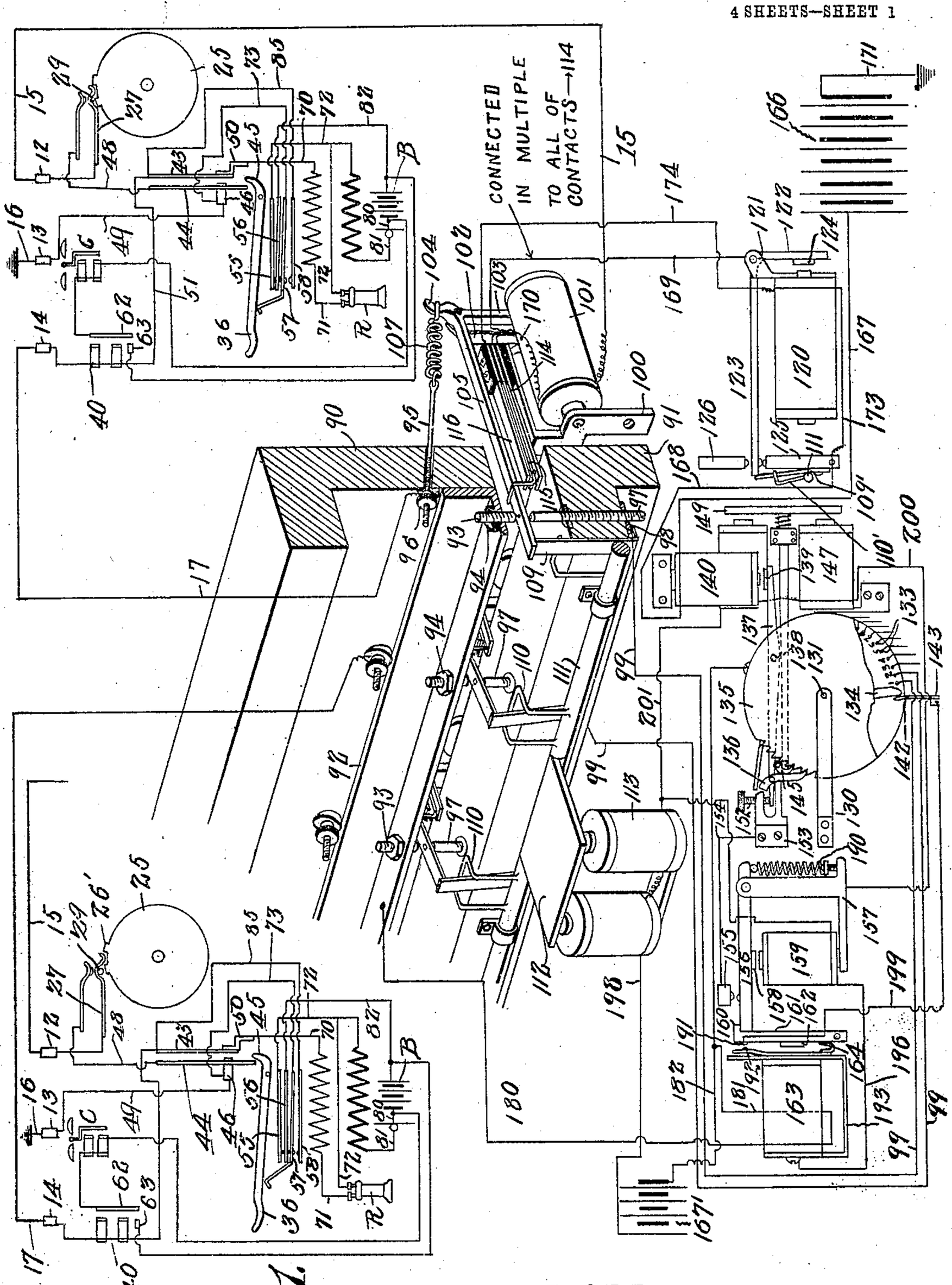
No. 847,356. PATENTED MAR. 19, 1907.

A. A. MONSON.

AUTOMATIC TELEPHONE SWITCHBOARD.

APPLICATION FILED APR. 2, 1906.

4 SHEETS—SHEET 1



WITNESSES:
E. F. Stewart
Jno. C. Parker

August A. Monson, INVENTOR
By Church & Church
ATTORNEYS

No. 847,356. PATENTED MAR. 19, 1907.

A. A. MONSON.

AUTOMATIC TELEPHONE SWITCHBOARD.

APPLICATION FILED APR. 2, 1906.

4 SHEETS—SHEET 2.

Fig. 3.

Fig. 4.

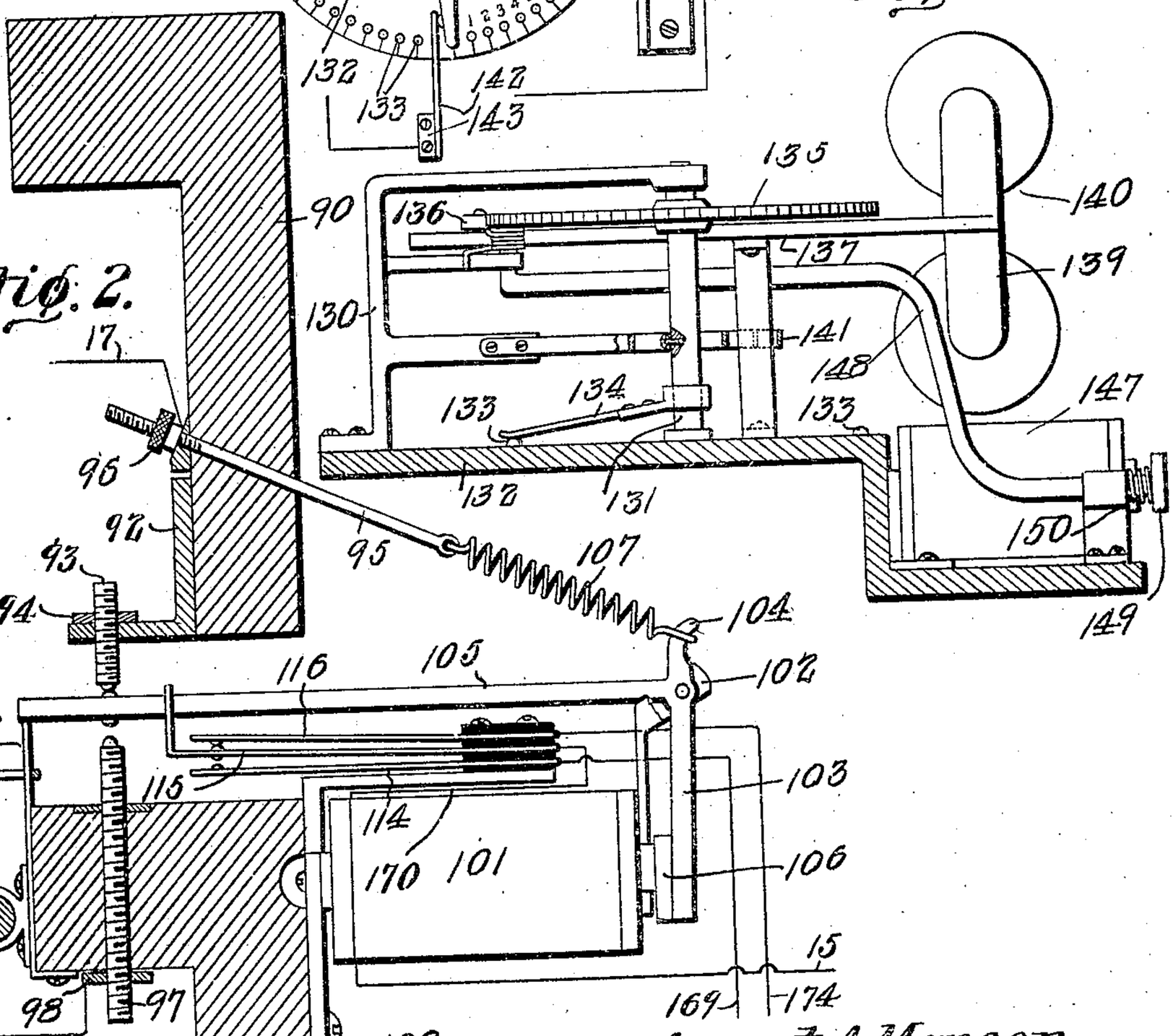


Fig. 2.

