UNITED STATES PATENT OFFICE.

ALTON E. STEVENS, OF FALL RIVER, MASSACHUSETTS.

CONTROLLER FOR AUTOMATIC TELEPHONE SYSTEMS.

No. 816,948. Specification of Letters Patent. Patented April 3, 1906.

Application filed July 12, 1905. Serial No. 269,429.

To all whom it may concern:

Be it known that I, ALTON E. STEVENS, a citizen of the United States, residing at Fall River, in the county of Bristol and State of Massachusetts, have invented a certain new and useful Controller for Automatic Telephone Systems, of which the following is a specification.

In automatic telephone systems each station or telephone is provided with a mechanical device for controlling the central-exchange apparatus, and when such device is used it causes the said apparatus to move and select the line desired by the operating party.

In certain automatic telephone systems it is necessary to have a controller which will upon removal of receiver from its hook bring one line-wire into momentary connection with ground, which upon operating a numbered member in the manner provided will automatically cause one line-wire to be brought into momentary connection with ground a number of times in succession, the number of contacts corresponding with the number of the member operated, and after each series of connections will cause a final momentary connection between the other line-wire and ground and which will upon replacing receiver on its hook cause both wires to be pressed together and brought into momentary connection with ground.

The objects of my invention are, first, to use keys or push-buttons in place of the usual dial or indicator, said keys or push-buttons being more convenient to operate; second, to provide a controller in which all the keys or push-buttons have a uniform movement; third, to provide a controller with parts easily detached for repair or replacing; fourth, to provide a controller in which the largest possible size of number can be used on the numbered members, thus reducing liability to mistake in operating.

I accomplish my objects by mechanism illustrated in the drawings.

Figure 1 represents a plan of controller. Fig. 2 represents a plan of a speed-governor. Fig. 3 is a right side elevation of controller. Fig. 4 is a rear elevation of the same. Fig. 5 is a left side elevation showing circuit-springs and frame. Fig. 6 is a diagrammatic representation of the circuits.

In the drawings illustrating the principles of my invention and the best mode now known to me of employing the same, 1 2 3 4 5 6 7 8 9 0 11 in Fig. 1 are numbered keys, (shown in elevation at 1 6, Fig. 3.) They are metal stampings and fit into slots of the proper width in a rocker-plate 13, each having a rocking bearing on the bottom of its respective slot, as at 75, Figs. 1, 3. A face-plate 12, Figs. 1, 3, is slotted to allow a free up-and-down movement of the keys and is secured to rocker-plate 13 by screws and nuts 14 15. A controller-frame 16 supports its several parts. A selector-frame 18 carries at its extremity a wheel 26, which engages a cam 23, fast to shaft 25. This frame 18 is hinged to piece 19 by screw-bearings 20. Said piece 19, Fig. 3, also serves to prevent the keys from leaving their slots.

A thin strip of metal 21 is provided with, say, eleven contact-points, such as 56, which are insulated from all other parts by insulation 39. Strip 22 is similar to 21, except it has one point only. The cam 23, Figs. 1, 3, 4, is engaged by wheel 26 upon the selector-frame 18, which when moved vertically by action of any one of the keys causes the shaft 25 to turn, the extreme limit of the turning being about ninety degrees, the contact-arm 27, Fig. 1, hence being brought to position shown in dotted lines at 37, Fig. 1. Secured to the shaft 25 by friction is a flat spring 24, the shaft being allowed to turn freely, while the movement of the spring is limited by screws 30 31, Fig. 1. The shaft 25 has its lower bearing in frame 16 and its upper bearing in a detachable piece 32. Carried by this shaft is a contact-arm 27, a gear 17, the contact-spring 24, the cam 23, and a pin 67, Figs. 3, 4. A spiral spring 68, secured to pin 71, always tends to move the shaft 25 back to normal position. The contact-arm 27, Figs. 3, 4, consists of two strips of springy metal, which upon coming in contact with each of the points of strips 21 22 separate and contact the top and bottom of it. A hook-switch 28 supports a telephone-receiver. It is secured to frame by screw 29 upon which it turns, its up and down movements being limited by a metal strap 33, Figs. 1, 5. Upon removal of receiver it is moved upward by spring 70, secured to frame by screw 69. It carries a piece 77, which when the receiver is replaced upon the hook engages a pin 59 in cam 23 and causes shaft 25 to turn backward slightly until arm 27 occupies position shown in dotted lines at 38, Fig. 1. Hook

28 also carries a piece 86, Figs. 4, 5, which upon moving upward engages spring 83, presses it away from spring 84, and upon being moved downward presses spring 83 into contact with spring 84 and the two springs into contact with spring 85. Likewise springs 79 80 82, Figs. 4, 5, 6, are operated by hook-switch 28, which engages insulation 81 when the hook is in extreme upper position, and springs 88 89 are operated by said hook 28 engaging insulation 87 when the hook is in extreme lower position.

A spring 62, Fig. 3, is secured to piece 19, there being one for each key for the purpose of holding it in normal position or of returning it to normal position, the extreme movements of the keys being limited by points 74 engaging the under side of frame 64. 63, Figs. 3, 4, is a lock and prevents keys from being operated when shaft 25 is out of normal position. When the shaft is in normal position, pin 67 engages pin 66 and lock 63 is moved out of engagement with points 74, said lock being contained in frame 64, hinged at 78 and held in engagement with points 74 by spring 65.

The dotted lines between 72 73 show the different lengths of extensions of the keys, the number selected depending upon the length of the extension of the key operated, as will later more fully appear. 190 is a representation of the extreme end of 19, Fig. 3, the piece 19 being rounding, and the part to which the selector-frame 18 is hinged.

A speed-governor 34 (best shown in Figs. 2, 3) is provided with a gear-wheel 41 and a ratchet-wheel 42, the two being in one piece and having free movement around shaft 43. A disk 40 is fast upon the shaft and has mounted thereon a pawl 44, which is held in engagement with ratchet 43 by spring 49. Two arms 45, having weights 46 at their extreme ends, are so moved by the centrifugal force upon rotation of disk 40 that shoes 47 are brought into contact with a friction-disk 48, fixed to frame 61, the friction retarding the rotation. The governor 34 being mounted in the frame 61, it is with its frame self-contained and secured to controller-frame 16 by screws 35 36. The frame 16 is cut away to allow the gear 17 to accomplish its full movement, is strengthened by piece 76, Fig. 4, and is slotted under screw 35, and therefore allows an easy adjustment of gear 41 in its relation to gear 17.

Springs 50 51, Figs 1, 4, 5, 6, are mounted on frame 52 and are controlled by extension 53 of gear-wheel 17, 55 being an insulated wedge on spring 51 and 54 being a support for frame 52. 58, Fig. 1, is a support for ground-screw 31. A push-button 93, Fig. 6, operates the springs 90 91 92 and is not shown in the other drawings, as it has no mechanical connection with the controller and may be placed in any convenient place on telephone. It is used to signal a called party. 60 represents the woodwork of the telephone-box.

Having explained the parts of my invention, I will now explain its mechanical action.

Normally with receiver on the hook, 77 has engaged pin 59 and moved shaft into such position that contact-arm 27 is in position 38, Fig. 1, and spring 24 is in contact with screw 30. Upon removal of receiver, 77 disengages pin 53 and allows spring 68 to turn shaft and bring spring 24 into contact with ground-screw 31, which is insulated from frame, the effect being to ground the shaft, and consequently contact-arm 27, which moves across point 57, thereby contacting and grounding same during its passage. Pin 67 engages pin 66, Figs. 3, 4, and moves lock 63 out of engagement with points of keys 74. Keys are now unlocked and can be depressed to cause operation of the exchange mechanism. Suppose we depress key 11, which is used as a long-distance call. Its extension engages selecting-frame 18 at 72 and selecting-frame 18 is lifted until point 74 is stopped by the under side of top of lock-frame 64. Wheel 26 is caused to roll up the inclined face of the cam 23, which turns and moves the shaft 25 to the limit of its movement, 11 being the largest number. This brings contact-arm 27 into position 37, Fig. 1. Although in moving to this position arm 27 has made contact with point 57 and each of the points 56 of the strip 21, this has no electrical effect, because upon the start of movement the spring 24 has been caused by its friction on the shaft 25 to break from ground-screw 31 and rest against screw 30. When shaft 25 is moved from normal position, lock 63 engages remainder of keys, and thus allows only one key to be operated at a time, which key upon being returned to normal position by spring 62 forces out lock 63 and then immediately allows the lock to return, thus locking all of the keys until the shaft 25 has returned to normal position. Upon release of depressed key the frame 18 drops back to normal position, frees cam 23, and spring 68 returns shaft to normal position, carrying the arm 27 into contact successively with each of the points on strip 21, thus, as has been explained, grounding 21, which is connected direct to a line-wire, eleven times, and finally contacting 57, which at this time is connected to the other line-wire. The extension on key 1 ends at 73, so if this key should be depressed the selector-frame 18 would not be moved until 73 had reached said frame, and as the key could be depressed but slightly farther the wheel 26 would only move up the face of the cam 23 but slightly, and arm 27, Fig. 1, would move to a position between the first and second points on the strip 21. Upon its return the arm would contact one point only and finally—viz., point 57. As before explained, the difference in length of the exten-

sion of the keys between 72 73, Fig. 3, determines the distance that the selecting-frame 18 will be raised, and consequently the distance the shaft and arm 27 will be turned. When the shaft 25 leaves normal position, the gear 17 engages the gear 41, Fig. 2, the pawl 44 allowing the latter to turn without turning the governor. Upon return of shaft toward normal position, however, the pawl 44 engages ratchet 42 and causes the governor to revolve and govern speed of return, the centrifugal force throwing out arms 45 and causing the shoes 47 to engage the friction-disk 48 to a greater or less extent. In normal position extension 53 of gear 17 holds spring 50 in contact with spring 51.

Having described the mechanical operation of my invention, I will now describe its electrical functions.

Referring to Fig. 6, a party to call this station causes in a well-known way signaling-current to flow over wires 101 102, the only closed path being from wire 101, strip 21, through ringer 100, springs 89 88, to wire 102. When receiver is on hook, arm 27 is in position 38 and spring 24 is out of contact with 31. When, however, receiver is removed from the hook, arm 27 is moved toward normal position, contacting the point 22, while 24 is brought into contact with 31. This closes a circuit momentarily from wire 101 through strip 21, springs 82 80, point 22, arm 27, spring 24, point 31, to ground 94, which causes central-office mechanism to move into position to receive selective impulses. At the beginning of the upward movement of hook after receiver is removed the springs 88 89 are allowed to break contact, and at the finish of the movement spring 80 breaks contact with spring 82 and contacts spring 79. The calling party now presses down a key, which causes arm 27 to move back over point 22 and points of strip 21, the distance depending on which key is operated. This backward movement causes spring 24 to break contact with spring 31. As the key is released and arm 27 starts toward normal position again the arm contacts as many points of 21 as it has moved over during its backward movement and establishes a circuit from line 101, through strip 21, arm 27, spring 24, point 31, to ground 94 as many times as there are points with which to contact, a final contact being made from line 102, through springs 79 80, point 22, arm 27, spring 24, point 31, to ground 94. As arm 27 starts from normal position it allows springs 50 51 to break contact. At the completion of a call, button 93 is operated and causes spring 91 to break contact with spring 92 and make contact with spring 90, thus completing a signaling-circuit from wire 101, through strip 21, spring 91, spring 90, to ground 94. Common transmitter-battery is now applied to lines 101 102 from central station through the following circuit: from 101, through strip 21, springs 91 92, primary winding of induction-coil 96, transmitter 97, springs 50 51, to line 102. Conversation can now be carried on, 98 representing the secondary winding of the induction-coil, and 99 the receiver. Replacing receiver causes springs 83 84 85 to be pressed momentarily together, thus connecting lines 101 102 to ground at 95, which causes by suitable mechanism restoration of central-office apparatus. Spring 80 is allowed to come back into contact with spring 82, spring 88 is brought into contact with spring 89, arm 27 is moved to position 38, and spring 24 breaks from ground-screw 31.

In fine, by means of my invention I have provided a controller compact in form and convenient to operate, having keys that have a uniform movement, having parts accessible, easily detached and assembled, and having on its keys numbers the size of which is such that they can be easily seen, and thus reducing the liability to mistake in operating the keys, and, further, the shape of the controller is such that the mechanism may be conveniently placed under the shelf of a telephone in the position commonly occupied by the ringer in common-battery telephones, thus economizing space.

What I claim is—

1. A shaft; a cam mounted thereon; a contact-arm; a series of contacts with which the contact-arm may be moved successively into engagement; a series of manually-operated parts operatively connected with said cam, whereby said contact-arm may be moved into engagement with one or more of said series of contacts.

2. A shaft; a contact-arm fixed thereon; a cam fixed to said shaft; a pivoted member engaging said cam; a series of parts, any one of which may be moved into engagement with, and move said pivoted member, all being so designed that each part moves said member a different amount and causes a corresponding difference in the movement of the cam, shaft, and contact-arm.

3. A shaft; a contact-arm fixed thereto; a cam mounted thereon; a pivoted member engaging the cam; a series of levers to engage and move said pivoted member.

4. A shaft; a contact-arm fixed thereto; a cam fixed to said shaft; a pivoted member engaging the cam; a series of levers, all of which are capable of equal movements, and each of said levers having an extension thereon differing in length from that of any other, and engaging said pivoted member, whereby the pivoted member, cam, and shaft may give to the contact-arm movements of corresponding lengths.

5. A shaft; a contact-arm fixed thereto; a series of levers having uniform movements, and provided with extensions of different lengths; means operatively connected with

said shaft, and designed to be engaged by the extensions on said levers, whereby a full movement of any lever will cause the shaft, and hence the contact-arm, to move a distance peculiar to the lever moved, but different from that peculiar to any other lever.

6. A shaft; a gear fixed thereto, in combination with a governor, which comprises a gear, meshing with said gear fixed to the shaft; a ratchet-wheel integral with said gear, and loose on the shaft; a disk fast to said shaft; a pawl pivoted to said disk; arms pivoted to said disk, and provided with shoes to engage a friction-disk fast to the governor-frame; all being designed to regulate the speed with which the shaft moves in one direction, and to provide a regulator which is self-contained.

7. A series of levers; a shaft; a lock-bar in locking engagement with said levers; a hook-lever; means whereby a movement of said lever causes the lock to become disengaged from said levers, and leaves each one free to be operated; means whereby a movement of the shaft out of its normal position, caused by a movement of any one of the levers, causes the lock again to lock all of the other levers; and permits the used lever, on its return to normal position, to become locked also.

8. In a controller, a shaft provided with a metal contact-arm; a metal piece loosely mounted upon the shaft, but in frictional engagement with the shaft; two points, between which the free end portion of the metal piece is free to move, one of said points being electrically connected with ground.

9. In a controller, a frame, having a governor mounted therein; a shaft and a gear fixed thereto; said frame being pivoted, and provided with means whereby the mechanism of said governor may be adjusted and secured in engagement with said gear on the shaft.

In testimony whereof I affix my signature in presence of two witnesses.

ALTON E. STEVENS.

Witnesses:
MARY R. HOLT,
JAMES H. KENYON, Jr.

No. 816,948. PATENTED APR. 3, 1906.

A. E. STEVENS.

CONTROLLER FOR AUTOMATIC TELEPHONE SYSTEMS.

APPLICATION FILED JULY 12, 1905.

3 SHEETS—SHEET 1.

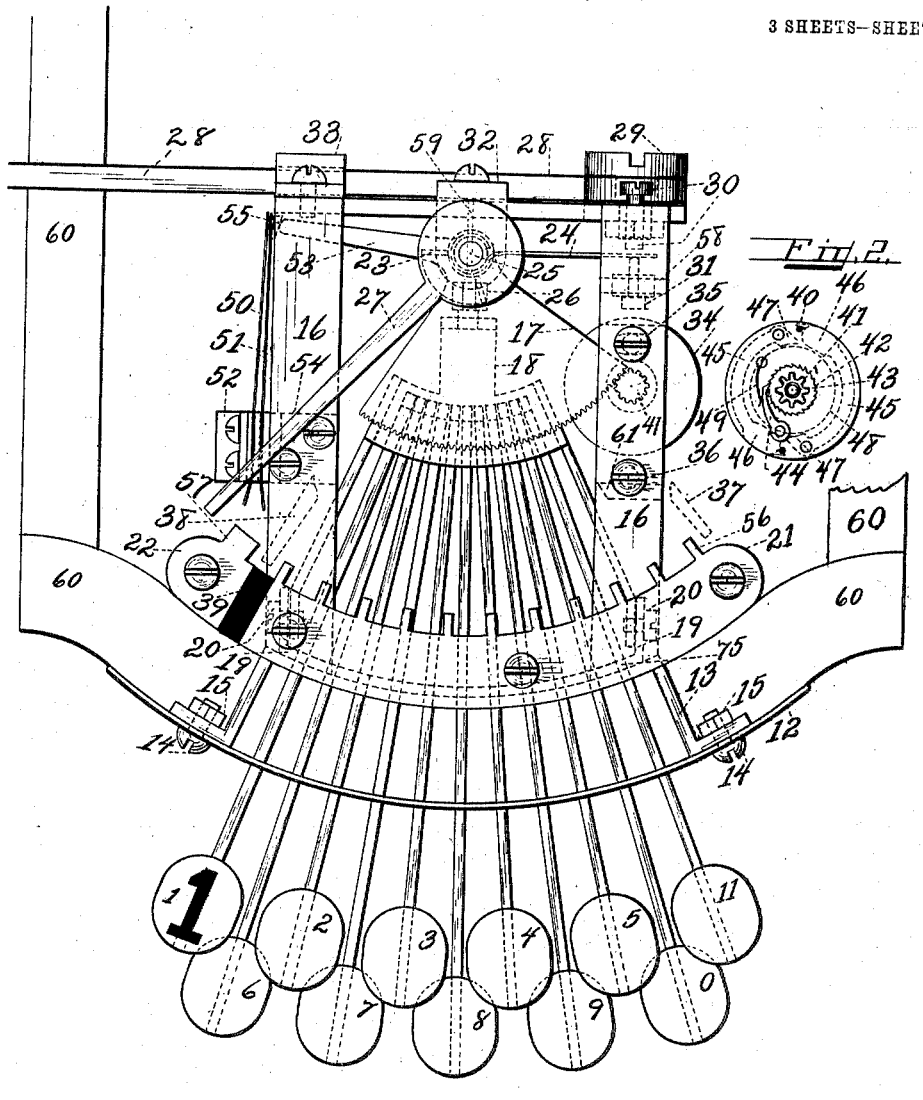

Fig. 1.

Fig. 2.

WITNESSES:

G. F. V. Dalcin

E. F. Horine

INVENTOR

Alton E. Stevens

BY Charles F. Richardson

his ATTORNEY

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3 SHEETS—SHEET 2.

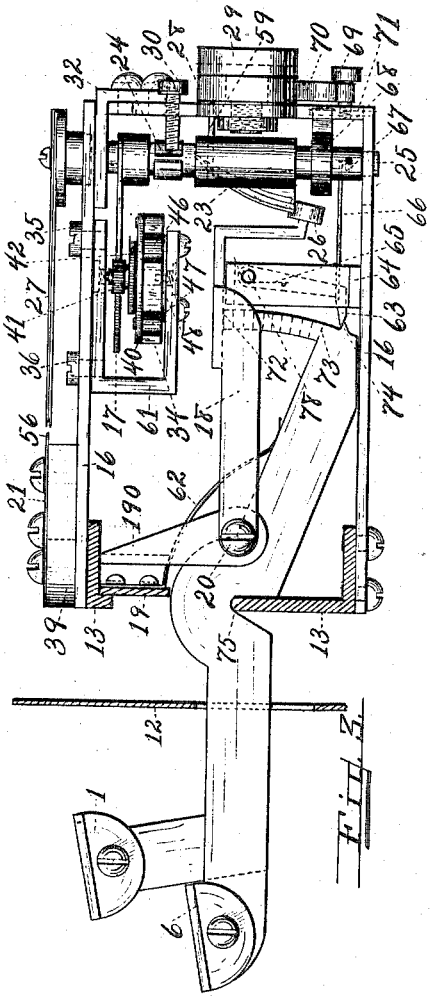

Fig. 3.

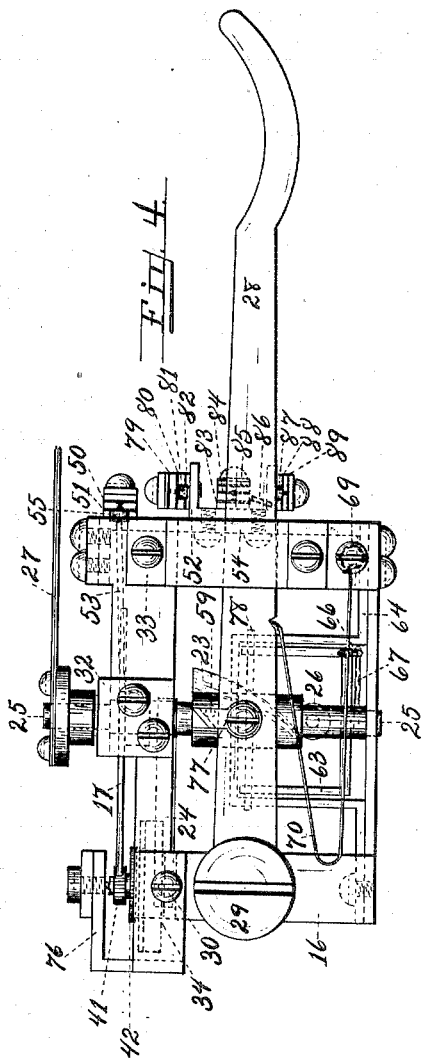

Fig. 4.

WITNESSES:

F. J. V. Dakin

E. F. Maniac.

INVENTOR

Alton E. Stevens

BY Charles F. Richardson

his ATTORNEY

No. 816,948. PATENTED APR. 3, 1906.

A. E. STEVENS.

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3 SHEETS—SHEET 3.

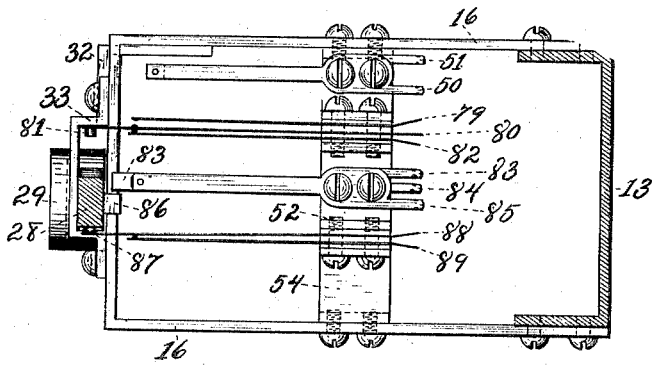

Fig. 5.

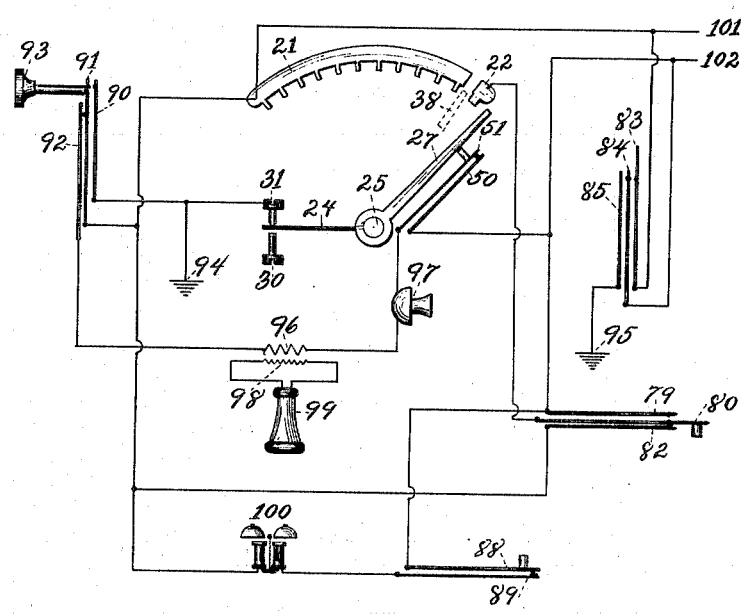

Fig. 6.

WITNESSES:

F. J. V. Dakin

E. F. Uniac

INVENTOR

Alton E. Stevens

BY Charles F. Richardson

his ATTORNEY

UNITED STATES PATENT OFFICE.

ALTON E. STEVENS, OF FALL RIVER, MASSACHUSETTS, ASSIGNOR OF THREE-FIFTHS TO SAMUEL H. COUCH, OF WOLLASTON, MASSACHUSETTS.

AUTOPHONE SYSTEM.

957,909. Specification of Letters Patent. Patented May 17, 1910.

Application filed November 6, 1908. Serial No. 461,304.

To all whom it may concern:

Be it known that I, ALTON E. STEVENS, a citizen of the United States, residing at Fall River, in the county of Bristol and State of Massachusetts, have invented a certain new and useful Autophone System, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to that class of automatic telephone systems designed for use in small centers of population, or for private telephone systems, where only a limited number of connections or lines is required. The system illustrated herein is of one hundred lines capacity.

Among the objects of my invention are the following:—To produce a system which will meet the requirements of different classes of service with practically uniform or standard apparatus, and is of such simplicity as to require a minimum amount of inspection, and to eliminate, as far as possible, causes of faulty operation.

The principal features of my invention reside in first, means whereby several stations may become electrically united in a group, for the purpose of intercommunication. Second, means whereby stations so united in a group are inaccessible to other stations, and the parties to the group may converse privately. Third, means whereby additional parties or stations may be embraced in the group and eliminated at any time at the option of the original members thereof, and may yet be unable of themselves to join the group. Fourth, means whereby independent communication may be established simultaneously between members of any number of pairs or groups of telephone stations. Fifth, means whereby common transmitter battery may be supplied to local lines, and local transmitter battery be supplied at stations on long or "farmers' lines," and the two classes of lines united for purposes of conversation in a common system. Sixth, means whereby a station on a multi-party line may signal another station on the same line by operating the calling station in a manner similar to that required to signal a station on another line. Seventh, means whereby the signaling relay of a called line is used to signal a station on that line, thereby making possible a clear called line and obtaining the maximum efficiency in signaling. Eighth, means whereby a line may be normally open at the central station to permit of efficient signaling, and a called line may be supplied by a calling line with current to operate its selector to an "off normal" position, for the purpose of supplying common transmitter battery to the called line. Ninth, means whereby the busy tone is made operative only when a call is actually made to a busy line, or a line in use. Tenth, means whereby a party calling a busy line may be at once aware of the fact when said busy line ceases to be busy, and is accessible to the calling party, and means whereby said calling party can communicate with the formerly busy called party without further operation except to signal said called party. Eleventh, means whereby direct current, and alternating current, signaling devices may, with facility, be interchanged in private systems.

In the drawings illustrating the principles involved in my invention, and the best mode now known to me of embodying those principles, Figure 1 represents diagrammatically the circuits of the autophone system, as employed in public or village systems. Fig. 2 represents diagrammatically the circuits of the autophone system, as employed in private telephone systems. Figs. 3, 4, 5 represent diagrammatically details of circuits employed in the autophone system. Fig. 6 represents a plan of mechanical details of a selector, while Fig. 7 represents a plan of electrical details of same; and Fig. 8 represents a left side elevation of same. Figs. 9, 10 represent details of construction. Fig. 11 represents diagrammatically a detail of circuits. Fig. 12 is a diagrammatic representation of an alternating current signaling circuit, and apparatus which may be substituted for direct current signaling circuit and apparatus shown in Fig. 1.

Reference is now made to Figs. 1 and 2, for the purpose of a general description of the autophone system. Diagrammatically represented are the circuits and apparatus associated with two telephone lines, either of which may through operations hereinafter described, call, signal, and become electrically associated with the other for the purpose of communication.

Line 9, 14, station A, Fig. 1, and the central station equipment associated therewith, contemplate a common transmitter battery system with one or more stations connected

to the line, yet in this case, one station on the line cannot signal another on the same line.

Line 50, 51 and the central station apparatus associated therewith contemplate a long, or "farmers'" line with two or more stations B, C, connected thereto, the central station selector being controlled by a selecting relay 57, and the transmitters fed by local batteries 72, 118. In this case, one station can signal another on the same line.

The station A on line 9, 14, embraces a make-and-break impulse transmitter 17, receiver 1, hook 2, transmitter 13, ringer 124, condenser 123, ringing key 41, and induction coil 10, 75. The impulse transmitter 17 may be any one of several, well known to the art.

Associated with the line 9, 14, at the central station is a selector comprising the following elements:—Selecting magnet 6 around which is a non-inductive shunt 62, a connecting magnet 15, constructed to present high impedance to sound-produced currents, a lockout magnet 79, a ringing or signaling relay 127; also two banks of terminals, a line bank 24, and a lockout bank 23.

The terminals or contact points in the banks are arranged radially around a common center, all of the terminals of a particular class being in the same plane. At the center of the arc described by the terminals is a shaft carrying two movable contact brushes,—a line brush 22, and a lockout brush 21, insulated from each other and from the shaft, and designed, upon the rotation of the shaft, to contact successively the terminals in their respective planes.

As the shaft carrying the brushes 21, 22, moves two steps from normal position, the spring 25 is permitted to contact the point 26, thereby grounding said point and consequently the lockout bank wire 38 of calling line 9, 14; the spring 28 being permitted on the first step, to contact point 29 for purposes to be hereinafter made plain.

A source of signaling current 48, an impedance coil 480, and apparatus 84, 85, associated with "busy" signal, and a battery 5, are used in common by all calling lines in the system. The current of battery 5 is supplied to the system through two bus-bars 4, 16, the latter being grounded at 86.

Additional stations on line 9, 14, may be readily arranged and provided with means to signal between said stations by supplying, for example, an impedance coil as shown at 114 station B, and arranging the circuits to conform with those shown in connection with ringing key 64.

A "farmers'" party line 50, 51, employing local battery transmission, is illustrated, with two stations B, C, connected thereto.

The sub-station equipment comprises the usual receiver 54, transmitter 71, switch hook 55, ringer 52, condenser 122, impulse transmitter 87, ringing key 64, and in addition, an impedance coil 114, a local battery 72, and an induction coil, having three windings,—a primary 73, an intermediate 68, and a secondary winding 74, the action of which will be hereinafter explained.

The central station equipment for line 50, 51, is identical with that described in connection with line 9, 14, with the following exceptions:—In the place of the selecting magnet 6 is a selecting relay 57 operating through its contact springs the selecting magnet 93 which is included in a local circuit. As the selecting magnet 93 remains energized during a conversation and is in a local circuit and of comparatively low resistance, it would ordinarily become overheated; therefore, for the purpose of preventing this, and of economizing current, a suitable resistance 97 is included in series with the said selecting magnet 93 upon the attraction of its armature 94 which moves the spring 95 out of contact with point 96, thereby including the resistance 97 in the local circuit.

To obtain the maximum efficiency upon a long line as 50, 51, the magnets 57, 58, have necessarily many more turns of wire than magnets 6, 15, through which common battery is supplied to the transmitters and are of much higher resistance.

Reference is now made to Fig. 2. It illustrates diagrammatically the circuits and apparatus of the autophone system in a form which is best adapted to private telephone systems, and which is a modification and simplification of that shown in Fig. 1. A common wire 286, as shown, or two wires as 9, 14, and ground 86, 20, Fig. 1, may be used, but the former common wire is preferable. Springs 228, 260, move out of contact with points 229, 261, and into contact with points 236, 243 respectively, when their respective selectors move from normal position.

The preferred form of each selector at the central station, for either system shown in Fig. 1 or Fig. 2, embraces the following three elements:—selecting magnet 206, connecting magnet 215, and lockout magnet 380—the line relay 57 and ringing relay 44, Fig. 1, used only in the village system, being preferably mounted separately and not mechanically combined with the selector—therefore the foregoing description of the said three magnets of each selector shown in Fig. 1, will suffice for the description of each selector shown in Fig. 2.

The method of using direct current signaling devices is illustrated in Fig. 2; where, to make the complete operation of the system clearer, are shown the two stations A, and B, which are identical in construction and operation. Also for the sake of clearness, the "talking" circuit, or circuit trav-

ersed, by the sound-produced currents, is indicated by heavy lines, both in Fig. 1 and Fig. 2.

Fig. 3 represents diagrammatically in a simplified form the circuits traversed by the voice or sound-produced currents when a common battery station as A, Fig. 1, calls and becomes connected with a line having local battery stations associated therewith; a condition which may exist in connection with Fig. 1, and which embraces the fifth feature of my invention, the operation of which I will now describe.

Common battery 5, see also Fig. 3, is supplied to the transmitter 13 through bus-bars 4, 16, resistances 6, 15, and primary 10. The brush 22 connects the calling with the called line, the circuit, when connection is complete, being from wire 14, Fig. 1, through spring 80, points 81, 31, spring 30, brush 22, bank point and wire 40, contacts 42, 59, 60, 61 to wire 50. In other words, the brush 22 bridges the impedance coils 15, 58; otherwise the resistance 15, which is inductive, and so constructed as to present high impedance to sound-produced currents, would prevent transmission between the two lines, even though they be connected to the same bus-bar 16. The inductive resistances 6, 57 are bridged by non-inductive resistances 62, 63, to permit sound-produced currents to pass around the said inductive resistances. Condensers may of course be used in place of the said non-inductive resistances. Battery current also flows from 5 through bus-bars 4, 16, see Fig. 3, to the called line, and through intermediate windings 68, 119, of stations A and B, providing the receivers at both stations are removed from their hooks.

A comparatively small amount of current however flows through the said intermediate windings, on account of the comparatively high resistance of the relay magnet 57, and of the impedance coil 58; the current flowing through these coils however being sufficient for the proper control of the central station selector. Sound, or articulate speech will cause through the medium of the transmitter 13, variations of the resistance of the circuit to the calling station A, which will cause in turn corresponding fluctuations of the current flowing to the called line and through the intermediate windings 68, 119.

To describe the operation more particularly, a sound produced adjacent to the transmitter 13, will cause a greater or less amount of current to flow through the calling station circuit. If the resistance is lowered, the difference of potential of the battery will be lowered at the point where the two connected lines meet, therefore the called line will receive less current; if however the resistance of the calling circuit is increased the potential of the battery 5 is increased at the point where the two lines meet, resulting in the called line receiving an increased amount of current. These fluctuations of current in the called line affect through the medium of intermediate windings 68, 119, the secondary windings 74, 120, the receivers 54, 115, which are thereby in a well-known manner, caused to reproduce the sounds transmitted from station A. If however, a sound is produced adjacent to the transmitter 71, the resistance of its local circuit through primary 73 is thereby varied and a greater or less amount of current from battery 72 is permitted to flow through said primary 73 thereby producing by induction, currents in the intermediate winding 68. The amount of current flowing from the central battery 5 through the intermediate winding 68 varies as the direction of the sound produced currents in the said intermediate winding coincides with, or opposes the flow of current from said battery 5. The consequent variation of current flowing to the called line varies correspondingly the amount of current flowing to the calling line, in a manner already made plain, and through the inductive relations of primary 10 and secondary 75, the receiver 1 is caused to reproduce the sounds transmitted by transmitter 71.

The receiver at station C is affected by variations in the local circuit at station B or vice versa, in the following manner:—A normal amount of current flows to the line from battery 5, part of which flows through each of the intermediate windings 68, 119. In the intermediate winding 68 there may be produced through the medium of the transmitter 71, battery 72, and inductive relation of the primary windings 73 to said intermediate winding, a series of currents of varying intensity, and alternating in character. These currents oppose or reinforce to a greater or less degree the current flowing through said intermediate winding 68 from battery 5. If the induced current in winding 68 opposes the direction of the current from battery 5 through said winding, it coincides with the direction of flow of said battery 5 through the intermediate winding 119 of station C, therefore the winding 119 receives momentarily the benefit of the combined currents. If the induced current in intermediate winding 68 coincides with the direction of flow of current from battery 5 through said winding 68, it opposes the flow of current of said battery 5 through intermediate winding 119, thereby reducing for the moment the amount of current through said winding 119; these fluctuations in current influencing by induction the secondary winding 120 and hence the receiver 115. If however the line received no current from battery 5, but was open at each end with stations as B, C connected across

as shown, conversation could still take place between stations, as currents induced in the intermediate winding at one station would flow through the intermediate windings at other stations and consequently affect the secondary windings and receivers at those stations.

Fig. 4 illustrates diagrammatically the circuits and apparatus of a busy tone or signal, designed to notify a calling party if the called line is in use, or inaccessible to said party, and herein resides the ninth feature of my invention. What is illustrated is assumed to be part of the system shown in Figs. 1 or 2; and I will now describe its operation.

The lockout magnet 79, becomes energized when the brush 21 contacts a "busy" or grounded terminal in its bank 23, as will be hereinafter made apparent, and attracts its armature, causing spring 80 to contact point 82, thereby completing a circuit from the "busy" wire 83 to the calling line. A busy tone or signal is produced in the wire 83 in the following manner:—Upon the lockout magnet 79 becoming energized the spring 111 is caused to contact point 112 thereby completing a circuit through primary winding 403 of an induction coil or transformer, battery 404, "busy" magnet 405, armature 406, point 407; the above circuit producing in a well-known manner a vibration of the armature 406, the resulting series of electric impulses in the circuit causing currents to be induced in the secondary winding 84 which, while lockout magnet 79 is energized, is included in the circuit to the calling station. Wires leading to contacts 111, 112, are multiplied in to all of the selectors in common as at 401, 402, so that the busy signal apparatus may be operated by any selector.

Any one of several forms of busy tone apparatus well known to those conversant with the art, may be substituted for the one shown.

