itself at 60 thereby maintaining the jack switch in operative position. Closure of contact 49 onto contact 53 establishes a circuit from wire 125 through contacts 22, 23, 20, 21 by wire 126 to magnet 14, contacts 49, 53, wires 128, 161 and relay 129 to ground. Relay 129 then breaks the initial ground for contact 54 corresponding to this trunk in this and all other jack switches multipled thereto, thus preventing any subsequent connection being made on this trunk as long as it is in use, and at the same time relay 130 operates armature 139, 143, to take both sides of the selected trunk at central, off of ground and

put them on the connections 144, 145 of the jack switch, thus establishing a calling connection to the unused trunk, which it will be understood is a different trunk from the one over which central was called.

The energization of magnet 14 acts through its armature 15 and hooks 28, 27, to cause contact 24 to make with 25 before contact 20 breaks with contact 21, thus maintaining the circuit to magnet 14 until the further armature stroke is completed, whereupon the hook 27 (see Fig. 4) is disengaged from hook 28 by incline 30 riding on pin 29, allowing the spring contacts 24, 25 to separate. Both circuits for magnet 14 are now broken and the armature is retracted and closes at 20, 21, the original circuit for the magnet, whereupon the operation is repeated and the magnet 14 is thus intermittently operated throughout its full stroke.

In the above described position of the jack switch, the contacts 47, 48 rest on contacts 51, 52, and complete the connections from the two sets of contacts of the selective impulse transmitter to the tip and sleeve sides of the trunk. These circuits are traced as follows:—on the sleeve side, from wire 125 by contacts 33, 34 and wire 131 to contacts 47, 51, wire 144, armature 139, sleeve side 4 of trunk, armature 184, wire 198, contacts 101, 103, and magnet 81 to ground and back to battery 99. On the tip side, from wire 125, by contacts 35, 36, wire 132, contacts 48, 52, wire 145, armature 143, tip side 5 of trunk, armature 185, and wire 199 to magnet 88, and ground.

By operation of the selected impulse transmitter, sequential series of selective impulses are thus sent out, first on the sleeve and then on the tip side of the trunk, the number of impulses at each side depending on the line number, (for example, for station on 44 there would be 4 impulses on the sleeve and 4 on the tip). The first series of impulses operates through magnet 81 to move the trunk switch arm 65 forward step by step, each step covering a group of the contacts of the switch, and the second series of impulses moves the arm 65 by smaller steps, each step advancing it from any row of contacts to the next, in the group to which it has been brought by the first operation. When the trunk switch has thus been brought to proper position the connections are established from side 4 of the trunk through wires 198, 203, contacts 75, 78 and wires 207, 211, to one side of subscriber's line, and from side 5 of trunk by wires 199, 204, contacts 74, 77, and wires 206, 210 to the other side of subscriber's line, thus putting the subscriber onto the trunk for communication. At the same time the brush 76 passing onto contacts 79, in the same radial row, establishes a connection to ground for the stop magnet of the corresponding line switch at the sub central station, so that when the subscriber takes his telephone from the hook in response to a call from central station the circuit is closed through said stop magnet from battery 177 through armature of relay 174 and the said stop magnet 61 holds the line switch from operation. As the selective impulse transmitter completes its motion, it closes contacts at 37, 38, for the tip and sleeve connections of the jack, independent of the contacts 33, etc., so that the plug which is connected through wires 136, 140, and condensers 141, to the trunk to calling subscriber, the connection is continued through the plug and contacts 37, 38, to trunk to called subscriber.

When the magnet 88 has been operated as above described, it closes contacts 101, 102, so that the current flowing from the sleeve side of the cord to the trunk passes through wire 198, contacts 101, 102, wire 200, through magnet 105, wire 201, and back contact of relay 196 to ground, thus energizing magnet 105, and attracting the armature 106 thereof (see Fig. 6) so that when the operator at central withdraws the plug from the jack and this circuit is broken the retraction of the said armature operates through members 108, 113, to release the detaining pawls 90, 94, 96, and allow the trunk switch to be reset to normal position by its spring 67. As trunk switch is thus reset arm 111 releases the member 108 from member 113, thus restoring the original condition by allowing pawls 90, 94, 96 to move under the action of spring 97, or of gravity, to position to engage the respective rack means.