WITNESSES:

E. F. Stewart

Jno. E. Porter

August A. Monson,
INVENTOR.

By Cachow & Co
ATTORNEYS

No. 847,356. PATENTED MAR. 19, 1907.

A. A. MONSON.

AUTOMATIC TELEPHONE SWITCHBOARD.

APPLICATION FILED APR. 2, 1906.

4 SHEETS—SHEET 3.

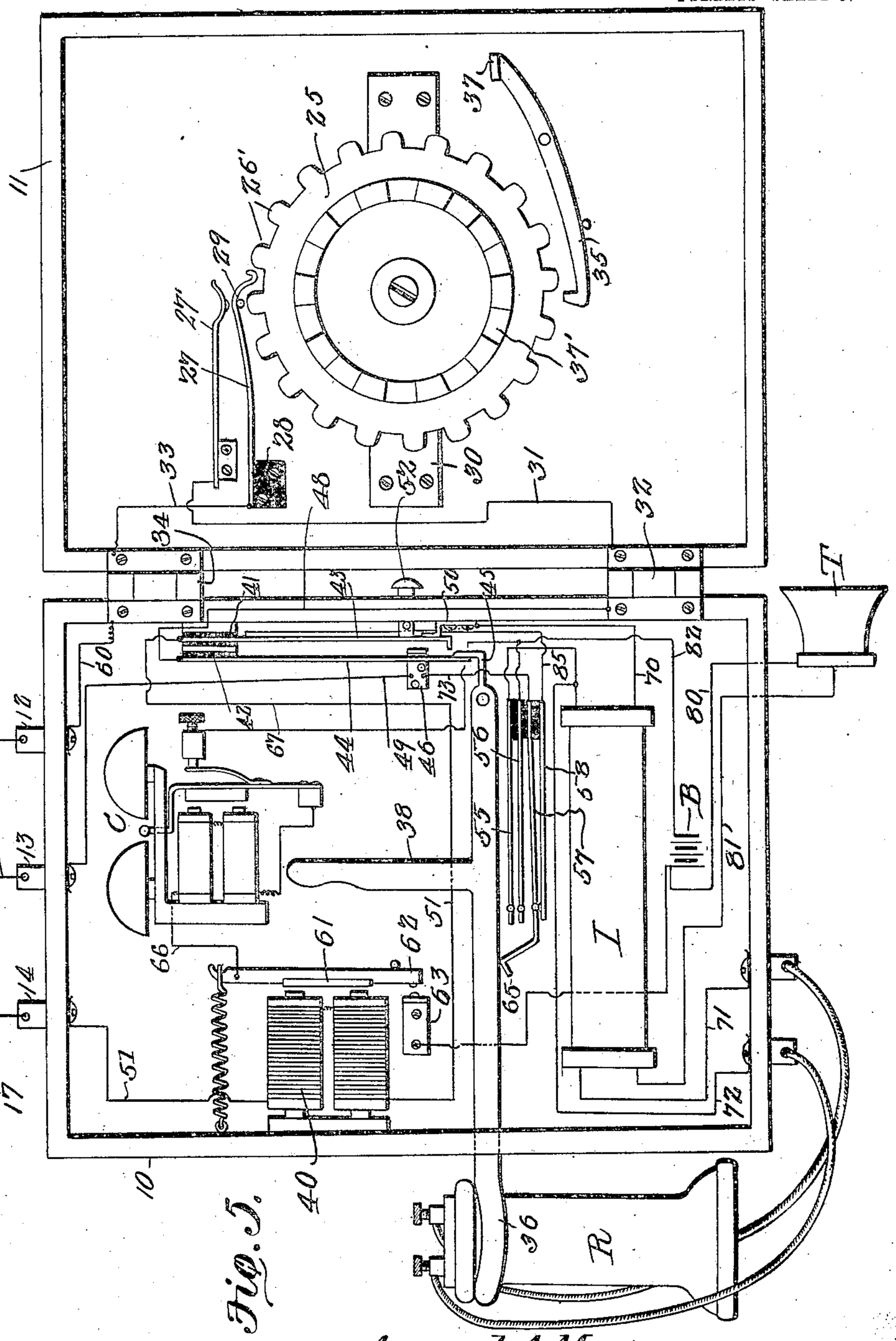


Fig. 5.

WITNESSES:

E. F. Stewart

Jno. E. Parker

August A. Monson, INVENTOR

By C. A. Snow & Co

ATTORNEYS

No. 847,356. PATENTED MAR. 19, 1907.

A. A. MONSON.

AUTOMATIC TELEPHONE SWITCHBOARD.

APPLICATION FILED APR. 2, 1906.

4 SHEETS—SHEET 4.

Fig. 6.