Fig. 5 illustrates diagrammatically the method of connecting the bank wires to the terminals of the lockout bank to permit a station on a party line to cause his central station selector to connect to that line for the purpose of signaling another station on the same line. This method consists in disconnecting in each selector its own individual lockout terminal from its lockout bank wire. As an illustration, six banks of lockout terminals are shown, numbered 1, 2, 3, 4, 5, 6, respectively, their grounding, or "off normal" springs as 78, and their individual bank wires being designated by like characters. If No. 1 desires to signal another station on his own line, he calls in the usual manner. The selector moving from normal position causes bank wire 1 to become busy or grounded through spring 78 and point 77, thereby grounding or making busy the terminal 1 in all of the selectors in the group with the exception of his own selector in which bank wire 1 is disconnected, therefore his own selector can connect to his own line while other selectors will be locked out. Likewise No. 2 calling would ground and make busy the terminal 2 in all of the selectors except his own; and so on.

Having completed a general description of the construction and operation of what is disclosed in Figs. 1, 2, 3, 4, 5, I will now consider a central station selector which is of standard construction and is diagrammatically shown in Figs. 1 and 2.

Figs. 6, 7, 8, 9 represent details of a central station selector. A bed plate 601, Fig. 8, forms a base on which the several elements are mounted. A cup 660 is forced up from the base to provide a suitable place for the motor spring 665 which holds the shaft 630 in, or returns it to, normal position. The inner end of the spring 665 is fast to the shaft 630, while the outer end is looped over one of pins 641 of an adjusting disk 640, and spread by the other pin. The disk 640 is held in a circular groove under cup 660, in the lower side of plate 601 by screws 649 which may be loosened, and the disk turned to adjust the tension of the motor spring 665. A frame 617 is secured to the plate 601 at each end, as shown, and serves as the upper bearing for shaft 630, the lower bearing being in the center of the cupped part 660 of the plate 601. The shaft 630 carries at one end a ratchet wheel 629, and at the other end two contact brushes 221, 222, Figs. 7, 9, also a pin 650, Fig. 7, which operates the springs 225, 228. A selecting magnet 206 is secured to a yoke 602 which forms part of its magnetic circuit and which is in turn secured to plate 601. An armature 603 is pivoted at 604 to the yoke 602, and is designed to be attracted by the magnet 206, upon the latter becoming energized. A spring 607, adjusted by a stop 608, returns the said armature 603 to normal position. An extension 605 of the armature 603 carries a pawl 606 which upon attraction of armature 603 by selecting magnet 206 engages the ratchet wheel 629 and steps the latter around, one tooth for each attraction of the said armature 603. Two pieces are punched up out of the frame 617; 609, Fig. 6, which acts as a stop for the pawl at the limit of its forward movement, and 610 which lifts the pawl from engagement with the ratchet wheel 629 at the limit of its backward movement; the selector being shown in an active or connected position. A lock 618 is pivoted to the frame 617 by a screw, its free end being engaged and moved by the pawl 606 when the latter acts; the lock being of such shape as to prevent the inertia of the moving ratchet wheel from throwing

out said pawl 606 when the latter reaches the limit of its forward movement. Secured to the lock 618 is a flat spring, the free end of which is formed into two projecting parts; one 619 extends through a suitable aperture in the said lock, the other 620 is bent backward, both for purposes to be hereinafter explained.

A dog 616 is secured to a shaft 615 which has an upper bearing in the frame 617 and a lower bearing in plate 601. One end of said dog 616 is designed to engage the ratchet wheel 629 and hold the latter in each successive position where it may be stepped by the operation of the selecting magnet 206. The other end is cut down around the lock 618 forming a slot in which the said lock may work and permit the two parts 619, 620 of its spring to engage alternately the two sides of the slot, forming an escape movement between the dog 616, and lock 618 which is operated by the pawl 606. A spring 621 tends to hold both the lock 618 and dog 616 in their normal positions. An extension 614 of dog 616 is designed to be engaged by piece 613 on shaft 612 for purposes to be hereinafter made plain.

A connecting magnet 215 is secured to the plate 601 by two non-magnetic supports 631. The said magnet 215 is constructed to present a high impedance to sound-produced currents. It is also designed to attract an armature 611 which is secured to the shaft 612; this attraction causes the piece 613 to engage and move the extension 614 of dog 616 thereby moving the latter out of engagement with ratchet wheel 629. Through the shaft 612 is a pin 622, which normally operates the springs 631, 632, 633, but this operation of the pin may be prevented by an extension 627 of armature 625 of lockout magnet 380 for purposes to be hereinafter explained.

At the lower end of the shaft 612, Fig. 7, is a pin carrying an insulation 646, and at the lower end of the shaft 615 is a pin carrying an insulation 647, both to operate the contact springs 330, 332, 331, 235, 237, for purposes that will appear later.

The bank 223, Fig. 7, is secured to the plate 601 on the side opposite the apparatus shown in Fig. 6; the view however is seen from the same direction as Fig. 6; the plate 601 and apparatus shown in Fig. 6 being removed.

The lockout magnet 380, Fig. 6, is secured to a yoke 628 which is in turn secured to plate 601. Its armature 625 is pivoted at 626 to the yoke 628; and the extension 627 of the armature 625 is designed to operate contact springs 111, 112, 280, 281, 282.

Referring particularly to Figs. 7, 8, 9, the bank terminals as 651, also at 223, 224, are secured in insulating material and clamped together by the two metal rings 661. Part of the upper ring is cut away in Fig. 7 to show the spacing of the terminals. The brushes 221, 222, are secured to the shaft 630, and when said shaft rotates the said brushes contact in succession the terminals as 651 in their particular planes of movements. An electric circuit is maintained to said brushes 221, 222 during their entire operation, through the medium of the feeder brushes 648, 670.

The supports 642, 643, Fig. 7, secure their particular groups of contact springs to the lower side of plate 601. Spacings as 644, Fig. 8, maintain the proper relative positions between the plate 601 and bank 223.

The bank terminals in Fig. 7 are spaced one hundred and eight to the circle; three being left out to make room for the feeder brush 648; the two terminals 652 being left idle as resting terminals for the brushes 221 at normal and connected positions; the arrangement contemplating the use of the third, fourth and fifth terminals for trunk lines, one hundred terminals for regular lines.

Fig. 10 represents a mechanical means, and Fig. 11 an electrical means, for accomplishing a certain object in connection with a party on a party line calling another party on the same line. I prefer, however, to employ the latter means, which I will now describe.

In ringing out on a called line, it is necessary to have the called line open at the central station, see Fig. 1, or, if closed, it must be through high impedance as 480, otherwise there would be a tendency to short circuit the ringing circuit and prevent the proper amount from reaching the sub-stations. When the ringing relay 44 is energized from a calling station, as A, contact is broken between spring 46 and point 49, and springs 45, 46 are caused to contact points 47 which are connected to a suitable source of signaling current 48; the said current is thus supplied direct to the called line, and no difficulty is presented when one line calls another. When, however, one station desires to signal another station on the same line, a certain difficulty arises. The selecting relay 57 of a calling line must remain energized to hold the selector upon the connection to the called line, as when the connection is completed, all other means for holding said connection have been removed. It will be evident that if a party at station "B" wishes to signal station "C", he must while operating his own ringing relay 44, maintain a flow of current through the selecting relay 57 to prevent the latter from causing a release of the selector; for connecting the selector to his own line is the only way for supplying ringing current to the line. This is perferably accomplished, see Fig. 11, by supplying the relay 57 with

an additional spring 691 and contact 692, and the ringing relay 44 with an additional spring 690, the latter spring being so arranged as to contact the point 49 before the spring 46 breaks contact with said point 49. Now if the selecting relay 57 is energized as on a calling line, and the said calling line energizes ringing relay 44 to signal on said line, the spring 690 contacts the point 49 thereby maintaining an active circuit through the relay 57 from bus-bar 4, through said relay and point 49, springs 690, 691, point 692 to opposite side 16 of battery; thus the line spring 46 can break from point 49 and open the line to receive signaling current, without deënergizing the relay 57. However, as all that is actually necessary is to prevent the pawl 606 Fig. 6 from releasing the ratchet wheel 629 when the ringing relay 44 is energized, this may be accomplished mechanically as shown in Fig. 10, by placing the ringing relay in such mechanical relation to the selecting magnet as 206 Figs. 6, 10, that they may operate as illustrated. The armature 603 is supplied with an extension 686 designed to be engaged by a spring 681 secured to armature 680 of ringing relay 44. If the latter relay is energized during the time the armature 603 is attracted, the spring 681 engages the extension 686 thereby holding and preventing the pawl 606 from disengaging the ratchet 629 even though the selecting magnet 206 is deënergized through the breaking of the connection between contacts 46, 49. If the selecting magnet 206 is deënergized when the ringing relay 44 is energized, this being the case when one line calls another, the extension 686 is in the path of the spring 681, but there is enough flexibility to this spring to permit the armature 680 to operate properly.

I will now explain the coöperative action of several elements of the selector, and will first consider the lockout magnet 380, Figs. 2, 6, and its relation with the connecting magnet 215. When a call is complete to a desired line, both the selecting magnet 206 and the connecting magnet 215 remain energized, whether the called line is busy or not. Also the lockout magnet 380 must remain energized while the selector is connected to a busy line; therefore some means must be provided for preventing the energized connecting magnet 215 from causing the spring 232 to break from point 233 and thus to prevent the lockout magnet from remaining energized when connected to a busy line. The means is shown in Fig. 6. With the connecting magnet 215 deënergized and armature 611 in normal position, the spring 232 is forced by insulation 623 into contact with spring 233, its normal position, although the tension on spring 232 is in such direction as to cause it to tend to contact the spring 231, and is normally permitted to do so while the connecting magnet 215 is energized. If, however, the called line is busy, the lockout magnet 380 is energized, in a manner to be hereinafter explained, and by reason of the consequent attraction of its armature 625, the extension 627 prevents the spring 232 from breaking contact with spring 233.

Having described the construction and operation of the separate elements of the selector, there remains to be explained their cycle of operations.

The selector shown in Figs. 6, 7, 8, 9, is in an energized or connected position. Now, if the receiver is replaced at the station controlling the selector, the selecting magnet 206 and connecting magnet 215 would be deenergized, resulting first in the withdrawal of the pawl 606 from the ratchet wheel 629 and the consequent return of that member, and hence of the contact brushes 221, 222, to normal position by reason of the motor spring 665. The lock 618 would follow the pawl 606 to the limit of the slot in the extension of the dog 616 in which it plays. As armature 611 of connecting magnet 215 returns to normal position, the piece 613 disengages the extension 614 of dog 616, thereby permitting the latter to move toward engagement with the ratchet wheel 629. It is prevented however from engaging the ratchet 629 by reason of the part 620 of the spring secured to the lock 618 which engages the edge of the slot in which the lock plays. The selector is then in normal position. Should the party make a call, the selecting magnet 206 is energized by the operation of the impulse transmitter at the calling station, a number of times corresponding to the number of the desired line. The ratchet wheel 629 is thereby stepped around a number of teeth corresponding to the called line, and hence through the medium of shaft 630, the brushes 221, 222 are moved into connection with the bank terminals of the desired line. The first action of the said selecting magnet 206 causes the pawl 606 to engage and move the lock 618 to the position shown which causes the point 620 to release the side of the slot in the extension of the dog 616 thereby permitting the said dog 616 to engage and hold the ratchet wheel 206 in each successive position into which it may be stepped by action of selecting magnet 206.

Before the interruption of the final impulse, a circuit is completed through the calling station which causes the selecting magnet 206 to remain energized and thereby hold the selector in its connected position, and the connecting magnet 215 to become energized and attract its armature 611 which causes the dog 616 to disengage the ratchet wheel 629; the point 619 engaging the inner side

of the slot in the extension of said dog 616, and locking the latter out of engagement with the ratchet wheel 629. It has been mentioned that the shafts 612, 615 extend down through the plate 601, and carry insulations 646, 647, which operate certain contact springs. Referring to Figs. 2, 6, 7, 8, when the armature 611 of the connecting magnet 215 is attracted, the two shafts 612, 615, are caused to turn in opposite directions; the shaft 612 causing the springs 330, 235 to contact the springs 331, 237, respectively, and the shaft 615 causing the spring 332 to follow, but not to contact the spring 330. The spring 332 is now locked in this position by reason of the engagement of the point 619 with the dog 616, and must so remain while the selecting magnet 206 is energized. The connecting magnet 215 may now be deënergized in a manner to be later described, and permit the spring 330 to drop back into contact with spring 332 for the purpose of signaling the called station. This may be repeated by the calling party until the called party replies.

At the first step of the selector from normal position, the pin 650 in shaft 630 permits spring 225 to contact spring 226 and spring 228 to break contact with spring 229 and make contact with spring 236 for purposes which will be later apparent.

Having described the operation of the several elements of the autophone system, I will next take up in detail the operation of the system as a whole.

Referring to Figs. 2, 6, 7, 8:—station A desires to communicate with station B. The receiver 201 is removed from hook 202, and if station B is No. 2 the impulse transmitter 217 is operated to cause the springs 218, 219 to contact each other twice, thereby completing twice the following selecting circuit:—from battery 205 through bus-bar 204, selecting magnet 206, wire 209, point 203, hook 202, springs 218, 219, common wire 286, to bus-bar 216 and opposite side of battery 205. The selecting magnet is thereby energized twice resulting in the brushes 221, 222, being stepped to the second terminals in their respective banks. Before the interruption of the final contact between springs 218, 219, the springs 211, 212, have been caused, in a well known manner, by the action of the impulse transmitter 217, to contact each other, thereby completing a common transmitter battery circuit which is maintained after the interruption of the final selecting contact, and is as follows:—from bus-bar 204 through selecting magnet 206, wire 209, point 203, hook 202, transmitter 213, primary 210, spring 211, 212, spring 228, which when the selector moved from normal position, broke contact with point 229 and made contact with point 236, said point 236, connecting magnet 215 and bus-bar 216, thereby completing the circuit to the other side of battery 205, and causing the selecting magnet 206 to remain energized, and the connecting magnet to become energized. The brushes 221, 222, are now connected to their second terminals in the direction indicated by the arrows, to which are also connected the bank wires 239, 240, of the called line.

It should be observed that normally wires as 214, 250, are open at the central station end, and have a normal connection to their line bank wires. It should also be observed that during the time of selection, the circuit to line brush 222 is open at spring 330. For convenience we will hereinafter call bus-bar 204 "positive battery", and bus-bar 216, "negative battery." As the calling selector moved from normal position, spring 225 was permitted to contact the point 226 thereby connecting negative battery 216 to bank wire 238 of the calling line, and upon the connecting magnet 215 becoming energized after selection and causing spring 232 to contact point 231, negative battery 216 is thereby connected to the brush 221, and to the lockout terminal, and hence the lockout wire 239 of the called line; both calling and called lines are thus rendered busy or inaccessible to other calling lines, in a manner to be hereinafter described. The connecting magnet 215 has, upon becoming active, also caused springs 330, 235, to contact the points 331, 237, respectively, and caused the spring 332 to move and become locked adjacent to, but not in contact with, spring 330.

Station A is now in a position to signal station B, which is accomplished by pressing the key 241 into connection with the point 220, thereby short-circuiting and deenergizing the connecting magnet 215 in the following manner:—The said connecting magnet 215 is energized from positive battery 204 through the resistances of selecting magnet 206, transmitter 213, primary 210, and its own resistance, to negative battery 216. When key 241 is operated the circuit is as follows:—from positive battery 204 through selecting magnet 206 which remains energized, line 209, point 203, hook 202, point 220, key 241, to common wire 286 which is of practically no resistance, back to negative battery 216, thereby placing the connecting magnet 215 with resistances 210, 213 in series, in multiple with the common wire. As the connecting magnet is thus deenergized, the spring 330 is permitted to drop back into contact with spring 332 thereby completing the following signaling circuit:—from positive battery 204, through contacts 332—330, and 280—281, to brush 222, bank wire 240, contacts 261—260, direct current ringer 252, contacts 270—269, to common wire 286; the ringer 252 being caused, in a well known manner, to operate and to signal the called party, who there-

upon lifts his receiver 254 from hook 255, thereby causing contact between said hook 255 and point 256, and interrupting the signaling circuit at 269—270.

The called line selector must be out of normal position to permit the spring 260 to contact the point 243 for the purpose of supplying common transmitter battery through the connecting magnet 258 to the called line; a result which is attained in the following manner, and which involves the eighth feature of my invention:—As the receiver 254 is removed from hook 255, an energizing circuit is completed from positive battery 204 through selecting magnet 257, wire 251, point 256, hook 255, transmitter 271, primary 268, springs 267—266, wire 250, contacts 260—261, bank wire 240, brush 222, contacts 281—280, 330—331, 228—236, connecting magnet 215 to negative battery 216. Selecting magnet 257 is thereby energized and steps the called line selector out of normal position, and the called line now receives its supply of transmitter battery current through its own connecting magnet 258. The spring 260 is caused to move from contact with point 261 and into contact with point 243 as the called selector steps from normal position, and the connecting magnet 258 becomes energized and causes spring 242 to contact point 259, thereby maintaining a connection to the calling line, which had been momentarily interrupted by breaking of connection between contacts 260—261.

It should be noted that when the springs 228—235 of the calling line contact their points 236—237, and the springs 260—242 of the called line contact their points 243—259, the two connecting magnets 215, 258 are in multiple, which would prevent a called station from making a subsequent call until the calling station released his connection, as both said magnets 215—258 would remain energized through the completed circuit to the calling station, were it not for the fact that when the circuit is interrupted at the called station, and the selecting magnet 257 is thereby deënergized, thus causing the selector to return to normal position, the spring 260 is caused to break contact with point 243; the connecting magnet 258 being thereby removed from the circuit and becoming deënergized permits contacts 242—259 to separate, and removes the said connecting magnet 258 from further connection to the calling line, until the called selector has again moved out of normal position and a circuit completed through the called line, either through making a connection to a third line, or through removing the receiver as in replying to the calling station. The calling line has therefore two connections to the called line:—the first through point 261 for the purpose of signaling the called line, which is otherwise open, the second through spring 242, that connects the lines for purposes of conversation, and which second connection includes the connecting magnet 258. The first, second, third and fourth features of my invention are directly dependent upon an arrangement in substance like that just described, for their successful accomplishment, and will be considered next.

Station A has called station B, Fig. 2, and it is desired that the two stations become connected to a third station. Station A maintains his connection to station B, and station B operates the impulse transmitter 287 in a proper manner to call the station desired, all of which results in the return of station B's selector to normal position by reason of the interruption of its holding circuit at springs 266—267; and in spring 260 breaking contact with point 243; the connecting magnet 258 becoming thereby deënergized and causing spring 242 to break contact with point 259. The spring 260 however immediately contacts again the point 243, as the selector moves out of normal position to connect to the desired line, thereby severing all connection between stations A and B until the selector of station B has completed the connection to the third line, and also completed its common battery circuit through the springs 266—267, whereby the connecting magnet 258 is again energized. The brushes 301—302 are now connected to the terminals of the third line in the same manner that the brushes 221, 222 of station A's selector were connected to the line of station B.

It now remains for station B to signal the line called which is accomplished by pressing the key 264 into contact with point 265 which will cause the connecting magnet 258 to become deënergized in a manner already explained in connection with station A, thereby causing spring 305 to contact spring 307, and to complete a signaling circuit from positive battery 204 through said springs 307—305, and 308—309 to brush 302 and bank wire of the third line and thence through the ringer to the common wire and negative battery 216, as was the case in signaling station B. It will be observed that as the connecting magnet 258 is deënergized short-circuiting same by means of the common wire 286 for the purpose of signaling, the connecting magnet 215 which is in multiple, will also have a tendency to become deënergized, which does not take place however as the contact between spring 242 and point 259 is immediately interrupted, thereby disconnecting station A from station B while the latter is signaling. The third station, upon replying could now call a fourth station, and the fourth a fifth, and so on; and thus several stations may be placed in communication.

The second feature of my invention is involved in a private or lockout device. It has been made obvious, how a selector in calling, connects negative battery 216 to its lockout bank wire which is multiplied into all of the selectors, and how a calling selector connects said negative battery 216 to the lockout bank wire of the called line; therefore, the lockout bank wires of two or more connected lines will each be connected to negative battery. Suppose this were the case with station B for instance, and negative battery 216 were connected through contacts 277—278 with bank wire 239 by reason of the selector being out of normal position. Station A operates his impulse transmitter to connect to station B. The lockout brush 221 comes to rest on the lockout terminal connected to lockout wire 239, thereby completing a lockout circuit from negative battery 216 through contacts 277—278, lockout wire 239, brush 221, contacts 232—233, lockout magnet 380 to positive battery 204; the lockout magnet 380 becoming thereby energized and causing spring 280 to break from contact 281 and to contact point 282, thereby first severing all connection between the calling line, and its line brush 222, which rests on the line terminal of the called line, and, upon the connecting magnet 215 becoming energized and causing contact between spring 330 and point 331, connecting the calling line to the wire 282 in which is produced through the medium of the secondary 284 as has been explained in connection with Fig. 4, a "busy" tone, the circuit being as follows:—from line 209 through shunt 262, bus-bar 204, condenser 285, secondary 284, wire 283, contacts 282, 280, 330—331, to wire 214.

It should be borne in mind that the lockout magnet upon being energized prevents spring 232 from breaking contact with point 233 even when the connecting magnet 215 is energized.

It will be evident from the above that any number of stations connected in pairs or groups, can converse privately and remain inaccessible to any calling stations, wherein the second and fourth features of my invention are embraced.

The description of the tenth feature of my invention now consistently follows, as we have station "A" connected to the busy line of station B. The busy tone will be repeated to station A as long as the connection is maintained, and the selector of station B remains out of normal position. If the selector of line B should be restored to normal position however, causing the lockout magnet 380 to be deënergized by interrupting its circuit by separating the contacts 278, 277, the spring 280 would break from the point 282, thereby disconnecting the calling line from the busy tone, and connecting said calling line to brush 222 which rests on the line terminal of B's line. The party at station A knows immediately by the disappearance of the busy tone that he now has access to the called line and that station B can be signaled in the usual manner without repeating the operation of calling.

The third feature of my invention:—Several parties at different stations are conversing, when it is decided to refer certain matter to a party out of the group, and who is not to be permitted to join in the general conversation; the last party called may call this party, and any one or all of the members of the group may converse with him, and after desired information has been obtained, he may be eliminated from the group simply by the party who called him releasing the connection.

It will be noted that the lockout magnet 380, is energized each time the brush 221 contacts a busy terminal while said brush is passing to a desired line. This however is in no wise detrimental to the proper operation of the system.

The eleventh feature of my invention will be apparent from a study of Fig. 2. The direct current signaling devices 324, 252, may be replaced by alternating current signaling devices 3240, 2520, Fig. 12, and a suitable source of alternating current, as 3320, and 3070 bridged between springs 332—307, and the bus-bar 216; in which case the signaling circuit would be as follows:—Suppose station A has called and become connected to station B. The ringing button 241 at station A is operated and causes the impedance coil relay 215 to release its armature, thereby causing an alternating current signaling circuit from source 3320 to bus bar 216, and to contacts 332, 330, 280, 281, brush 222, called terminal and bank wire 240, contacts 261, 260, signaling device 2520, contacts 270, 269, to common wire 286 and back to bus bar 216; the alternating current signaling device 2520 being thereby operated, and station B signaled.

It will be evident to those skilled in the springs 225, 226, and 231, 232, 233, and all of the apparatus pertaining to lockout devices, lockout magnet 380 and springs 280, 281, 282, bank 223, and wiring, brush 221, springs 225, 226, and 231, 232, 233, and all apparatus pertaining to busy tone, could be eliminated, and the system still possess all of the features enumerated except that of privacy.

It has been herein mentioned that the contacts 225—226, become operative upon the second step of the selector from normal position. The reason of this is, should station A call and become connected to station B, the connecting relay 215 would be deënergized during the time station A is signaling; therefore the contacts 232—233 would close

the circuit of the lockout magnet 380, to the lockout brush 221, and if, during this period, B's selector should be stepped from normal position by reason of the removal of the receiver at station B, contact between springs 277—278 would, in a manner already described, operate the lockout magnet 380 of A's line, provided said contacts 277—278 were made operative upon the first step of the called selector from normal position.

I will now describe in detail the operation of so much of the complete autophone system as is illustrated diagrammatically in Fig. 1, and relates to features six and seven of my invention; the mechanical operation of the system having already been made plain.

A ground return may be used as is illustrated, or a common return wire as is shown in Fig. 2. In the case of the complete system Fig. 1, however, in which lines may extend to a considerable distance, the ground return is preferable.

Suppose a party at local battery station B desires to communicate with station A. The receiver 54 is removed from hook 55, and the impulse transmitter 87 is operated in a proper manner to call station A whose call in this case is one, whereby the following selecting circuit is completed: from ground 86 and battery 5, through bus-bar 4 selecting relay 57, contacts 49—46, hook 55, contact 56 springs 88—89, to ground 90. The selecting relay 57 becomes energized a number of times corresponding to the number of the called station, thereby operating through its contacts 91—92, the selecting magnet 93 as has already been explained, the said selecting magnet 93 causing the brushes 101, 102 to step to the terminals of the desired line; the subsequent completed circuit through station B rendering active the connecting magnet 58, thereby first making the called line busy by connecting ground 86, through contacts 100—98, and brush 101 to the lockout wire 38 of the called line, and causing connection between contacts 105—106 thereby connecting the calling line to its line brush 102 which is now connected to the line terminal and bank wire 113 of the called station A; the spring 107 having been also moved adjacent to the spring 105 for the latter to contact for the purpose of signaling. To facilitate explanations I will hereinafter refer to bus-bar 4 as "battery", and to bus-bar 16 as "ground".

To signal station A, the key 64 at station B is pressed into contact with grounded point 127, thereby shunting and deënergizing the connecting magnet 58, in a manner already explained, and causing the spring 105 to contact the spring 107, thereby completing a ringing relay circuit from battery 4, through springs 107—105, brush 102, bank wire 113, contacts 35—36, ringing relay 127, to ground 16; the said ringing relay 127 becoming energized and causing spring 8 to break its contact with point 7 thereby opening the called line and creating a most favorable condition to receive signaling current; and now follows the seventh feature of my invention. The springs 8—126 are now caused by action of ringing relay 127 to contact the points 125 which lead to a suitable source 48 of signaling current, this current being supplied therethrough direct to line 9—14, and causing the operation of the ringer 124 through the condenser 123; the contact between 7 and 8 having been first severed by the action of said ringing relay 127. It will be evident that on lines having only one station connected thereto, the condenser 123 may be dispensed with, and a means provided as shown in contacts 207—208, Fig. 2 for opening the ringer circuit when the receiver is removed from the hook. The station A now responds by removing the receiver 1 from hook 2, thereby causing the selecting magnet 6, and the connecting magnet 15 to become energized and to step the selector of station A out of normal position; said station A obtaining its supply of common transmitter battery through said magnets; the connecting magnet 15 causing spring 35 to contact point 37 thereby completing the connection to station A through bank wire 113, contacts 35—37 and 29—28, to line 14. Conversation may now be carried on between stations A and B; the conditions having been already explained and shown in connection with Fig. 3, with the exception that the call is reversed. The calling and called lines have now been rendered inaccessible to other lines, and the called station can call, as has already been shown, a third station.

I will now explain the operation of the elements embraced by the sixth feature of my invention.

It will be observed, in relation to the sixth feature of my invention, that with the receiver 54 removed from the hook 55, the normal battery circuit is from wire 50 through key 64, point 65, contacts 66—67, intermediate winding 68, point 56, hook 55 to wire 51; thus there is maintained a closed circuit through the station, to hold the selecting relay 57 and connecting magnet 58 energized after a call has been made. Now, if key 64 is operated to signal a called station, the first object of the impedance coil 114 becomes apparent, for if the circuit through the station is interrupted between key 64 and point 65, the selecting relay 57 will become deënergized and cause the release of the connection. It is therefore necessary to maintain a closed circuit through the station B while the latter is signaling; and this closed circuit must

present such high impedance to signaling current that the latter will not be short-circuited when the called station is on the same line as the calling station. If station B desires to communicate with station C which is on the same line, the normal conditions are such that conversation may be carried on. It remains however for station B to signal station C. Station B calls the number of his own line, the brushes 101—102 being thereby caused to contact the representative terminals of line 50—51, and the selecting relay 57 and connecting magnet 58 to become and to remain energized. The signal at station C is, for instance, two rings; therefore the key 64 is operated twice, causing the connecting magnet 58 to be twice deenergized (it being energized after each deenergization by current supplied through impedance coil 480 to line 51) and to complete each time the following ringing relay circuit; from battery 4, through contacts 107—105, brush 102, contacts 42, 43, ringing relay 44, to ground 16; the said ringing relay 44 becoming thereby energized and causing spring 46 to open the circuit to the line 51 at point 49, and causing springs 45—46 to contact the points 47, thereby causing the source of signaling current 48 to become connected direct to the line 50—51 resulting in the operation of all the signaling devices connected thereto. In response to his particular signal the party at station C removes his receiver 115 from hook 116 and the parties at the two stations on the same line may now converse, the talking conditions being herein explained in relation to stations B and C, Fig. 3.

It should be borne in mind that normally the severing of the connection between contacts 49 and 46 would cause the selecting relay to become deënergized and cause the connection to be released were it not for the means illustrated in Fig. 11 for preventing same, or the mechanical means illustrated in Fig. 10 for preventing the armature of the selecting magnet as 93 from permitting pawl 606 (Fig. 6) from releasing the ratchet wheel 629.

I have now described my invention in detail, and have illustrated and described the best embodiment now known to me of the several features thereof, yet I do not wish to limit myself to the structures defined herein, as they are susceptible of modifications which may be suggested by experiment or experience, without material departure from the principles and spirit of my invention.

Desiring to protect my invention in the broadest manner legally possible, what I claim is:—

1. In an automatic telephone system, telephone lines; automatic means whereby a calling line may become electrically associated with a called line for the purpose of communication; means whereby the said calling line and called line may become electrically associated with a called third line for the purpose of inter-communication; and means whereby electrical current from a central source may be supplied to the transmitters in multiple, at the connected stations.

2. In an automatic telephone system, telephone lines; automatic means whereby a calling line may become electrically associated with a called line for the purpose of communication; means whereby the said calling and called lines may become electrically associated with a third line for the purpose of inter-communication, and means whereby electrical current from a central source may be supplied to the transmitters at the connected stations; and automatic means for each line to restore its operated apparatus to normal position.

3. In an automatic telephone system, telephone lines; automatic means whereby a calling line may become electrically associated with a called line for the purpose of communication; means whereby the said calling and called lines may become electrically associated with a third line for the purpose of inter-communication, and means whereby electrical current from a central source may be supplied to the transmitters at the connected stations; and means whereby said lines may be made inaccessible to other lines.

4. In an automatic telephone system, telephone lines; automatic means whereby a calling line may become electrically associated with a called line for the purpose of communication; means whereby the said calling and called lines may become electrically associated with a third line for the purpose of inter-communication, and means whereby electrical current from a central source may be supplied to the transmitters at the connected stations; automatic means for restoring the system to normal position; and means whereby said lines are inaccessible to other lines.

5. In an automatic telephone system, telephone lines; automatic means whereby a calling line may become electrically associated with a called line for the purpose of communication; means whereby the said calling and called lines may become electrically associated with a third line for the purpose of inter-communication; means whereby electrical current may be supplied to the transmitters at the connected stations; and automatic means for restoring the system to normal position.

6. In an automatic telephone system, telephone lines; automatic means whereby a calling line may become electrically associated with a called line for the purpose of

communication; means whereby the said calling and called lines may become electrically associated with a third line for the purpose of inter-communication; means whereby electrical current may be supplied to the transmitters at the connected stations; and means whereby said lines are inaccessible to other lines.

7. In an automatic telephone system, telephone lines; automatic means whereby a calling line may become electrically associated with a called line for the purpose of communication; means whereby the said calling and called lines may become electrically associated with a third line for the purpose of inter-communication; means whereby electrical current may be supplied to the transmitters at the connected stations; automatic means for restoring the system to normal position; and means whereby said lines are inaccessible to other lines.

8. In an automatic telephone system, telephone lines; automatic means whereby several of said lines may become electrically united for the purpose of inter-communication; means whereby one or more of the remaining lines may be associated with said several lines, and automatic means whereby said one or more remaining lines may be disconnected from said several lines.

9. In an automatic telephone system, telephone lines; automatic means whereby several of said lines may become electrically united for the purpose of inter-communication; and means whereby one or more of the remaining lines may be associated with said several lines; automatic means whereby said one or more remaining lines may be disconnected from said several lines; and means whereby said several lines may be rendered inaccessible to said one or more remaining lines.

10. In an automatic telephone system, telephone lines; automatic means whereby several of said lines may become electrically united for the purpose of inter-communication; and means whereby one or more of the remaining lines may be associated with said several lines; automatic means whereby said one or more remaining lines may be disconnected from said several lines; and automatic means whereby each line may restore its part of the connection to normal position.

11. In an automatic telephone system, telephone lines; a selecting magnet and circuit associated with each line, whereby a line may become united with another line; a ratchet wheel coöperating with said selecting magnet, and means to engage and hold said ratchet wheel; a connecting magnet; apparatus whereby said means may be caused by said connecting magnet to disengage said ratchet wheel when said line has become united with another line; and means whereby the selecting magnet holds such union operative.

12. In an automatic telephone system, telephone lines; a selecting magnet and circuit associated with each line whereby a line may become united with another line; a ratchet wheel coöperating with said selecting magnet, and means to engage and hold said ratchet wheel; a connecting magnet; apparatus whereby said means may be caused by said connecting magnet to disengage said ratchet wheel when said line has become united with another line; and means whereby the selecting magnet holds such union operative; and means whereby the selecting magnet upon becoming deënergized, causes disconnection between the two lines.

13. In an automatic telephone system, telephone lines; a sub-station associated with each line, having a local transmitter circuit, closed when said sub-station is in use; for each line, a selecting magnet and a connecting magnet; means whereby common transmitter battery is supplied therethrough to sub-stations in use; said magnets becoming thereby energized; and means whereby said connecting magnet may be shunted, and thereby deënergized for the purpose of signaling a called sub-station.

14. In an automatic telephone system, telephone lines; for each line, a selecting magnet; a ratchet wheel; a dog; said ratchet wheel being operated step by step by said selecting magnet, and said dog holding said ratchet wheel at each step; a connecting magnet; and means whereby said connecting magnet upon becoming energized, causes said dog to disengage said ratchet wheel; and means whereby said dog may not again engage said ratchet wheel until said selecting magnet has been deënergized and again energized.

15. In an automatic telephone system, telephone lines; for each line, a telephone station, a selecting magnet, a non-inductive shunt for said selecting magnet, an impedance coil, a central battery, and means whereby electrical current from said battery may be supplied to a telephone station through said selecting magnet and said impedance coil; a movable connecting terminal, whereby a path suitable for conveying sound-produced currents, may be bridged across the impedance coils of a calling line and a called line, for the purpose of uniting said lines for conversational purposes; and means operated by the impedance coil of a calling line, to signal a called line.

16. In an automatic telephone system, telephone lines; for each line, a telephone station, a selecting magnet, a non-inductive shunt for said selecting magnet, an impedance coil relay; a central battery; and means whereby electrical current from said battery may be supplied to a telephone station through the said selecting magnet to one limb of the line, and the impedance coil

relay, to the other limb of the line; a movable connecting terminal whereby a path suitable for conveying sound-producing currents may be bridged across the impedance coil relays of a calling line, and a called line; and means whereby the impedance coil relay of a calling line may be operated to signal a called line.

17. In an automatic telephone system, telephone lines; an impedance coil relay for each line; a source of signaling current; a movable terminal electrically connected to said source; a connecting terminal which may be electrically associated with a called line; means whereby the impedance coil relay upon becoming energized, causes the movable terminal to move and to become locked adjacent to the connecting terminal; and means whereby the said impedance coil relay may, upon becoming deënergized, permit the said connecting terminal to contact the said movable terminal, for the purpose of signaling a called line.

18. In an automatic telephone system, telephone lines; one limb of each line being associated with a selecting magnet circuit, and the other limb being normally open at a central station; a central battery; common return circuit connected to one pole of said battery; a signaling device on each telephone line, and connected to said common return circuit and to said open lines; and means whereby a calling line may connect to the open line of a called line the opposite pole of said battery, for the purpose of operating the signaling device on said called line.

19. In an automatic telephone system, telephone lines; one limb of each line being associated with a selecting magnet circuit, and the other limb being normally open at a central station; a central battery; a common return circuit connected to one pole of said battery; a signaling device on each line and connected to said common return circuit and to said open limb; an impedance coil relay; and means whereby a calling line may, through the agency of the impedance coil relay, connect to the open limb of a called line, the opposite pole of said battery, for the purpose of operating the signaling device on said called line.

20. In an automatic telephone system, telephone lines; one limb of each line being associated with a selecting magnet circuit, and the other limb being normally open at a central station; a called line; selective apparatus associated therewith; a telephone station on said line; and means whereby the removal of the receiver from its hook completes a circuit between the selecting magnet limb, and the open limb; and means whereby a calling line may complete a circuit to the open limb of a called line whereby the selecting circuit of the called line may become operative and cause said selective apparatus to move from normal position, to supply common transmitter battery to the called line through apparatus associated with that line.

21. In an automatic telephone system, telephone lines; a signaling relay associated with each line; and means whereby a calling party may upon completion of a call, operate the signaling relay of a called line at will to signal a station on said called line.

22. In an automatic telephone system, telephone lines; a signaling relay associated with each line; means whereby a calling party may upon completion of a call, operate at will the said signaling relay of a called line to signal a station on said called line; a source of signaling current; means whereby the signaling relay opens the line to the called station, and connects to said open line said source of current, to operate a signaling device thereon.

23. In an automatic telephone system, a calling telephone line; a relay associated therewith; a called line; a signaling relay associated therewith; means whereby a calling party may, upon completion of a call, through the agency of said relay, control at will the said signaling relay for the purpose of signaling a station on the called line.

24. In an automatic telephone system, a telephone line; a calling station, and a called station thereon; a selector associated therewith and operated by the calling station to connect to that line; a selecting magnet associated with said selector, and holding it in its connected position; a signaling relay associated with said line, said signaling relay being controlled by the calling station for the purpose of signaling the called station; means associated with said signaling relay for preventing the said selecting magnet from becoming deënergized when said line is opened by said signaling relay for the purpose of signaling the called station thereon.