The term "subcentral station" is herein applied and limited to a branch central station at a distance from the central station in distinction to switching devices at the central station, so that the length of the trunk lines connecting them is an important consideration in the cost of the system, and the saving of wires by having comparatively short subscriber's wires converge to the proximate sub central station instead of to the main central station, effects a material reduction in cost. This advantage is secured in maximum degree by the use of the automatic switch at such sub central station as this enables the distribution of the subscriber's lines in small groups giving the shortest possible lines. This feature of the sub central stations, in connection with the application of the automatic switch, is essential to the invention and as far as I am aware is original with me.

The local circuit of a subscriber is from battery 177 through wires 178, 179, relay 174, wire 171, subscriber's instrument 165, wire 172, retardation coil 166, to ground. The operation of the subscriber's instrument in the circuit as traced, sets up impulses

through the trunk to central in the incoming talking circuit as follows:—from wire 171 through brush 47, contact 51, wires 180, 182, trunk 5, to central, armature 143, condenser 137, wire 136, sleeve 135 of cord, tip 138 of plug, wire 140, condenser 141, armature 139, and from central by trunk 4, wires 183, 181, contact 52, brush 48, to wire 172. When the connection has been established from central to the called subscriber the talking circuit to the called subscriber is from wire 136, sleeve 135 of plug, sleeve 133 of jack, wire 131, through circuit closer 37, to brush 47, contact 51, wire 144, to trunk 4, armature 184, wires 198, 203, brush 75, contact 78, wires 207, 211, (and the hook 168 being up) subscriber's instrument 165, wires 210, 206, contact 77, brush 74, wires 204, 199, armature 185, trunk 5 back to central station, armature 143, wire 145, contact 52, brush 48, circuit 132, through circuit closer 38 to the tip 134 of jack and tip 138 of plug, wire 140, through relay 155, to ground. Current is fed for the talking circuit from battery 99, wire 148, relay 149, wire 150, to wire 136 aforesaid, whence the circuit extends to the subscriber as stated, and returns through ground 166 and relay 155. When connection has been made by the switch board spring jack devices at central, the incoming and outgoing talking circuits are connected through the spring jack devices, the insertion of the plug into the selected jack first causing the selection of a subscriber by the automatic operation above described and thereupon establishing the talking circuit to said subscriber through the same spring jack, and the complete talking circuit is through the two circuits as above described, said circuit joining at the wires 136, 140, it being understood that the outgoing talking circuit is to a different subscriber from that of the incoming talking circuit. Ringing current is cut in on the cord circuit 136, 140, by usual means, not shown, the current passing as above traced for the outgoing talking circuit, except that on reaching subscriber's station it passes through the bell 157 by reason of the hook being down. If the line is busy on receiving a call, relay 189 is energized and current passes from battery 177 through wires 178, 197, circuit closer 122, 123, relay 196, to ground at relay 189. Relay 196 on being energized opens ground on wire 201, thus deënergizing relay 105, and releasing trunk switch, the latter then moving automatically to normal position as above described, so that no connection can be made by the trunk switch to any line as long as line is busy.

What I claim is—

1. A telephone system, comprising a central station, a plurality of sub central stations, a plurality of subscriber's lines connected to each sub central station, each sub central station having automatic switch means responsive to selective impulses from the central station to connect one end of the subscriber's line to a line from the central station, a plurality of selective impulse transmitters at the central station, each selective transmitter being adapted to send a selective series of impulses corresponding to one of the subscriber's lines at the sub central station, and manual switch means at the central station having an individual connection for each of the selective impulse transmitters, whereby the said manual switch means manually selects the selective impulse transmitter, and said transmitter automatically selects the subscriber's line.

2. A telephone system comprising a central station, a plurality of sub central stations, a plurality of trunk lines from the central station to each sub central station, and a plurality of subscriber's lines extending from each sub central station, an automatic switch in each sub central station, for each subscriber's line, for automatically connecting a subscriber's line to a trunk line which is not in use; a manual switch at the central station having an individual connection for each subscriber's line at the sub central station, and means controlled by such individual connection for sending selective impulses over a trunk line.