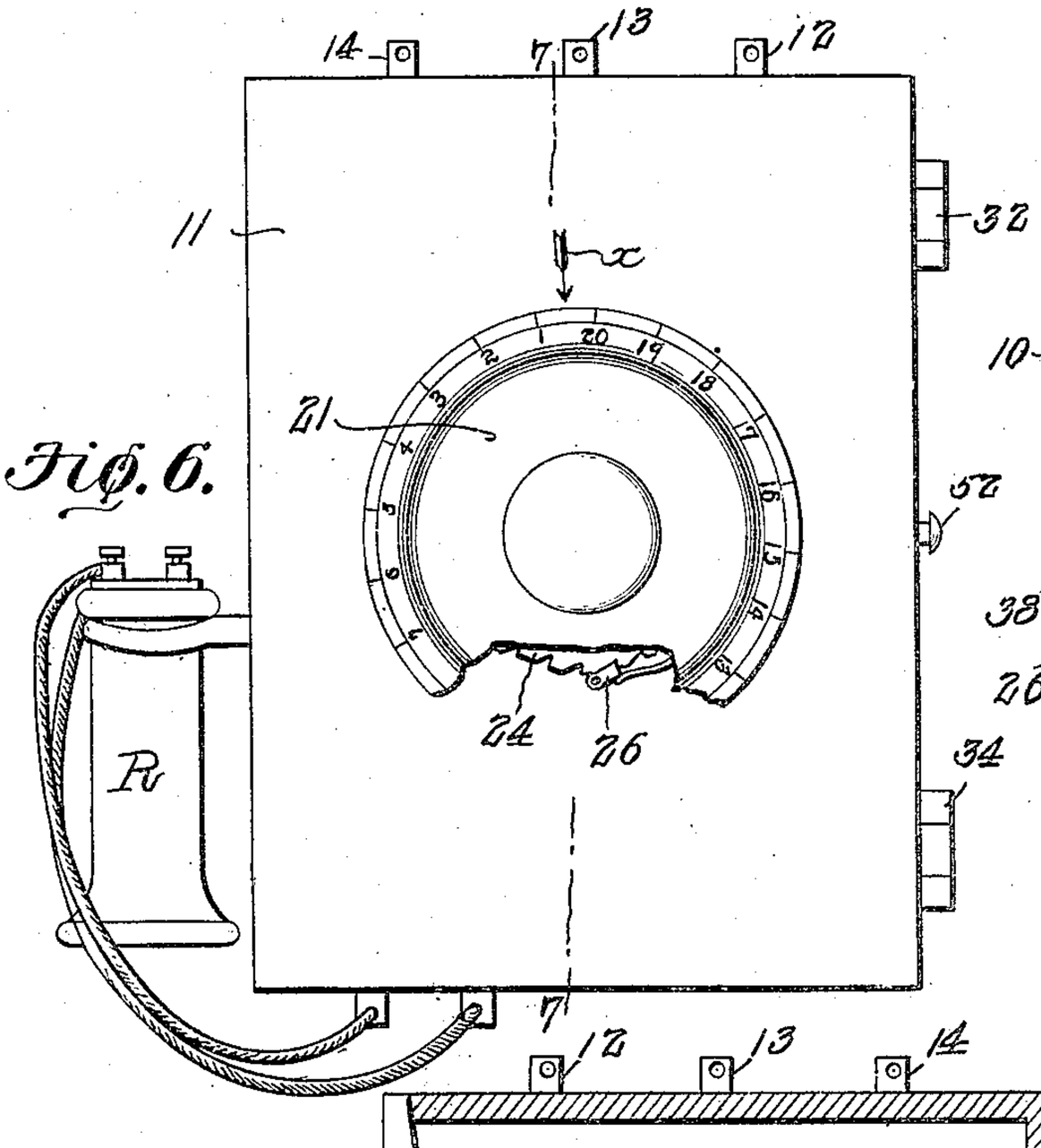


Fig. 7.

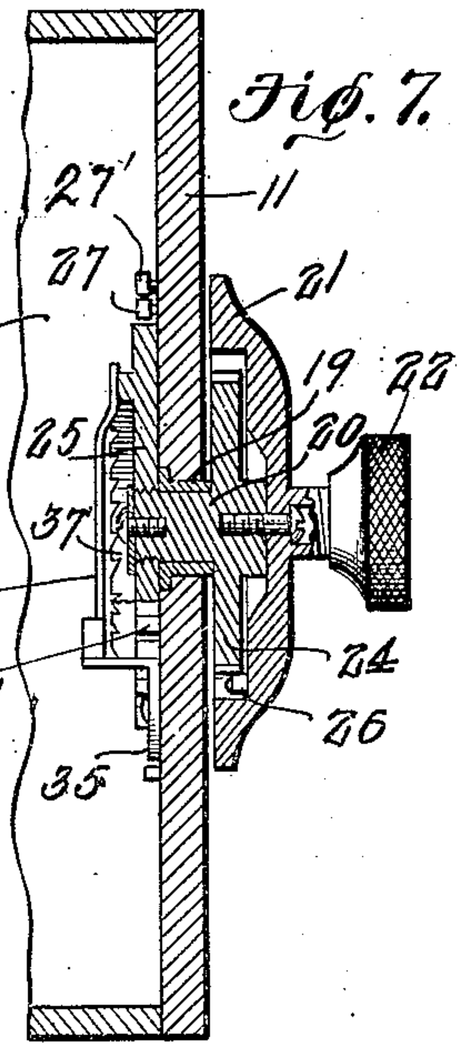
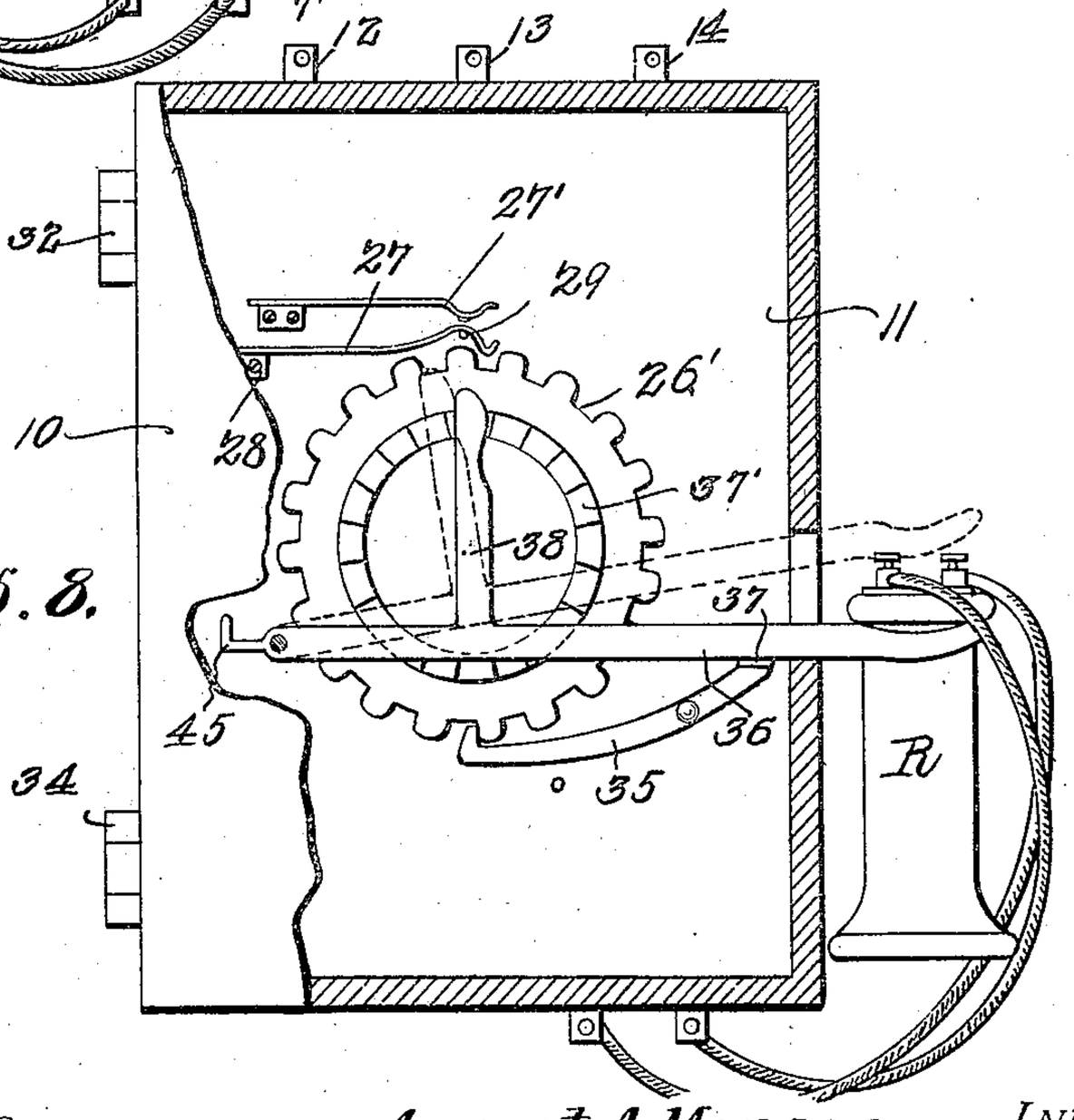


Fig. 8.



WITNESSES:

E. F. Hallenbeck

Jno. C. Parker

August A. Monson,

INVENTOR.

By Church & Co

ATTORNEYS

UNITED STATES PATENT OFFICE.

AUGUST ALVIN MONSON, OF MINNEAPOLIS, MINNESOTA.

AUTOMATIC TELEPHONE-SWITCHBOARD.

No. 847,356. Specification of Letters Patent. Patented March 19, 1907.

Application filed April 2, 1906. Serial No. 309,402.

To all whom it may concern:

Be it known that I, AUGUST ALVIN MONSON, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented a new and useful Automatic Telephone-Switchboard, of which the following is a specification.

This invention relates to telephone systems, and particularly to that class of systems wherein an automatic switchboard is employed at the central exchange to permit a subscriber at any substation to connect with any other substation without the intervention of an operator at the central station.

The principal object of the invention is to provide a system which may be installed at comparatively small initial expense and in which the operating mechanism is of very simple construction and will not require the services of an expert to maintain the same in working condition.