25. In an automatic telephone system, a telephone line; a calling station, and a called station, thereon; a selector associated therewith and operated by the calling station to connect to that line; a selecting magnet associated with the selector and holding it in its connected position; a signaling relay associated with said line; said signaling relay being controlled from the calling station for the purpose of signaling the called station; and means associated with the said signaling relay for preventing the restoration to normal of said selector, when said line is opened by said signaling relay for the purpose of signaling the called station thereon.

26. In an automatic telephone system, telephone lines; associated with each line, a selector having a bank of lockout terminals; a movable lockout terminal; a lockout magnet and circuit, said circuit being normally

closed to said movable lockout terminal, and through said lockout magnet to battery; means whereby, upon the completion of a call to a non-busy line, said lockout magnet is disconnected from said movable lockout terminal, and a lockout potential is connected to said movable lockout terminal; said lockout circuit being separate from the talking circuit; a lockout bank wire for each selector, and connected to an individual lockout terminal in each other selector; means whereby a selector in use connects through its multiple bank wire, a lockout potential to its individual lockout terminal in all of the other selectors in the system, for the purpose of rendering a line in use inaccessible to a calling line; each multiple bank wire being disconnected from the lockout terminal of its individual selector, for the purpose of rendering a line accessible to its own selector.

27. In an automatic telephone system, a calling telephone line; a telephone station thereon; a selector associated therewith, and connected to a called line; a local circuit in said calling station whereby the said selector may be held in connection with a called line while the latter line is being signaled; an impedance; the latter being included in the local circuit of a calling station while said station is signaling, for the purpose of preventing the short-circuiting of the signaling current at a calling station when the called station is on the same line.

28. In an automatic telephone system, telephone lines; associated with each line, a selector having a bank of lockout terminals; each selector having connection to a representative lockout terminal in the lockout bank of each of the other selectors; a busy relay electrically associated with a movable terminal which may connect in succession to the lockout terminals in its individual lockout bank; an impedance coil relay; the circuit of said busy relay being normally closed through contacts operated by said impedance coil relay, said busy relay being thereby normally in a position to act when the movable terminal contacts an active lockout terminal; means whereby the said impedance coil relay of a calling line becomes energized upon the completion of a connection and thereby disconnects the said busy relay from its said movable terminal, and connects a lockout potential thereto, for the purpose of rendering the called line inaccessible to other lines.

29. In an automatic telephone system, telephone lines; associated with each line, a selector having a bank of lockout terminals; each selector having connection to a representative lockout terminal in the lockout bank of each of the other selectors; a busy relay electrically associated with a movable terminal which may connect in succession to the lockout terminal in its individual bank, the circuit of said busy relay being normally closed through contacts operated by an impedance coil relay; said busy relay being thereby normally in a position to act when the movable terminal contacts an active lockout terminal; and means whereby the said busy relay upon becoming energized by reason of its movable terminal contacting a lockout terminal upon which is a lockout potential, opens the circuit which would otherwise be established between a calling line and a called line.

30. In an automatic telephone system, telephone lines; associated with each line, a selector having a bank of lockout terminals; each selector having connection to a representative lockout terminal in the lockout bank of each of the other selectors; a busy signal; a busy relay electrically associated with a movable terminal which may connect in succession to the lockout terminal in its individual bank, the circuit of said busy relay being normally closed through contacts operated by an impedance coil relay; said busy relay being thereby normally in a position to act when the movable terminal contacts an active lockout terminal; and means whereby the said busy relay upon becoming energized by reason of its movable terminal contacting a lockout terminal upon which is a lockout potential, opens the circuit which would otherwise be established between a calling line, and a called line, and connects said busy signal to said calling line.

31. In an automatic telephone system, telephone lines; associated with each line, a selector having a bank of lockout terminals; each selector having connection to a representative lockout terminal in the lockout bank of each of the other selectors; a busy signal; a busy relay electrically associated with a movable terminal which may connect in succession to the lockout terminals in its individual bank; and means whereby the said busy relay upon becoming energized by reason of its movable terminal contacting a lockout terminal upon which is a potential, opens the circuit which would otherwise be established between a calling and a called line, and connects the busy signal to said calling line; an impedance coil relay associated with said calling line which would normally open the circuit of the busy relay upon the completion of a connection, the circuit of said busy relay being normally closed through contacts operated by the said impedance coil relay; said busy relay being thereby normally in a position to act when the movable terminal contacts an active lockout terminal; and means associated with the said busy relay to maintain said circuit closed when a call is made to a line in use.

32. In an automatic telephone system, telephone lines; associated with each line, a busy

signal, a busy relay; means whereby said busy relay of a calling line becomes energized when a connection is made to a line in use; and means operated by said relay, whereby the calling line is locked out from connection to the called line and connected to said busy signal; means whereby the busy relay becomes deënergized when the called line is accessible to the calling line; the said busy relay thereupon disconnecting the busy signal from the calling line, and completing the connection to the formerly busy called line.

33. In an automatic telephone system, telephone lines; associated with each line, a selector, having a bank of line terminals; each selector having connection to a representative line terminal in the line bank of all of the selectors in the system; a movable line terminal which may connect in succession to the line terminals of its individual line bank; said movable terminal being normally disconnected from the circuits of its selector; an impedance coil bridged between the grounded pole of a battery and line; said battery; said impedance coil serving to prevent short-circuiting of a talking circuit; an armature for said impedance coil whereby said coil may act as a relay; and means whereby said impedance coil relay of a calling line becomes energized upon completion of a connection to a called line; and causes the two lines to become united for purposes of conversation.

34. In an automatic telephone system, telephone lines; associated with each line, a selector having a bank of lockout terminals; a lockout bank wire for each selector; and means whereby a selector in use connects a lockout potential to its individual lockout terminal in each of the other selectors; a movable terminal which may contact in succession the lockout terminals in its individual lockout bank; a busy relay electrically associated with said movable terminal, and energized when said movable terminal contacts a lockout terminal upon which is a lockout potential; a busy tone producing device, said device being normally at rest; means operated by said busy relay, when the latter becomes energized, for rendering active the said busy tone producing device; all for the purpose of permitting the busy tone producing device to remain inactive until a call is actually made to a busy line.

35. In an automatic telephone system, common battery lines; local battery lines; transmitters at stations on the said common battery lines, said transmitters being supplied with electrical current from a central source; at each station on local battery lines, a receiver, a transmitter, and an induction coil having three windings, a primary, an intermediate and a secondary; and automatic means for uniting said common battery lines and said local battery lines for conversational purposes.

36. In an automatic telephone system, common battery lines; local battery lines; transmitters at stations on the said common battery lines, said transmitters being supplied with electrical current from a central source; at each station on local battery lines, a receiver, a transmitter, and an induction coil having three windings, a primary, an intermediate and a secondary; automatic means for uniting said common battery lines and said local battery lines for conversational purposes; and means whereby sound produced currents from a common battery line will, through the intermediate winding, affect the secondary and receiver at a local battery station; and means whereby sound produced currents from a local battery station induced in the intermediate winding by reason of its inductive relation to the primary winding, wherein, through the medium of a transmitter, current from a local battery is caused to vary in quantity, will affect through the primary winding at a common battery station, its secondary winding and receiver.

37. In an automatic telephone system, common battery lines; local battery lines; a transmitter, a receiver and a selector, for each line; means whereby the transmitters at stations on common battery lines may be supplied with electrical current from a central source; means whereby transmitters at stations on local battery lines may be supplied with current from a local source; at a local battery station, a receiver, a transmitter, and an induction coil having three windings, an intermediate winding bridged across the line to maintain a closed circuit through said station and complete a holding circuit, to maintain its selector in a connected position; a primary winding inductively related to said intermediate winding, and in series with the transmitter and a local source of current; and a secondary winding inductively related to said intermediate winding and in series with the receiver in a closed circuit.

38. In an automatic telephone system, telephone lines; a calling line, and a called line, united for conversational purposes; means whereby the called line may call a third line; and means whereby the connection to the calling line is severed until the connection is completed to the said third line, whereupon the connection is reëstablished to the calling line.

In testimony whereof I affix my signature in presence of two witnesses.

ALTON E. STEVENS.

Witnesses:
E. F. Uniac,
F. J. V. Dakin.

A. E. STEVENS.

AUTOPHONE SYSTEM.

APPLICATION FILED NOV. 6, 1908.

957,909.

Patented May 17, 1910.

6 SHEETS—SHEET 1.

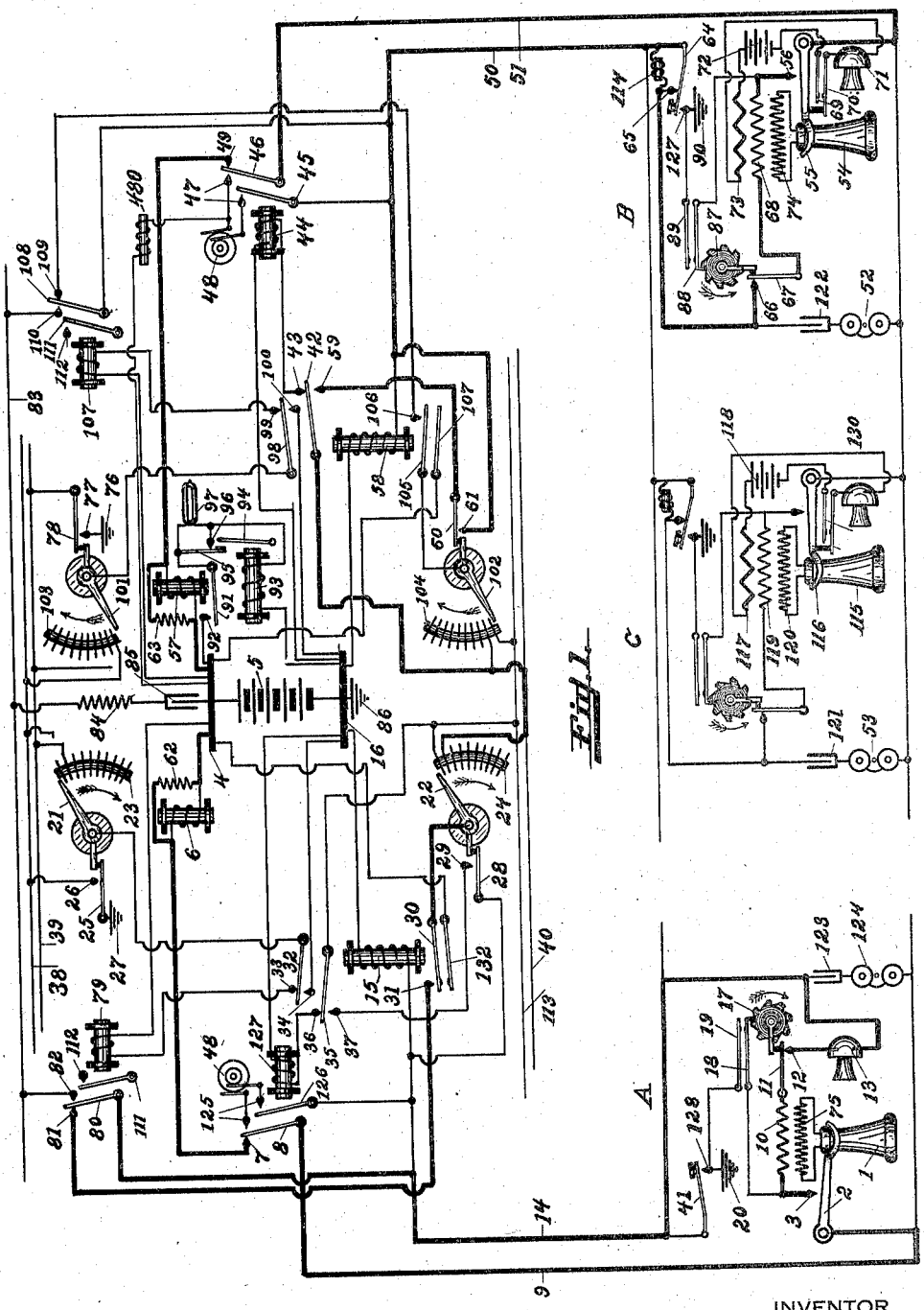

Fig. 1.

WITNESSES:

E. F. Uniac.

O. S. Bowen

INVENTOR

Alton E. Stevens

BY

Charles J. Richardson

Its ATTORNEY

A. E. STEVENS.

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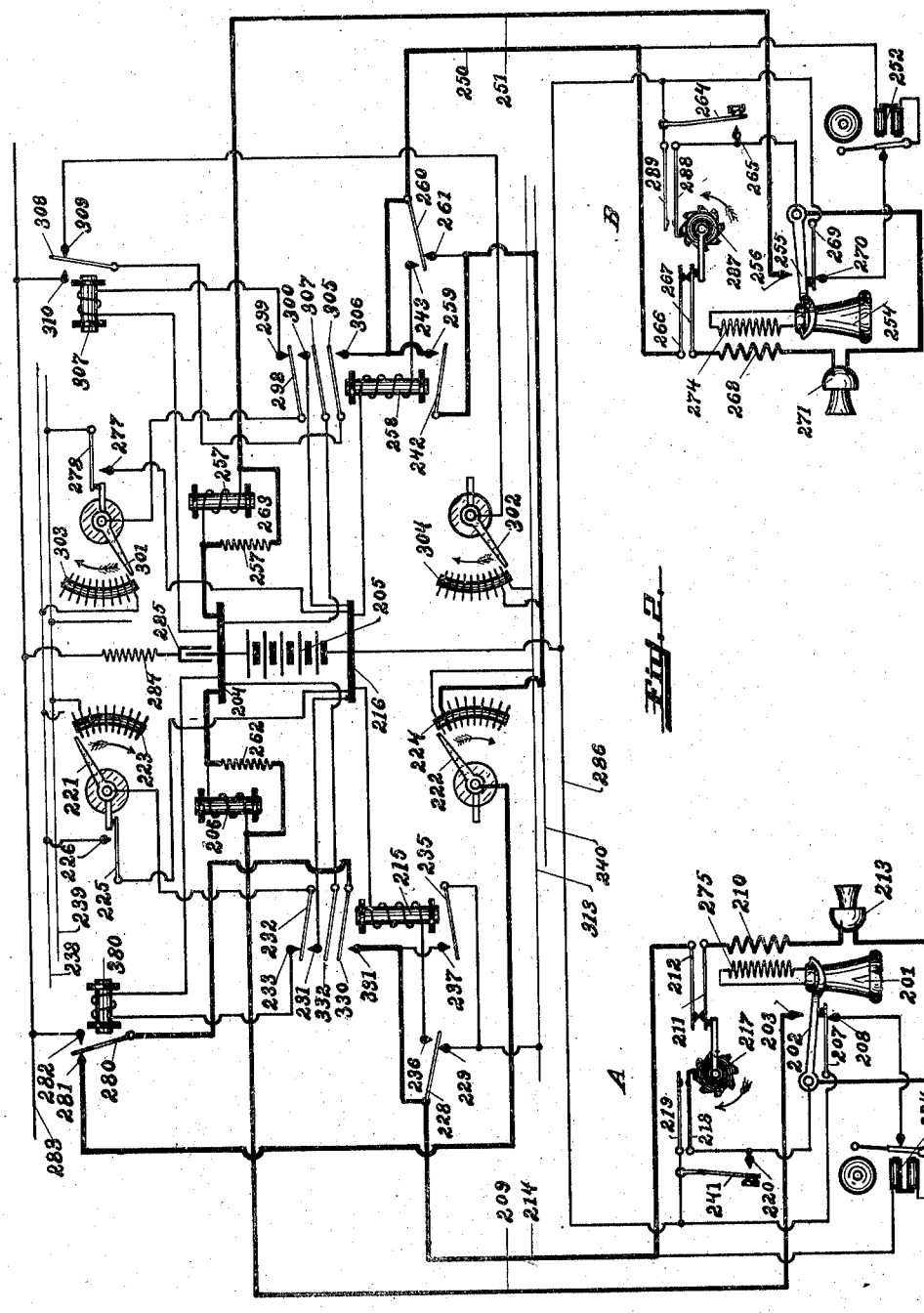

Fig. 2.

WITNESSES:

E. F. Uniac.

O. S. Bowen.

INVENTOR

Alton E. Stevens

BY

Charles F. Richardson

his ATTORNEY

A. E. STEVENS.

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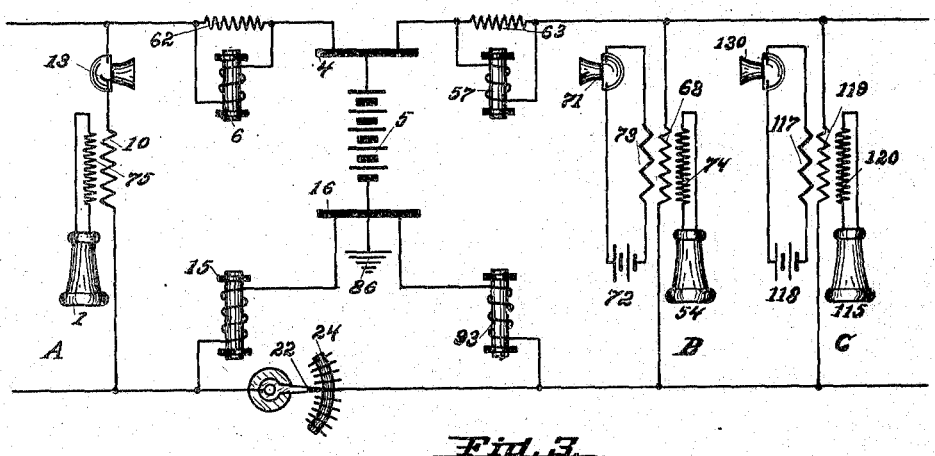


Fig. 3.

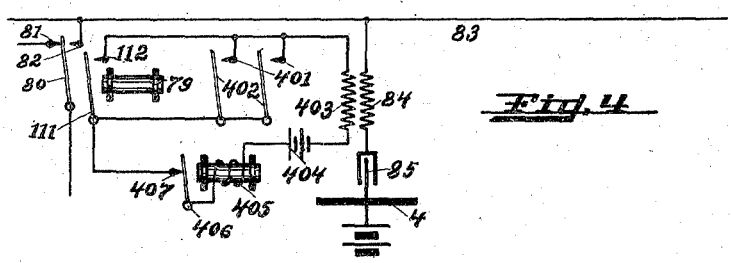
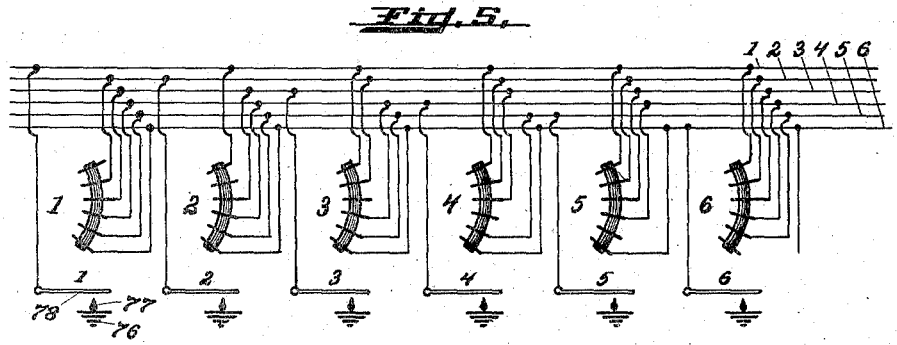


Fig. 4.

Fig. 5.



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E. F. Doniac.

O. S. Bowen

INVENTOR.

Alton E. Stevens

BY

Charles F. Richardson

his ATTORNEY

A. E. STEVENS.

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6 SHEETS—SHEET 4.

Fig. 6.

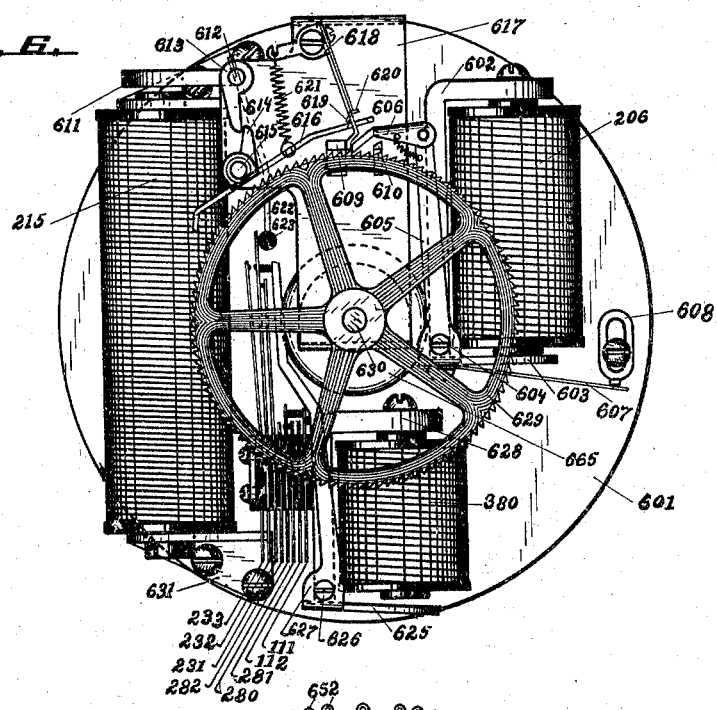
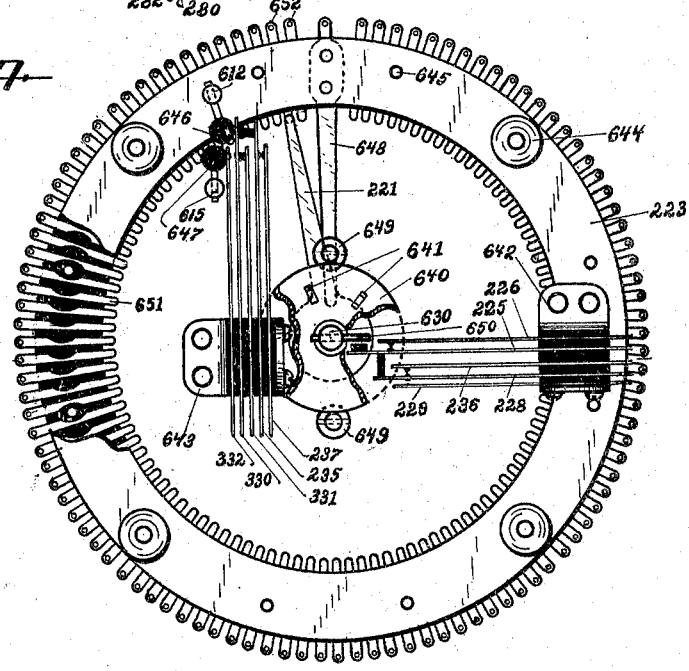


Fig. 7.



WITNESSES:

E. F. Uniac.

O. S. Bowen.

INVENTOR

Alton E. Stevens

BY

Charles F. Richardson

Its ATTORNEY

A. E. STEVENS.

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6 SHEETS—SHEET 5.

Fig. 8.

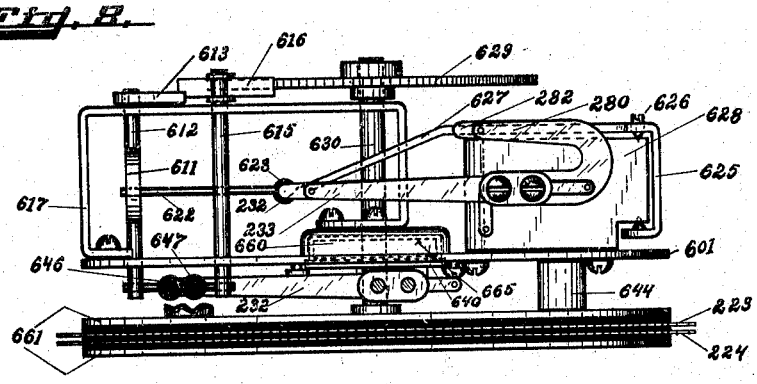


Fig. 9.

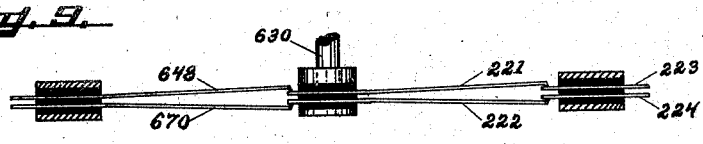
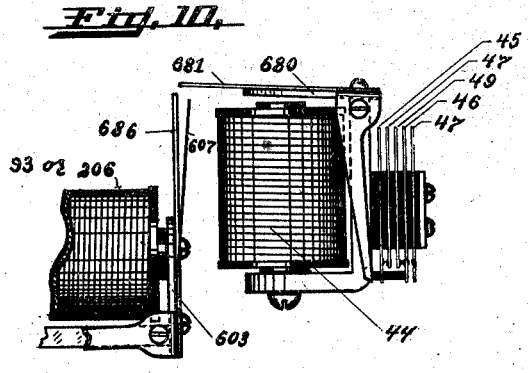


Fig. 10.



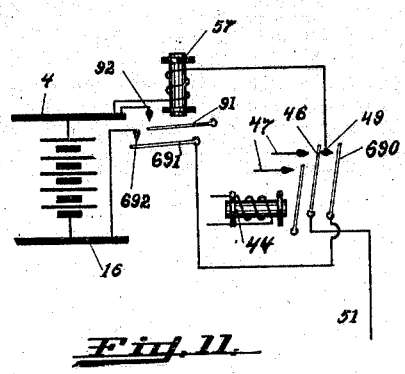


Fig. 11.

WITNESSES:

E. F. Kniac.

O. S. Bowers.

INVENTOR

Alton E. Stevens

BY

Charles F. Richardson

his ATTORNEY

A. E. STEVENS.

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Patented May 17, 1910.

6 SHEETS—SHEET 6.

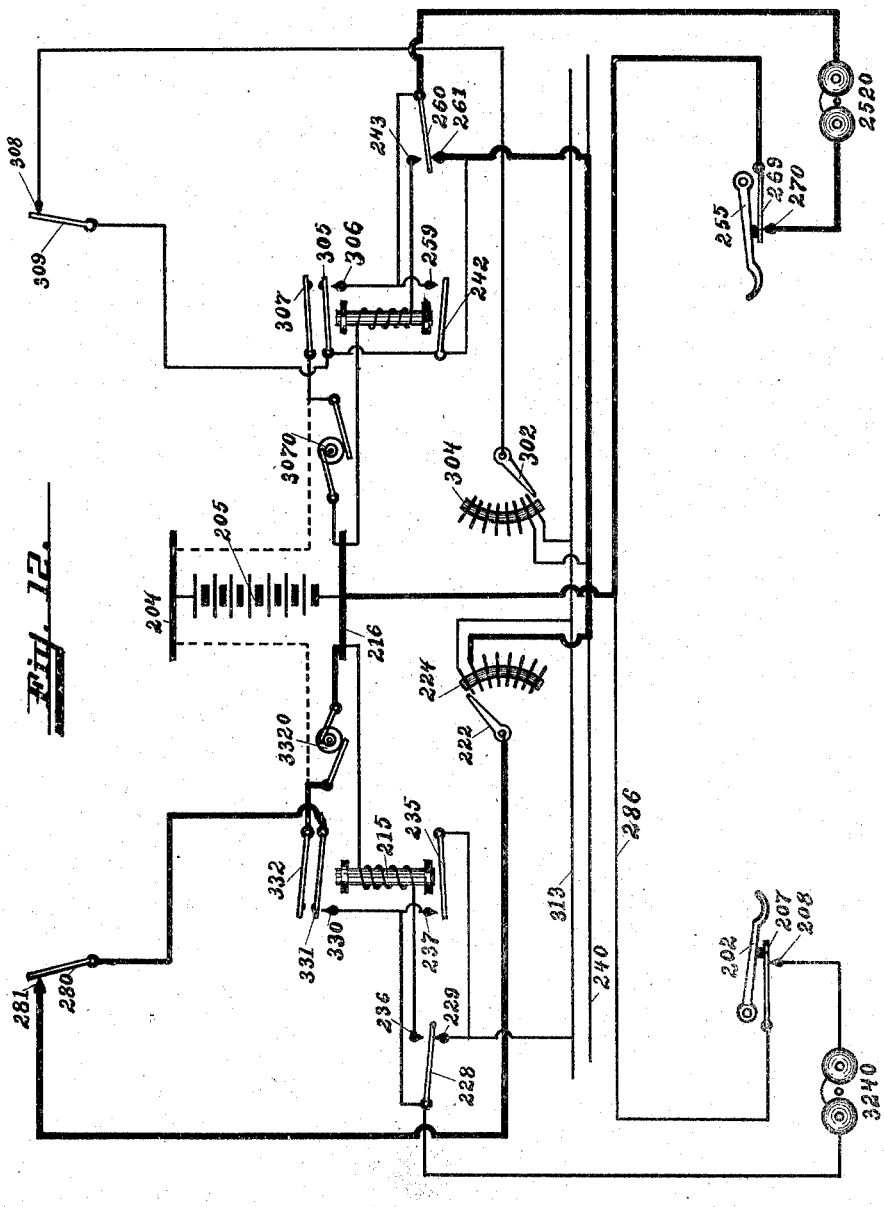


Fig. 12.

Witnesses:
E. F. Maniac.
F. J. V. Dakin

Inventor
Alton E. Stevens
By Charles F. Richardson
his Attorney

UNITED STATES PATENT OFFICE.

ALTON E. STEVENS, OF PROVIDENCE, RHODE ISLAND.

AUTOMATIC TELEPHONE CENTRAL-STATION APPARATUS.

1,265,398. Specification of Letters Patent. Patented May 7, 1918.

Application filed April 28, 1917. Serial No. 165,126.

To all whom it may concern:

Be it known that I, ALTON E. STEVENS, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Automatic Telephone Central-Station Apparatus, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to switching apparatus employed at the central station of an automatic telephone system; and it resides in features, and various combinations thereof, which may be cheaply and quickly made, and assembled, and are so designed and arranged, as to allow faulty or broken parts to be easily removed, and perfect ones substituted.

My invention may be said to reside particularly in demountable selector-racks, and terminals, and demountable selectors, used in such automatic telephone systems.

Some of the purposes of my invention may be said to be:—

First: to so design the combination of a selector-rack and terminal-board, that they as a whole and individual unit, may be readily installed in, or removed from, the central station switch board.

Second: to combine the selector-rack with the line terminal-board, so as to obtain the greatest economy in switch board wiring.

Third: to so arrange the selector-rack, banks, and bank terminals, that a bare wire conductor can be used to multiple the terminals together.

Fourth: to so design the selector-rack, and selector, as to facilitate the installation, or interchange of selectors.

Fifth: to provide a simple way of securing the bank contact points in the contact bank.

In the drawings illustrating the principle of my invention, and the best way now known to me, of embodying the same in operative structure,

Figure 1 is a front view of a selector-rack showing one selector in position;

Fig. 2 is a reduced elevation showing in detail, a number of selector rack jacks about to engage switchboard jacks connected by multiple cables;

Fig. 3 is a rear view of the selector-rack and connections;

Fig. 4 shows multiple cables and switchboard jacks to receive the jacks of a selector rack; only one row being shown to avoid confusion;

Fig. 5 is a plan of two rows of switchboard jacks;

Fig. 6 shows in detail selector rack jack engaging switchboard jack;

Fig. 7 is a top view of a selector in position in the selector-rack;

Fig. 8 is a detailed cross section, showing the selector brushes engaging a contact of a selector-rack;

Fig. 9 is a bottom view of the selector with a section of a selector rack;

Fig. 10 is a diagrammatic view of wiring and apparatus employed by a calling and a called station making use of my invention.

The selector-rack consists of a metallic frame of two angle irons 1, bound together at top and bottom, by a horizontal bar 2. Arranged one above another, and secured to ears 3, Figs. 3 and 7, fixed in the vertical members 1 of the frame, at regular intervals, are segments 4 of insulating material, as fiber. Radially disposed in these segments, are a series of two holes 5, Figs. 7 and 8, near the front and rear edges of the segment 4. Up through each pair of holes is passed a staple-shaped metal strip to form a bank terminal 6, of such length that when the vertical end portions of the staple are bent down outwardly and backwardly, the points of the strip extend beyond the front and rear edges of each segment; the respective strips and points being in the same vertical radial planes of the segments. Attached to each vertical series of rear points, as by solder, is a vertical bank wire, 7, Figs. 3 and 7, corresponding to its station of the system. So much of each of these bank wires as is below the lowest segment, is insulated, as at 8, Figs. 1 and 3, so that all of such parts of the bank wires, may converge and be gathered together, and connected to plugs 9 of the usual form, in the plug strip 10 of the frame. The points of the strips 6 projecting forwardly beyond the edge of the segment, form contact points of the contact bank terminals, for the pivoted brush 12, Fig. 7, of a selector mechanism, later to be generally described. This method of constructing the segment and its contact strips, is of great simplicity and utility; the bank terminals 6 being part of the segment 4, are firmly and readily attached in the selector-rack.

Fixed, as by screws 13, to the side 1, of

the frame, is a flat terminal-board 14, Figs. 1, 3 and 7, of insulating material, having for each selector, and horizontally disposed upon the front of the frame, and in the board, means whereby the selector, as C, a unit, may be removably secured to the frame, and terminal-board 14, both mechanically and electrically.

These comprise horizontal pairs of selector supporting posts 15, Fig. 7, extending out from the face of the frame; spring jacks 16, Figs. 1, 7, and 10, to receive and contact with the plugs 17 on the selector; and binding posts 18, 19 and 20, on the terminal-board 14, to receive the necessary line, signaling and common wires 21, 22 and 23, Fig. 10, for the system. From the back of these binding posts 18 and 19, suitable leads 24 and 25, Figs. 3, 10 are led to the proper jack 16 and 27; while from the vertical bank wire 7 of one of the stations on the selector-rack, leads the home wire 40 to the jack 26. The jack 28 for each selector is connected to a wire 35 in the busy circuit, and has its individual plug in the plug strip 10, Fig. 3, in the selector rack frame. Binding-posts 30 and 31 are mounted at the bottom of the terminal-board 14, Fig. 1, to receive battery current from a suitable source; one of which binding-posts, as 30, is connected with a common wire to the jack 29 of each selector; and the other post, as 31, being connected to a common wire 23, Fig. 3, mounted on the rear of the terminal-board 14.

The plugs 9 of the selector-rack, when the latter is to be installed in a switchboard, are first caused to engage a corresponding group of switchboard jacks 41, Figs. 2, 4, 5, 6 and 10, made integral with the switchboard. When two or more selector-racks are required, there are as many groups of switchboard jacks as there are selector-racks, as for example see Fig. 2; the jacks being multipled together by suitable cables 42, in a well-known manner.

It will now be obvious that in case of trouble or breakage, a selector-rack and terminal board, entire, may readily be removed from the switchboard, and a new unit carrying a like but operative set of electrical connections, can be quickly substituted, thereby greatly hastening the making of repairs required.

Mounted on the pins 15, projecting from the face of the frame, are the necessary number of selectors, one selector, as is well known, being required for each telephone station. One is illustrated in the drawings, and only so much of it, as will show its demountability, as a unit, from the rack and board, will be described; it being understood that any selector of suitable construction, may be used in the system.

Of the selector, itself, there is a frame 50, having for manual convenience, a handle 51 at the front, integral therewith. On each side is a cylindrical member 52 pierced with a hole and adapted to slide over the pair of pins 15, Fig. 1, on the selector-rack. Mounted on the pivot 53, Fig. 7, is the selector brush 12 comprising two metallic spring members, adapted to pass, one above, and the other below, and contact with, the contact bank terminals, 6, as shown in Figs. 7 and 8. The remaining elements of the selector, such as its selector magnet 54 and armature 55; its holding magnet 56 and armature 57; its lockout magnet 58 and armature 59; and the various springs for controlling the numerous circuits, are all diagrammatically illustrated in Fig. 10, and fully explained and claimed in application, Serial No. 72428, for automatic telephone system filed by me January 17, 1916. As the selector mechanism does not itself constitute a feature of my invention, it is felt that a further description of its construction and operation is not required.

Likewise, as the manufacture, setting up and taking down of the selecting mechanism, at the central station, involve only the selector-rack A, terminal-board 14, and demountable selector C; the operative automatic telephone system embracing them, constitutes their environment, and is shown in said diagrammatic view, Fig. 10, only to explain the relations of the parts of my invention to an operative system, a complete disclosure of which will be found in my said application No. 72428.

The only necessary electrical connections that must be severable, between each selector and the rest of the system, are the plug 17 and jack 16 in the line circuit 21; the plug 61 and jack 26 in the home wire 40 of the telephone station; the plug 63 and jack 27 in the selecting circuit 22; the plug 65 and jack 28 in the busy circuit 35; and the plug 67 and jack 29 in the battery circuit 23; all of which are clearly and diagrammatically indicated in Fig. 10 of the drawing.

It will now be plain that one or more selectors may be mounted in the positions provided upon the selector-rack, and that by pushing the selector frame in, upon the pins, as far as it will go, all of the electrical connections required will be made; and that by drawing it off the pins, all connections will be severed; also that each selector-rack and terminal-board may as a whole be mounted in or removed from a switchboard, if they are so manipulated that the plugs in the selector-rack are moved to engage or disengage their multiple jacks in the switchboard.

Further, it will be obvious that the combination of the selector-rack and terminal-board provides a construction whereby the amount of wiring in the central station ap-

paratus is reduced to a minimum; and the positioning of the banks and the arrangement of the back contact points of the bank terminals are such that they require a minimum amount of labor in wiring.

The patentable features, disclosed in diagrammatic drawing, Fig. 10, but not claimed herein, are fully described and claimed in my said pending application for "automatic telephone system," Serial No. 72428, filed January 17, 1916 and in my application for "automatic telephone sub-station mechanism" Serial No. 163590, filed April 21, 1917.