3. A telephone system comprising a central station, a plurality of sub central stations, a plurality of trunk lines from the central station to each sub central station, a plurality of subscriber's lines extending from the sub central station, an automatic switch in each sub central station, for connecting the subscriber's lines to a trunk line which is not in use, a plurality of trunk switches in each sub central station, responsive to the impulses from the trunk lines to automatically connect any trunk line to any of the subscriber's lines, a manual switch at the central station having individual connecting means for each subscriber's line at the sub central station, and means controlled by such individual connecting means for sending selected impulses over the trunk line.

4. A telephone system comprising a central station, a sub central station, a plurality of trunk lines from the central to the sub central station, a switch-board apparatus at the central station comprising spring-jacks and plugs, a selective impulse transmitter at the central station for each subscriber's line at the sub central station to send selective impulses over a trunk line for the selection of subscriber's line, means controlled by the operation of the spring-jack and plug to operate said selective impulse transmitter and an automatic switch at the sub central station controlled by the selective impulses to connect the operating trunk line to any subscriber's line at the sub central station.

5. A telephone system comprising a central station, a sub central station, a plurality of trunk lines connecting the central station and sub central station, means for grounding each trunk line at the central and at the sub central stations, automatic switches at the central and sub central stations for connecting the operating circuits at each station to a trunk line which is grounded at the other station, and means controlled by the operation of the automatic switch at each station to break the ground for the trunk line at that station.

6. A telephone system comprising a central station, a sub central station, trunk lines connecting said stations, and adapted to form a metallic circuit, a plurality of selective impulse transmitters at the central station, a switch board comprising spring-jack devices having individual connections for manually selecting selective impulse transmitters, connections, whereby said selective impulse transmitters are connected to send impulses over the line, and a talking circuit connection through the same spring jacks of the switch board that control the selected impulse transmitters.

7. In a telephone system, the combination with a switch board comprising spring jack devices, of a plurality of trunk lines, a plurality of transmitters for sending selective line impulses, operating means for said transmitters controlled by the spring jacks, an automatic switch for selecting a trunk line, and talking circuit connections to said trunk lines controlled by the said spring jacks, and by said automatic switch.

8. In a telephone system the combination with the spring-jack devices of a switch board, of transmitters for sending selective line impulses and each comprising means operating automatically to transmit a definite sequence of impulses, operating means for said transmitter controlled by the spring-jacks, and a talking circuit connection, through the same spring-jacks that control the operation of the selective impulse transmitters.

9. In a telephone system, a trunk line, subscribers' lines, a selective impulse transmitter for each subscriber's line for sending over the trunk line selective impulses corresponding to the subscriber's line, an automatic operating means therefor, and selective impulse transmitter controlling means for bringing any one of said transmitters into operation on the trunk line.

10. A telephone system, a trunk line, subscribers' lines, a selective impulse transmitter for each subscriber's line for sending over the trunk line selective impulses corresponding to the subscriber's line, an automatic operating means therefor, selective impulse transmitter controlling means for bringing any one of said impulse transmitters on the trunk line, said controlling means comprising spring jacks and circuits operated thereby, and magnets in said circuits for operating the selective impulse transmitters.

11. A telephone system comprising a central station, a sub central station, a trunk line from the central to the sub central station, a plurality of subscriber's lines from the sub central station, a plurality of selective impulse transmitters at the central station, each transmitter comprising means for automatically transmitting a definite sequence of impulses, a manual switch board and circuits therefor controlling the operation of the respective selective impulse transmitters.

12. In a telephone system, a trunk line, a sub central station connected thereto, a plurality of subscriber's lines connected to the sub central station, a trunk switch having an operative connection with the trunk line to be operated by selective impulses therefrom, said trunk switch comprising contacts and circuits therefor for connection with any one of the subscriber's lines, the contacts of said trunk switch being arranged in groups and said trunk switch being provided with two operating means, one of which steps the switch forward from group to group, and the other steps the trunk switch forward in each group, the said two operating means being connected for operation from the two sides of the trunk line, and a central station provided with a transmitter for sending sequential series of impulses over the two sides of the trunk line.

In testimony whereof, I have hereunto set my hand at Los Angeles California this 20th day of April 1907.

CHARLES R. AUSTIN.

In presence of—
ARTHUR P. KNIGHT,
FRANK L. A. GRAHAM.