A still further object of the invention is to provide an automatic switchboard which may be built up in sections of a practically unlimited number and in which additional sections may be installed and connected from time to time as the system expands.

A still further object of the invention is to provide a system in which absolute privacy is insured without, however, permitting any one subscriber to monopolize the system, the mechanism being so arranged that any calling subscriber will control the section of the switchboard to which he is connected to the exclusion of all other calling subscribers in that section, but will not prevent any other subscriber in the same section from receiving a call from a subscriber of another section.

A still further object of the invention is to provide a mechanism of simple character connected by readily-traced circuits for insuring the automatic restoring of all parts of the mechanism to initial position as soon as a conversation is finished and the calling subscriber hangs up his receiver.

A still further object of the invention is to improve and simplify the calling mechanism and circuits of the subscribers, so that the call-bells or other sounders may be operated as distinctly at remote stations as at stations close to the central station.

With these and other objects in view, as will more fully hereinafter appear, the invention consists in certain novel features of construction and arrangement of parts hereinafter fully described, illustrated in the accompanying drawings, and particularly pointed out in the appended claims, it being understood that various changes in the form, proportions, size, and minor details of the structure may be made without departing from the spirit or sacrificing any of the advantages of the invention.

In the accompanying drawings, Figure 1 is a diagram illustrating a central-station switchboard and selecting mechanism arranged and constructed in accordance with the invention and showing also two substations connected to the central station. Fig. 2 is a detail sectional view of the main portion of the switchboard. Fig. 3 is a plan view of a selecting device arranged at the central station, parts being broken away in order to more clearly illustrate the construction. Fig. 4 is a front elevation of the same. Fig. 5 is an elevation of a switch-box of a substation, the door of the box being shown in open position in order that the wiring connections may be more clearly followed. Fig. 6 is a front elevation of the switch-box with the cover in closed position, parts being broken away to illustrate the construction of a selecting-disk. Fig. 7 is a transverse sectional view of the same on the line 7 7 of Fig. 6. Fig. 8 is a view looking at the inner face of the door of the switch-box, the switch-box proper being shown in section.

Similar numerals of reference are employed to indicate corresponding parts throughout the several figures of the drawings.

In order to arrive at a clearer understanding of the operation of the automatic switchboard at the central station, the construction and operation of the calling and circuit-controlling devices at each substation will be first described.

The switch-box 10 of each substation is provided with a hinged door 11, which is shown in open position in order to more clearly illustrate the construction and arrangement of the circuits and circuit-controlling mechanism, and at the top of the switch-box are arranged three binding-posts 12, 13, and 14, the binding-post 12 being connected to a signaling-line 15, which runs to the central station, the binding-post 13 being connected to a grounded wire 16 and the binding-post 14 being connected to a wire 17, which leads to the central station and is termed the "talking-wire." The central portion of the door 11 is provided with an opening for the recep-

tion of a sleeve 19, within which is mounted a spindle 20, the shaft being arranged to rotate independently of said sleeve. On the outer end of the spindle is loosely mounted a calling-disk 21, having an operating-knob 22 for convenience in turning the disk first in one direction and then in the other direction to send the number of impulses necessary to connect the calling-station to the called station. The periphery of this disk is graduated, and the graduations are provided with letters or numerals indicating the numbers of the several stations included in the system, and the disk in the present instance is shown as provided with twenty numerals, although the number may be increased or diminished.

The spindle 20 carries at one end a ratchet-wheel 24 and at the opposite end a toothed disk 25. The ratchet-wheel fits within the dished portion of the disk 21 and is engaged by a pawl 26, carried by said disk 21, so that when the disk is turned to the right the pawl will click over the teeth of the ratchet-wheel without turning the latter; but when the disk is turned to the left the movement will be transmitted through the pawl to the ratchet-wheel and shaft 19 and the disk 25 will also be turned. The ratchet-wheel 24 is provided with teeth of a number corresponding to the number of graduations on the disk 21, and the disk 25 also has a corresponding number of teeth or shoulders 26′, which may move into engagement with the end of a spring contact 27 for the purpose of raising said spring into engagement with a spring contact 27′ and closing the selecting-circuit.

The spring 27 is carried by an insulating-block 28, that is secured to the inner face of the door, and the free end of spring 27 is curved downward and normally lies in a space between two of the teeth 26′, but out of contact with the disk 25 and spring 27′, the selecting-circuit being normally broken. The downward movement of the contact 27 is limited by a stop-pin 29, that projects from the inner face of the door. To the inner face of the door is secured a plate 30, which serves as a reinforce or carrying member for the hollow sleeve 19. Leading from the door-hinges to the spring 27′ is a wire 31, while the spring contact 27 is connected to a wire 33, leading to a second hinge 34. In operating this part of the mechanism the highest numeral "20" of the calling-dial normally stands in a position opposite an indicator or pointer x and the spring contact 27 is normally opposite one of the spaces between the teeth 26′ of the selecting-disk. When a subscriber wishes to call a substation—for instance, substation 5—he grasps the knob 22 and turns the disk 21 to the right until the numeral "5" of the disk is opposite the indicator x. During this movement the pawl 26 clicks over the teeth of the ratchet-wheel 24; but the ratchet-wheel and the selecting-disk are held stationary by a locking-pawl 35, pivoted to the inner face of the door and under the control of the receiver-hook 36, which when depressed by the weight of the receiver R engages an arm 37, projecting from the pawl 35, and presses the toothed inner end of the pawl between two of the teeth of the selecting-disk. The subscriber then removes his receiver from the hook and the latter is elevated in the usual manner, and as the inner end of the locking-pawl 35 is much heavier than that end which engages the receiver-hook it will move by gravity from engagement with the selecting-disk, whereupon the subscriber turns the dial 21 to the left and the pawl 26 engages the teeth of the ratchet-wheel 24, turning the latter and the selecting-disk 25, and the teeth 26′ of said disk pass successively under the spring contact 27, making and breaking the selecting-circuit five times, corresponding to the number of the station to be called, and at the completion of this movement the contact-spring 27 rests in contact with one of the teeth of the selecting-disk and contact 27′ and remains in that position until the conclusion of the conversation.

Projecting from the inner face of the selecting-disk is a crown ratchet-wheel 37′, having teeth of a number corresponding to the number of teeth of the selecting-disk, and the teeth of this ratchet-wheel are arranged to be engaged by an arm 38, projecting upward from the receiver-hook 36, these parts being so proportioned and arranged that when the receiver is once more hung on the hook the arm 38 in moving downward will engage one of the teeth of the crown-ratchet 37′ and will turn the selecting-disk for a distance to half the space between two adjacent teeth, this movement being sufficient to break the connection between the spring contacts 27 and 27′ and restore the parts to initial position with the selecting-circuit broken. In this connection it may be observed that it is necessary to send to the central station a number of electrical impulses corresponding to the number of the station to be called, and should the number of that station be greater than the highest number of the disk the disk may be turned more than a single revolution. For instance, if the station to be called is number "107" the calling-disk 21 will be turned to the left to the extent of five complete revolutions, and as each revolution of the disk means twenty makes and breaks five revolutions would be equal to one hundred impulses sent over the selecting-line, and then the operator turns the disk to the right until the number "7" appears on the indicator x and then to the left until the highest number is again under the indicator x, so that one hundred and seven impulses

are sent to central station and substation 107 will be automatically connected by the mechanism at the central station.

At each of the substations is a transmitter T, an inductorium I, a call-bell C, and a relay 40, the latter being so connected in the line that when a calling-circuit is closed it will connect the call-bell with the local battery B, so that the bells of all stations will ring, no matter how remote they may be from the central station.