Desiring to protect my invention in the broadest manner legally possible,

What I claim is:

1. A vertical rack; horizontal contact banks of line terminals, one above another, the contact points being multipled together with bare vertical wire conductors; pins perpendicular to the face of the rack; one or more selector frames with holes therein to allow a selector to be removably mounted upon said pins; the free end portions of said contact bank terminals being engageable by the selecting brush of the selector.

2. A vertical rack; horizontal contact banks of line terminals, one above another, the contact points being multipled together with bare vertical wire conductors; pins perpendicular to the face of the rack; one or more selector frames with holes therein to allow a selector to be removably mounted upon said pins; the free end portions of said contact bank terminals being engageable by the selecting brush of the selector; jacks secured to said rack, whereby the selector circuits become connected or disconnected, when the selector is mounted on, or demounted from, the selector rack.

3. A vertical rack; horizontal contact banks of line terminals, one above another, the contact points being multipled together by bare wire vertical conductors; a terminal board secured to the rack and having terminals therein horizontally adjacent to each contact bank of line terminals.

4. A vertical rack; horizontal contact banks of line terminals, one above another, the contact banks being multipled together by bare wire vertical conductors; pins perpendicular to the face of the rack; a terminal board secured to the rack, and having terminals and jacks therein horizontally adjacent to each contact bank of line terminals; one or more selector frames with holes therein, and with jacks, whereby each selector frame may be removably mounted upon said pins, and the selector circuits may become connected, or disconnected, when the selector is mounted on, or demounted from the selector rack.

5. A vertical rack; horizontal contact banks of line terminals, one above another; the contact points being multipled together by bare wire vertical multiple conductors; a multiple jack mounted upon said rack; insulated jack plugs mounted therein; each jack plug being connected to its individual vertical multiple conductor.

6. A vertical rack; horizontal contact banks of line terminals, one above another; the contact points being multipled together by bare wire vertical multiple conductors; a multiple jack mounted upon said rack; insulated jack plugs mounted therein; each jack plug being connected to its individual vertical multiple conductor; a switch board; multiple jacks mounted therein; insulated spring clips in each of said jacks to receive the insulated male plugs in the selector rack; and a multiple cable whereby the corresponding points in the switchboard jacks are multipled together.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

ALTON E. STEVENS.

Witnesses:
CHARLES F. RICHARDSON,
A. I. CRAWFORD.

A. E. STEVENS.

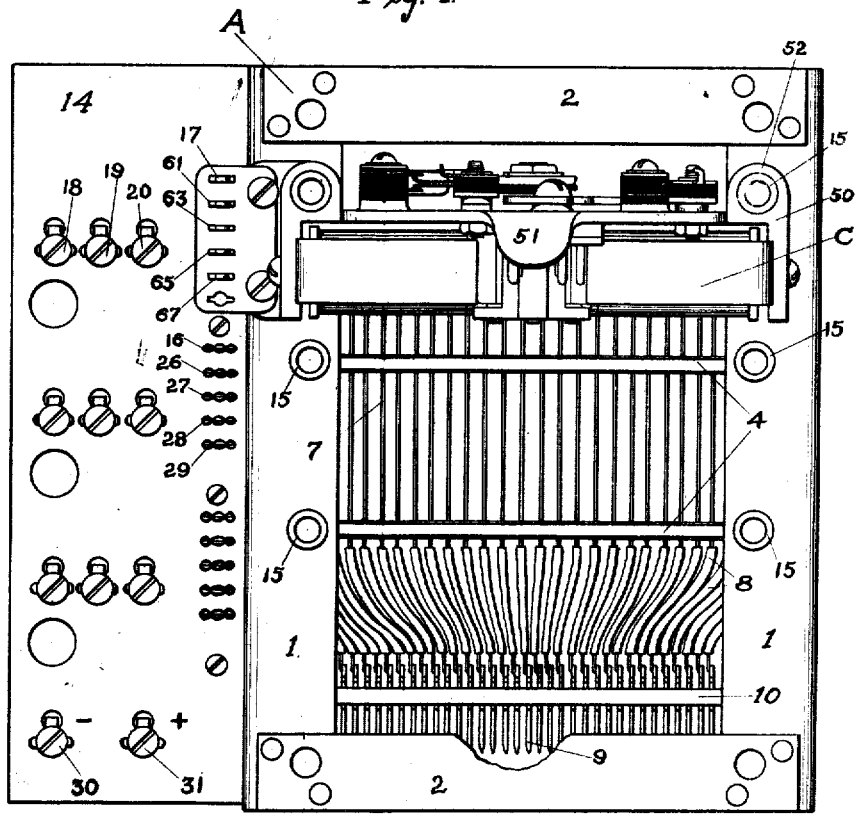
AUTOMATIC TELEPHONE CENTRAL STATION APPARATUS.

APPLICATION FILED APR. 28, 1917.

1,265,398. Patented May 7, 1918.

5 SHEETS—SHEET 1.

Fig. 1.



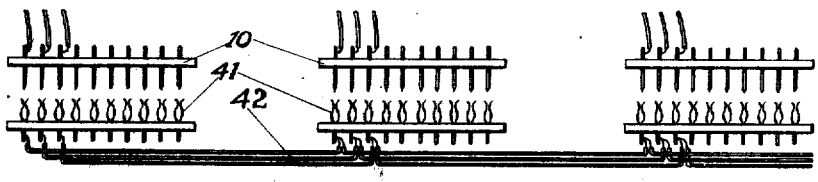


Fig. 2.

Inventor.

Alton E. Stevens

by Charles D. Richardson

his Attorney

A. E. STEVENS.

AUTOMATIC TELEPHONE CENTRAL STATION APPARATUS.

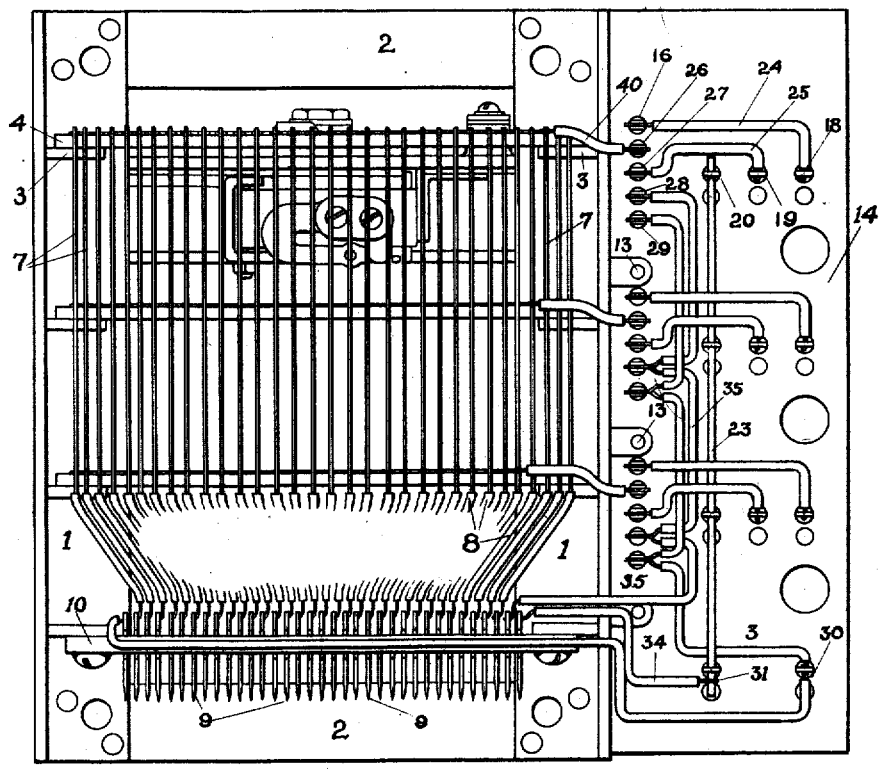
APPLICATION FILED APR. 28, 1917.

1,265,398.

Patented May 7, 1918.

5 SHEETS—SHEET 2.

Fig. 3.



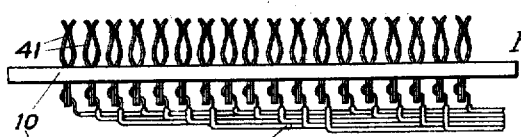


Fig. 4.

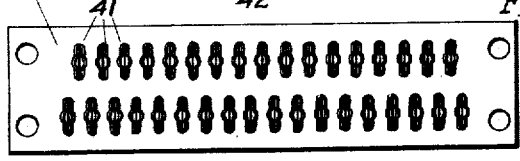


Fig. 5.

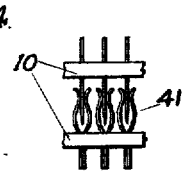


Fig. 6.

Inventor: Alton E. Stevens
by Charles D. Richardson,
his Attorney.

A. E. STEVENS.

AUTOMATIC TELEPHONE CENTRAL STATION APPARATUS.

APPLICATION FILED APR. 28, 1917.

1,265,398. Patented May 7, 1918.

5 SHEETS—SHEET 3.

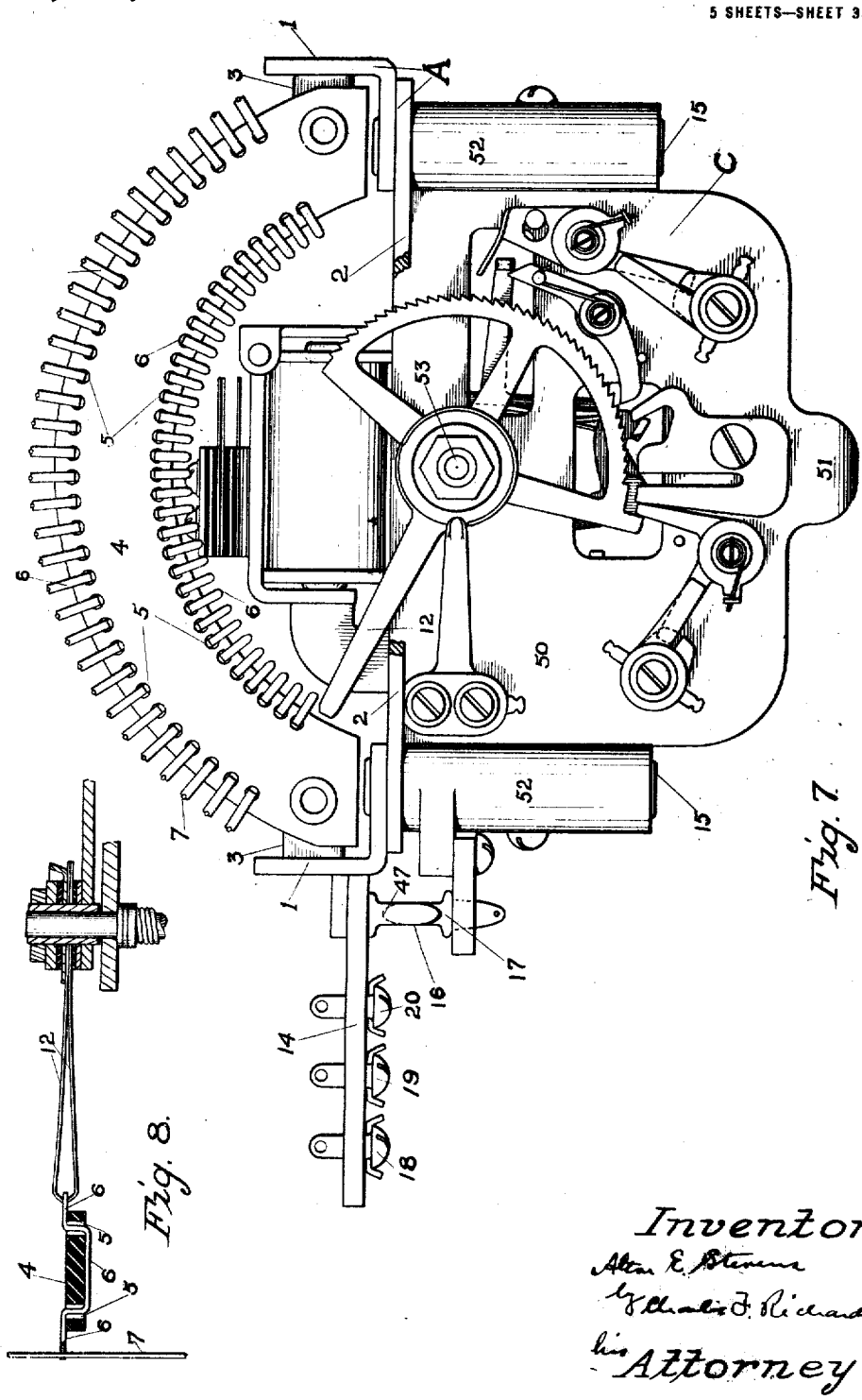


Fig. 7.

Fig. 8.

Inventor:
Alan E. Stevens
by Charles J. Richardson
his Attorney.

A. E. STEVENS.

AUTOMATIC TELEPHONE CENTRAL STATION APPARATUS.

APPLICATION FILED APR. 28, 1917.

1,265,398.

Patented May 7, 1918.

5 SHEETS—SHEET 4.

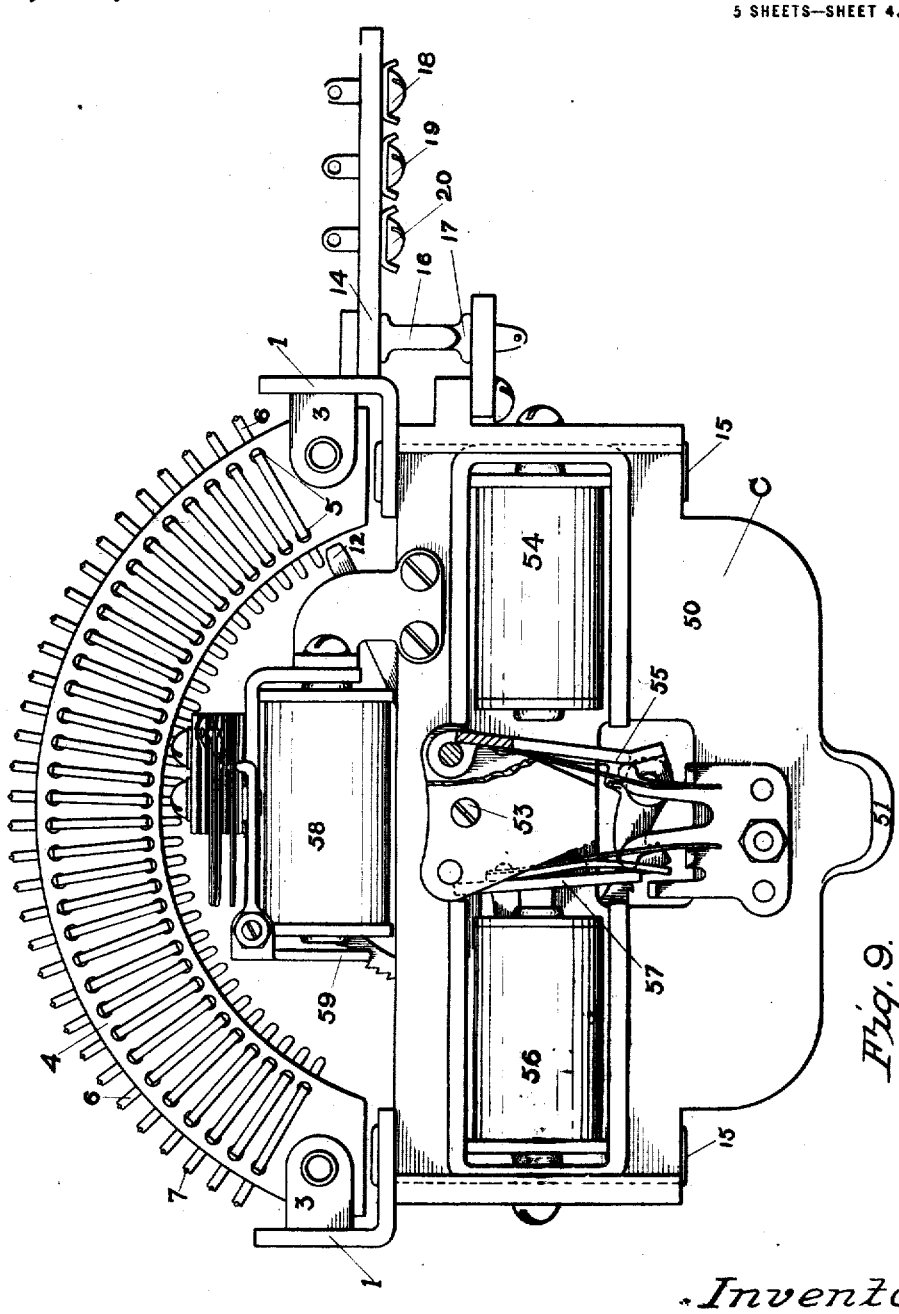


Fig. 9.

Inventor:
Nelson E. Stevens
by Charles F. Richardson
his Attorney:

A. E. STEVENS.

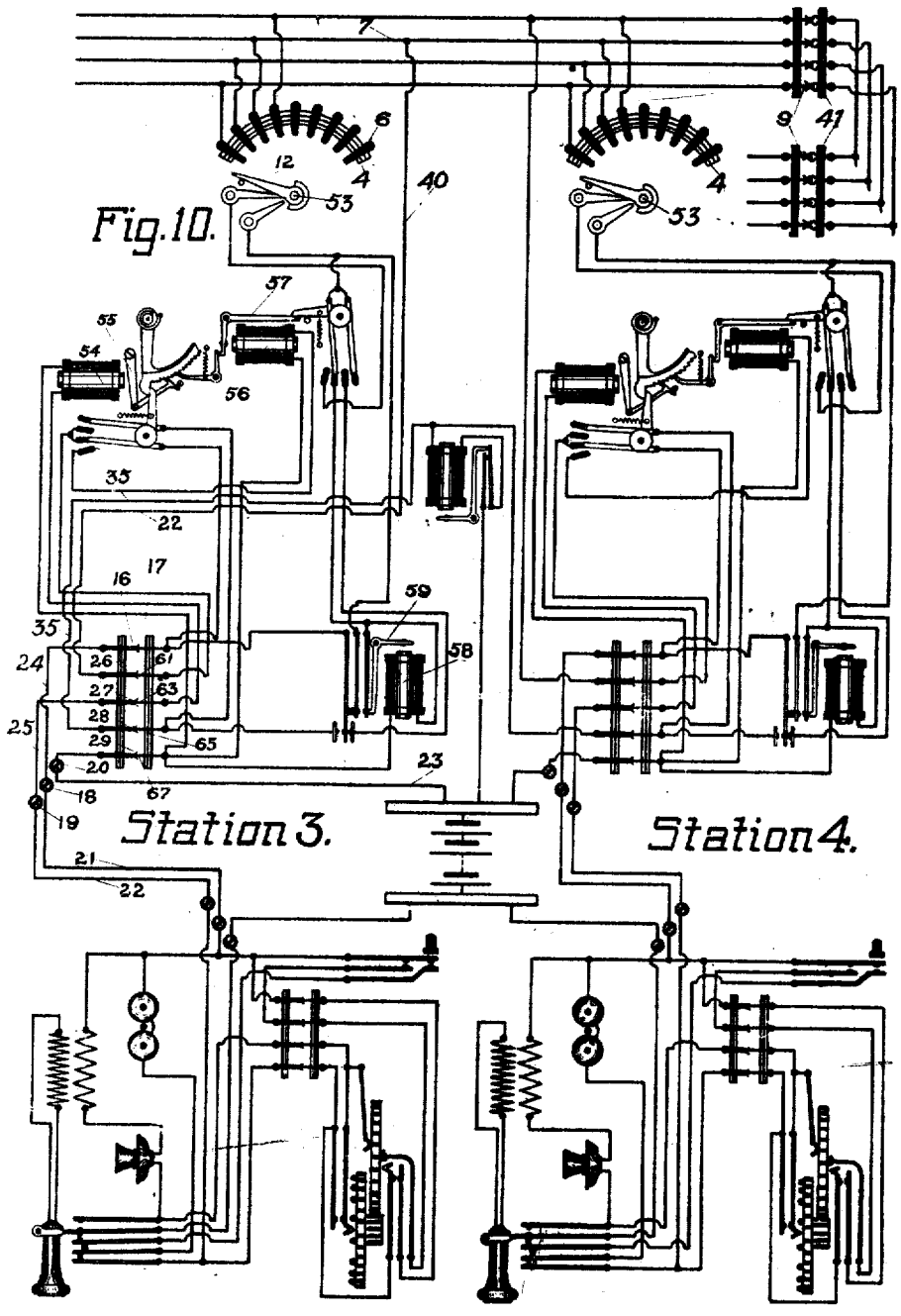
AUTOMATIC TELEPHONE CENTRAL STATION APPARATUS.

APPLICATION FILED APR. 28, 1917.

1,265,398. Patented May 7, 1918.

5 SHEETS—SHEET 5.

Fig. 10.



Inventor: Alton E. Stevens
by his attorney
Charles F. Richardson.

UNITED STATES PATENT OFFICE.

ALTON E. STEVENS, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO SCREW MACHINE PRODUCTS CORPORATION, OF PROVIDENCE, RHODE ISLAND.

AUTOMATIC TELEPHONE SYSTEM.

1,280,096. Specification of Letters Patent. Patented Sept. 24, 1918.

Application filed January 17, 1916. Serial No. 72,428

To all whom it may concern:

Be it known that I, ALTON E. STEVENS, a citizen of the United States, and a resident of Providence, in the county of Providence and State of Rhode Island, have invented a new and useful Automatic Telephone System, of which the following is a specification.

My invention relates to that class of automatic telephone systems primarily designed for private installation and limited in the number of possible connections, and has for its object the simplifying of telephone apparatus of this class, to reduce the number of operations necessary in making the connections from one telephone to another, and to eliminate as far as possible causes of faulty operation.

The principal features of my invention relate to the means whereby several stations may become electrically united for the purpose of inter-communication, whereby secrecy is secured for those parties so connected; whereby battery power may be supplied to the entire system for communicating and ringing purposes by one common battery; whereby all stations may be automatically simultaneously signaled from any station; and whereby such other results may be attained as may hereinafter appear.

In the drawings, Figure 1 represents the central station, showing the mechanism associated with three telephone lines, together with the electrical circuits connected therewith. Fig. 2 represents three telephone stations in conjunction with the central station shown in Fig. 1; both figures are in diagrammatic form.

The following description covers the most approved embodiment of my invention and can best be explained by describing in detail its operations as they take place.

We assume that a party at station A, Fig. 2, wishes to call a party at station C. The first operation for the calling party is to turn the impulse wheel 1 in a clockwise direction a distance which will cause the spring 3 to contact with spring 4 three times, when the impulse wheel 1 returns to its normal position. The spring arm 2 holds the impulse wheel in the position to which it is turned until the receiver 5 is removed from the hook 6, whereby the spring arm 2 is disengaged from the impulse wheel 1 and permits it to return to normal position under tension of a suitable spring 110. While the impulse wheel 1 is returning to its normal position, the spring 3 makes contact with spring 4 three times, thereby closing a selecting circuit from ground 11 through springs 7 and 8 which will come in contact upon the removal of the receiver 5, through the wire 12, the springs 3 and 4, the wire 13, the selecting magnet 14, Fig. 1, to battery 15 and ground 16. The selecting magnet 14 is thereby energized three times, and attracts its selecting armature 17, causing the pawl 18 connected therewith to engage three teeth in succession in the ratchet wheel 19, thereby stepping brush 20 to the third contact point 43 in the contact bank 21 which contact point is connected by bank wire 44 to the selector and telephone of station C.

At the first step from normal position of the ratchet wheel 19, the holding detent 21ˣ is caused to engage the teeth in said ratchet and hold it at each successive step in the following manner: As said ratchet wheel first moves from normal position its arm 22 has disengaged the spring 23, thereby permitting it to make contact with spring 25, establishing a holding circuit through the holding magnet 28 as follows: from ground 26 through battery 27, the magnet 28, the springs 25 and 23, the wires 29 and 30, the transmitter 31, Fig. 2, the receiver 5, the wires 32 and 12, the springs 8 and 7 to the ground 11. This causes the holding magnet 28 to be energized and attract its holding armature 33, thereby permitting the detent 21 to engage the ratchet wheel by the pressure of a small spring 111.

This holding armature 33 carries an extension which engages an insulated extension 34 on the spring 35. The tension of the spring 35, however, is so great that the amount of current flowing through the coils of the magnet 28 is not sufficient to energize this magnet sufficiently to attract the armature 33 to move the spring 35 out of contact with the spring 76. While the springs 3 and 4 are in contact for the last of the series of selecting impulses, the ringing pin 36, on the impulse wheel 1 causes the ringing spring 37 to make contact with the spring 38, thereby short-circuiting the transmitter 31 and receiver 5, and by reducing the resistance in the holding circuit, causing an additional amount of current to flow through the coils of the holding magnet 28,

thereby increasing its energy to such a degree as to cause the holding armature 33 to overcome the tension of the spring 35, whereby the spring 35 breaks contact with the spring 76 and makes contact simultaneously with the springs 41 and 42. The contact between the springs 37 and 38 being broken, when the impulse wheel 1 comes to rest at its normal position, the transmitter 31 and receiver 5 are again brought into circuit with the coils of the magnet 28, and the amount of current flowing in this holding circuit is decreased. This current, however, is sufficient to cause the magnet 28 to hold the armature 33 after it has once been attracted.

The contact between springs 37 and 38, Fig. 2, made as just described completes a ringing circuit, whereby the ringer at station C is operated, this ringing circuit being as follows: from the ground 11 through springs 7, 8, 37 and 38, the wires 30 and 64, Fig. 1, the springs 39 and 40, 41, 35 and 42, to the brush 20 which is in contact with the point 43, bank wire 44 and the wire 45 of station C, the springs 46 and 47, the wires 48 and 49, Fig. 2, the ringer 50, the springs 51 and 52, the wire 53, the selecting magnet 54, Fig. 1, the battery 55, and the ground 56. The ringer 50 is of high resistance, and the selecting magnet 54 is of low resistance, this latter being adjusted so that it will not operate through the resistance of the ringer.

The party at station C upon receiving his signal removes the receiver 57 from the hook 58 and can now communicate with the party at station A over the following talking circuit: from the ground 11 through springs 7 and 8, the wires 12 and 32, the receiver 5, the transmitter 31, the wires 30 and 64, Fig. 1, the springs 39 and 40, the springs 41 and 42, to the brush 20 and contact point 43, bank wire 44, wire 45, springs 46 and 47, wires 48 and 49, transmitter 61, Fig. 2, receiver 57, wires 62 and 63, springs 59 and 60 to ground 94. The springs 59 and 60 are brought in contact with each other upon the removal of the receiver 57 from the hook 58 which is drawn up by the small spring 112.

Battery power is supplied to energize the transmitters and receivers at each station as follows: from ground 26, Fig. 1, battery 27, through the magnet 28, the springs 25 and 23, the wire 29, to the wire 30, Fig. 2, thence over the wire 30 to station A, and over the wire 64, Fig. 1, to station C.

Stations A and C having finished communication, the connection is discontinued by placing the receiver 5 on the hook 6, thereby breaking connection between the springs 7 and 8, causing the holding magnet 28 to become deënergized, whereupon its armature 33 is released and causes the detent 21 to disengage the ratchet wheel 19. This ratchet wheel upon being released is returned to its normal position, as shown in the drawings, by any suitable spring, as 113.

If station C when called had been in communication with a called party at another station, as B, station A would have been prevented from making connections with station C and also notified of the fact that station C was in use, by the following means:

When the ratchet 65, Fig. 1, of station C has moved from normal position, as shown, the arm 66 has allowed the spring 47 to break contact with spring 46, and spring 67 to make contact with spring 46, thereby completing a busy tone circuit from ground 73 through battery 72, interrupter 71 and 70, busy tone magnet 69, bus-bar 68 to springs 67 and 46, wire 45 and bank wire 44. This circuit being established, when the brush 20, for station A, reaches the point 43 connected with bank wire 44 in connection with the selecting impulses of station A, the busy tone circuit was established as just described to the brush 20, springs 42, 35, 41, 40 and 39, wires 64 and 30, Fig. 2, transmitter 31, receiver 5, wires 32 and 12, springs 8 and 7, to ground 11. The current through this circuit causes the interrupter 71 and 70 to operate in a manner well-known in such devices, and produces a hum in receiver 5, thereby notifying the party at station A that station C is in use.

If upon the attempt of station A to establish a connection, station C had been busy by reason of its having been called by another station, as B, station A would have been prevented from communicating with station C in the following manner:

The bank wire 44, Fig. 1, in its normal state is not grounded, but when connection is made to this bank wire for the purpose of calling its associated station, this wire is grounded over the following circuit: from ground 11, Fig. 2, to springs 7 and 8, wires 12 and 32, receiver 5, transmitter 31, wires 30 and 64, Fig. 1, springs 39, 40, 41, 35 and 42 to brush 20 and contact point 43; thence to bank wire 44. Now assuming that bank wire 44 has been grounded in this manner by a station other than A and that station A attempts to connect with bank wire 44 and its associated station C, station A will be prevented from doing so in the following manner: As the ratchet wheel 19 of station A is stepping around so that the brush 20 has passed the contact point 84, the spring 74 is permitted to make contact with spring 75, thereby establishing a lock-out relay circuit from ground 79, battery 78, lock-out relay magnet 77, springs 76 and 35, 75 and 74, to brush 20, and thence to point 43 connected with bank wire 44 which is already grounded by reason of station C

having been called by the other party, as heretofore described. The lock-out relay magnet 77 thereby becomes energized, and attracts its armature 83, thereby completing a holding lockout circuit from ground 79, battery 78, magnet 77, springs 81 and 82, 75 and 74, brush 20, contact point 43, and wire 44 which is now grounded. The magnet 77 will, therefore, remain energized until the ground is removed from wire 44 or until the brush 20 returns to its normal position. During the time this magnet is energized, a busy tone circuit is maintained from ground 73 to battery 72, interrupter 71 and 70, magnet 69, bus-bar 68, wire 95, springs 80 and 39, wires 64 and 30, transmitter 31, receiver 5, wires 32 and 12, springs 8 and 7 to ground 11. The interrupter 71 and 70 is thus caused to operate, and causes a buzz in the receiver 5 over this circuit just described. The calling party, in this case station A, is thereupon notified that station C is busy, and replaces his receiver 5 on the hook 6.

It is many times desirable to locate a party who is not at his usual telephone station but may be near some station on the system. To facilitate this, I provide a general call or signal system made up of a series of bells or other signaling devices, as 93, Fig. 1, which may be placed in various places served by the system and operated from any telephone station. In such a case as this, if a person at station A had called for example station B, received no response by reason of the person usually at station B being away from said station B and his whereabouts being unknown to the calling party at station A, the party at station A will operate his selecting device in such a manner as to cause the brush 20 to make contact with the point 84 which is connected to bank wire 85 and signal relay 86, by means of which a code signal may be sounded on the signal device at the will of the party calling.

The signal relay circuit just referred to is as follows: from ground 11, Fig. 2, springs 7 and 8, wires 12 and 32, receiver 5, transmitter 31, wires 30 and 64, springs 39 and 40, 41, 35 and 42, brush 20, contact point 84, wire 85, magnet 86, battery 87 to ground 88. The resistance of the receiver 5 and the transmitter 31 is such that sufficient current is not permitted to pass through the magnet 86 to energize the same to a sufficient degree to cause it to attract its armature 89. However, whenever the receiver 5 and the transmitter 31 are short circuited, as when, at the calling station, the springs 37 and 38, are momentarily closed, by the ringing pin 36 on the ratchet impulse wheel 1 returning to normal position; or as when the springs 99 and 100 are manually pressed by the button 98, Fig. 2, to give a characteristic call, enough current flows through signal relay magnet 86 to cause it to attract its armature 89. This closes a circuit, including battery 90 between the wires 91 and 92, thereby operating the signal devices 93 which are bridged between these wires. The party, desired, thus receives an automatic warning call, and a manual characteristic call, and, upon hearing his signal, may converse with the party calling from any station, such as C, by so operating such station as to cause the brush 101 to be brought in contact with point 102, and hence with bank wire 85 which is also connected with the point 84 of the station calling.

It should be noted that whenever any station becomes connected to the line 85, either for calling, or for answering a call, a single ringing impulse is sent through the ringing relay in it, as through the contact of the springs 37 and 38, by the return of the ringing pin to normal position, and any station responding to the call, will send in a like signal through all of the signaling devices; so that should the calling party desire to leave the receiver off the hook, and attend to other matters, the station, on responding, would send an automatic signal that he was ready to converse.

It should be noted also that although the bank wire 85 is grounded by reason of its having been called by station A, yet station C is not prevented from connecting to this same bank wire 85 by my lock-out device, for the reason that the springs 103 and 104 do not make contact until the brush 101 has passed contact 102, and as the circuit of the lock-out relay 105 of station C depends upon the contact between these springs for its energizing current, it is apparent that this lock-out relay will not act to prevent connection to any line, unless the springs 103 and 104 are in contact with each other.

Having now described the operation of my automatic telephone system, I claim—

1. In an automatic telephone system, telephone lines, automatic means whereby a calling line may become electrically connected with any other line for the purpose of communication, means whereby both lines may be supplied with electric current to the transmitters and receivers at the connected stations: a ringing circuit with a suitable source of current; a spring operated impulse wheel at the calling station; a pair of contact springs in the ringing circuit; a ringing pin on the impulse wheel to close momentarily said springs, after the impulse ratchet wheel has sent its last selecting impulse; a telephone hook switch with a spring catch normally engaging the teeth of said impulse wheel; spring grounding contacts, one grounded, and the other connected to the ringing circuit; and means whereby, upon the removal of the receiver from the

hook switch, said grounding contacts become engaged, and the spring operated impulse wheel released, to cause the calling and called lines to become connected, and to cause the ringing pin to close momentarily the ringing circuit through the ringing springs and give a single signal at the called station.

2. In an automatic telephone system having telephone lines, and connecting means whereby a calling line may become automatically connected to another line:—a selecting circuit with a suitable source of electrical current; a selecting magnet in said circuit; a selecting armature to step said connecting means into operative position; a holding circuit with a suitable source of electrical current; a holding magnet in said circuit and an armature to hold in, and release from, said connected position, said connecting means; a telephone hook switch whereby the selecting circuit may be rendered operative, and the holding circuit may be grounded, upon the removal of the receiver from the hook switch, and remain grounded until the receiver is replaced upon the hook switch.

3. In an automatic telephone system having telephone lines, and connecting means whereby a calling line may become automatically connected to another line:—a selecting circuit with a suitable source of current; a selecting magnet in said circuit; a selecting armature to step said connecting means into operative position; a holding circuit with suitable source of current; a holding magnet in said circuit, and an armature to hold in, and release from, said connected position, said connecting means; a telephone hook switch whereby the selecting circuit may be rendered operative, and the holding circuit become grounded, upon the removal of the receiver from the hook switch, and remain grounded until the receiver is replaced upon the hook; the telephone receiver being in the holding circuit; a pair of contact springs in the holding circuit; and automatic means to cause them to make momentary contact, after said calling line has become connected to a called line, to short-circuit said transmitter and receiver momentarily, to energize, sufficiently, the holding magnet to cause its armature to move toward it and to overcome the tension of armature springs of said holding magnet, and to be there retained by the magnetic field due to the reduced current by reason of the no longer short circuited transmitter and receiver.

4. In an automatic telephone system having telephone lines, and stations connected therewith, and automatic means for each station whereby one of said stations may become connected with another:—a source of electrical energy; a signaling relay circuit having a signaling relay therein, and a point of contact in each of said automatic means, whereby any one or more stations may become connected in a talking circuit; a signaling electric circuit having therein, wherever desired, signaling devices, and the armature of the signaling relay; and manual means at the calling station whereby said signaling relay circuit may be closed and opened, a characteristic number of times for the purpose of correspondingly energizing the signaling relay and causing its armature to make and interrupt the signaling circuit, and operate the signaling devices as required; and automatic means whereby the signaling relay is operated whenever a calling station becomes connected to the signaling relay circuit.

5. In an automatic telephone system having telephone lines and stations connected therewith, and automatic means for each station whereby any one of said stations may become connected with another:—a source of electrical energy; a signaling relay circuit having a signaling relay therein, and a point of contact in each of said automatic means, whereby any one or more of said stations may become connected in a talking circuit; a signaling electric circuit having therein wherever desired, signaling devices, and the armature of a signaling relay; a transmitter and a receiver being in the signaling relay circuit; springs and a press button in the signaling relay circuit, with which to short circuit the transmitter and the receiver and permit enough current to pass through the signaling relay to energize it, said button thereby controlling the signaling relay circuit to cause it to close and open the signaling relay circuit, and the signaling circuit for the purpose of causing the signaling devices to give the characteristic signal required; and automatic means whereby the signaling relay is operated whenever a calling station becomes connected to the signaling relay circuit.

6. In an automatic telephone system having telephone lines and connecting means whereby a calling line may become automatically connected with any other line for the purpose of communication:—a selecting circuit with suitable source of electrical current; a holding circuit with suitable source of electrical current; a ringing circuit having a suitable source of current; an impulse wheel at the station of the calling line; a telephone switch provided with a spring to movably hold the impulse wheel in the position to which it is manually moved; contact springs in the selecting circuit, normally open, but operated by the teeth of the released impulse wheel; contact springs in the ringing circuit normally open; a ringing pin on the ratchet wheel to close momentarily the ringing contact springs; two grounding contact springs, one grounded and the other

connected with the selecting circuit, the holding circuit and the ringing circuit; means whereby a removal of the telephone from its hook switch, causes the grounding springs to make contact, and the hook switch spring to disengage the impulse wheel, permitting the latter to return to normal position, and causing the selecting springs to contact the desired number of times to send the required connecting impulses over the selecting circuit; and then before stopping at normal position, causing the ringing pin momentarily to close the ringing circuit to signal the calling station; the holding circuit remaining closed until the receiver is replaced upon its hook switch, when the ground contact springs separate and break the holding circuit.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

ALTON E. STEVENS.

Witnesses:

LORIN M. COOK,

MAURICE H. COOK.

A. E. STEVENS.

AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED JAN. 17, 1916.