Within the switch-box are arranged two blocks 41 and 42, formed of insulating material and carrying circuit-closing strips 43 and 44, that are insulated from each other. The lower end of the strip 44 is arranged in the path of movement of an upwardly-bent arm 45, that is carried by the inner end of the switch-hook 36, so that when the receiver is on the hook this arm engages the contact 44 and holds it out of engagement with a contact 46, that is secured within the switch-box. When the receiver is removed from the hook, the arm 45 descends and the contact 44 is allowed to engage contact 46. This contact 44 is connected by a wire 48 with the hinge 32, and the contact 46 is connected by a wire 49 to the ground binding-post 13. The contact 43 normally engages a stationary contact 50, that is secured within the switch-box, and said contact 43 is connected by a wire 51 to the relay-magnets 40, the wire being thence continued to the binding-post 14 of the talking-wire. At one side of the telephone-box is a push-button 52, extending through an opening in the side wall of the box and arranged to engage the contact 43 and press the same into engagement with the contact 44, and as a result of this contact 43 is moved out of engagement with contact 50 and contact 44 is moved out of engagement with the contact 46.

Arranged below the receiver-hook 36 are four spring contacts 55 56 57 58, the free end of the contact 57 being bent upward and being engaged by the receiver-hook when the latter is depressed by the weight of the receiver, and when the receiver-hook is down the contact 57 is forced into engagement with the contact 58, while the contacts 55 and 56 are wholly disconnected. Tracing now the selecting-circuit from ground at the substation to wire 16, binding-post 13, wire 49, contact 46, (receiver removed from hook,) contact 44, wire 48, hinge 32, wire 31, contact-spring 27′, spring 27, wire 33, hinge 34, wire 60, binding-post 12, wire 15, central station, and at the central station through the automatic selecting mechanism and a battery to ground. The selecting impulses having been sent and the spring 27 being allowed to remain on one of the teeth 26′ of the selecting-disk, the subscriber at the calling-station presses the button 52 and forces the contact 43 into engagement with the contact 44, thus moving contact 43 from contact 50 and contact 44 from contact 46. This completes a circuit from the battery and signaling mechanism at central through wire 15, binding-post 12, wire 60, hinge 34, wire 33, contact 27, contact 27′, wire 31, hinge 32, wire 48, contact 44, contact 43, wire 51, the electromagnets of relay 40, and out through binding-post 14 and the talking-wire 17 back to the central station and from thence, as will be hereinafter described, through the similar circuits of the called subscriber in order to energize the relay-magnets 40 of both the calling and the called stations. When the relay-magnets are energized, each magnet attracts its armature 61 and the armature-lever 62 moves over against the contact 63, that is carried by the casing, and this closes a local circuit through the call-bell C, which may be traced from the battery B through wire 65, contact 63, armature-lever 62, wire 66, the electromagnets of the call-bell and call-bell frame to wire 67, back to battery, and this system is followed in each of the substations, so that no matter how remote the station may be from central the call-bell will be sounded with sufficient distinctness to be heard. After pressing the button if the call-bell of the calling-station is sounded the subscriber knows that the call-bell of the called station has also sounded and that he is connected; but if the bell fails to sound he is informed that the line is busy and that he cannot be connected at that time.

In following the talking-circuit from the talking-wire 17 it will be seen that the current will flow through binding-post 14, wire 51, and the relay-magnets to the spring contact 43, contact 50, wire 70 to the secondary of the inductorium, wire 71, receiver R, wire 72, contact 55, contacts 56 57, wire 73, contact 46, wire 49, binding-post 13, and to ground by wire 16, the connections at the other substation being completed in a similar manner.

The primary circuit may be traced from battery B through wire 80, transmitter T, thence by wire 81 to the primary of the inductorium, wire 72, contact 55, (receiver-hook elevated,) contact 56, wire 82, to battery. When the receiver-hook is down, contacts 55 and 56 are disconnected and the primary circuit is broken. When the receiver-hook is down, the line is open to receive a calling-signal from the talking-wire 17, binding-post 14, wire 51, the electromagnets 40 of the relay, contact 43, wire 85, contact 58, contact 57, wire 73, contact 46, wire 49, binding-post 13, and wire 16 to ground.

The switchboard at the central station is divided into sections, each section comprising a frame which may be made in two parts 90 and 91, or these parts may be formed integral and provided with suitable openings for the several circuit-controlling levers which pass through the frame. Each section is ar-

ranged to control a certain number of substations—for instance, ten stations—and the sections may be arranged and connected in any suitable manner and additional sections added as may be necessary from time to time. The member 90, which is formed of insulating material, carries on its front face a metallic angle-bar 92, through which extends a contact-screw 93, which may be adjusted and then locked in position by a nut 94, and there is one of such screws for each substation. Extending through the member 90 is a threaded rod 95, of which there is one for each substation, and the talking-wire 17, leading from the substation, is connected to this rod and is confined in place by a binding-nut 96. The lower member 91 of the switchboard-section, which is also formed of insulating material, carries a screw contact 97, that is in vertical alinement with the contact 93, but is spaced therefrom. This contact 97 may be locked in place by a nut 98, that also serves to connect a wire 99, that leads to the selecting mechanism proper, there being a separate wire 99 for each substation.

To the inner face of the portion 91 of the switchboard is connected a frame 100, that carries an electromagnet 101, there being one frame and one electromagnet for each substation. The outer portion of the magnet-frame has an upwardly and forwardly extending arm 102, to which is pivoted a lever having three arms 103, 104, and 105, the downwardly-extending arm 103 carrying an armature 106, that is disposed within the field of force of the magnet, while the arm 104 is connected to the threaded rod 95 by a metallic spring 107, that serves normally to hold the armature away from the poles of the magnet. The third arm 105 is arranged to play between the contact-screws 93 and 97 and is normally held in engagement with the contact 97 by the stress of the spring 107; but when the armature 106 is attracted by the electromagnet the arm 105 moves upward, breaking the circuit with contact 97 and engaging contact 93 to close another circuit. When the arm 105 moves up, a spring retaining-arm 109 moves under its outer end and holds said arm in the elevated position, and the arm 105 cannot return until the retaining-arm 109 is drawn outward to release position. A separate retaining-arm 109 is employed for each of the arms 105, and all of these retaining-arms may be engaged by yoke-shaped rocker-arms 110, carried by a rock-shaft 111, that is journaled at the front portion of the frame and is provided with a laterally-extending armature 112, that is disposed within the field of force of an electromagnet 113 at the front of the board. During a certain stage of the operation this electromagnet will be energized and the armature 112 will be attracted, rocking the shaft 111 and all of the arms 110, so that all of the retaining-arms 109 will be drawn outward to release the arms 105. During the initial operation of the device only one of the arms 105 will be locked in elevated position at one time, and the releasing mechanism is so arranged as to control all of them.

The frame 100 forms a support for three spring contact-arms 114 115 116, that are insulated from the frame and from each other. The intermediate contact-arm 115 is bent upward at its free end and extends over the arm 105. Normally this intermediate contact-arm engages the contact 114; but when the arm 105 is raised it carries with it the arm 115, and the latter moves into engagement with the arm 116, closing the circuit through said arm 116 before the circuit is broken at the arm 114; but as the movement is continued the arm 115 finally leaves and breaks circuit with the arm 114, the object being to transfer or shunt the circuit without any abrupt break in so doing.

To the rear of the switchboard member 91, generally at one end of the switchboard-section and occupying a position similar to the electromagnets 101, is arranged a relay-magnet 120, which in the diagram is shown as removed from position in order that the electrical connections may be more readily traced. The frame of this magnet carries an upwardly and forwardly extending arm 121, on which is pivoted a lever having two arms 122 and 123. The arm 122 carries an armature 124, arranged within the field of force of the electromagnet 120, while the arm 123 is arranged to play between a contact-screw 125 and a stop-screw 126. Normally the arm 123 is in engagement and closing circuit with the contact-screw 125; but when the electromagnet is energized and the armature is attracted the arm 123 is elevated into engagement with the stop 126, and at the same time a retaining-arm 109′ engages under said arm and holds it in elevated position. This retaining-arm 109′ is under the control of a yoke-shaped releasing-arm 110′, that is secured to the rock-shaft 111 and is operated together with the arms 110, each time said rock-shaft 111 is moved by its operating-magnet 113. There is also at the central station a selecting device in the form of a step-by-step circuit-closing mechanism, the selecting device being preferably arranged on a horizontal table in front of the switchboard. On this table is mounted a suitable frame 130, having bearings for a vertically-disposed shaft 131, the lower portion of which extends through a dial-plate 132, formed of insulating material and provided with equidistantly-spaced contact-buttons 133, of which there may be any desired number, said buttons being arranged in an annular series and each being independently connected to one of the contact-screws 97 by a wire 99, there being one contact-screw, one

wire, and one contact-button 133 for each substation. The shaft 131 carries a contact-arm 134, which is arranged to move over the contact-buttons and engage therewith to close circuits through any one of the wires 99 and contact-screws 97.

To the upper portion of the shaft 131 is secured a ratchet-wheel 135, which has teeth of a number corresponding to the number of contact-buttons 133, and with this ratchet-wheel engages a spring-pressed pawl 136, that is carried by a lever 137, pivoted on a pin or stud 138, carried by the frame 130. At that end of the lever opposite the pawl is an armature 139, that is disposed within the field of force of an electromagnet 140, and the latter is connected to the selecting-circuit, as hereinafter described, in such manner that each time the selecting-circuit is closed the electromagnet will be energized and will attract the armature-lever, thereby advancing the ratchet-wheel and the contact-arm 134 a single step, and the number of steps which the contact-arm moves depends on the number of the station to be called. To the shaft 131 is secured the inner end of a spiral spring 141, the outer end of which is secured to the frame 130, and during the selecting movement of the arm 134 the spring is placed under stress, and when released the unwinding of the spring serves to return the ratchet-wheel and contact-arm to initial position, this position being determined in the present instance by engagement of the arm 134 with a spring-contact 142, that is carried by an insulating-block 143, said contact serving not only as a stop, but also as a means for closing a circuit through certain other mechanism to insure the restoration of all of the parts to initial position in readiness for a subsequent operation. During the selecting movement the ratchet-wheel 135 is held from reverse movement by a retaining-pawl 145, that is mounted just within the line of the pawl 136.

Below the electromagnet 140 is arranged an electromagnet 147, and between the spools of this magnet is guided a rod 148, carrying an armature 149, disposed within the field of force of the electromagnet, the armature being normally held outward from the poles of the magnet by a spring 150. The opposite end of the rod 148 is arranged in alinement with the two pawls 136 and 145, and after the completion of a selecting operation and the finishing of the conversation the electromagnet 147 is energized, its armature 149 is attracted, and the rod 148 is moved in the direction of the pawls, moving both pawls from engagement with the ratchet-wheel and allowing the spring 141 to restore the ratchet-wheel, the shaft, and the contact-arm 134 to initial or zero position. The pawl-carrying end of the lever 137 is arranged to engage a contact 152 when at rest, said contact being carried by a metallic plate 153, which is electrically connected by a wire 154 to a contact 155. Below the contact 155 is an armature-lever 156, pivoted on a standard or frame 157 and carrying a suitable armature 158, the latter being disposed within the field of force of an electromagnet 159. Normally the armature-lever 156 is held down out of engagement with the contact 155 by a catch 160, that is formed at the upper end of an armature-lever 161. The armature-lever 161 carries an armature 162, that is disposed within the field of force of an electromagnet 163 and normally is held outward from the poles of the magnet by a spring 164. A line-battery 166 and a local dry battery 167 complete the central-station system, and the circuits may now be traced.

When a circuit is closed through the selecting-disk 25 and contact 27 at any substation, a circuit may be traced from the battery 166 through wire 167, electromagnet 140, wire 168, contact-screw 125, arm 123, wire 169, contact 114, contact 115, wire 170, electromagnet 101, wire 15, through the previously-described mechanism at the substation to contact 27, contact 27′, ground-wire 16 to ground and from ground at the central station through wire 171 to battery 166. The first effect of this closing of the circuit is to energize the electromagnet 140, which attracts the armature 139 and moves lever 137, the pawl 136 advancing the ratchet-wheel one step and the contact-arm 134 moving from zero position into contact with button No. 1 of the series of contact-buttons 133. The circuit is also completed through the electromagnet 101, and this attracts the armature 106, moving the three-armed lever 103, 104, and 105. The arm 105 in rising moves from engagement with the contact-screw 97 into engagement with the contact-screw 93, and thereupon the locking-arm 109 moves in under the arm 105 and locks the same in elevated position, preventing its return until after all the parts are ready to resume initial position. During the upward movement of the arm 105 it carries with it the upbent arm of the contact 115; but contact 115 does not abruptly break circuit with contact 114, but, on the contrary, the arm 114 will follow up the contact 115 until the latter is in engagement with the contact 116, and on slight further movement contact 115 will move from contact 114 and break the circuit with the latter, and thus shift or shunt the circuit without breaking the flow of current.

It is to be here remarked that all of the contact-strips 114 are connected in multiple with the wire 169, so that if the circuit through wire 169 is broken no other substation can close circuit through it until the circuit has first been restored by the subscriber making the first call. In accomplishing this result the breaking of contacts 114 and 115 is

the first step, and as the current can no longer flow from wire 168 through contact-screw 125, arm 123, wire 169, and contact 114 to contact 115, it must seek another course, and this is provided for by wire 173, which leads from contact-screw 125 to electromagnet 120, and from thence leads a wire 174 to contact 116, and as the latter is in engagement with contact 115 the circuit is completed through wire 170, electromagnet 101, and wire 15 back to the substation. As soon as arm 123 rises it is locked in elevated position by the arm 109′, and while this arm remains in elevated position the circuit of wire 169 of that section of the switchboard is wholly disconnected, and no other subscriber can close a circuit through the same or otherwise interfere with the substation making the first call. Another feature of the shunt of the circuit from contact 114 to contact 115 is that there is no interference with the sending of the impulses from the selecting-disk 25 at the substation, and as said selecting-disk is turned and the circuit is alternately made and broken the pawl 136 will advance the ratchet-wheel and the contact-arm 134 will finally stop in engagement with that contact-button representing the number of the substation to be called and will remain there until the conversation is finished, while the contact 27 will, as previously described, remain in electrical contact with contact 27′. A circuit is now closed from the calling-station to the central station and from the central station to the called station, it being premised that the subscriber at the calling-station has removed his receiver from the hook and is pressing on the button 52 for the purpose of ringing the call-bells of both stations. Starting at the battery 166 of the central station, the current flows through wire 167, electromagnet 140, wire 168, wire 173, electromagnet 120, wire 174, contact 116, contact 115, wire 170, electromagnet 101, wire 15 to the calling-circuit, entering at binding-post 12, through wire 60, hinge 34, wire 33, contact 27, spring-contact 27′, wire 31, hinge 32, wire 48, contact 44, contact 43, wire 51, relay-magnet 40, binding-post 14, talking-wire 17 to central station, where it is connected to the rod 95 belonging to the calling-station, and from thence through spring 107, arm 104, arm 105, contact-screw 93, angle-bar 92, wire 180, electromagnet 163, wire 181, wire 182 to frame 130 of the selecting device. From thence the circuit continues through the shaft 131, contact-arm 134 to the contact-button 133 of the called station. From thence through wire 99, contact-screw 97, arm 105, arm 104, spring 107, rod 95, and wire 17 to the called station, where it enters at binding-post 14, through wire 51, relay-magnet 40, wire 51, contact 43, wire 85, contact 58, contact 57, wire 73, contact 46, wire 49, binding-post 13, wire 16 to ground at the called station, back through ground to the central station, and through wire 171 to battery 166 at the central station. This completes the circuit in which the relay-magnets 40 are connected, and said magnets are energized, attracting their armatures 61 and closing the local call-bell circuits of both calling and the called stations. If the bell of the calling-station does not sound, the subscriber is informed that the line is busy.