1,280,096.

Patented Sept. 24, 1918

2 SHEETS—SHEET 1.

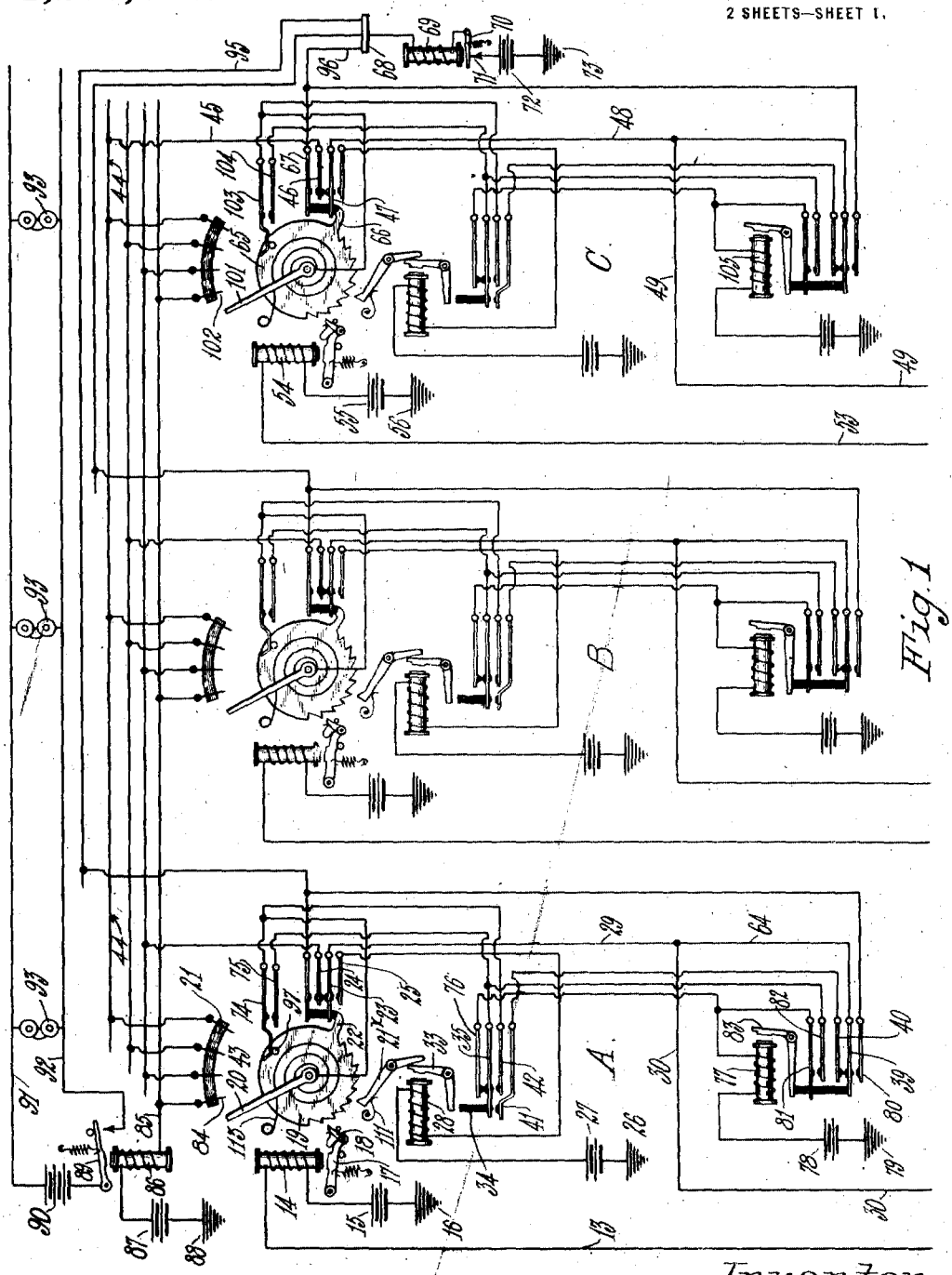


Fig. 1

Inventor.
Alton C. Stevens
by
Browne Woodworth & Cook
Attorney

A. E. STEVENS.

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2 SHEETS—SHEET 2.

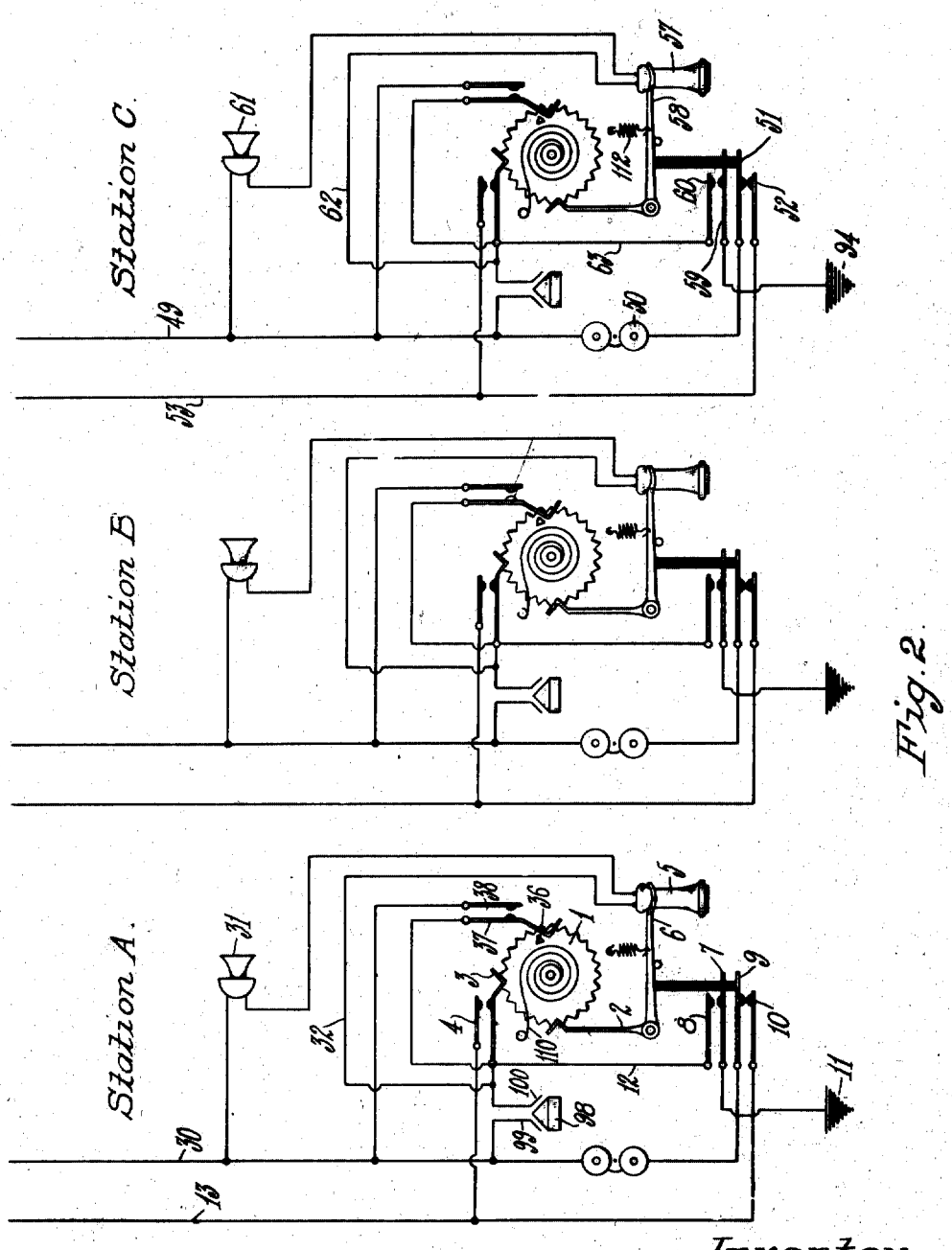

Fig. 2.

Inventor
Alton E. Stevens
by
Browne Woodworth & Cook
Attorney

UNITED STATES PATENT OFFICE.

ALTON E. STEVENS, OF PROVIDENCE, RHODE ISLAND.

AUTOMATIC-TELEPHONE SUBSTATION MECHANISM.

1,280,097. Specification of Letters Patent. Patented Sept. 24, 1918.

Application filed April 21, 1917. Serial No. 163,590.

To all whom it may concern:

Be it known that I, ALTON E. STEVENS, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Automatic-Telephone Substation Mechanism, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to means employed at the calling station of an automatic telephone system, for selecting, signaling, communicating with a called station, and particularly when said means are mounted in a unit embracing the telephone transmitter and receiver.

My general purposes are to reduce to a minimum, the manual movements required in making telephone connection to a desired station; to compel the operator to use the apparatus in the way intended; and to prevent any tampering on his part, from interfering with the successful operations of the apparatus.

The various features of said invention may be said to reside, first, in means whereby the rotatable selecting dial of a telephone station may, without injury to the mechanism, be manually moved beyond the position required for calling any desired station, and then back to, and left in, said position.

Second, in means for governing the speed of the return of said dial and connected mechanism, to normal position.

Third, in means whereby when the receiver is removed from its hook, the dial and connected mechanism become locked against any forward manual movement, until the receiver is placed upon its hook.

Fourth, in means whereby when the receiver is removed from its hook switch, the dial and connected mechanism, will automatically return to normal position and in so doing will send the desired selecting, and the ringing impulses required in communicating with a called station.

Fifth, in means for operating contact springs to cause an automatic single signal at the called station; and for rendering the manual ringing circuit operative upon the return of the mechanism to normal position.

Sixth, in means whereby the ringing circuit of a manually operated ringing button, may be held open while the impulse transmitting mechanism is out of normal position.

Seventh, in various other particular forms embodying the broad features of my invention.

My invention is designed primarily to operate with an automatic telephone system, more fully described and claimed in my application for Letters Patent, No. 72,428, filed January 17, 1916, but its use is not necessarily limited to that system.

In the drawings illustrating the principle of my invention and the best mode now known to me of embodying the same in operative structure,

Figure 1 represents a side elevation of a telephone station;

Fig. 2 represents a front view of the same, partially broken away and showing the sending dial;

Fig. 3 is a side elevation of the base of the station, shown in Fig. 1, with the casing cut away to show mechanism within;

Fig. 4 is a bottom view of what is shown in Fig. 3;

Fig. 5 is a cross section of the base of Fig. 1;

Fig. 6 is a side elevation of the sending dial;

Fig. 7 is a bottom view of the sending dial, shown in Fig. 6;

Fig. 8 is a view of the opposite side of the sending mechanism, shown in Fig. 6;

Fig. 9 is a detail view of the governor on the sending mechanism;

Fig. 10 is a detail view of the impulse wheel of the sending mechanism;

Fig. 11 is a diagrammatic view of wiring and apparatus employed by a calling and a called station making use of my invention, and, excepting that it is more specific as to some details, is substantially the same as so much as corresponds and is shown in the drawings of my said pending application. Other features, indicated in Fig. 11, but not described and claimed herein, are described and claimed in application, Serial No. 165,126, for automatic telephone central station apparatus, filed by me April 28, 1917.

A station may consist of a base 1, Figs. 1 and 2, and standard 2, and a transmitter 3, and a receiver 4, all of the usual commercial type. On the base 1 is mounted what may

be called the sending mechanism 5, showing externally a knob 6 attached to a dial 7 which is fixed to a shaft 8, Figs. 3 and 4, and which may be manually moved under a stationary indicator-hand 9, by means of the knob 6. Upon this dial are arranged letters or numbers, say 1–30 which, in connection with the indicator, show when the apparatus has been manually moved to the proper point to allow the system to establish connection with the party desired. The knob and shaft tend to return to their normal position by the action of a flat coil spring 10, Fig. 8, in the space underneath the dial 7.

Mounted loosely on the shaft 8 is a small pinion 11, Fig. 6, which by means of a pawl 12 pivoted to a centrifugal governor 13, drives the governor, thereby controlling the speed of the device, while returning to normal position. This governor also is loosely mounted on the shaft 8, Fig. 9, and consists of small weights 16 attached to one end of brake levers 17, pivotally mounted at points 18 on the frame of the governor. The outer extremity of the levers are turned up to form brake shoes 19 which are pressed against the circumference of a drum 14, as the weights 16 are moved out by centrifugal force; the drum 14, being attached to the frame 15, Fig. 6 of the sending device.

A driving gear 20, Fig. 3, fixed to the shaft 8, drives an impulse gear wheel 21, on shaft 8′, Figs. 7 and 10, through a pinion 22 fastened to its under side. The under surface of the impulse wheel has impulse points or projections 23, Figs. 7 and 10, to close a selecting circuit; and also has near the circumference, a ratchet 24.

In an extension 25, Fig. 6, of the base of the frame 15, is mounted a shaft 26, secured to the top of which is an arm 27, Fig. 7. This arm carries at each end, pawls 28 and 29, Fig. 10, the pawl 28 engaging, and being held in engagement with, the teeth on the impulse wheel 21, by a spring 30, Fig. 6; while the pawl 29, Fig. 10, is being held in contact with the teeth 24 on the circumference of the impulse wheel, by a small spring 300, Fig. 10. Secured to the lower portion of the shaft 26, are two arms 31 and 32, V-shaped,—one 31 carrying a vertically extended cam 33; to the other 32, there is attached a small spring 34 fixed to the frame.

Mounted on a stub 35, Fig. 6, and fastened to the frame, are two contact springs 36 and 37, the upper spring having an upwardly extending V-shaped bend 38, resting on the under surface of the impulse wheel 21 in the line of the impulse projections 23. Upon the same stub are three other contact springs 39, 40 and 41; Fig. 8; the spring 39 being adapted to be moved into contact with the spring 40 by means of a projection 120′ on the upper face of the driving gear 20; and the spring 41 being adapted to contact, and remain in contact with, said projection when the driving gear returns to normal position.

Electric current is conveyed to these several contact springs by wires leading to the fixed contact or jack springs 42, 43, 44, and 45, Figs. 6, 7 and 11, which are mounted upon the dial frame, and insulated therefrom. When the dial unit is inserted in the standard, these springs contact similar springs 46, 47, 48, and 49, Fig. 4, fixed in insulating material in the standard, thus effecting a junction between the wiring of the unit and of the telephone station.

It should be noted that all the mechanism just described is mounted upon, and contained in, the frame 15 of the sending device 5, which is readily removed from, and replaced in, the base 1 of the sending station, shown in Fig. 1; a screw 62, Fig. 1, holding the device in the base.

A receiver hook 50, Fig. 2, of the usual pattern is pivoted in the standard 2 of the station at any convenient point 51. Attached to this and adapted to be moved vertically, is a connecting rod 52, having limited motion, and being held normally at the top of its stroke, when the receiver is removed from the hook, by means of a coil spring 53, Fig. 3. This connecting rod 52 engages, at its bottom, with an angle arm 54, pivoted at a central point 55, and held in contact with the connecting rod 52, by means of a small spiral spring 56. The other extremity 57 of this angle arm engages and disengages with the cam 33 on the extremity of the arm 31, whereby a slight degree of motion is given to the extremity of the angle arm 27. The angle arm 54 carries on its under side, an insulated boss 58 resting upon the main contact spring 59, Fig. 5, one of the conventional hook contact springs mounted upon a stub 60 attached to the frame of the base; the main spring 59 being moved by the boss 58 on the end of the angle arm 54.

A push-button 66, Fig. 5, of the usual form, is mounted on one side of the base 1, and moves the contact springs 67, 68, and 69, which are mounted in the frame on the stub 70.

In the base 1 is also contained an induction coil 71, Figs. 3 and 4, of the form generally used in telephone practice. A distributing strip 72 is also fixed in the base 1 to which the conductors of the usual desk-set cord may be attached.

It should be especially noted that my construction, above described, is simple; that all mechanism of the sending station can be readily reached for inspection, and any part can easily be removed for repairs or replacement, without disturbing any other part. When the unusually complicated character of such apparatus is considered, the great

advantages of my construction will be perceived.

Having now briefly described the preferred form of construction of my telephone station, I will now describe its operation.

Let us suppose that a person at station 3, Fig. 11, desires to call station 4. The knob 6, Fig. 2, and dial 7 are turned forward until the fixed indicator 9 points to the desired station 4, on the dial; but simultaneously, the impulse wheel 21 also turns, allowing four teeth in the ratchet 24, Figs. 6 and 7, to pass the pawl 28, which is held against the ratchet by the arms 27 and 32, and spring 34. By means of this pawl, the sending device 5 is held from the normal position, to which it tends to return by the action of coil spring 10, Fig. 8. If, for any reason, the dial 7 is manually moved ahead of the character indicating the desired station, the dial may be moved back to the position required; for the reason that the pawl 28 and its controller spring 30, Fig. 6, being of such form and strength that, by the use of sufficient manual force, the teeth of the rack 24 will overcome the spring 30, and pass by the point of the pawl. Thus the first feature of my invention attains its object.

Next, the receiver 4 is removed from its hook 50, which is lifted by the action of the spring 53 on the connecting rod 52. As the connecting rod rises, the spring 56 on the pivot 55, causes the angle arm 54, to move, when the pressure of the connecting rod, on its inner extremity, is released. The other extremity 57 of the angle arm is then brought in contact with the cam 33, turning the shaft 26 slightly. As the shaft 26 turns, it moves the arm 27 away from the circumference of the impulse wheel 21, causing the pawl 28 to disengage the ratchet 24.

The spring 10 driving the shaft 8, is now free to rotate the shaft 8 and the impulse wheel 21, to its normal position, the speed of return being controlled by the pressure of the brake shoes 19 of the governor, on the drum 14. This explains the second feature of my invention.

As the shaft 26 moves the pawl 28 from engagement, it causes the pawl 29, Fig. 10, on the other extremity of the angle arm 27, to engage the teeth in the circumference of the impulse wheel 21, and allows no motion of the impulse wheel, except that returning it to normal position. The third feature is now plain.

While the impulse wheel 21 is returning to normal position, four impulse projections 23, Figs. 6, 7, 10, and 11, pass the V-shaped bend in the spring 36, causing the spring 36 to contact four times with spring 37, thus closing the selecting circuit to central station, four times. When, in setting the device, the impulse wheel 21 was turned by the knob 6 and shaft 8, the driving wheel 20 was also revolved a proportionate part of a revolution. While the system is returning to normal, the projection 420 on the upper surface of the driving wheel 20 is, after the selecting impulses have been sent, but before the driving wheel reaches normal position, brought into contact with the cam-like projection on the extremity of the spring 39, causing it to make and break contact once with the spring 40. This causes current to be sent through the bells at the called station, automatically operating them without further effort on the part of the operator of the calling station. The fourth feature of my invention becomes clear.

But after the projection 420 on the driving wheel 20, has passed the ringing springs, it contacts, and remains in contact with, the spring 41, the driving wheel having returned to normal position and stopped. This renders operative the manually operated ringing circuit, which may be operated when the sending apparatus returns to normal. While this apparatus is out of normal, the ringing circuit is interrupted, and hence cannot be operated. This explains the operation of the fifth and sixth features of my invention.

To show how the various features of my invention at the sending station, as 3, are combined in an automatic telephone system, I will refer to diagrammatic view Fig. 11, and describe the electric circuits employed, and apparatus operated, in calling any particular station.

The party at station 3, wishing to talk with person at station 4, as already stated, has turned the knob and the impulse wheel 21 in a clockwise direction to the point marked "4", the spring arm holding the impulse wheel in position. Upon the removal of the receiver 4 from the hook 50, the spring arm becomes disengaged from the impulse wheel 21, and permits it to return to normal position, under tension of the spring. While the impulse wheel 21 is returning, the projections 23 cause the spring 36 to make contact with spring 37, four times, thereby closing a selecting circuit from ground 85, through springs 86 and 87, which came into contact upon the removal of the receiver, through wire 88, springs 36 and 37, wire 89, selecting magnet 90, to battery 91. The selecting magnet 90 is thereby energized four times, and attracts its selecting armature 92, causing the stepping pawl 93 connected therewith, to engage four teeth in succession, in the ratchet wheel 94, thereby stepping the brush 95 to fourth contact point 96, in the contact bank 97, which contact point is connected by bank wire 98, to the selector and telephone of station 4.

At the first step from normal position of

the ratchet wheel 94, the holding detent 140 is caused to engage the teeth in said ratchet, and hold it at each successive step in the following manner: As said ratchet wheel first moves from normal position, its arm 99 has disengaged the spring switch 100, thereby permitting it to make contact with spring 101, establishing a holding circuit through the holding magnet as follows:—From ground 85, through battery 91, magnet 102, springs 101 and 100, wires 103, induction coil 71, transmitter 3, springs 87 and 86 to ground 85. This causes the holding magnet 102 to be energized, and attract its holding armature 105, thereby permitting detent 140 to engage the ratchet wheel by the pressure of small spring 106. This holding armature 105 carries an extension which engages an insulated extension 107 on a switch 108. The tension of the spring 141, however, is so great that the amount of current flowing through the coils of the magnet 102, is not sufficient to energize the magnet sufficiently to allow the armature 105 to move the switch 108 out of contact with the point 109. While the springs 36 and 37 are in contact for the last of the series of selecting impulses, the projection 420 on the driving wheel 20, causes the ringing spring 39 to make contact with the spring 40, thereby short-circuiting the transmitter 3 and induction coil 71, and, by reducing the resistance in the holding circuit, causing an additional amount of current to flow through the coils of the holding magnet 102, thereby increasing its energy to such a degree as to cause the holding armature 105 to overcome the tension of the spring 141, and make contact simultaneously with the springs 109 and 110. The contact between the springs 39 and 40 being broken when the impulse wheel 21 comes to rest at its normal position, the transmitter 3 and induction coil 71, are again brought into circuit with the coils of magnet 102, and the amount of current flowing in this holding circuit is decreased. This current, however, is sufficient to cause the magnet 102 to hold the armature 105, after it has once been attracted.

The contact between springs 39 and 40, made as just described, completes a ringing circuit, whereby the ringer 111, at station 4, is operated, this ringing circuit being as follows: From the ground 85, through springs 86, 87, driving wheel 20, projection 420, springs 39 and 40, wires 103 and 112, springs 113 and 114, 115, 108, and 110, to brush 95 which is in contact with the point 96, bank wire 98 and wire 116 of station 4, the springs 117 and 118, the wires 119 and 120, the ringer 111, the springs 121 and 122, the wire 123, the selecting magnet 124, battery 91 and ground 85.

The ringer 111 is of high resistance, and the selecting magnet 124 is of low resistance, this latter being adjusted so that it will independently not operate through the resistance of the ringer.

The party at station 4, upon receiving his signal, removes the receiver 125 from the hook 126, and can now communicate with the party at calling station 3, over the following talking circuit:—From the ground 85, through springs 86 and 87, transmitter 3, induction coil 71, the wires 103 and 112, springs 113 and 114, springs 115, 108, and 110 to the brush 95 and contact point 96, bank wire 98, wire 116, springs 117 and 118, wires 119 and 120, induction coil 142, transmitter 127, wire 128, springs 131 and 130, to ground 85; the springs 130 and 131 being brought in contact with each other, upon the removal of the receiver 125 from the hook 126, which is drawn up by the spring 130.

Battery power is supplied to energize the transmitters and receivers at each station as follows:—From ground 85, battery 91, through magnet 102, springs 101 and 100, wire 103 to station 3; and over the wire 143, to station 4, by a duplicate circuit.

Stations 3 and 4 having finished communication, the connection is discontinued by placing the receiver 4, on the hook 50 thereby breaking connection between springs 86 and 87, causing the holding magnet 102 to become deënergized whereupon its armature 105 is released, and causes the detent 140 to disengage the ratchet wheel 94. This ratchet wheel, upon being released, is returned to its normal position, as shown in the drawings by any suitable spring. If the called party does not respond, the calling party, the receiver 4 being off its hook 50, may manually call him by pressing a button 66, which makes a circuit between springs 67 and 69; the receiver 4 and transmitter 3 being short-circuited; the manual circuit being from ground 85, springs 86 and 87, wire 88, driving wheel 20, projection 420, spring 41, springs 69 and 67, and the ringing circuit already described.

Should the button 66 be pressed while the sending apparatus is out of normal position, the circuit would not thereby be completed, for the circuit to ground, would be broken between the projection 420 on the driving wheel 20, and the spring 41.

In conclusion, the particular sending mechanism here shown is that actually used at each calling and called station of the system shown diagrammatically in Fig. 11, and disclosed and claimed in my said pending application.

Desiring to protect my invention in the broadest manner legally possible,

What I claim is:

1. A rotatable call dial; selecting impulse mechanism provided with a ratchet wheel; a spring controlled arm, and a spring con-

trolled pawl pivoted thereto, and in engagement with said ratchet wheel; all arranged to allow the dial to be manually moved forward or back and retained in the position where manually left, to facilitate the positioning the dial; a receiver switch; a receiver removably mounted thereon; means connecting said switch with said spring controlled arm, whereby a removal of the receiver from its switch, permits the latter, through said means, to operate said arm and move said spring controlled pawl to disengage said ratchet wheel and allow said selecting impulses to be transmitted.

2. A rotatable call dial; selecting impulse mechanism provided with a ratchet wheel; a spring controlled arm, and a spring controlled pawl pivoted thereto, and in engagement with said ratchet wheel; all arranged to allow the dial to be manually moved forward or back and retained in the position where manually left, to facilitate in positioning the dial; a spring controlled lock pawl pivoted to a second arm integral with the first, and designed to be moved into engagement with said ratchet wheel when the latter has become disengaged by the first spring controlled pawl, to prevent a movement other than toward normal position.

3. A rotatable call dial; selecting impulse mechanism provided with a ratchet wheel; a spring controlled arm, and a spring controlled pawl pivoted thereto, and in engagement with said ratchet wheel; all arranged to allow the dial to be manually moved forward or back and retained in the position where manually left, to facilitate positioning the dial; a spring controlled lock pawl pivoted to the said arm, and designed to be moved into engagement with said ratchet wheel when the latter has become disengaged by the first spring controlled pawl; a receiver switch; a receiver removably mounted thereon; means connecting said switch with said spring controlled arm, whereby a removal of the receiver from its switch, permits the latter, through said means to operate said arm, and cause said spring controlled pawl to disengage said ratchet wheel and allow selecting impulses to be transmitted and to cause said spring controlled lock pawl to engage said ratchet wheel and prevent the opposite movement of the said wheel, until the replacing of the receiver upon its switch allows the pivoted arm to return to normal position, the lock pawl disengaging and the positioning pawl engaging the ratchet wheel.

4. A rotatable call dial; selecting impulse mechanism provided with a ratchet wheel; a spring controlled arm, and a spring controlled pawl pivoted thereto, and in engagement with said ratchet wheel; all arranged to allow the dial to be manually moved forward or back and retained in the position where manually left, to facilitate the positioning the dial; centrifugally operated governing and braking means rotatably connected with said dial by a ratchet and pawl connection, whereby the return of the dial and impulse selecting mechanism, to normal position, is properly retarded.

5. In an electrical impulse transmitting device for the calling station of an automatic telephone, a pair of ringing contact springs; a spring operated wheel, having a cam surface thereon which, after the selecting impulses have been sent, momentarily closes contact between said springs before said wheel reaches normal position; for the purpose of sending to the called station a single ringing signal.

6. In an electrical impulse transmitting device for the calling station of an automatic telephone, a pair of ringing contact springs in an automatic ringing circuit; a spring operated wheel, having a cam surface thereon which, after the selecting impulses have been sent, momentarily closes contact between said springs before said wheel reaches normal position; for the purpose of sending to the called station a single ringing signal; a manual ringing circuit, a contact spring in the said manual ringing circuit, that is contacted by said cam as it returns to and while it remains in normal position, to render operative the manual ringing circuit when in normal position.

7. In an electrical impulse transmitting device for the calling station of an automatic telephone, a ringing circuit; a manually operated ringing button, to close said circuit; a spring operated wheel which has a cam surface electrically grounded; a contact spring in said ringing circuit, which engages said cam surface only when said wheel is in normal position, so that the ringing circuit is held open and cannot be manually closed, while the transmitting device is out of normal position.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

ALTON E. STEVENS.

Witnesses:

CHARLES F. RICHARDSON,

A. I. CRAWFORD.

A. E. STEVENS.

AUTOMATIC TELEPHONE SUBSTATION MECHANISM.

APPLICATION FILED APR. 21, 1917.

1,280,097.

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5 SHEETS—SHEET 1.

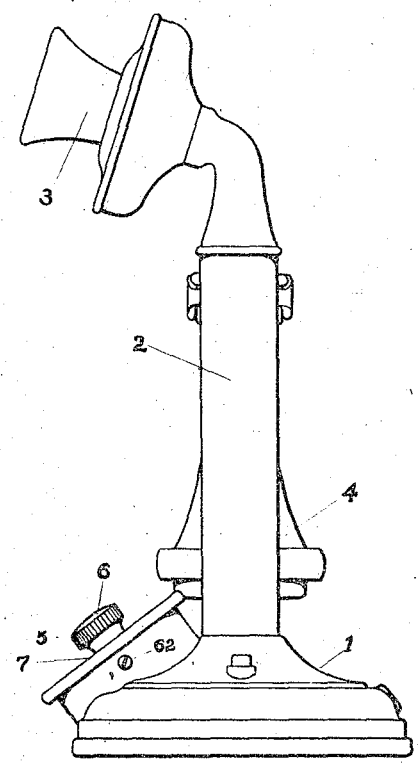

Fig. 1.

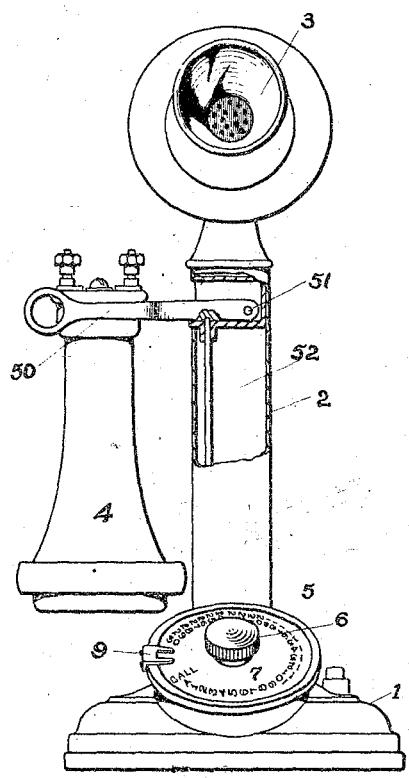

Fig. 2.

Inventor:
Alvin E. Stevens
by Charles B. Richardson
his Attorney.

A. E. STEVENS.

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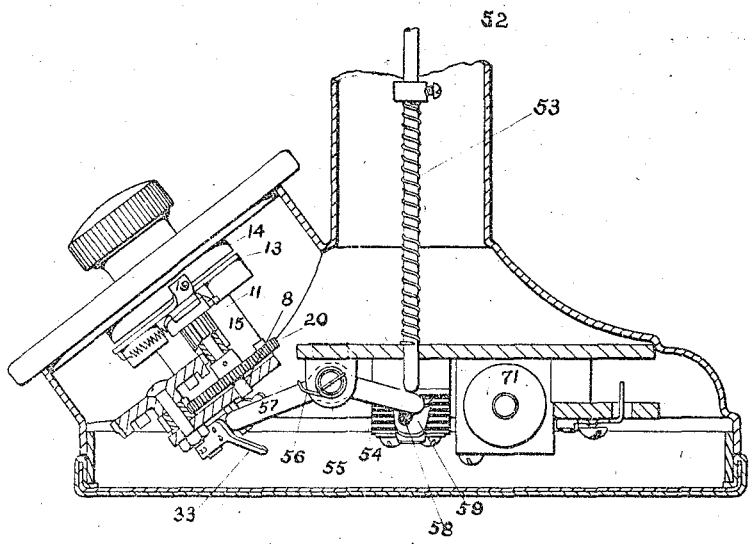

Fig. 3.

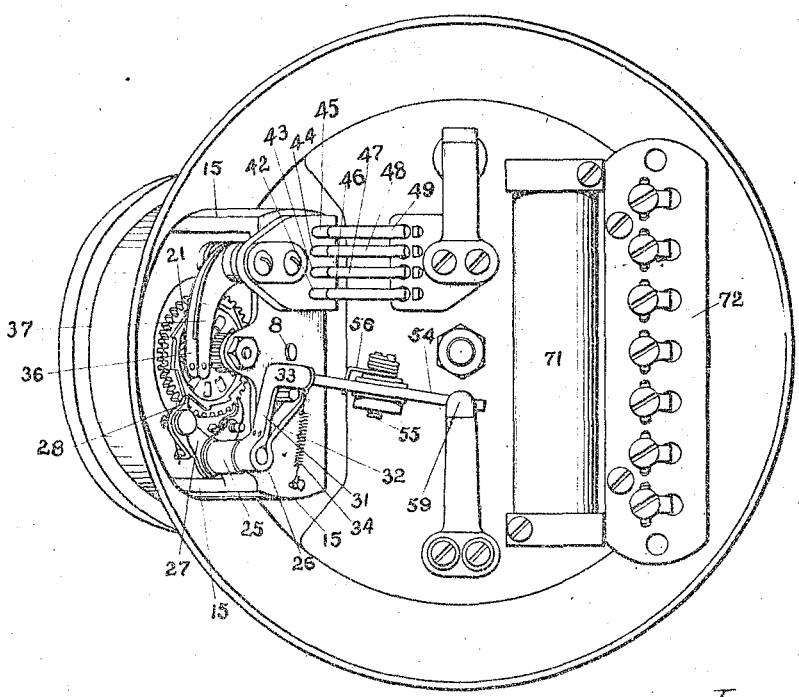

Fig. 4.

Inventor:
Nelson E. Stevens
by Charles D. Richardson
his Attorney.

A. E. STEVENS.

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APPLICATION FILED APR. 21, 1917.

1,280,097. Patented Sept. 24, 1918.

5 SHEETS—SHEET 3.

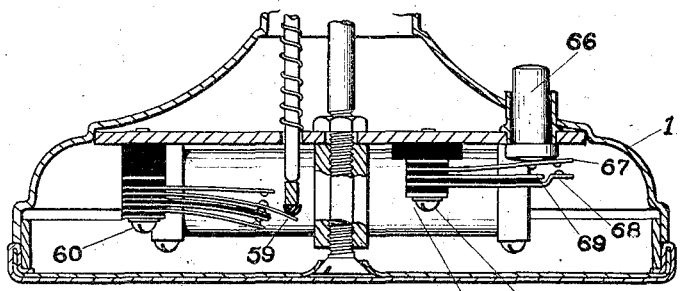


Fig. 5.

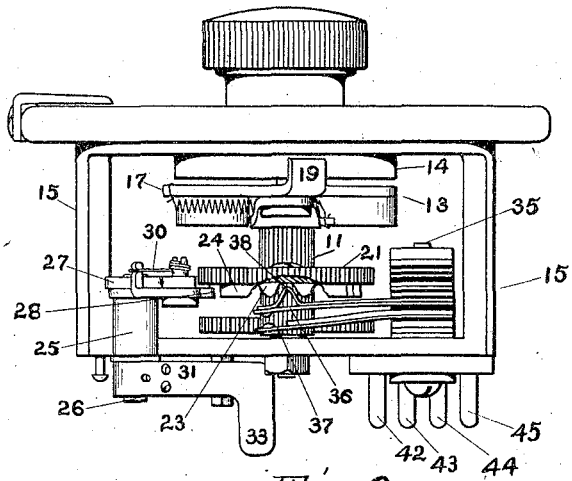


Fig. 6.

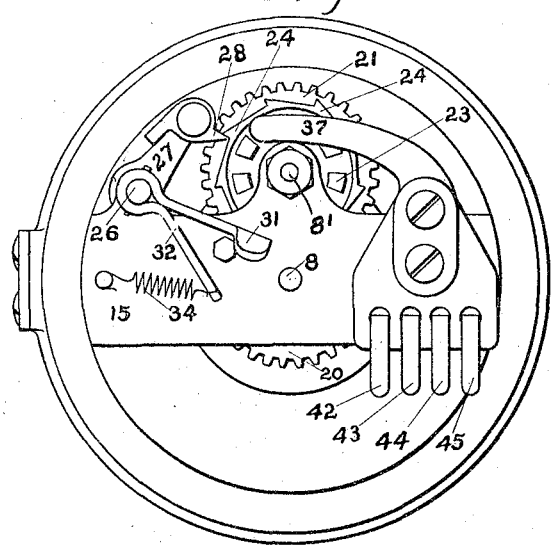


Fig. 7.

Inventor:
Victor E. Stevens
by Charles F. Richardson
his Attorney.

A. E. STEVENS.

AUTOMATIC TELEPHONE SUBSTATION MECHANISM.

APPLICATION FILED APR. 21, 1917.

1,280,097. Patented Sept. 24, 1918.

5 SHEETS—SHEET 4.

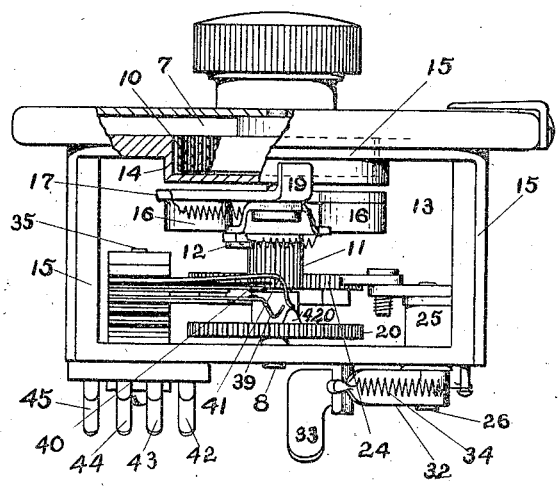


Fig. 8.

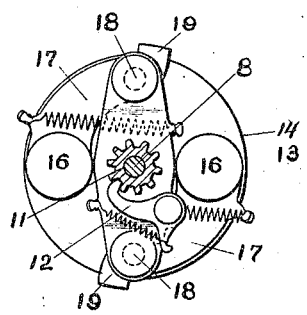


Fig. 9.

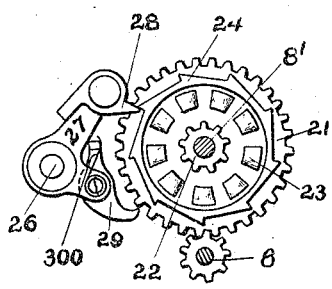


Fig. 10.

Inventor:
Alton E. Stevens
by Charles D. Richardson
his Attorney.

A. E. STEVENS.

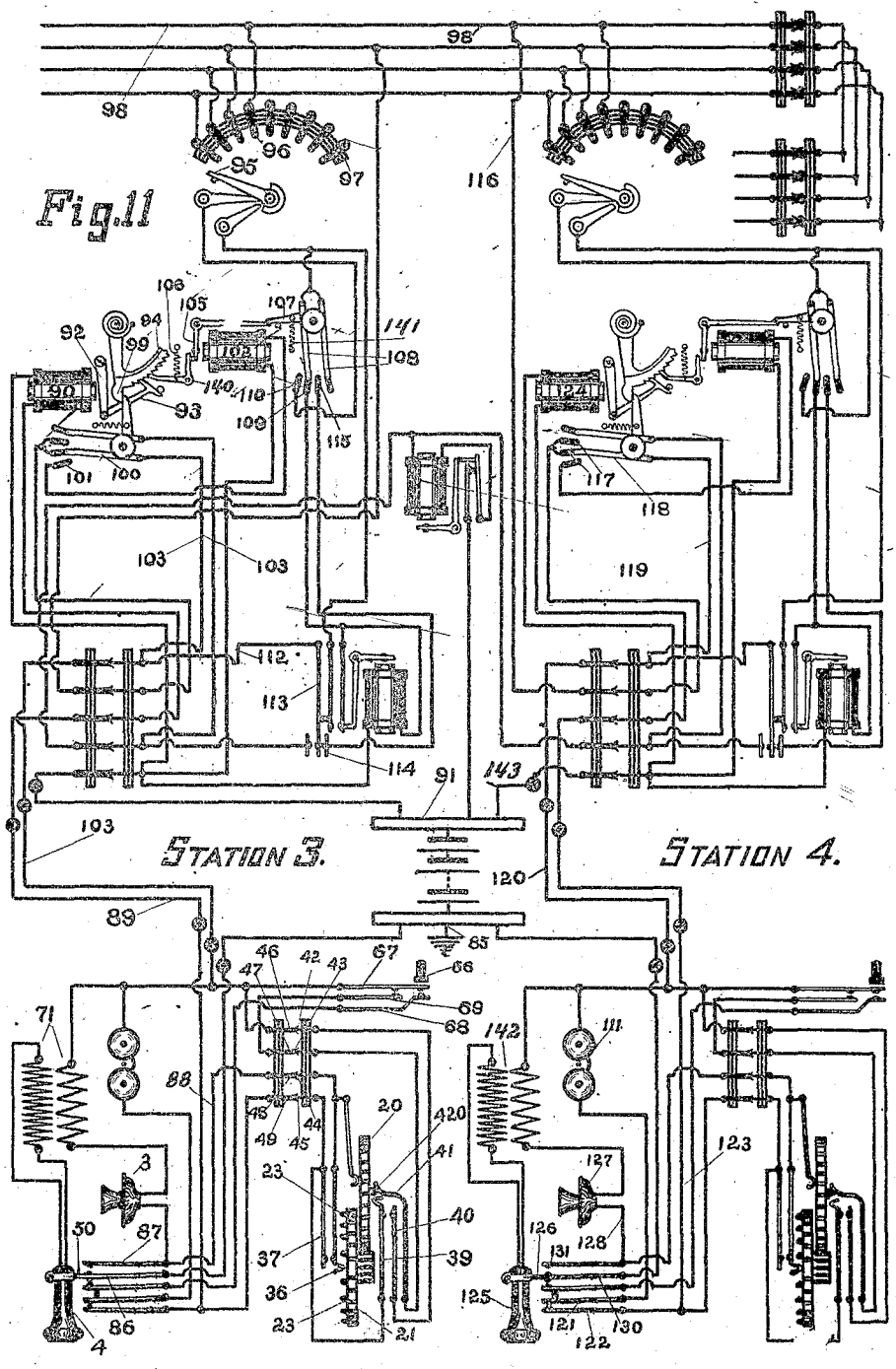
AUTOMATIC TELEPHONE SUBSTATION MECHANISM.

APPLICATION FILED APR. 21, 1917.

1,280,097. Patented Sept. 24, 1918.

5 SHEETS—SHEET 5.

Fig. 11



Inventor: - Alton E. Stevens
by his attorney
Charles F. Richardson

Patented Oct. 9, 1923. 1,470,202

UNITED STATES PATENT OFFICE.

ALTON E. STEVENS, OF PROVIDENCE, RHODE ISLAND.

SELECTOR RACK FOR AUTOMATIC TELEPHONE SYSTEMS.

Application filed August 2, 1921. Serial No. 489,289.

To all whom it may concern:

Be it known that I, ALTON E. STEVENS, citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Selector Racks for Automatic Telephone Systems, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates particularly to racks used in the central switchboards of private telephone systems, for supporting the selector mechanism, and has for its object, the simplification of the construction of such racks, and the facilitation of their manufacture.

In the drawings illustrating the principle of my invention, and the best mode now known to me of embodying the same in operative structure:

Fig. 1 is a plan of a bracket integral with a backboard, not shown.

Fig. 2 a plan of the top of jack end of the selector rack;

Fig. 3 a plan of the rack with top piece removed;

Fig. 4 a front elevation of the rack, and bracket;

Fig. 5 a side elevation of the rack, bracket and back-board;

Fig. 6 a simplified diagram of the circuits of an automatic telephone system employing these racks.

Referring to Figs. 1, 2, 3 and 4, to a backboard 1, Fig. 5, are permanently secured a bracket 2, and two posts 3. The bracket 2, Fig. 1, is slotted at 4, and has secured to its upper surface by eyelets 6, a sheet of insulating material 7, carrying a number of jack springs, as 8 arranged radially to conform to the radius of the slot 4, and "staggered" as shown. The jack springs 8 are secured by eyelets 9, Figs. 1 and 4.

The selector rack is removably secured to the bracket 2, and back-board 1, and consists of two angle irons 10 held at the bottom by a strap 11, Figs. 4 and 5, which is riveted to the angles, and a top piece 12, Figs. 2 and 4, also riveted to the angles. On the face of the angles are pairs of pins 13 arranged one pair above another, each pair to receive a selector 14, Figs. 3, 4, and 5, the selectors thus being arranged in a vertical series, and each selector being secured by screws 15 in pins 13; the selector frames having holes to slide over the pins.

Adjacent to each pair of pins and secured to the angles, is a horizontal metal arch 16, Figs. 3, 4 and 5, carrying a segment of insulating material 17, each segment having a series of holes 18 for the reception of vertical metal contact bus-bars 19, Fig. 4, said holes 18 being arranged radially around a common centre at which is located the shaft 20, Fig. 3, of each selector mechanism, when this latter is in its place on the pins 13.

The top piece 12 has a curved slot 21, Fig. 2, so that the contact bus-bars 19, held in the segments 18 may pass through without contacting the metal.

Secured to the top piece 12 by rivets as 22, is a segment 23 of insulating material, having holes 24 corresponding in position with the holes 18, in segments 17.

A second segment of insulating material 25, Figs. 2 and 4, of the same shape as 23, is also secured to the top piece 12 by the same rivets 22, as is the first segment 23; the said rivets 22 having a shoulder whereby the two segments are held a distance apart corresponding to the diameter of the contact bus-bars 19. The second segment 25 has holes as 26, these holes being "staggered" and positioned the same as the jacks 8 in the piece 7, of the bracket 2.

The contact bus-bars 19, see Fig. 4, are given a "bayonet" bend near their upper end; that is, two right angle bends as illustrated. When these contacts bus-bars 19 are assembled in the rack, one for each hole as 18 in segments 17, the rods extend vertically from the top segment 23 through the entire series of segments as 17, to the bottom of the rack, the bent ends of the bus-bars 19 being "staggered", so that the short vertical ends extend through the holes as 26 in segment 25, these short ends forming plugs which engage and contact the jack springs 8, when the plugs are pushed up through the eyelets 9 which secure the springs 8 to the piece 7.

The parts of the selector rack are assembled as follows: The pins 13, see Figs. 4 and 5, are staked into the angles 10; the top piece 12 and the strap 11 are then riveted on, thus holding the rack together; next the arches 16, carrying the segments 17 are riveted to an angle at each end, and lugs

27, designed to support a line terminal board 28, are staked into the left hand angle. Next, the segment 23 is riveted to top piece 12, and a contact bus-bar 19 run down through each of the holes in each of the segments 23, the bent ends being above this piece 23, and staggered so that the segment 25 may be pushed down over them and riveted into place on the upper end of rivets 22.

The horizontal bends in the contact bus-bars 19, between the two segments 23, 25, lock the said bus-bars 19 against longitudinal movement, which are thus held for their entire length in insulating material, and have their upper ends so positioned, that each will enter an eyelet hole as 9 in piece 7, and contact a jack spring as 8; the said jack springs having a tag 102, to which wires may be soldered to connect them to corresponding springs on other rack brackets. A line terminal board 28, Figs. 3, 4, and 5, of insulating material is secure to the lugs 27.

A battery jack has one member 29, Fig. 1, secured to bracket 2 and carries two contact jacks 30, 31; while a second member 32, secured to top piece 12, carries two jack plugs 33 and 34, designed to engage the contact jacks 30, 31, when the rack is inserted in place in relation to the bracket 2. The jacks are shown in circuit, in Fig. 6.

Adjacent to each selector position, on the line terminal board 28, are three spring jacks as 37, 38 and 39, Figs. 5 and 6; and in each selector frame as 14, are three jack plugs 40, 41 and 42, in an insulating block 43, Fig. 4, and designed to contact jacks 37, 38, and 39, when a selector is installed on the pins 13.

The line terminal board also carries three connectors for the lines assigned to each selector, as at 43, 44 and 45, Figs. 4 and 6.

To install the selector rack in the bracket 2, on the back-board 1, the pins 36, on the sides of the rack are moved up into the slots 35, Fig. 5, in the bracket, thereby causing the plug ends of the contact bus-bars 19, to register correctly with the eyelets 9 in the jack springs 8, Figs. 1 and 4; the jack plugs 33 and 34 in the top piece 12 engaging the contact jacks 30, 31 of the battery jack secured to the bracket 2. The rack is retained in position by two screws 50, through holes 51, screwed into posts 3.

Each selector, as 14, Figs. 3, 4 and 5, is secured on pins 13 by screws 15, and carries an arm 47, on which is mounted a spring contact shoe 48, the arm 47 being secured to shaft 20 and ratchet wheel 49 but insulated from them. As the shaft 20 is caused to rotate, the arm 47 turns with it, and causes shoe 48 to successively contact the contact bus-bars 19. The teeth in the ratchet wheel 49 are spaced corresponding to the spacing of the contact bus-bars 19, so that each step of the ratchet wheel, advances the contact shoe to the next succeeding contact bus-bar.

A brush 51 maintains electric contact with the arm 47 during the latter's rotation, for circuit reasons, in a well known manner.

Complete selector mechanism has not been shown in Figs. 3, 4, 5 as this forms no part of the present invention, but for the purpose of explanation, it has been illustrated diagrammatically in Fig. 6.

As there may be several racks in each system, and as the contact bus-bars in the same positions in each rack are connected to the same telephone station line, each jack spring as 52, Fig. 1, on the first bracket, is connected to a corresponding jack spring as 53, 54, on other brackets in a system by a wire as 55, 56, these wires being laced together in the form of a multiple cable, as in common practice.

I will now describe the operation of a simple automatic telephone system in connection with my invention. Referring to Fig. 6, "A" represents the circuits and apparatus of a calling telephone station, and "B" the selector mechanism. "C" represents the circuits and apparatus of a called telephone station, and "D" the selector mechanism of same.

A wishes to call C. The receiver 57 is lifted, causing hook 58 to break from 59, and bringing contacts 60, 61 together, thereby completing a holding circuit from positive side 64 of battery 65, through jack 30, wire 66, connector 45, contacts 60, 61, primary 69, transmitter 70, wires 71, 72, connector 43, jack 37, connecting magnet 73, jack 38, wire 64, jack 31 to negative side 69' of battery 65; connecting magnet 73 is thereby energized and attracts armature 74, which causes spring detent 75 to engage ratchet wheel 49, and retain it in each successive step to which it may be moved. Armature 74 has comparatively weak adjustment, while armature 75 is adjusted stiffly, and is not attracted on account of the resistance of primary 69 and transmitter 70, in the circuit.

Stepping key 62 is now pressed into contact with 63 four times, this being the call number of station "C". A stepping circuit is thereby completed four times, from positive side 64 of battery 65, through jack 30, wire 66, connector 45, contacts 60, 61, 63, key 62, connector 44, jack 39, stepping magnet 67, jack 38, wire 64, jack 31, to negative side 69 of battery 65. Stepping magnet 67 is energized four times, attracting armature 68, and causing pawl 76 to engage, ratchet 49, and step it around four teeth, thus bringing the shoe 48 into contact with contact bus-bar 77, upon which it will come to rest.

Ringing key 78 is now pressed into contact with 79 and completes a connecting and

ringing circuit, by short circuiting the primary 69 and transmitter 70; the elimination of this resistance causing enough current to flow through magnet 73 to attract connecting armature 75, which causes contact between springs 80, 81, and completes a ringing circuit as follows:—from positive side 64 of battery 65, through jack 30, wire 66, connector 45, contacts 60, 61, 79, key 78, wires 71, 72, connector 43, jack 37, springs 80, 81, brush 51, arm 47, shoe 48, contact bus-bar 77, wires 78, 82, connector 83, ringer 84, contacts 85, 86, connector 87, jack 88, magnet 89, jack 90, wires 91, 64, jack 31, to negative side 69 of battery 65. The ringer 84 is therefore operated, and signals the party at station "C".

The ringer 84 is of high resistance and the magnet 89 is of low resistance, and does not attract its armature which is stiffly adjusted, strongly enough to operate same.

The armature 75 is so adjusted, in a manner well known, that after it pulls up against the end of magnet 73, it sticks there after the key 78 is released, and the resistance of 69 and 70 re-introduced.

The called party at station "C" now removes receiver 92 from hook 86, causing 93 to contact 94, and the parties at the two stations may now converse, the transmitter at each station being energized over their holding circuits as before described.

The talking circuit is as follows:—from common wire 95, through connector 45, contacts 60, 61, primary 69, transmitter 70, wires 71, 72, connector 43, jack 37, springs 80, 81, brush 51, arm 47, shoe 48, bus-bar 77, wires 78, 82, connector 83, transmitter 96, primary 97, contacts 94, 93, connector 98, back to common wire 95. Transmitters A and C are each energized over individual battery circuits, the energizing circuit of A being as follows:—from positive side 64 of battery 65, through 30, 66, 45, 60, 61, 69, 70, 71, 72, 43, 37, impedance 73, wire 64 to negative side 69′ of battery 65. The energizing circuit of station C may be traced in a like manner.

Fluctuations of current through the primaries 69, 97, caused by transmitters 70, 96, are repeated by induction in secondaries 99, 100, and affect the receivers 57, 92, in a well known manner, and conversation can be carried on.

When the receiver 57 is replaced on hook 58, the member 60 breaks contact with 61, thereby interrupting the holding circuit and causing the magnet 73 to become de-energized, the armature 74 returning to normal position, and causing detent 75 to release ratchet wheel 49, permitting the latter, and the arm 47 and shoe 48, to return to normal position by reason of a suitable spring, shown at 101, Fig. 4.

Having now described the features and operation of my invention, and desiring to protect the same in the broadest manner legally possible,

What I claim is:—

1. A vertical rack; horizontal insulating spacers, one above another; fixed vertical contact bus-bars retained in their relative positions by said spacers; selectors for said rack; and means whereby said selectors may successively engage said bus-bars.

2. A vertical rack; horizontal insulating spacers, one above another; vertical contact bus-bars retained in their relative positions by said spacers; pins perpendicular to the face of the said rack; one or more selector frames with holes therein to allow a selector to be removably mounted upon said pins; the said contact bus-bars being each engageable by the wiper of said selector.

3. A vertical rack; horizontal insulating spacers, one above another; vertical contact bus-bars retained in their relative positions by said spacers; pins perpendicular to the face of the rack; one or more selector frames with holes therein to allow a selector to be removably mounted on said pins; the said contact bus-bars being each engageable by the wiper of said selector; jacks secured to said rack whereby the selector circuits become connected or disconnected when the selector is mounted on, or demounted from the selector rack.

4. A vertical rack; horizontal insulating spacers, one above another; vertical contact bus-bars retained in their relative positions by said spacers; pins perpendicular to the face of said rack for the purpose of receiving and positioning selectors; a terminal board secured to the said rack and having terminals therein horizontally adjacent to each selector position.

5. A vertical rack; horizontal insulating spacers, one above another; vertical contact bus-bars retained in their relative positions by said spacers; pins perpendicular to the face of the rack; one or more selectors with frames having holes therein whereby they may be removably mounted on said pins, the said contact bus-bars being engageable by the wiper of said one or more selectors; a terminal board secured to the rack and having terminals and jacks horizontally adjacent to each selector position; a plug jack for each selector whereby the selector circuits may become connected or disconnected when the selector is mounted on or demounted from said rack.

6. A vertical selector rack; horizontal insulating spacers, one above another; vertical contact bus-bars held in their relative positions by said spacers; a back board carrying a series of jacks and means whereby said bus-bars may engage said jacks.

7. A vertical selector rack; vertical contact bus-bars arranged radially around a

common centre, each having a free end; horizontal insulating spacers to retain said bus-bars in their relative positions; a back board carrying a series of jacks; and means whereby the free ends of said bus-bars may engage said jacks.

8. A back board carrying two or more series of jacks; a multiple cable whereby each jack in each series is permanently connected to a corresponding jack in each other series; vertical selector racks each having a series of vertical contact bus-bars, each bus-bar having a free end; and means whereby the said selector racks may be removably mounted on said back board, the free ends of said bus-bars engaging the said jacks.

9. A vertical selector rack; vertical contact bus-bars, each having a bent free end, the bends being arranged alternatively in opposite directions, or "staggered;" a series of jacks suitably mounted to receive the bent free ends of said bus-bars; selectors for said rack; and means whereby said selectors may successively engage said bus-bars.

10. A fixed vertical selector rack; vertical contact bus-bars each having a free end; a series of jacks suitably mounted; and means whereby the free ends of said bus-bars engage said jacks; selectors for said rack; and means whereby said selectors may successively engage said bus-bars.

11. Two or more series of jacks; a suitable mounting for same; a multiple cable whereby each jack in each series is permanently connected to a corresponding jack in each other series; a plurality of selector racks, each having a vertical series of contact bus-bars, engaging said jacks, suitably held in insulating material and arranged radially adjacent to a series of selector positions; pins at each selector position perpendicular to the face of the said rack; a series of jacks horizontally adjacent to each selector position; selectors having frames with holes therein whereby they may be removably mounted on said pins, each selector having a contact member for engaging the said bus-bars; and each selector having a series of plugs to engage the said jacks adjacent to itself.

12. A vertical selector rack; vertical contact bus-bars suitably held in insulating material and arranged in radial relation to a series of selector positions; pins at each selector position perpendicular to face of said rack; a terminal board secured to said rack and having a series of jacks and a series of terminals horizontally adjacent to each selector position; selectors, each having a frame with holes whereby it may be removably mounted on said pins; each selector having a series of plugs to engage the said jacks; and each selector having a rotatable contact member for engaging said bus-bars.

In testimony whereof I hereunto affix my signature.

ALTON E. STEVENS.

Oct. 9, 1923. 1,470,202

A. E. STEVENS

SELECTOR RACK FOR AUTOMATIC TELEPHONE SYSTEMS

Filed Aug. 2, 1921

Fig. 1.

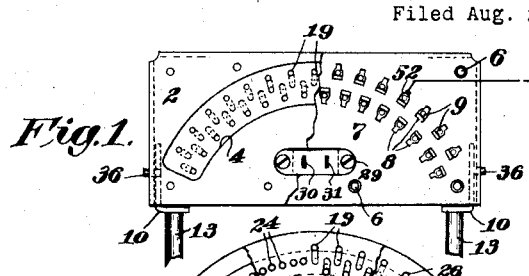


Fig. 2.

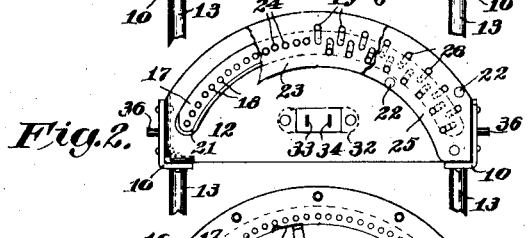


Fig. 3.

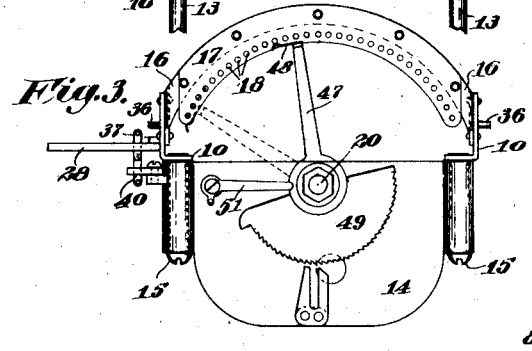


Fig. 6.

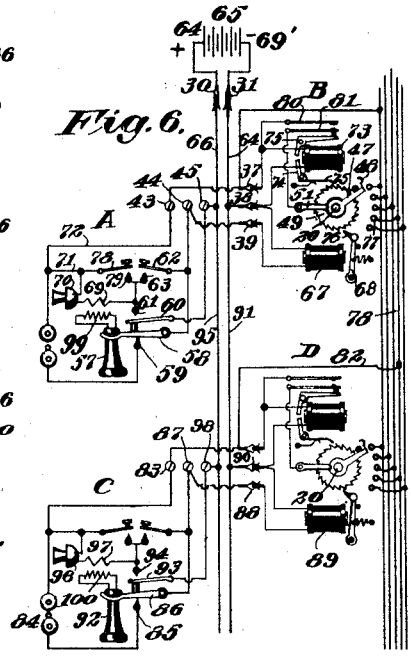


Fig. 4.

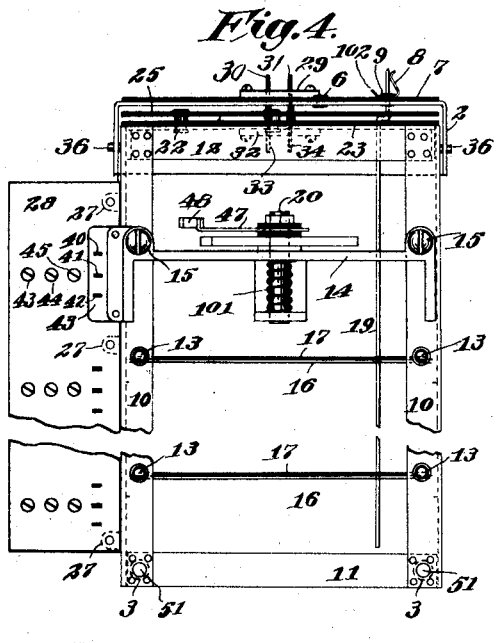
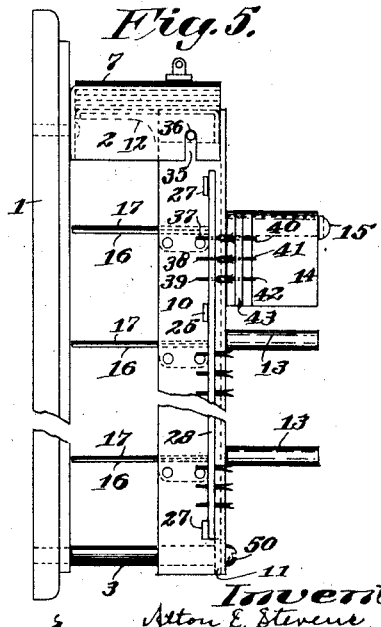


Fig. 5.



Inventor:
Alton E. Stevens,
by his Attorney,
Charles F. Richardson.

Patented May 19, 1925. 1,538,141

UNITED STATES PATENT OFFICE.

ALTON E. STEVENS, OF PROVIDENCE, RHODE ISLAND; MAUDE L. STEVENS ADMINISTRATRIX OF SAID ALTON E. STEVENS, DECEASED.

TELEPHONE SYSTEM.

Application filed May 28, 1921. Serial No. 473,469.

To all whom it may concern:

Be it known that I, ALTON E. STEVENS, citizen of the United States of America, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates more particularly to a combination of an automatic telephone system and a signalling system for use in private installations, and has for its object the provision of a means for quickly signalling a person, say, in an unknown part of an institution, and of means for conveniently establishing telephonic communication with him.

In the diagrammatic drawings illustrating the principle of my invention and the best method now known to me of embodying the same in operative structure,

Fig. 1 shows apparatus of a telephone station embraced in an automatic telephone system.

Fig. 2 illustrates a similar station embraced in said system.

Fig. 3 shows central station apparatus for the two stations exhibited in Figs. 1 and 2.

Fig. 4 is a modification showing another method of connecting an auxiliary calling circuit and an auxiliary answering circuit.

It is to be understood that the impulse sending means, shown in Figs. 1 and 2, may be any suitable so-called automatic impulse sending device, or impulse transmitter; and also that the system may embrace any reasonable number of telephone stations like those of Figs. 1 and 2.

Each telephone station, see Fig. 1, comprises an impulse sending key 1, a ringing key 2, a direct current ringer 3, a transmitter 4, a receiver 5, a receiver hook 6, and an induction coil having a primary 7, and a secondary 8.

The telephone station, Fig. 1, is connected to the central station apparatus, Fig. 3, by three wires, 9, 10 and 11. At the central station is an individual selector for each telephone station, comprising a radial bank of contact points 12, the said contacts all being in the same plane; a shaft 13, carrying a wiper 14, designed to successively engage the said contacts when the shaft 13 is rotated; a ratchet wheel 15, which is driven by a pawl 16, on armature 17, of stepping magnet 18, one step for each time the said magnet is energized; a connecting magnet 19, having an armature 20, designed to engage and hold ratchet wheel 15 in each successive step, and an armature 21 which operates certain contact springs; and a lockout relay magnet 22, which, when energized, operates certain contact springs for the purpose of preventing its selector from connecting to a line in use. 23 is a busy tone buzzer used in common by all stations.

A party at station Fig. 1, wishing to call a party at station Fig. 2, lifts the receiver 5 from hook 6 which contacts point 28, thereby completing a holding circuit by permitting current to flow from the positive side 29, of battery 30, through wire 9, hook 6, contact 28, primary 7, transmitter 4, wire 11, around magnet 19, wire 31 to negative side 32, of battery 30. The magnet 19 is thereby energized and attracts armature 20 which causes spring detent 33 to engage ratchet wheel 15, and hold it in any position to which it may be moved.

The impulse key 1 is now depressed four times, into contact with point 34, each time completing a stepping circuit from 29, through 9, 1, 34, 10, 18, 35, to 32; thereby causing magnet 18 to be energized four times, and to attract its armature 17, and cause pawl 16 to engage ratchet 15 and step it ahead four steps, with the result that wiper 14 is brought into contact with point 36.

It is well known that a relay armature may be so adjusted that a weak current through the magnet will not cause its attraction, but when a stronger current causes its attraction and then the current is reduced to its former weakness, it is still sufficient to hold the armature. Now the adjustments of armatures 20 and 21 of magnet 19, are such that current over the above holding circuit, through the resistance of 7 and 4, will cause armature 20 to operate, but 21, being more stiffly adjusted will not operate until ringing key 2 is pressed and contacts point 36 which short circuits resistances 7 and 4, thereby permitting enough additional current to flow over the holding circuit to cause 21 to be attracted and cause spring 37 to contact spring 38 and push it out of contact with point 39. The strong current which flows from 29 through station Fig. 1 when

ringing key 2 is depressed, splits at point 40; on account of the high resistance of 19, the greater part of the current flowing through wire 41, spring 42, point 43, wire 44, springs 37 and 38, wires 45 and 46, to wiper 14 which has contacted point 36; the current continuing over wire 100, multiple wire 101, home wire 47′, wires 48, and 49, ringer 50, Fig. 2, contacts 51, 52, wire 53, stepping magnet 54, Fig. 3, wire 55 to negative side 32 of battery 30; the ringer 50 thus signalling the party at station Fig. 2. The current passing through magnet 54 does not cause its operation, as it is of comparatively low resistance. The party at station Fig. 2, by removing receiver 56 from hook 57, which now contacts point 58, can converse with the calling party at station, Fig. 1.

The transmitter 4, at station Fig. 1 receives its energizing current over its "holding circuit" hereinbefore described, the magnet 19 being of high impedance, as is also magnet 59; while the transmitter 60 of station Fig. 2 receives its energizing current over its own "holding circuit," as follows:— from positive side 29 of battery 30, through 63, 57, 58, 61, 60, 48, 59, 62, to opposite side 32 of battery 30. The circuit followed by the voice produced currents is as follows:— from positive side 29, of battery 30 through 9, 6, 28, 7, 4, 11, 40, 41, 42, 43, 44, 37, 38, 45, 46, 14, 36, 100, 101, 47′, 48, 60, 61, 58, 57, 63, back to 29. The fluctuations in the primary windings 7 and 61 of the induction coils at each station, inductively affect the secondary windings, which in turn affect the receivers in a well-known manner, and conversation can be carried on between the two stations.

Now if station Fig. 2 is in use when station Fig. 1 is called, the latter will be prevented from connecting thereto and will receive a "busy" hum in his receiver for the following reasons:—

Receiver 56, Fig. 2, would be off of hook 57, which would be in contact with 58 and, therefore, a guarding or lockout potential would be found on point 36, Fig. 3, by brush 14, causing the lockout relay 22 to operate and prevent a connection to the busy station; the lockout potential circuit being as follows:—from positive side 29 of battery 30, through 63, Fig. 2, 57, 58, 61, 60, 48, home wire 47′, 101, 100, to contact 36, thence over the lockout circuit of the calling station Fig. 1, from contact 36, over 14, 46, 45, 38, 39, around lockout magnet 22, to negative side 32 of battery 30.

The lockout relay 22 is energized, and attracts armature 65, causing spring 66 to contact 67, and push 42 away from point 43 and into contact with point 68, first completing a local locking-circuit from the live point 36, through 14, 46, 69, 67, 66, 22 to 32, causing 22 to remain energized as long as the called station remains busy, or until receiver 5 is replaced. A busy tone circuit notifying the calling party at station Fig. 1, that the station Fig. 2 is busy, is completed by the energization of 22, as follows:—from negative side 32 of battery 30, through wire 69, busy-tone buzzer 23, contacts 70, 71, through 72, 68, 42, 41, 11, 4, 7, 28, 6, 9, to positive side 29 of battery 30; the magnet 23 attracting armature 70 away from 71, and causing a buzz in a well-known manner which is repeated into secondary 8 and receiver 5; and the party at station Fig. 1 is aware that station Fig. 2 is busy.

Replacing the receiver 5 of the calling station, causes magnet 19 to be de-energized, which releases armature 20, causing detent 33 to disengage ratchet 15 which is restored to normal position by spring 73, shown in dotted lines.

Having described briefly the general construction and operation of an automatic telephone system, I will now describe the principal features of my invention, and their adaptation to, and combination with, such automatic telephone system, whereby 1st, a person in an unknown part of an institution, may be called by a calling station for the purpose of telephonic communication; 2nd, said called party may place himself in telephonic communication with the calling party; and 3rd, telephonic communication may be had without the possibility of a connection to the line by a third station, that is, the attainment of private communication between only two stations, namely, the calling and the called stations.

A general call circuit, 24, 25, Fig. 3, is run throughout an institution with signal bells or horns as 26, installed at various locations, not necessarily adjacent to telephone stations, the signals being so placed that when the circuit is rendered active by battery current being supplied to the circuit, one or more of the signals may be heard in any part of the institution. A code of signals is arranged, and each individual having a code call, and who may be in various parts of the institution, may be signalled, and may reply, from any telephone.

The party at station Fig. 1, upon calling station, as Fig. 2, and finding the individual he wants is at an unknown point on the premises, releases the connection, or if the calling party knows that the party desired is not at his usual substation, then in either case, the calling party operates key 1, once, thereby stepping his wiper 14 to 74, then presses key 2 a number of times corresponding to the code ring of the wanted party; each press of key completes an auxiliary signal or relay circuit from positive side 29 of battery 30, through 9, 6, 28, 36, 2, 11, 40, 41, 42, 43, 44, 37, 38, 45, 46, 14, 74, 75, 76, around relay 102 through wire 77, to

negative side 32 of battery 30. The armature 78 is stiffly adjusted, as is armature 21, both of which operate when key 2 is pressed. Armature 21, however, is adjusted so that it holds up after key 2 is released, while armature 78 is so adjusted as to return to normal when key 2 is released. The armature 78 upon being attracted by magnet 102, contacts point 79 and bridges battery 82 across general call circuit 24, 25, over wires 80, 81, and the signal devices 26 are operated a number of times corresponding to the code number of the party wanted, who, upon hearing his signal, steps to any telephone of the system, as Fig. 2 for instance, removes his receiver, as 56, and operates his key 83 into contact with 84, twice, and the stepping magnet 54, causes the wiper 85 to contact the point 86 which is connected to multiple wire 87 of an auxiliary answering or relay circuit. Key 88 is now pressed into contact with point 89, thereby completing said auxiliary answering or relay circuit from positive side 29 of battery 30, through 63, 57, 58, 89, 88, 48, 94, 95, 96, 47, 98, 99, 93, 85, 86, 87, 103 to negative side 32 of battery 30; thereby operating the relay 103 in the same manner as the key 2 operated 102; armature 90 contacts point 91, and closes the general call circuit between wires 80, 81, 24, 25, thereby causing signals 26 to operate once, and notify the calling party who has connected to multiple wire 75, of auxiliary signal circuit, that the wanted party has answered, and is connected to multiple wire 87 of the auxiliary answering circuit. The two can now converse by reason of condenser 92 which permits voice produced currents to pass between the two multiple wires.

If a party at another station now attempts to connect to either the calling or answering point on the signalling circuit, he will find a guarding or lockout potential on each multiple of either point throughout the system. This guarding circuit would extend from positive side 29 of battery 30, through 9, 6, 28, 7, 4, 11, 40, 41, 42, 43, 44, 37, 38, 45, 46, 14, to point 74 and multiple wire 75, and thence to all points connected to this wire, as would also be the case with point 86 and multiple wire 87.

Each party upon the completion of his communication, or for any other reason, may cause his apparatus to be restored to normal position, in the manner already described, namely: Replacing the receiver 5, as of the calling station Fig. 1, upon its receiver hook 6, causes the magnet 19 to be de-energized, which releases armature 20, causing detent 33, to disengage ratchet 15, which is restored to normal by spring 73, shown in dotted lines.

The modification shown in Fig. 4, comprises a single signalling relay 110 having parallel windings 111 and 112 from the auxiliary signal multiple wire 75, and auxiliary answering multiple wire 87, leading to the negative side of battery, as 30, not shown. Whenever this relay is energized for signalling purposes, by the calling, or the called party, its armature 113, contacts point 114, and completes the general call circuit, as already explained.

By this construction, a single relay is substituted for the two relays and condenser described, and the two auxiliary signalling and answering circuits are inductively united for conversational purposes.

For proof of authority given Maude L. Stevens, administratrix, to intervene and prosecute this pending application, filed by Alton E. Stevens, deceased, and to receive Letters Patent that may be granted thereon, reference is hereby made to liber W 122, page 519, of Transfer of Patents, wherein is recorded a certified copy of letters testamentary, appointing the said Maude L. Stevens, administratrix of the estate of the said Alton E. Stevens, deceased.

Having described my invention and its features and their operations, and desiring to protect in the broadest manner legally possible, the combinations, and the sub-combinations of elements embracing said invention and said features,

What I claim is:—

1. In a telephone system, a plurality of substations; means whereby any substation may become connected with any other substation for the purpose of communication; an auxiliary signalling circuit; an auxiliary answering circuit; and means of telephonic communication between said signalling and answering auxiliary circuits.

2. In a telephone system, a plurality of substations; means whereby any substation may become connected with any other substation for the purpose of communication; an auxiliary signalling circuit; an auxiliary answering circuit and means for uniting the auxiliary signalling and answering circuits for the purpose of telephonic communication.

3. In a telephone system having a plurality of substations; an auxiliary signalling circuit, an auxiliary answering circuit; automatic means whereby one substation may become connected to, and operate the signalling circuit; signalling means controlled by said signalling circuit; and automatic means whereby a second substation may become connected to and operate the auxiliary answering circuit, said signalling means being controlled by said answering circuit.

4. In a telephone system having a plurality of substations; an auxiliary signalling circuit, an auxiliary answering circuit; automatic means whereby one substation may become connected to, and operate the signal-

ling circuit; signalling means controlled by said signalling circuit; automatic means whereby a second substation may become connected to, and operate the auxiliary answering circuit, said signalling means being controlled by said answering circuit; and means connecting said signalling circuit and said answering circuit, for the purpose of communication; and means whereby the said auxiliary signalling circuit and auxiliary answering signal circuit are inaccessible to the remaining substations.

5. In a telephone system, a plurality of substations; automatic means whereby any substation may become connected to any other substation for the purpose of communication; and means whereby said connection may be restored to normal position; an auxiliary signalling circuit; an auxiliary answering circuit; automatic means whereby any substation may become connected to the said auxiliary signalling circuit; automatic means whereby any remaining station may become connected to the said auxiliary answering circuit; and means for uniting the said auxiliary signalling and auxiliary answering circuits for the purpose of telephonic communication.