It is to be here noted that the current must flow continuously through the electromagnets, especially the electromagnet 140, after the selecting device has been moved to make connection with the contact-button of the called station, as any subsequent make and break would shift the contact-spring 134 to the next station. It is therefore essential that in moving the spring 43 by means of the push-button 52 that there be no interruption in the current, and spring 43 therefore engages and closes circuit with the contact-spring 44 before the latter moves from the grounding contact 46, the current being thus shifted or shunted without any abrupt break. The called subscriber now removes his receiver from the hook, and this allows contact 44 at the called station to engage the grounding contact 46. The operator at the calling-station releases the push-button 52, and the contact 44 engages the grounding contact 46 at the calling-station.

Before describing the talking-circuit it will be well to note the effect of the first closing of the calling-circuit. When this circuit is established through wire 180, the electromagnet 163 is energized and attracts the armature 162. This pulls the armature-lever 161 over and releases the catch 160 from engagement with the armature-lever 156, whereupon the spring 190 of the latter moves said lever up into engagement with the contact 155, and at the same time a contact 191, carried by the armature-lever 161, engages the contact 192 of the frame 193 of the electromagnet 163. When the armature-lever 156 moves up, it locks the lever 161 over in engagement with the contact 192. From the frame 193 of the electromagnet leads a wire 196, which is connected to the electromagnet 159 and thence to the electromagnet 113. From the electromagnet 113 leads a wire 198 to the local battery 167, and to this battery is connected the wire 182, which leads to the frame 130 of the selecting device. From the carrying-block 143 of the stop member 142 of said selecting device leads a wire 199 to the contact 191, and it will thus be seen that a circuit which includes both the electromagnets 113 and 159 is partly closed and simply awaits the return of the selecting-arm 134 to zero position to fully close a circuit which will energize such magnets. Another circuit which is partly closed may be traced from the battery 167′ through the

wire 182 to the frame 130 of the selecting device, the pawl-carrying lever 137, contact 152, (broken at this point while the electromagnet is energized,) block 153, wire 154, contact 155, armature-lever 156, frame 157, wire 200, the pawl-releasing magnet 147' wire 201, electromagnet 113, wire 198 back to battery, so that there are two circuits only waiting the closing of single connections to restore all of the central-station apparatus to initial position.

In tracing the talking-circuit we may start from ground at the calling-station through wire 16, binding-post 13, wire 49, contact 46, wire 73, contact 57, contact 56, contact 55, through the wire 72 to the receiver, wire 71, the secondary of the inductorium, wire 70, contact 50, contact 43, wire 51, relay-magnet 40, binding-post 14, talking-wire 17 to central station, rod 95 of the calling-station, spring 107, arm 104, arm 105, contact-spring 93, flange 92, wire 180, electromagnet 163, wire 181, wire 182, the frame 130 of the selecting device, shaft 131, selecting-arm 134, the contact-button 133 of the called station, wire 99, contact-screw 97 of the called station, arm 105, spring 107, rod 95, wire 17 of the called station, entering at binding-post 14, relay-magnet 40, wire 51, contact 43, contact 50, wire 70, the secondary of the inductorium, wire 71, receiver, wire 72, contact 55, contact 57, wire 73, contact 46, wire 49, binding-post 13 to ground at the called station. The primary circuits of the calling and called stations have been previously described and are connected in the usual manner. After the conversation is finished the calling subscriber hangs the receiver on the hook. This carries the cam-shaped end of the arm 38 against one of the teeth of the crown ratchet-wheel 37', and the latter is turned, together with the selecting-disk 25, to the extent of half a tooth, so that the contact-spring 27 moves down into engagement with the stop 29 and now rests at a point opposite a space between two of the teeth 26' of the selecting-disk, and the circuit is broken. At the same time the descent of the receiver-hook moves the pawl 35 up into engagement with the selecting-disk, so that the latter cannot be again turned until the receiver is removed from the hook.

The first effect of the breaking of the circuit will be to release the lever 137, whereupon the pawl-carrying end of the lever will be moved into engagement with the contact 152, and the circuit will be closed, as previously described, from battery 167', through wire 198, electromagnets 113, wire 201, electromagnets 147, wire 200, frame 157, armature-lever 156, contact 155, wire 154, contact 152, pawl-carrying lever 137, frame 130, wire 182, back to battery. The electromagnet 113 is energized and attracts the armature 112, thus rocking the shaft 111, and the yoke-like arms 110 pull all of the locking-arms 109 and the locking-arm 109' outward, releasing the arm 105, belonging to the calling-station, and the arm 123 of electromagnet 120. These members then move down to initial position, arm 105 engaging the contact-screw 97 and arm 123 engaging the contact-screw 125. At the same time the electromagnet 147 is energized and attracts the armature 149, pushing rod 148 in such manner as to release both pawls 136 and 145, so that the spring 141 may restore the ratchet-wheel and the selecting-arm 134 to zero position. As soon as the selecting-arm 134 strikes the combined stop and contact 142 a path of less resistance is provided for the current, and it will now flow from the battery 167', through the wire 198, electromagnets 113, wire 196, in which electromagnet 159 is connected, to frame 193, contact 192, contact 191, wire 199, block 143, contact 142, selecting-arm 134, frame 130, and wire 182, back to battery. This energizes the electromagnet 159, and armature 158 is attracted, drawing down the armature-carrying lever 156 from engagement with the catch 160, whereupon the spring 164 moves the armature-carrying lever 161 to the right, and the catch 160 engages and locks the armature-carrying lever 156. As soon as the contacts 191 and 192 are separated the circuit through the several electromagnets is broken and the armature 112 is free to move from the electromagnet 113, and the rock-shaft and yoke-like arms 110 resume normal positions in readiness for another operation. It will be seen that as soon as any subscriber makes a call he obtains exclusive control of that section of the switchboard to which he is connected, and as soon as he accomplishes the breaking of the circuit through the wire 169 no other subscriber can close the circuit therethrough and interfere with the call. At the same time any other subscriber connected to that section of the switchboard may receive a call, as connection may be made through any of the wires 99 and contact-screws 97 to the talking-wires of the other substations.

In ordinary telephone systems employing a central battery of sufficient strength to reach the stations at the greatest distance from central it is usual to place sufficient resistance in those connections nearest central in order to prevent burning out. In carrying out the present invention, however, auxiliary batteries are employed in the long branches, these being of the same polarity as the main-line battery and their strength being added to that of the main battery when calling over lines of great length. This results in considerable saving in battery power and does away with the resistance-coils.

I claim—

1. In telephony, a number of substations, a central station, a selecting and circuit-

closing means at the central station, means at each substation for operating the selecting means to connect a calling-station to a called station, signaling and talking wires connecting the substations and the central station, a switchboard at the central station, a series of contacts carried by the switchboard, there being an independent contact for each substation, an electromagnet controlling the movement of each contact, the signaling-wire being connected in multiple to all of said electromagnets, and contacts arranged to break such multiple connection on the sending of a signal by any substation, whereby circuit may be closed through but one of said electromagnets.

2. In an automatic central-telephone-exchange mechanism, a series of independent contacts, there being one contact for each substation, an independent electromagnet controlling the movement of each contact, a calling-circuit having a multiple connection with all of said electromagnets, and means for breaking the multiple circuit when any one electromagnet is energized, thereby preventing the energizing of any of the remaining electromagnets.