6. In a telephone system having a plurality of substations; the combination of automatic means whereby any substation may connect to any other substation for the purpose of communication; and an auxiliary signalling circuit and an auxiliary answering circuit, providing an alternate means for telephonic communication.

7. In a telephone system having a plurality of substations; the combination of automatic means whereby any substation may connect to any other substation, with an auxiliary signalling circuit; an auxiliary answering circuit; means whereby the two said auxiliary circuits are permanently united for conversational purposes; a general call circuit having signal devices therein; and manual means at each substation for controlling through said auxiliary circuits the signal devices in said general call circuit.

8. In a telephone system having a plurality of substations; the combination of automatic means whereby any substation may connect to any other substation, with an auxiliary signalling circuit; signal devices controlled thereby; an auxiliary answering circuit; means whereby the two said auxiliary circuits are inductively united for conversational purposes; a general call circuit having signal devices therein; and manual means at each substation for controlling through said auxiliary circuits the signal devices in said general call circuit.

9. In a telephone system having a plurality of sub stations; the combination of automatic means whereby any substation may call and converse with any other substation, with a general call circuit having signal devices therein; an auxiliary signalling circuit and a separate auxiliary answering circuit; automatic means whereby any station may connect to the said signalling circuit, and an automatic means whereby any remaining substaition may connect to the said auxiliary answering circuit, to control the general call circuit having signal devices therein; means for uniting the said signalling and the answering circuits, for the purposes of conversation; and means whereby the said signalling and answering circuits are inaccessible to the remaining substations.

10. In a telephone system having a plurality of substations; the combination of means whereby any station may connect to any other station, means for signalling the called station; means to restore the system to normal position; with an auxiliary signalling circuit; signal devices controlled thereby; means whereby any station may connect to said auxiliary signaling circuit; manually operated means for successively closing an opening said signalling circuit, in accordance with a predetermined code of signals; an auxiliary answering circuit; and means whereby any remaining station may connect to said auxiliary answering circuit.

11. In a telephone system having a plurality of substations; the combination of means whereby any station may connect to any other station; means for signalling the called station; and means to restore the system to normal position; with an auxiliary signalling circuit; signal devices controlled thereby; means whereby any station may connect to, and operate said auxiliary signalling circuit; an auxiliary answering circuit; means whereby any remaining station may connect to said auxiliary answering circuit, and control said signal devices; and means for connecting said auxiliary signal circuit and said auxiliary answering circuit, for the purposes of communication, between the calling and the called station.

12. In a telephone system having a plurality of substations; the combination of means whereby any station may connect to any other station, means for signalling the called station; and means to restore the system to normal position; with an auxiliary signalling circuit; signal devices controlled thereby; means whereby any station may connect to and operate said auxiliary signalling circuit; an auxiliary answering circuit; means whereby any remaining station may connect to said auxiliary answering circuit and control said signalling devices; means for connecting said auxiliary signal circuit and said auxiliary answering circuit for the purposes of communication between the calling and the called stations; and means

whereby said auxiliary signalling circuit and auxiliary answering circuit are rendered inaccessible to the remaining substations.

13. In a telephone system having a plurality of substations; the combination of means whereby any station may connect to any other station; means for signalling the called station; means whereby the calling station may converse with the called station; and means to restore the system to normal position; with an auxiliary signalling circuit; signal devices controlled thereby; means whereby any station may connect to said auxiliary signalling circuit; manually operated means for successively closing and opening said signalling circuit in accordance with a predetermined code of signals; an auxiliary answering circuit; and means whereby any remaining station may connect to said auxiliary answering circuit.

14. In a telephone system having a plurality of substations; the combination of means whereby any station may connect to any other station; means for signalling the called station; means whereby the calling station may converse with the called station; and means to restore the system to normal position; with an auxiliary signalling circuit; signal devices controlled thereby; means whereby any station may connect to, and operate said auxiliary signalling circuit; an auxiliary answering circuit; means whereby any remaining station may connect to said auxiliary answering circuit and control said signal devices; and means for connecting said auxiliary signal circuit and said auxiliary answering circuit for the purposes of communication between the calling and called stations.

15. In a telephone system having a plurality of substations; the combination of means whereby any station may connect to any other station; means for signalling the called station; means whereby the calling station may converse with the called station; and means to restore the system to normal position; with an auxiliary signalling circuit; signal devices controlled thereby; means whereby any station may connect to and operate said auxiliary signalling circuit; an auxiliary answering circuit; means whereby any remaining station may connect to said auxiliary answering circuit and control said signalling devices; means for connecting said auxiliary signalling circuit and said auxiliary answering circuit for the purposes of communication between the calling and the called stations; and means whereby said auxiliary signalling circuit and auxiliary answering circuit are rendered inaccessible to the remaining substations.

16. In a telephone system having a plurality of substations; the combination of means whereby any station may connect to any other station; means for signalling the called station; means whereby the calling station may converse with the called station; means to restore the system to normal position; means for rendering any busy station inaccessible to other stations; with an auxiliary signalling circuit; signal devices controlled thereby; means whereby any station may connect to said auxiliary signalling circuit; manually operated means for successively closing and opening said signalling circuit in accordance with a predetermined code of signals; an auxiliary answering circuit; and means whereby any remaining station may connect to said auxiliary answering circuit.

17. In a telephone system having a plurality of substations; the combination of means whereby any station may connect to any other station; means for signalling the called station; means whereby the calling station may converse with the called station; means to restore the system to normal position; means for rendering any busy station inaccessible to other stations; with an auxiliary signalling circuit; signal devices controlled thereby; means whereby any station may connect to, and operate said auxiliary signalling circuit; an auxiliary answering circuit; means whereby any remaining station may connect to said auxiliary answering circuit and control said signal devices; and means for connecting said auxiliary signal circuit and said auxiliary answering circuit for the purposes of communication between the calling and called stations.

18. In a telephone system having a plurality of substations; the combination of means whereby any station may connect to any other station; means for signalling the called station; means whereby the calling station may converse with the called station; means to restore the system to normal position; means for rendering any busy station inaccessible to other stations; with an auxiliary signalling circuit; signal devices controlled thereby; means whereby any station may connect to said auxiliary signalling circuit; manually operated means for successively closing and opening said signalling circuit in accordance with a predetermined code of signals; an auxiliary answering circuit; means whereby any remaining station may connect to said auxiliary answering circuit; means for connecting said auxiliary signal circuit and said auxiliary answering circuit for the purposes of communication between the calling and the called stations; and means whereby said auxiliary signalling circuit and auxiliary answering circuit are rendered inaccessible to the remaining substations.

In testimony whereof I hereunto affix my signature.

ALTON E. STEVENS.

May 19, 1925. 1,538,141

A. E. STEVENS

TELEPHONE SYSTEM

Filed May 28, 1921

Fig. 3.

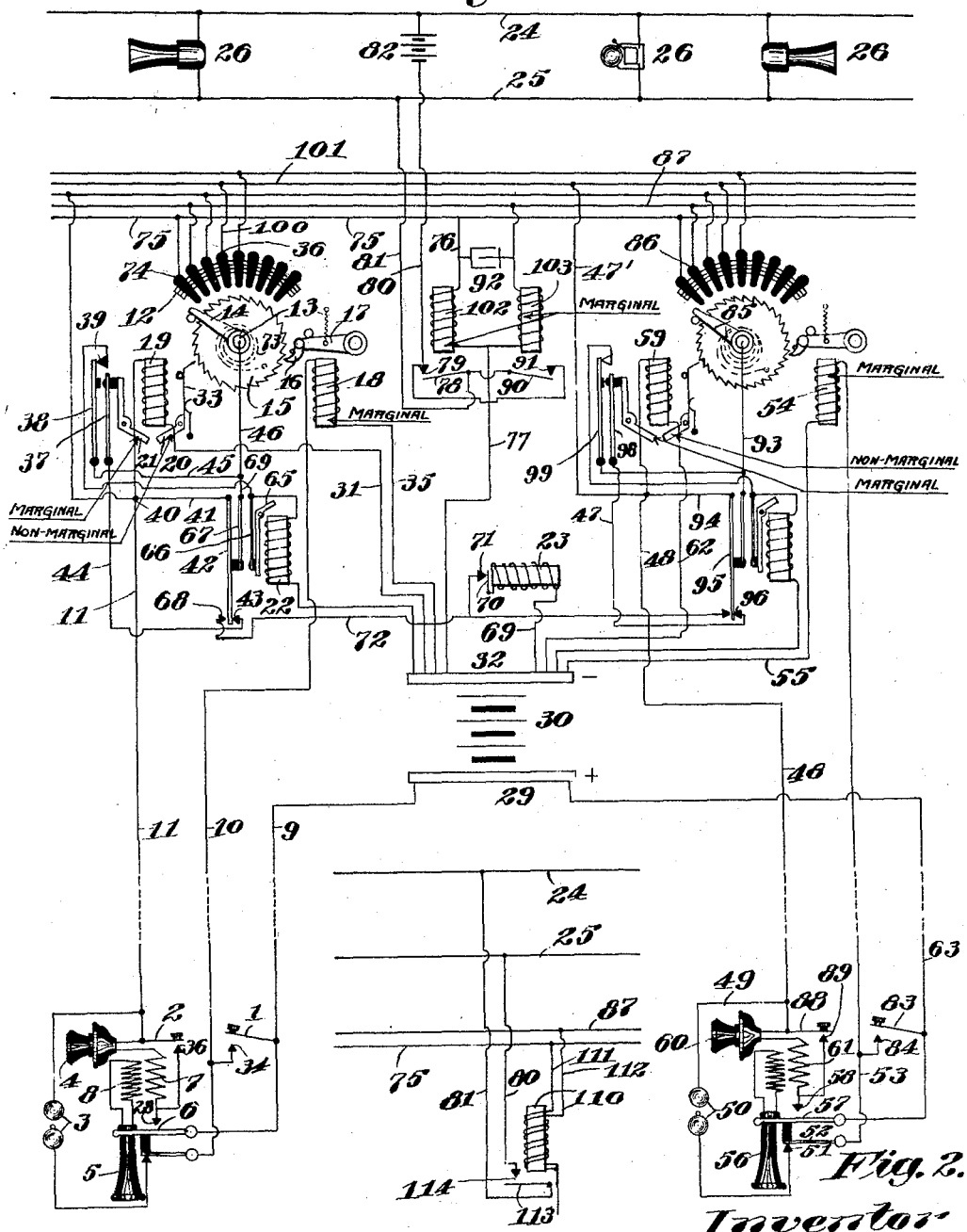


Fig. 1.

Fig. 4.

Fig. 2.

Inventor
Alton E. Stevens,
by his Attorney
Charles F. Richardson

Patented Sept. 3, 1940 2,213,933

UNITED STATES PATENT OFFICE

2,213,933

TELEPHONE SYSTEM

Theodore N. Saaty, Providence, R. I., assignor to Screw Machine Products Company, Inc., a corporation of Rhode Island

Application June 14, 1937, Serial No. 148,075

16 Claims. (Cl. 179—90)

This invention relates to a telephone of the type more particularly used for intercommunicating within a plant which will have one or more executives and a plurality of other stations.

One of the objects of this invention is to simplify the manual operation necessary in the operation of the system by reducing the necessary manual movements to a minimum.

A more specific object of the invention is to provide a telephone system having a plurality of stations with one station so arranged that a person at that station may call another station by merely pushing a single button in a single direction, which button will correspond to the station to be called, after which it is merely necessary for the person at the calling station to listen and talk without any further manual manipulation for the conversation.

Another object of the invention is to provide an arrangement so that should the calling person or the called person omit to restore the circuit to normal by some manual operation, the circuit will still be operative for the making of additional calls after the instant call is completed.

Another object of the invention is to speed up the communication between two stations by mechanically informing the called station of the station which is calling, making it unnecessary to exchange the usual salutations of defining who is speaking at each end.

Another object of the invention is to provide in the system an arrangement so that the called station will known in advance of his act in receiving the call what station is calling him by means of some characteristic ringing or buzzing operation for effecting this result.

Another object of the invention is the provision of an arrangement which is exceedingly flexible in that new stations may be added without materially changing over the system in its designed capacity.

Another object of the invention is to provide a system in which the number of wires running to any one station will be a minimum.

Another object of the invention is the provision of a system which will be of a low cost for maintenance, such for instance as the provision of a system where trouble may be more quickly located than in similar but inferior systems which are in use at the present time.

Another object of the invention is to provide a plurality of units connected to a central station so that trouble in any one of the units may be quickly located.

Another object of the invention is the provision of a single station in which a power amplified loud speaker is provided to take the place of a manually handled receiver.

Another object of the invention is the provision of a radio in the unit station connected in with the telephone in such a way that a loud speaker or power amplified loud speaker may be used with either or both the telephone or the radio.

Another object of the invention is the provision of radio and telephone in which the operation of the radio will be cut off upon placing the telephone into communication.

Another object of the invention is the provision of the radio and audio amplifier, loud speaker, dialing mechanism and the remainder of the telephone each as separate units so that one may be removed and replaced by a fresh one if desired without disturbing the others, by a simple plugging in operation.

A more specific object of the invention is the provision of a station which will send impulses to the central station by merely a push button arrangement which causes a dial mechanism to operate.

Another object of the invention is the prevention of arcing in the automatic dial by preventing current flow through the commutator at the time of impulsing or change from one contact to another.

Another object of the invention is to so divide the talking current from the receiving current by means of separate conductors that no feed back will be transmitted to the receiver of the calling 'phone to cause a noise in the circuit.

Another object of the invention is to transmit insufficient talking current over the receiving line to cause any feed back.

With these and other objects in view, the invention consists of certain novel features of construction, as will be more fully described, and particularly pointed out in the appended claims.

In the accompanying drawings:

Fig. 1 is a diagrammatic view illustrating some of the wiring diagram in one of the stations;

Fig. 2 is a diagrammatic view of two of the units of the central selector mechanism;

Fig. 3 is a diagrammatic view illustrating the portion of the wiring at a station which will receive the call from the station shown in Fig. 1;

Fig. 4 is an elevation looking at the back side of the panel upon which some of the operating parts of the apparatus are mounted;

Fig. 5 is a section on line 5—5 of Fig. 4;

Fig. 6 is an enlarged sectional view of one of the keys shown in Fig. 5;

Fig. 7 is a perspective view with portions removed and showing a fragmentary detail of the control apparatus;

Fig. 8 is a perspective view of a fragmental detail of more of the apparatus and looking from the opposite side from that shown in Fig. 7;

Fig. 9 is a perspective view of another fragmental detail of a control mechanism.

The telephone system which is contemplated by this invention involves a central selecting mechanism which may be of a general type illustrated in the Stevens Patent No. 1,265,398, dated May 7, 1918, or of a slightly different arrangement such as that shown in the diagram of Fig. 2; while there is an arrangement for connecting to this central selecting mechanism a plurality of stations, by a minimum number of wires such for instance as three, by which they are each arranged to be connected to the central station and through the central station to each other. One such station is shown diagrammatically in Fig. 3. The stations are more or less similar, one, however, which for convenience in designation may be called an executive station, is more elaborate than some of the other stations, in that it has a power amplified loud speaker and sensitive transmitter, whereas the other stations may have hand sets. One such executive station is shown more particularly in Fig. 1, and as many such executive stations as are desired may be used.

The plan of the executive station is that it will have several units each detachable and replaceable, such as a telephone comprising a key mechanism K built into the main chassis of the station, a dial mechanism unit D, a loud speaker unit T, and a radio and audio amplifier unit R, the loud speaker being common to both the telephone and the radio and serving as the receiver for the transmitted messages. These several units, the telephone, including the dial unit, loud speaker, radio and audio amplifier, are assembled in a single casing and the dial mechanism, loud speaker and radio and audio amplifier are plugged in so that they may be removed from the casing for replacement by new or different speaker or radio and audio amplifier, the arrangement also being such that usually when the telephone is put into operation the radio is shut off. The radio and audio amplifier unit and the loud speaker unit are more or less standard instruments and the details of their structure play no important part of this invention except in the manner pointed out hereinafter, the novelty residing in the arrangement of the new combination of the two instruments built as a unit.

The executive telephone station of Fig. 1 comprises essentially, so far as its mechanical operation is concerned, mechanical and electrical mechanism built into the chassis of the station, and in Fig. 1 is that portion remaining or in area K after the units in the dotted line areas D, R and T, each area representing a separate unit, are subtracted. There are a plurality of keys or push buttons any one of which may be pressed inwardly a short distance and remain in this pressed-in position, the arrangement being such that if any other keys or buttons are pushed in, the first pressed-in button will be released. Circuits are closed as a result of the operation of the keys or buttons. There is also a motor driven impulse producing or dial mechanism which is a separable removable unit but which is actuated by the pressing inwardly of any one of the keys. Each key represents a corresponding number of impulses which will be sent out by the impulse producing mechanism by an arrangement which places in series a plurality of contacts over which the impulses are sent out, with each key breaking the series at some particular point so that after a certain number of impulses are sent out the circuit becomes broken and further rotation of the motor fails to send out further impulses. The impulses are sent from the calling station to the central selecting mechanism which automatically selects the station corresponding to the impulses sent and connects the calling station to the called station through this central mechanism and causes a ringing at the called station in such a manner as to designate the calling station so that the called station will know what station is calling and also connects up the talking current between the calling station and the called station as well as making it possible for a manual ringing of the called station as well.

The wiring diagram of the executive station shown in Fig. 1 will generally explain the operations occurring. This diagram indicates the mechanism in at rest or idle position ready for a call to be made.

The general arrangement of the executive station is that when any one key is pushed in the motor 28 will be energized to commence rotation of the shaft 28'. After the motor has commenced its operation a closing of contacts 40 and 42 will separately provide current to relay 17 so that even though the key is differently manipulated the motor will continue its operation through a complete cycle. The complete cycle requires that shaft 28' make two complete revolutions and shaft 39, which it turn by means of gears 36 and 37, will make one complete revolution. At the end of the complete revolution of the gear 37 lobe 39 of cam 38 will cause disconnection of the circuit causing flowing of current to the motor and consequently the motor will stop.

At the commencement of operation contacts 70, 71 are separated, positively assuring that the central station be restored to idle position. During the first revolution of shaft 28' the low portion of the cam 38 will maintain the dialing mechanism in circuit so that the dialing mechanism will operate to select the desired station and because of the high portion of the cam 38, which controls the ringing mechanism, the ringing mechanism will be out of circuit. The buzzer which is used for receiving a call is also disconnected when the motor starts, as otherwise each impulse and dialing will actuate the buzzer, which is undesirable. During the second revolution of the shaft 28' the ringing circuit will be placed in operation so that ringing will occur and the dialing mechanism will be out of circuit so that no further actuation of this selecting at the central station will occur. A more detailed working of the parts and a connecting in of the speech amplifier will be now explained.

Motor

There are a plurality of keys built into the executive station shown in Fig. 1 which I will number 1, 2, 3, 4 and others will be present up to the desired number but are herein omitted, as four will suffice to explain the invention. Should it be desired to call the station corresponding to station number 1, and which is shown in Fig. 3,

key number 1 will be pressed causing contacts 10 and 11 to separate and contacts 12 and 13 to engage. The closing of contacts 12 and 13 causes current to flow through leads 14 and 15, resistance 16 to energize coil 17 and over lead 23 back to the battery, as resistance 16 is present coil 17 is energized but partially, thereby causing armature 18 to pull up to the core which causes contacts 19 and 20 to separate and contacts 21 and 22 to engage. When contacts 21 and 22 are closed current flows through lead 31, 30, contacts 22, 21, lead 24, contacts 25 and 26, lead 27, to the motor 28, thence by lead 29 to the negative side of the battery. Thus, the motor starts to rotate and drives a shaft 28' and a plurality of parts mounted on the shaft, as will presently appear.

As the motor commences to rotate, gear 36 rotates turning gear 37 on shaft 39 which is twice the size of gear 36, thereby causing cam 38 also fixed on shaft 39 to rotate. As cam 38 rotates several circuits are operated. Contacts 40 and 41 in the bell ringing circuit separate, contact 40 engages contact 42 and contacts 43 and 44 separate, the latter contact engaging contact 45. The contacts 40 and 44 move together, being physically connected through a post 46 mechancally joining them. Current which could have flowed from the positive leads 31, 30 of the bell ringing circuit previously connected by contacts 40 and 41, is disconnected and the current is transferred to contact 42 and by lead 49 to the resistance 16, thereby supplying current to the relay 17 from a different source than previously explained (i. e., through the contacts 12 and 13, leads 14 and 15, etc.), which so locks the motor mechanism as to cause it to pass through its complete cycle ready for another call even though the operator should differently and improperly manipulate the actuating key 1. However, there are other circuits which will prevent the ringing of the station called, although the unit of the station operating or calling will pass through its complete cycle.

Automatic restoring central selector to idle

When pin 68 on gear 37 engages the lobe 69 of contact 70, this contact is separated from contact 71 to momentarily open circuit from terminal L over lead 72 and thence by lead 73 to contact 74 to restore the central selector to idle. At this stage the selecting mechanism passes through its impulsing cycle.

Buzzer

As outlined above, the closing of contacts 21 and 22 completes an interlocking circuit which maintains relay 17 energized. The closing of contacts 21 and 22 also sets up a circuit which is effective to render buzzer 65 ineffective. This is accomplished by energizing relay 96, one side of the relay being directly connected to terminal A— through leads 97, 98 and 67, and the other side of the relay being connected through leads 136, contacts 21 and 22, and leads 30 and 31 to terminal C+. One result of energizing relay 96 is to cause armature 101 to move contact 60 away from contact 61 and into engagement with contact 113. The separation of contacts 60 and 61 breaks the circuit between one side of the buzzer and the terminal S, the normal circuit being through lead 50, contacts 44 and 43, leads 57, 58, 59, contacts 60 and 61, lead 62 and contacts 63 and 64 to the buzzer. The other side of the buzzer is directly connected by leads 66, 98, and 67 directly to terminal A—. As will be outlined below, relay 96 remains energized during the call. As a result the buzzer is not energized by the dialing impulses, or by other signals.

The movement of armature 101 also moves contact 103 from contact 102, and engages contact 103 with contact 74. This latter action connects one side of the audio amplifier input circuit directly to terminal L through lead 104, contacts 103 and 74, lead 73, contacts 70 and 71, and lead 72. As will be pointed out below, the circuit from terminal C+ through the amplifier input circuit of the audio amplifier to terminal L is used as a resistant circuit during the time that the central selector is operating. Certain additional functions of relay 96 wil be pointed out below in connection with the speech amplifier and sensitive transmitter circuits.

Dialing

When contacts 44 and 45 are together S terminal is connected to the contact 44 through the lead 50 and through the contact 45 and lead 51 is connected to the contact 52 which as it engages with contact 53 by means of the lobes on the cam 54 will cause impulses to be transmitted over the leads just mentioned and out from terminal S to the selector as the commutator 55 engages live contacts such as 32, these impulses failing where contacts such as 56 are dead. These circuits controlled by keys, such as 1, 2, 3, 4, are in series so that those contacts such as 32 ahead of the keys or buttons which are pushed are alive, while those contacts such as 56 which are after the button pushed are dead.

When contacts 10 and 11 are open it breaks the series circuit from the positive battery which would carry the current through corresponding contacts of each of the other push buttons so as to leave the contact point 32 alive by reason of the connection through lead 33 to a point in the line connected through line 34 and 35 from the battery A— or C+ to contact 10. Key number 1 is for calling station number 1, the first station on the dial. In calling this station number 1 the circuit is energized at all times. Should station number 2 be called the first two contacts 32 and 56 alone will be alive and the next contact will be dead, as the positive current will be broken at 10', 11'.

Ringing

The shaft 28' has made one revolution and cam 38 has now advanced to a position where lobe 75 will engage the lobe 76 and brings back contact 40 to the position shown in the diagram in engagement with contact 41, and also brings contacts 43 and 44 into engagement and opens the contacts 44 and 45 to disconnect the impulse or dialing mechanism. At this point cam 77 has advanced so that lobe 78 of the cam will engage the hump 79 and cause contacts 80 and 81 to close or engage. Humps 78', 78'' likewise function to close these contacts 80 and 81, each for a certain length of time, so that a designating signal or ring dependent upon the length of engagement of the humps 78, 78' and 78'' will be transmitted to the called station. The circuit may be traced from the terminal L along the lead 72, contacts 71, 70, lead 73, lead 83, thence to the contacts 81, 80, along the lead 84, lead 47, contacts 41 and 40, lead 30, back to the positive battery terminal through lead 31. The contacts 85 and 86 through leads 87 and 88 connect with the leads to the terminals 80 and 81 to be located in parallel with the connections thereto so that

a manual ringing may occur as well as the automatic ringing by reason of the cam 77.

Stopping motor

When the lobe 89 of cam 38 engages the lobe 76 of the contact 40 it forces the contact 40 into engagement with contact 41 and in turn forces the contact 41 into engagement with the contact 90 which causes current to flow over lead 91 to the relay 17 and by reason of a connection between the resistance 16 and the relay 17 increases the flow in the relay which causes armature 92 to be attracted to close contacts 93 and 94, which closing lifts the contact 25 away from the contact 26 to separate them, thus breaking the motor circuit so as to stop the motor which will be at the completion of two complete revolutions of the shaft 28'.

Speech amplifier and sensitive transmitter

As pointed out above, the closing of contacts 21 and 22 energizes relay 96 by conducting current from the positive lead 30, across the contacts 21, 22, along lead 136, to relay 96, the circuit being completed over lead 97, 98 and 67 to the negative terminal A—. This causes the armatures 100 and 101 to be attracted, the latter opening contacts 102 and 103 and causing contact 103 to engage contact 74, thus completing connection through lead 104 to the in-put circuit of the speech amplifier. The armature 101 also closes contacts 105 and 106 causing current to flow from the positive side of the battery over lead 31, lead 107 through the contacts 106, 105, lead 108 and through the primary 109 of the sensitive transmitter of talking coil 110 and thence through the resistance 111 and back to the negative battery A— by lead 112.

The attracting of armature 101 also causes the opening of contacts 60 and 61 and the closing of contact 60 with contact 113. The opening of the contacts 60 and 61 disconnects the buzzer from the circuit. Closing contacts 60 and 113 puts in circuit through lead 114 the secondary 115 of the talking coil, the circuit being completed over lead 116, lead 47, contacts 41 and 40, lead 30 to the positive battery through lead 31.

When the armature 100 is attracted contacts 117 and 118 close as do also contacts 119 and 120. The closing of contacts 117 and 118 serve to connect the circuit which is broken by the opening of contacts 102 and 103. However, as the contacts are in series the circuit still remains open, this arrangement being for the purpose of connecting the amplifier in the telephone circuit for use and disconnecting the radio part of the apparatus, so that should a call come in and be answered or a call initiated, the radio would be shut off. Contact 117 is connected through lead 121 with the contact 102. Contact 118 is connected through lead 122 with the plate circuit of the radio tube. Contacts 119 and 120 when coming together connect the positive battery B through lead 123, the contacts 119 and 120, lead 124, to cause a positive charge on the plate of all of the radio tubes and also provides current through lead 125 to the field coil of the loud speaker 126. The circuit is now in a talking position.

Restoring to idle position

To release key number 1 and restore the circuit to idle position, key 127 is moved about its pivot 128 to rock the pivot rod 129 and release the latch bar 130 to permit the key number 1 to move out under spring action and thus opens contacts 12 and 13 and closes 10 and 11 which cause the circuit to go back to idle position, thus by the disconnection relay 17 is de-energized, allowing the armatures to move to idle position and the contacts returned to the position shown in the diagram. The de-energizing of relay 17 causes relay 96 to be de-energized and the contacts operated by it to be restored to the position shown in the diagram. In order that an incoming call may be received by a station, the same must be restored to idle position, otherwise a busy tone will be heard at the calling station.

Incoming call

An incoming call comes in through the S terminal over lead 50 through contacts 44 and 43, over lead 57, lead 58, lead 59, contacts 60, 61, lead 62, contacts 63 and 64 to buzzer 65 and thence back over leads 66, 98 and 67 to the negative battery A—, causing the buzzer to ring whenever current is impressed in the calling station by some known means, such as a manual pressing of the button, the same being transmitted through the S terminal at intervals which may be under manual and other control. This call coming in will go through a central switch board equipment which selects the station called in accordance with the mechanism of the central selector unit, which will be later explained.

The lever 127 is thrown down to answer an incoming call upon the buzzer 65 being operated, contacts 131 and 132 are closed and cause positive battery picked up from line 34 by lead 133 to be transmitted through lead 134 to contact 19 through contact 20, lead 135, lead 136 to relay 96, thence to the negative battery terminal through leads 97, 98 and 67. This causes the armatures 100 to be attracted and the contacts 117, 118 to close and 119 and 120 to close, which armature 101 also is attracted to cause opening of contacts 102 and 103 and the closing of contacts 103 and 74. Also, an opening of contacts 61 and 60 and the closing of contacts 60 and 113 which places in circuit the amplifier unit and the sensitive transmitter heretofore described, and disconnects the buzzer and the radio. In order to restore the circuit to normal after conversation has been completed, the lever 127 is restored to neutral position which opens contacts 132 and 131 restoring the circuit to normal. If this restoration is not manually made the station cannot be again called but may send out a call, as the first operation of the motor is to open contacts 70 and 71 which will break the circuit to terminal L, restoring the central selector to idle position.

In case the lever 127 were thrown downwardly into answering position and the operator at the station should not notice this position of key 127, but should desire to call some other station for instance, a station corresponding to the key 4, the key 4 would be pressed in which would commence the selecting operation which has heretofore been described, and would throw out of circuit the answering position of the circuit caused by the lever 127 being thrown down by reason of the breaking of contacts 19 and 20. Thus, the cycle of calling would be performed as if the lever were in its restored idle position shown. On the completion of the call and the operator at the calling station has finished and it is desired to "hang up," this is accomplished by moving the lever 127 to neutral position and in restoring the key which he pressed, to its idle

position, thus by moving the lever 127 he restores the circuit to normal or idle position, thus correcting the error which has occurred in leaving the answering signal on. It will thus be apparent that the calling takes precedence over the answering position of the lever 127. In case the lever 127 was not moved back to neutral or restoring position and a second key such as 3 were pressed, the motor would be connected to start operation, as heretofore explained in connection with pressing of key 1, and the previously pressed key 1 would be mechanically released to snap back to idle position.

Radio

If it is desired that the radio be used without operating the telephone, the contacts 137 and 138 are closed which causes positive battery current to flow through the lead 136, resistance 139, contacts 137, 138, lead 140, through lead 134, down through contacts 19 and 20, lead 135 into relay 96, causing the armature 100 only to be attracted to close the contacts 117, 118 and 119, 120 and puts the radio in operation as well as the amplifier.

If the radio happens to be operating and a telephone call comes in, the buzzer will operate. The answering key 127 is then thrown down which causes contacts 131 and 132 to engage, and as previously explained, breaks the radio connection by causing armature 101 to be attracted and breaking of the contacts 102 and 103 to disconnect the radio from operation and connect the amplifier and sensitive transmitter into the answering circuit.

The units in the diagram are separated by dotted lines and represented in the areas D, T and R. Each unit is connected by a plug and socket arrangement shown by means of jacks 145 at each division of the diagram by the dotted lines.

The terminals B— and B+ are connected to a suitable source of high voltage for operation of the amplifying and radio tubes in the amplifier of the executive station.

This completes the description of the wiring diagram of the executive station which is a complete unit itself in a casing which may be disconnected and replaced by another like station should repairs be desired.

Central selectors

The central selectors may be located at any convenient point with lines running to the different stations, and in the embodiment shown in Figure 2, the central selector shown includes three solenoids 161, 228 and 150. One side of solenoid 150 is connected through leads 165, 163, 164, 209 and 210 to the negative side of battery 200. The other side of solenoid 150 is connected through lead 154, junction 211, lead 153, jack 152 and lead 151 to terminal L.

As indicated above, in connection with Figure 1, when the impulse producing mechanism is operating, contact 103 is held against contact 74, and thus terminal L is connected through lead 72, contacts 71 and 70, and lead 73, contacts 74 and 103, lead 104 and jack 105 to one side of the audio amplifier input circuit. The other side of the audio amplifier input circuit is connected directly to terminal C+; as shown in Figure 2, terminal C+ is connected through lead 223 to the positive side of battery 200. Thus, during the time that the impulse producing mechanism is operating, solenoid 150 is connected in series with the audio amplifier input circuit across battery 200, and solenoid 150 is partially energized, the partial voltage upon solenoid 150 being obtained by using the audio amplifier input circuit as a resistance unit.

Assuming that a call is being made in the manner outlined above and that the station being called is the station number 1 shown in Figure 3, the operation of the central selector is as follows: The L terminal of the selector receives current over the line wire from the L terminal of the calling station, such as shown in Fig. 1, the voltage of the circuit being lower than the full voltage, thus causing only partial magnetism of the relay coil 150, a portion of the circuit being traced over lead 151, jack 152, leads 153 and 154 to the coil 150 and returning to the negative lead 164 over lead 165. Due to partial energizing of this coil beneath the selector armature 155, is attracted to the core of the coil and detent 156, is caused to engage with the selecting ratchet of the calling selector to move wiper arm 157 up to the station called.

Impulses transmitted over the line wires of the calling station to the S terminal of the central selector, which I am discussing, pass over conductor 158 to jack 159, lead 160 to energize relay coil 161 in the number of times equivalent to the impulses transmitted. The armature which is energized is the one which actuates the wiper arm 157 by means of a suitable pawl stepping up the ratchet and moving the wiper arm 157 and wiper arm 162, one contact for each impulse. Relay 161 has its circuit completed over line 163 to the common negative line 164.

The leads 149 and 166 are shown as extending from wiper arms 157 and 162 but these represent leads from any selected position of the wiper arms at any one contact position, there being a similar pair of leads 149 and 166 from each corresponding position of the wiper arm, each pair leading to a different station which may be called. Lead 149 extends down to jack S, also designated as 167, while lead 166 leads to jack L designated as 168.

The selector has each of its leads 149, 166 connected to the terminals S and L, 167, 168 of the next selector unit, which enables the called station to call or impress upon this next selector of the central unit a number of impulses to call that next station. However, the jacks 167 and 168 play no part in the talking circuit except as a convenience in connection to the battery, but current continues on through leads to the remainder of the talking circuit and does not pass through the jacks and beyond into the next selector so far as the talking is concerned. Current is merely available at this point for use if necessary for a further call by the last called station. The position of the wiper arms 157 and 162 are shown as advanced from their at rest position, such as shown in the selector mechanism X at the right. Up to this point the description may be considered as if the wiper arms 157 and 162 were in their at rest position, such at selector X. The dotted line showing of the wiper of the selector Y is in a position just prior to ringing.

Full battery voltage from calling station is caused to flow after selecting is accomplished through terminal L over lead 151, lead 153 and 154 and into relay coil 150, causing armature 169 to be attracted to the core of the coil, causing contacts 170 and 171 to be closed and contacts 172 and 173 to be opened. The closing of con-

tacts 170 and 171 causes current originally on line 153 to flow which may be traced over line 174, through contacts 175, 176, line 177, to contacts 170 and 171, thence over lead 178 to wiper arm 157, thence up through lead 166 to terminal or jack L, 168, then over lead 179 to 169 or L of the called station, over lead 181, lead 182 to ringer coil 183, causing the ringer 184 to operate because of the circuit which is completed through lead 185, contacts 186, 187, lead 188, lead 189 to terminal 190 or S of the called station. The circuit being completed through leads 191, S jack 167, through lead 160' to the relay coil 161' of the unit X and thence back to the negative battery from this coil 161' over lead 163' and 164'.

When the receiver is picked up the rod 195 is relieved of its weight and contact arm 196 is forced upwardly by means of a spring to open contacts 197 and 198 and cause contact 198 to engage contact 199 and also contacts 186 and 187 are separated, thus disconnecting the ringing circuit. The closure of contacts 198 and 199 connect in the receiver and transmitter of the circuit.

The transmitter circuit may be traced from positive battery 200 over lead 201, terminal 202 or C of the called station, lead 203, through contacts 198 and 199, lead 204, lead 205 to resistance 206 and the transmitter 207, thence over lead 208, lead 181, to the terminal 180 or L of the called station, over lead 179 to the jack 168, over lead 166 to the selector arm 157, over lead 178, contacts 171, 170, lead 177, contacts 176, 175, lead 174, the junction point 211, lead 153, through jack 152, hence over lead 151 to terminal L and into the receiving circuit of the calling station. This transmitting circuit is connected at junction point 211 through lead 154 to relay coil 150, the other side of which is connected to the negative side of battery 200. Relay coil 150 is provided with an iron core and accordingly the pulsations produced at the transmitter do not flow through the relay coil 150. The receiver which is actuated by pulsating current is operated by means of circuit from terminal 202 or C of the called station, lead 203, contacts 198, 199, lead 204, lead 205 to junction point 212, thence by means of condenser 213, coil 214, lead 208 to receiver 215, thence to condenser 216, lead 217, contacts 218, 219, lead 220 and lead 189 to the S terminal 190, thence by lead 191 to jack 167, thence over leads 221 and 149, wiper arm 162, lead 222, jack 159, lead 158 to terminal S of the central apparatus, and thence to the transmitter circuit of the calling station.

If a called station is already in operation its talking current will be encountered on lead 166 when wiper arm 157 of the calling station has been brought into contact from which lead 166 extends by a selecting operation previously described. This talking current will flow through wiper arm 157 over lead 178, contacts 173, 172, lead 225 to junction 226, lead 227, through relay coil 229, over lead 229 and lead 164, to negative battery, the afore-mentioned talking current being of positive voltage causes coil 228 to be energized and its armature attracted to the core. This closes contacts 230 and 231, 175 and 232 and separates contacts 175 and 176 which are in the ringing circuit so that if an attempt were made to ring into a busy station no effect will be had. The closing of contacts 230 and 231 completes a circuit, bringing the operating talking current from wiper arm 157 over lead 178 to junction 234 through contacts 231, 230 and to relay coil 228, and back to negative battery by lead 229, thus holding this relay in an operating position even though armature 169 of coil 150 were operated in a manner previously described.