3. In automatic central-station telephone mechanism, a switchboard having talking-circuit contacts for each substation, an electromagnet having an independent calling wiring connection with each substation, a movable contact under the control of said electromagnet and arranged to close the talking-circuit of a calling-station, a single calling-wire arranged at the central station and connected in multiple to all of the electromagnets, and means for breaking circuit through said single calling-wire after any one of the electromagnets has been energized.

4. In automatic central-exchange telephone systems, a switchboard, a plurality of movable circuit-closing members, an independent talking-wire connecting each circuit-closing member to a separate substation, an electromagnet controlling the movement of each circuit-closing member, an independent calling or selecting wire extending from each substation to the electromagnet, a central battery-wire connected to all of said electromagnets to complete the calling or signaling circuits, and an electromagnetically-controlled circuit-breaker for breaking the battery-wire when any one electromagnet has been energized to prevent the energizing of any of the other electromagnets.

5. In automatic central-station telephone systems, a switchboard, movable circuit-closing devices carried thereby, there being an independent circuit-closing device for each substation, a talking-wire extending from the circuit-closing device to the substation, an electromagnet for controlling the movement of said circuit-closing device, an independent signaling-wire extending from each substation to its electromagnet, a conductor leading from a central-station battery to all of said electromagnets, said conductor including an armature-lever, and a pair of contacts, one of which is connected to, and moves with the movable circuit-closing device, the circuit being primarily broken when said circuit-closing device receives its initial movement, and a second circuit including an electromagnet arranged to operate said armature-lever, and through which the circuit is closed on movement of said circuit-closing device, thereby moving the armature-lever and breaking the initial calling-circuit to prevent the energizing of more than one of said electromagnets at one time.

6. In an automatic central-station telephone system, a switchboard, a plurality of movable circuit-closing devices, of which there is one for each substation, talking-wires independently connecting the circuit-closing devices to the substation, a selecting means arranged at the central station and provided with a series of spaced contacts, contact members arranged adjacent to the circuit-closing devices and independently connected to the contacts of the selecting mechanism, a movable contact forming part of the selecting mechanism and arranged to engage the series of spaced contacts, an electromagnet for actuating said movable contact, a plurality of contacts arranged over the circuit-closing devices and having a multiple connection with the movable circuit-closer, an independent electromagnet controlling the movement of each circuit-closing device, and an independent calling and selecting circuit extending from each substation through both of said electromagnets.

7. In telephony, a central station, substations, independent talking and signaling wires connecting each substation to the central station, a movable circuit-closer connected to each independent talking-wire, a pair of contacts arranged one above and one below each circuit-closer, a selecting device including a series of contacts that are independently connected to the lower contacts, a revolubly-mounted contact-arm arranged to engage the series of contacts, said arm being connected electrically to all of the uppermost contacts, an electromagnet for actuating said revoluble contact-arm, an electromagnet for each circuit-closer, the signaling-wire of the substation being connected to both electromagnets, and the energizing of the electromagnet of the circuit-closer moving the latter from a normal position in engagement with the lower contact to a position in engagement with the upper contact, whereby connection may be established from a calling-station through the circuit-closer, the upper contact, the selecting device, the lower contact of a called station, and through the cir-

cuit-closer and talking-wire of said called station.

8. In telephony, substations, and a central station, a switchboard at the central station, circuit-closers carried by the switchboard, an independent talking-wire leading from each substation to one of the circuit-closers, upper and lower contacts in alinement with the circuit-closer, the latter being normally in engagement with the lower contact, an electromagnet for operating each circuit-closer and moving the same from engagement with the lower contact into engagement with the upper contact, a selecting device including a movable contact-arm that is electrically connected to all of the upper contacts, a series of contact-points carried by the selecting device and each independently connected to one of the lower contacts, an electromagnet for moving the selecting device, a signaling-wire extending from each substation and connected to both electromagnets whereby the talking-wire of a calling-station may be connected through its circuit-closer to the upper contact, and from thence through the selecting device to the lower contact of a called station, and means for automatically breaking a portion of the singaling-circuit to prevent the energizing of more than one of the electromagnets of the circuit-closers at any one time.

9. In telephony, substations and a central station, a switchboard, independent circuit-closers carried by the switchboard, a talking-wire connecting each substation to its circuit-closer, upper and lower contacts between which each circuit-closer may move, said circuit-closer being normally in engagement with the lower contact, an electromagnet for moving said circuit-closer from engagement with the lower contact into engagement with the upper contact, means for locking a raised circuit-closer in engagement with the upper contact, a selecting device including a series of contacts that are independently connected to said lower contacts, and a revoluble contact-arm that is electrically connected to all of the upper contacts, an electromagnet for actuating the selecting device, a calling and selecting circuit extending from each substation through both of the electromagnets, and means for moving the locking means to release position when the circuits are broken.

10. In telephony, substations and a central station, a switchboard, a plurality of electromagnetically-operated contacts, of which there is one for each of the substations, an independent talking-circuit for each substation, the talking-circuits being under the control of said contacts, an independent signaling and selecting wire extending from each substation to the electromagnet, a battery arranged at the central station, and one pole of which is connected to the ground, a single conductor leading from the opposite pole of the battery to all of the electromagnets, and means for breaking or shifting the circuit through said single conductor when any one of the electromagnets is energized to prevent the energizing of any of the other electromagnets.

11. In a central-station mechanism for automatic telephone systems, a switchboard, a pair of alined upper and lower contacts supported thereby, an electromagnet, an armature-lever arranged to move between the two contacts, and normally in engagement with the lower contact, a locking-strip for engaging and holding said armature, lever in elevated position, means for releasing the locking member, three superposed contact-strips, the central strip being connected in the circuit of the electromagnet and having one of its ends connected to and movable with the armature-lever, the remaining contacts being both connected to a source of energy, the central contact-strip normally engaging the lower contact-strip when the armature-lever is depressed, and thereby closing the electromagnet-circuit, said central contact-strip being arranged to engage and close circuit with the upper contact-strip as the armature-lever moves upward without abruptly breaking circuit with the lower contact-strip.

12. In central-station mechanism for automatic telephone systems, a circuit-controlling device comprising an electromagnet, an armature disposed within the field of force of the electromagnet, a lever carrying said armature, a contact with which said lever engages when the electromagnet is deënergized, a battery-circuit that is closed through said contact and armature-lever when the magnet is deënergized, a shunt-circuit extending through the electromagnet, and means for breaking the main battery-circuit, thereby directing the current through the shunt, and energizing the electromagnet to effect disengagement of the armature-lever from the contact.

13. In central-station mechanism for automatic telephone systems, a switchboard, a plurality of movable circuit-closers, each arranged for connection to a separate substation, electromagnets for operating said circuit-closers, a locking-strip for automatically engaging and locking each circuit-closer after the latter has been moved, a rock-shaft, a plurality of arms carried thereby and arranged to engage said locking-strips, an armature carried by said rock-shaft, an electromagnet for said armature, and means for closing a circuit through said electromagnet to effect movement of all of said locking-strips to release position.

14. In telephony, substations and a central station, a series of circuit-closers arranged at the central station, independent talking-wires extending from the substations

to the circuit-closers, a selecting means at the central station for closing the talking-circuits of calling and called stations, signaling and selecting lines, electromagnets arranged therein, one of said electromagnets controlling the operation of the circuit-closer, and the other the operation of the selecting means, a locking-strip for each of the circuit-closers, a rock-shaft, arms carried thereby and arranged to engage the locking-strips, an armature projecting from the shaft, an electromagnet adjacent to said armature, and means operable on return of the selecting means to initial position for closing a circuit through said electromagnet, and thereby moving the rock-shaft and the locking-strips to release position.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

AUGUST ALVIN MONSON.

Witnesses:

CHAS. S. CAIRNS,

H. C. HAYNES.