Energizing of relay coil 228 also causes contact 175 to engage contact 232, which connects the receiving circuit of the calling station to a buzzing unit Z, causing a buzz or busy tone signal in the receiving circuit of the calling station. The connection from the busy sounding unit Z to these contacts may be traced through leads 235 and 236 to the jack 237, also designated as B, thence over lead 238 to the contact 232. The other lead from the busy unit Z designated 239 goes to the negative side of the battery to which contact 175 is also connected. Lead 240 from the battery 200 goes to coil 241 to complete the circuit to the sounding mechanism of the unit.

The unit Z is energized by the positive current picked up from C+ and conducted through the calling station to L, thence over lead 151, jack 152, lead 153, junction 211, lead 174, contact 175, contact 232, lead 238, jack 237, lead 236, lead 235, through coil 242, thence back to negative battery through lead 243 and 239. Current flowing through coil 242 energizes and pulls up armature 244, closing contacts 245 and 246 and completing a circuit from positive battery through lead 240, coil 241, lead 247, contacts 245, 246, lead 248, through contacts 249, 250, lead 251, buzzer coil 252 and back along lead 253, leads 243, 239, to the negative battery. The energizing of the buzzer coil 252 attracts armature 255 to break the circuit through the contacts 249 and 250 to cause a high frequency interruption of a usual buzzer type, which high frequency interruption is picked up by the coil 241 to be transmitted back to the calling station to give the busy sound.

The dial of the called station by which one may call or may not call so far as this invention is concerned, has its impulse cam designated as 350.

Some of the mechanical mechanism for causing the desired operations are shown in Figs. 4 to 9 inclusive. The chassis of the executive station has a front panel 260 which is provided with a false front 261 spaced therefrom and providing in this false front a bearing 262 for a plunger type key 263 which is urged outwardly by spring 264 acting between the flange 265 of the bearing and the head 266 of the key which extends through an opening 267 in the panel 260 and is suitably marked with a designating indication for corresponding to some other station in the system, for instance, such as the name of the person at the called station or as I have indicated in Fig. 1 the numerals 1, 2, 3 or 4. Upon the inner end of the key 263 I provide a collar 268 which has a flange 269 with beveled surfaces 270 and 271, the same being held in position on the reduced portion 272 between the shoulder 273 and the head 274 of a screw which is threaded into the end of this reduced portion 272. A plurality of keys are so mounted, one corresponding to each of the stations of the system.

In order that these keys may be held in their pressed-in position, I have mounted retaining bars 130 of L-shaped construction, each of which is attached to a rockable rod 276 by some suitable mounting member 277. The keys 263 are in aligned rows and in parallel relation so that one bar 130 will serve for all of the keys in one horizontal row, while another bar 130' will serve for all of the keys in another horizontal row, and a third bar 130'' will serve for all of the keys in a third horizontal row, and so on as the apparatus

or system is expanded in size. The present arrangement, as shown in Fig. 4, indicates four keys in each horizontal row or twelve in the three horizontal rows, but any desired number may of course be provided. The bars 130 which are attached to the rockable bar 276, 276', 276'', are connected together by a link 278 so that as any one of these bars is rocked about its pivot all of the bars will be rocked about their pivots, the link being pivotally connected to each bar as at 279, 279' and 279''.

As any one of the keys are pressed inwardly the beveled surface 271 moves the retaining bar 130 upwardly and as the flange 269 passes beneath the bar the bar slides down the bevel surface 270 and engages the straight portion of the flange 269 to hold the key against movement outwardly under influence of the spring 264. The bevel 270 is much shorter than the bevel 271 so that should an additional key be pressed in anywhere in the system the bar which locks the previously pressed in key will be raised and when it is raised a portion of the extent of the flange sufficient to bring its lower edge 281 into engagement with the bevel 270, the spring will act to then lift the retaining bar while the key which has previously been pressed in will be released, the finger pressing the instant key in holding the same in position until the bar has had an opportunity to drop back of the key being pressed in. Thus, only one key will be held inwardly at one time, as the pressing of an additional key releases any previously pressed in key.

The end of each key engages the rubber covering 282 on the end of the contact arm 11 so that movement of the key inwardly moves the contact arm 11 away from the contact arm 10, while closing the contact arms 13 and 12 for commencing the operation at the calling station for communication with the called station. Suitable supports 283 are provided for mounting the rock bars 276 at either of their ends.

The control key 127 is pivotally mounted on the pin 128 between the support 283 and support 284 and has fixedly mounted thereon a crank 285 which is movable about the pivot pin 128 into engagement with an arm 286 which is attached to the rock rod 276'' so that if this key is raised it will restore any of the keys 263 to idle position. In order to answer an incoming call, the control key 127 is pressed down instead of raised whereby the rod 287 is then moved upwardly along the inclined surface 288 to close contacts 131, 132 and place the station in condition for answering a call. After the call is finished the control key is restored to idle position by raising the same in the same manner as upon completion of a call made by the station.

The arrangement of the talking and receiving circuits, as perhaps may be plainest seen from Fig. 3, is such that there is a common line, such as 203 over which both talking and receiving current travels, the completion of the circuit for the receiving current being over line 139, to the terminal S, while the completion circuit of the talking current will be over line 131 to the terminal L, so that there is one common line to both talking and receiving circuits and also a separate line to the receiving circuit and a separate line to the transmitter of the talking circuit, which is a departure from the usual mode of arranging a telephone system enabling the use of a loud speaker and sensitive transmitter without any feed back.

The foregoing description is directed solely towards the construction illustrated, but I desire it to be understood that I reserve the privilege of restoring to all the mechanical changes to which the device is susceptible, the invention being defined and limited only by the terms of the appended claims.

I claim:

1. In a telephone system having a plurality of transmitting and receiving stations in which one station is automatically connected to another station, a signal switch mechanism comprising: a first switch operating cam; a second switch operating cam; a control cam; means responsive to movement of said control cam to close a first circuit and cause said first switch operating cam to be effective and then open said first circuit and close a second circuit to cause said second switch operating cam to be effective; whereby said first switch operating cam will perform its functions and immediately thereafter said second switch operating cam will perform its functions and the elements will be returned to their initial positions.

2. In an apparatus of the character described, a plurality of axially slidable keys mounted in alignment and each provided with a flange at right angles to the axis of the key and having beveled surfaces inclined to the axis of the key, the front bevel being a relatively long incline and the rear bevel being short and leaving a portion of the flange in a plane at right angles to the axis of the key, a spring urging each key outwardly, a locking bar mounted to swing about a horizontal axis and positioned to be moved upwardly along the long bevel as the key is moved inward and to drop along the short bevel to lie against the surface at right angles to the key and prevent it from moving outwardly.

3. In an apparatus of the character described, a plurality of axially slidable keys mounted in alignment and each provided with a flange at right angles to the axis of the key and having beveled surfaces inclined to the axis of the key, the front bevel being a relatively long incline and the rear bevel being short and leaving a portion of the flange in a plane at right angles to the axis of the key, a spring urging each key outwardly, a locking bar mounted to swing about a horizontal axis and positioned to be moved upwardly along the long bevel as the key is moved inward and to drop along the short bevel to lie against the surface at right angles to the key and prevent it from moving outwardly, another of said keys when moved inwardly serving to lift the bar above the extent of the right angular surface of the pressed in key whereby the pressed in key is no longer retained by the bar and moves outwardly by itself, lifting the bar due to its own spring action.

4. In a telephone system having a plurality of transmitting and receiving stations in which one station is automatically connected to another station, the combination of: a key assembly positioned at a calling station and including a key for each of a number of receiving stations, said keys being in alignment and each key being provided with a flange with a first cam surface and a second cam surface thereon; and a locking bar means adapted to move through a vertically extending arc to and from locking engagement with the flange on each of said keys, said first cam surface on each key being so positioned that it will move said locking bar vertically when the particular key is actuated, and said second cam surface on each key being so positioned that it will assist in lifting said locking bar means when

that key is being released—whereby each of said keys is locked by said locking bar means and in the locking operation said locking bar means is disengaged from all keys previously locked.

5. In an automatic signal transmitter in a telephone system, the combination of: a plurality of sliding keys mounted in alignment and each provided with a beveled flange at right angles to its axis of movement, and having a relatively long first bevel and a relatively short second bevel; resilient means urging each of said keys outwardly; and locking bar means for said keys pivotally mounted to swing in a substantially vertical arc, the movement of said locking bar means with respect to each key being upwardly along said first bevel and downwardly along said second bevel when the key is moved inwardly, and when one of said keys is being released, said resilient means urging the key to lift said locking bar means along its rear bevel.

6. In an automatic telephone system in which a plurality of stations may communicate with each other and in which interconnection is completed by a central selector mechanism including a central selector relay, the combination with said relay of an impulsing mechanism at one of said stations to produce a variety of impulse designs in accordance with which said central selector relay connects the calling station to the proper called station, said impulsing mechanism comprising, an auxiliary switch, a shaft, a cam rotatably mounted upon said shaft and having a plurality of lobes which mechanically open and close said auxiliary switch, a plurality of contacts, a wiper arm mounted to be moved to successively engage said contacts, and means electrically connecting said auxiliary switch and said wiper arm in series, said wiper arm and said cam being so related that as said wiper arm moves into complete engagement with each of said contacts said auxiliary switch is closed by one of said lobes and then said auxiliary switch is opened again before said wiper arm moves from complete engagement with said contact.

7. In an automatic telephone system in which a plurality of stations may communicate with each other and in which interconnection is completed by a central selector mechanism including a central selector relay, the combination with said relay of an impulsing mechanism at one of said stations to produce a variety of impulse designs in accordance with which said central selector relay connects the calling station to the proper called station, said impulsing mechanism comprising, an auxiliary switch, a shaft, a cam rotatably mounted upon said shaft and having a plurality of lobes which mechanically open and close said auxiliary switch, a plurality of contacts, a wiper arm mounted upon said shaft to be moved to successively engage said contacts, means electrically connecting said auxiliary switch and said wiper arm in series, and means to rotate said shaft, said wiper arm and said cam being so related that as said wiper arm moves into complete engagement with each of said contacts said auxiliary switch is closed by one of said lobes and then said auxiliary switch is opened again before said wiper arm moves from complete engagement with said contact.

8. In an automatic telephone system in which a plurality of stations may communicate with each other and in which interconnection is completed by a central selector mechanism including a central selector relay, the combination with said relay of an impulsing mechanism at one of said stations to produce a variety of impulse designs in accordance with which said central selector relay connects the calling station to the proper called station, said impulsing mechanism comprising, an auxiliary switch, a wiper arm connected electrically in series with said auxiliary switch, a plurality of contacts, mounting means for said wiper arm and said plurality of contacts including means to cause said wiper arm to successively engage said contacts, and means to control the opening and closing of said auxiliary switch and to synchronize this action with the engagement of said wiper arm with said contacts to close and open said auxilary switch during the time that said wiper arm is in engagement with each of said contacts.

9. In a telephone system of the class wherein a calling station is automatically connected to a selected one of a plurality of other stations by a central selector relay and the central selector relay is operated by an impulse design produced by an impulsing unit at the calling station, which impulsing unit comprises a switch means to make and break a circuit, the combination with said switch means of an auxiliary switch connected electrically in series with said switch means and means to synchronously operate said switch means and said auxiliary switch to close and open said auxiliary switch during each time that said circuit is completed by said switch means.

10. In a telephone system of the class wherein a calling station is automatically connected to a selected one of a plurality of other stations by a central selector relay and the central selector relay is operated by an impulse design produced by an impulsing unit at the calling station, which impulsing unit comprises a wiper which serially engages a plurality of contacts, the combination with said wiper arm of an auxiliary switch connected electrically in series with said wiper arm, and means to synchronously operate said wiper arm and said auxiliary switch to close and open said auxiliary switch during the time that said wiper arm is in engagement with each contact.

11. In a telephone system of the class wherein a calling station is automatically connected to a selected one of a plurality of other stations by a central selector relay and the central selector relay is operated by an impulse design produced by a unitary structure which has a predetermined operating cycle and which is at the calling station, and wherein the unitary structure then transmits over the circuit thus set up a signal design identifying the calling station, which unitary structure comprises, an auxiliary switch connected in series with a wiper arm which is adapted to successively engage a plurality of contacts, a shaft rotated by an electric motor and providing a mounting for said wiper arm so that said wiper arm moves upon rotation of said shaft to successively engage said contacts, a switch-operating mechanism mounted on said shaft and adapted to close and open said auxiliary switch each time said wiper arm is in complete engagement with one of said contacts, a signal switch, a signal-initiating cam adapted to close said signal switch to transmit a signal identifying the calling station, a multiple-unit switch having first, second and third pairs of contacts, and a control cam means mechanically connected to rotate with said shaft and mounted to control the movement of said pairs of contacts to and from their respective

engaging positions; said first pair of contacts being connected in series with said auxiliary switch and said wiper arm and said control cam means being adapted to maintain said first pair of contacts in engagement during the first portion of each operating cycle; said second pair of contacts being in series with said signal switch and said control cam means being adapted to maintain said second contacts in engagement during the latter portion of each operating cycle; and said third pair of contacts being so related that they are moved into engagement to stop said electric motor at the end of each operating cycle—whereby during each operating cycle said control cam first renders said auxiliary switch and said wiper arm effective to produce the impulse design corresponding to the station being called to thus complete the connecting circuit, and then said control cam means renders said signal switch effective to transmit the signal design through the circuit thus completed which signal design corresponds to the calling station, and rotation of said shaft is then stopped due to the stopping of said electric motor.

12. In an automatic telephone system in which a plurality of stations may communicate with each other and in which interconnection is completed by a central selector mechanism including a central selector relay, the combination with said relay of an impulsing mechanism at one of said stations to produce a variety of impulse designs in accordance with which said central selector relay connects the calling station to the proper called station, said impulsing mechanism comprising, an auxiliary switch, a shaft, a cam rotatably mounted upon said shaft and having a plurality of lobes which mechanically open and close said auxiliary switch, a plurality of contacts, a wiper arm mounted upon said shaft to be moved to successively engage said contacts, means electrically connecting said auxiliary switch and said wiper arm in series, and means to rotate said shaft, said wiper arm and said cam being so related that as said wiper arm moves into complete engagement with each of said contacts said auxiliary switch is closed by one of said lobes and then said auxiliary switch is opened again before said wiper arm moves from complete engagement with said contact, said impulsing mechanism having mechanically connected thereto a second impulsing mechanism to identify the calling station comprising a switch means and a double-acting control switch to render the first-named of said impulsing mechanisms ineffective at the end of its operation and to simultaneously render the last-named of said switch means effective for a period of time sufficient to transmit the proper signal.

13. In a telephone system of the class wherein a calling station is automatically connected to a selected one of a plurality of other stations by a central selector relay and the central selector relay is operated by an impulse design produced by an impulsing unit at the calling station, which impulsing unit comprises a wiper arm which serially engages a plurality of contacts, the combination with each of said contacts of a manually operated switch and circuit means connecting said switches in series to an incoming line and said circuit means connecting each of said contacts to one side of its corresponding switch so that when a particular one of said manually operated switches is opened the contact corresponding thereto is disconnected from said incoming line and any switch positioned electrically farther from the incoming line than the switch opened is also disconnected from the incoming line, and the combination with said wiper arm of an auxiliary switch connected electrically in series with said wiper arm, and means to synchronously operate said wiper arm and said auxiliary switch to close and open said auxiliary switch during the time that said wiper arm is in engagement with each contact, said last-named means including starting means which initiates said synchronous operation upon the opening of one of said manually operated switches.

14. In a telephone system of the class wherein a calling station is automatically connected to a selected one of a plurality of other stations by a central selector relay and the central selector relay is operated by an impulse design produced by an impulsing unit at the calling station, and wherein the calling station then transmits over the circuit thus set up a signal design identifying the calling station, which impulsing unit comprises a first switch means to make and break a circuit, and which signal design identifying the calling station is initiated by a second switch means, the combination with said impulsing unit and said second switch means of an operating mechanism to first operate said impulsing unit and then operate said second switch means.

15. In a telephone system of the class wherein a calling station is automatically connected to a selected one of a plurality of other stations by a central selector relay and the central selector relay is operated by an impulse design produced by an impulsing unit at the calling station, and wherein the calling station then transmits over the circuit thus set up a signal design identifying the calling station, which impulsing unit comprises a first switch means to make and break a circuit, and which signal design identifying the calling station is initiated by a second switch means, the combination with said impulsing unit and said second switch means of an operating mechanism to first operate said impulsing unit and then operate said second switch means, said operating mechanism comprising an electric motor having a shaft upon which is mounted a wiper arm forming part of said first switch means and an operating cam mounted to open and close said second switch at proper intervals.

16. In a telephone system of the class wherein a calling station is automatically connected to a selected one of a plurality of other stations by a central selector relay and the central selector relay is operated by an impulse design produced by an impulsing unit at the calling station, which impulsing unit comprises primary means to make and break a circuit to thereby transmit a signal corresponding to a station being called, the combination with said primary means of an auxiliary means connected electrically in series with said circuit and operating means to synchronously operate said primary means and said auxiliary means to cause said auxiliary means to start and stop the flow of current through said circuit each time that said circuit is completed by said first-named means.

THEODORE N. SAATY.

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TELEPHONE SYSTEM

Filed June 14, 1937 3 Sheets-Sheet 1

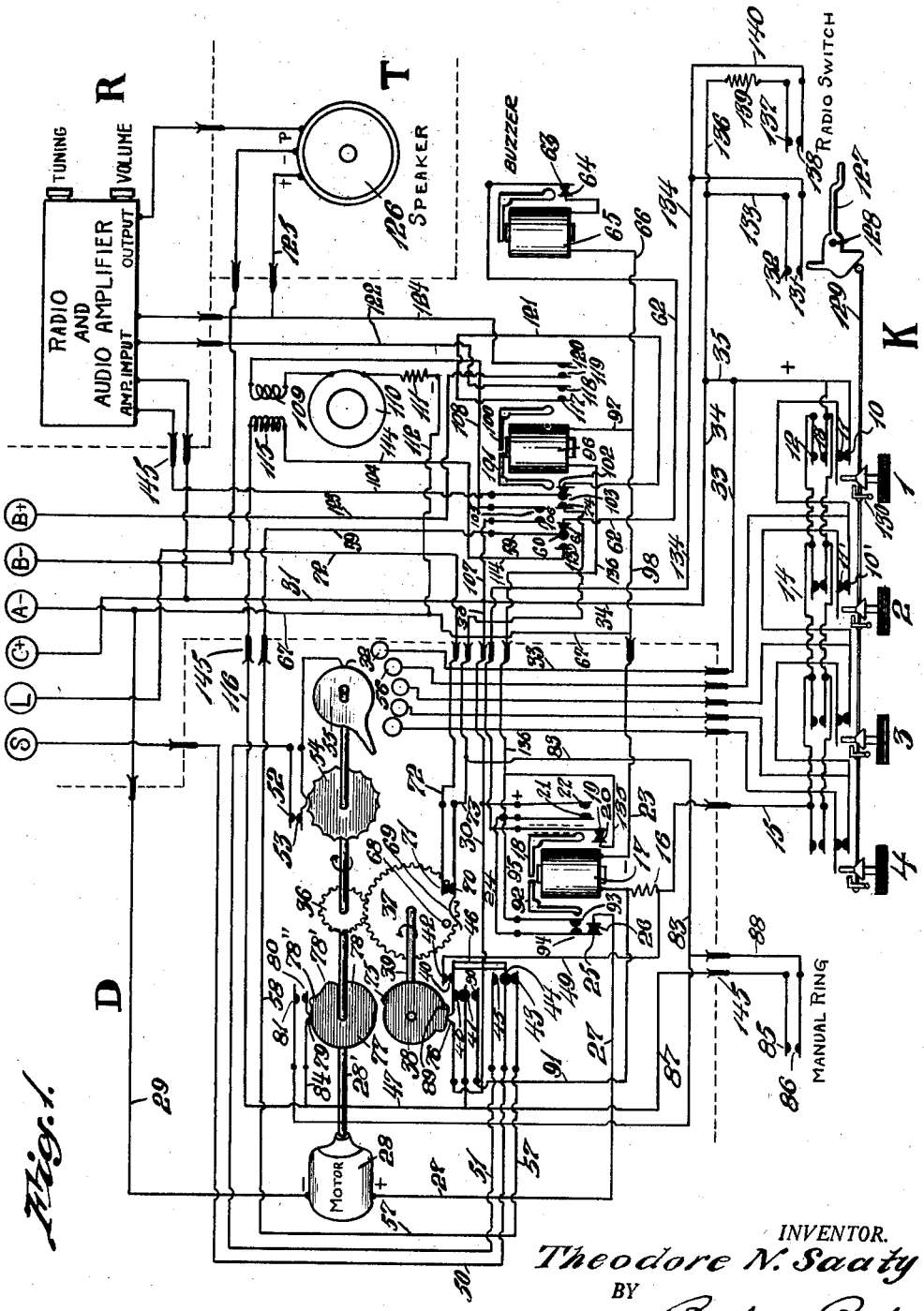


Fig. 1.

INVENTOR.
Theodore N. Saaty
BY
Barlow & Barlow
ATTORNEYS.

Sept. 3, 1940. T. N. SAATY 2,213,933

TELEPHONE SYSTEM

Filed June 14, 1937 3 Sheets-Sheet 2

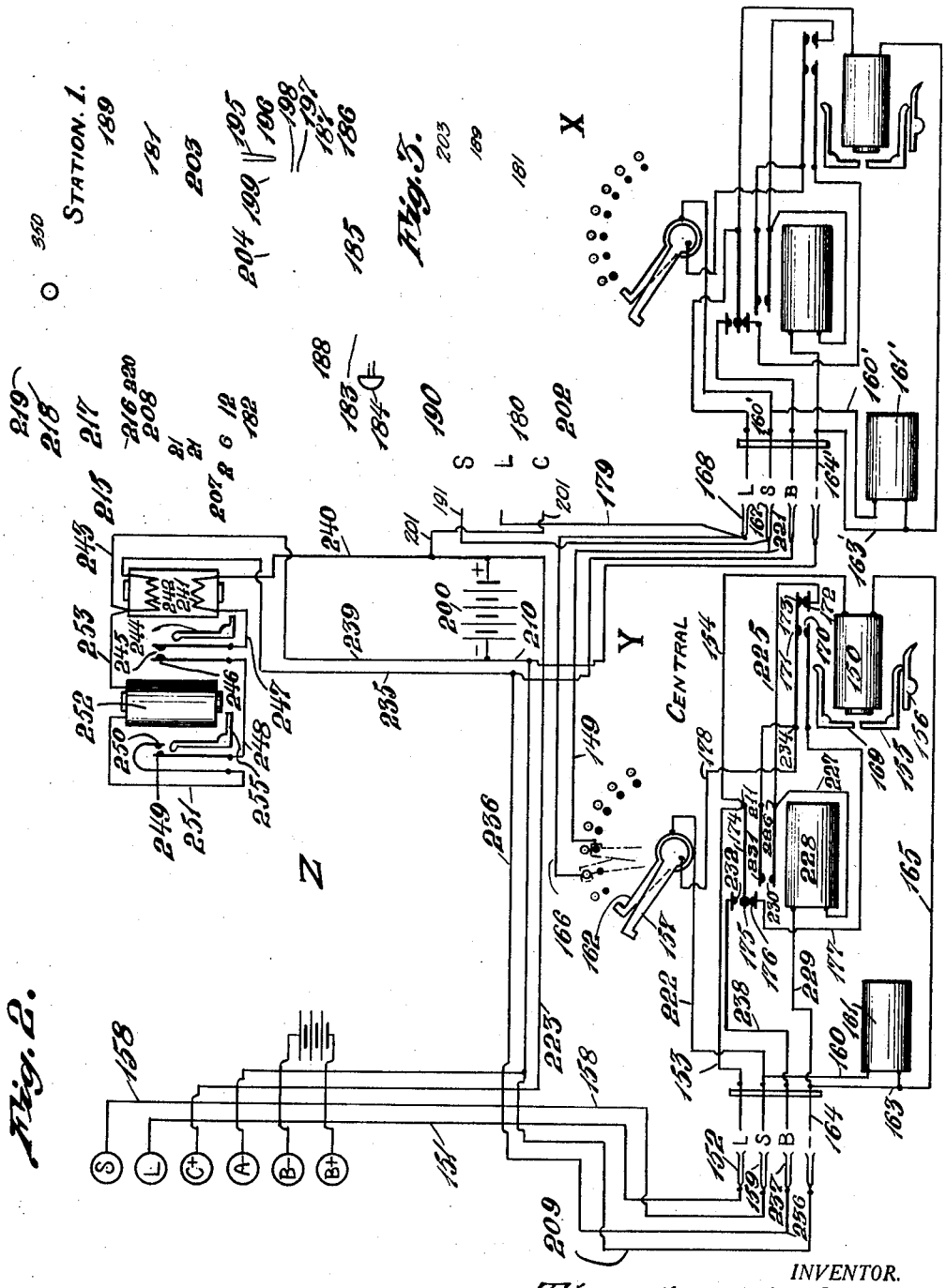


Fig. 2.

INVENTOR.
Theodore N. Saaty
BY
Barlow & Barlow
ATTORNEYS.

Sept. 3, 1940. T. N. SAATY 2,213,933

TELEPHONE SYSTEM

Filed June 14, 1937 3 Sheets-Sheet 3

Fig. 4.

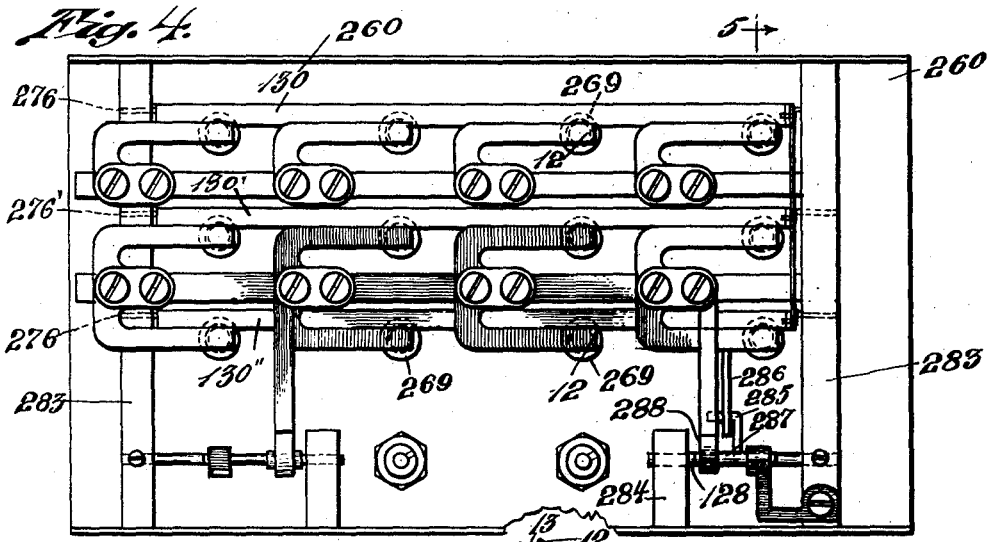


Fig. 5.

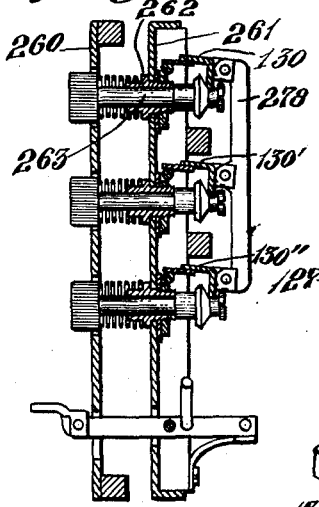


Fig. 7.

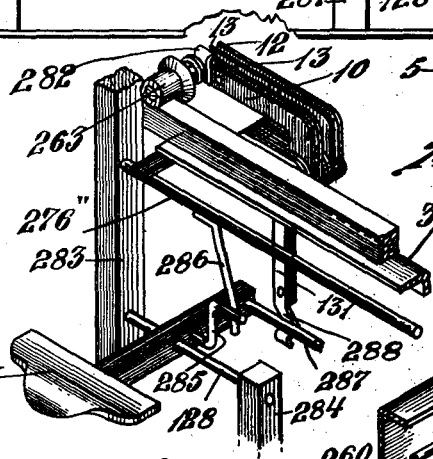


Fig. 8.

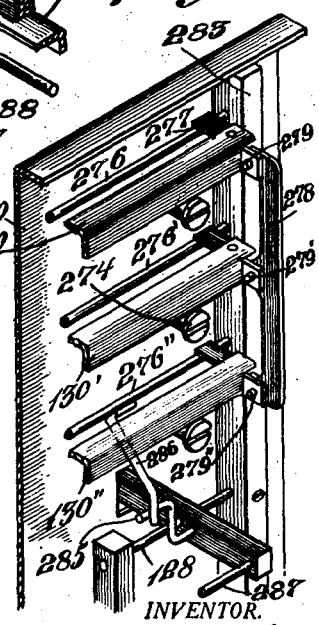


Fig. 9.

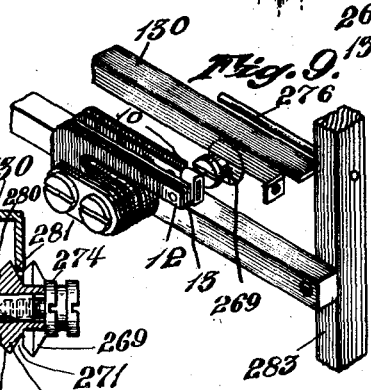
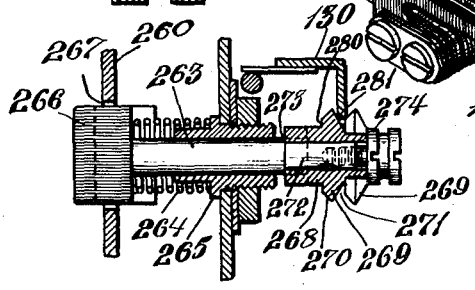


Fig. 6.



INVENTOR.

Theodore N. Saaty.

BY

Barlow & Barlow

ATTORNEYS.

Patented July 8, 1941 2,248,899

UNITED STATES PATENT OFFICE

2,248,899

TELEPHONE SYSTEM

Theodore N. Saaty, Providence, R. I., assignor to Screw Machine Products Company, Inc., Providence, R. I., a corporation of Rhode Island

Application August 3, 1940, Serial No. 350,843

9 Claims. (Cl. 179—40)

This invention relates to communication and more particularly to an automatic telephone system and apparatus used in conjunction therewith.

An object of this invention is to provide an automatic telephone system wherein the calling station is connected through a central station to the called station in an efficient and dependable manner with a minimum amount of equipment and a minimum number of lines between the various stations of the system. Another object is to provide an automatic telephone system which performs its various operations with maximum efficiency in a minimum of time, and which is flexible in use so that it is adaptable for efficient operation under a wide variety of conditions. Another object is to provide equipment of the above character which is sturdy and durable in construction and which is light in weight and can be constructed with a minimum of materials.

A further object is to provide a system of communication for use in an establishment such as one having a large number of offices where it is desirable for each office to have communication with each of the other offices, and where the number of stations in the system may be increased without disturbing the original equipment. A further object is to provide a system of communication wherein one of a number of stations may carry on telephone conversation with the other stations and wherein one or more of these stations has auxiliary talking and receiving equipment. Another object is to provide a system of two-way communication between any number of stations by means of a circuit having a minimum number of wires. Another object is to provide a telephone station wherein the dialing is automatic and the equipment is so arranged that errors in dialing are reduced to a minimum. A further object is to provide a telephone system which is dependable in its operation even though part or all of the stations are called infrequently. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combination of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter described and the scope of the application of which will be indicated in the following claims.

In the drawings:

Figure 1 is a diagrammatic representation of the main portion of a telephone station of a system constituting one embodiment of the invention;

Figure 2 is a diagrammatic representation of a telephone handset which is used in conjunction with the apparatus of Figure 1;

Figure 3 is a perspective view of a gear assembly which drives the timing cam at the left-hand side of Figure 1;

Figure 4 is a front elevation of a portion of the keyboard of the apparatus of Figure 1;

Figure 5 is a perspective view, with certain associated parts omitted, of a latch release mechanism shown diagrammatically in the central portion of Figure 1;

Figure 6 is a sectional view of one of the keys of the key assembly shown at the top of Figure 1;

Figure 7 is a multiple-unit contact assembly which is used in conjunction with the embodiment of Figure 1;

Figure 8 is a view on the line 8—8 of Figure 7; and

Figures 9 and 10 are perspective views of a portion of the apparatus of Figures 6 and 7 showing contactor arms which are associated therewith.

This application is a continuation-in-part of my copending application Serial No. 148,075 filed June 14, 1937, and reference may be had to that application for a more detailed discussion of certain phases of the embodiment of the present application. The embodiment of my copending application is hereby incorporated into the present application and the embodiment of the present application differs from the prior embodiment as herein pointed out.

In telephone systems, and particularly automatic systems where a party at one station automatically calls another station, it is important that the equipment be adaptable for use under a wide variety of conditions. Furthermore, the equipment should be dependable in operation even though parts of the equipment remain unused over a long period of time. The various automatic operations of such equipment should be carried on quickly and efficiently as a delay in completing a call is often a serious matter. In addition to avoiding tying up the equipment, the feature of saving time in completing calls may be a vital point in favor of installing automatic equipment.

Under some circumstances of use, it is important that the party being called be informed as to the calling party as this permits the called party to select calls which must be answered. In the past there have been frequent occasions when an organization having automatic equipment has gradually expanded so that the original equip-

ment can no longer handle the large number of stations. It is important under these circumstances that the equipment be easily adaptable for expansion without disturbing the original installation. Furthermore, it is desirable that equipment be standardized so that it may be manufactured, installed and serviced efficiently, and at the same time, the initial cost of a small installation must be small.

At times, one particular station of a system must be provided with auxiliary equipment, and this auxiliary equipment must not interfere with the normal operation of the system. For example, under some circumstances, it is desirable that the user be permitted to talk and listen through either a handset or a microphone and loud speaker.

It is an object of this invention to provide a system which attains these ends by providing a number of cooperating units wherein each unit of the system performs its functions in a dependable and efficient manner. In the illustrative embodiment, the major portion of one station is shown in Figure 1, and the mechanical details of certain operating units of the system are shown in the other figures. As indicated above, this system is related to that of my copending application, and reference may be had to that application for certain details of the system which have been omitted from the present detailed description for the sake of brevity. In this embodiment, the term "dialing" has been used in the sense of producing a set of impulses or a signal which identifies a station which is being called, even though in the present embodiment this operation is carried on by a motor-driven mechanism which differs from the normal telephone dial. The term "selecting" is used in the sense of connecting the calling station with the station being called, in the present embodiment this being done by means of the central selector relay which has a pair of wipers which are moved along an arcuate path. The term "ringing" has been used in the sense of being a signal at the station being called, and in the present embodiment, this signal notifies the called station of the particular party calling.

Referring particularly to Figure 1, the station consists of a group of units, the major ones of which are the keyboard assembly **50**, the motor assembly unit **52**, the amplifier unit **54**, the loud speaker unit **56**, and the chassis assembly **58**. External circuits enter the chassis assembly through receptacles **40** and **60**; these external circuits are the main line circuits which are connected through receptacle **60** and a privacy handset unit **62** (see Figure 2) which is connected through receptacle **40**. The privacy handset unit is used to dial beyond the capacity of the keyboard, and to carry on conversations without the use of the loud speaker unit.

The main circuit in this embodiment comprises three wires which are not shown but which extend from receptacle **60** to the switchboard at the central station. These three wires have been designated the C-circuit, the L-circuit and the S-circuit, and they are connected in receptacle **60** to terminals **1**, **2** and **3**, respectively. The C-circuit is common to all stations of the system and is connected at all times to all of the stations. The L-circuit connects its particular station to the central selector relay, and accordingly, each station is provided with its own L-circuit. The S-circuit is similar to the L-circuit in that it extends from its station to the central selector relay, the L-circuit and the S-circuit being used to carry the "dialing" signal for the selecting operation and for carrying on subsequent signaling and conversations. Terminal **1** is connected to the positive side of a thirty-volt battery **12** which has its other side connected to a terminal **8**. Terminal **1** is also connected through a lead **190** to one side of a twenty-five-volt, sixty-cycle, alternating current source, the other side of which is connected through a lead **192** to a terminal **6**. A one-hundred-and-twenty-five-volt battery **194** has its negative side connected through a lead **196** to terminal **8** and has its other side connected through a lead **198** to a terminal **7**. The uses of these various voltage sources is more fully discussed below.

As indicated above, this apparatus is easily adaptable for use under a wide variety of conditions, and under some circumstances, certain of its parts perform functions which are other than their normal functions. However, certain of the normal functions of the various units will be briefly outlined at this time. The central portion of the apparatus is the chassis assembly **58**, and this chassis assembly connects the other units together and coordinates their actions. The chassis assembly in itself includes a number of operating units which are more fully explained below, and among these are the following: a potentiometer unit **160** which is used to control the volume of the output of the loud speaker unit **56**; a resistance unit **166** which is regulated to control the tone of the output of the loud speaker unit **56**; a privacy relay **38** which is effective when energized to disconnect the loud speaker and microphone circuits when the privacy handset unit **62** (Figure 2) is being used; a keyboard release relay **96** which is shown with its associated mechanism in Figure 5, and which, after being energized and then deenergized, automatically releases all of the key latches on the keyboard; a control relay **36** which is energized to condition the station for talking; a buzzer relay **90** which is energized when there is an incoming call to perform the "buzzer" or "ringing" operation; a microphone unit **98** which is used to transmit voice from the station when the privacy handset unit is not being used; and a voltage divider **100** which has an adjustable voltage pick-up **102**.

The amplifier unit **54** receives the voice signals from the incoming circuits and transmits these signals, suitably amplified, to the loud speaker unit **56**. As indicated above, the volume and tone of the output of the loud speaker unit **56** are controlled respectively by units **160** and **166**, and this control is exerted through the amplifier unit **54**. The loud speaker unit **56** receives the amplified voice signals and translates them into sound. The keyboard assembly **50** includes the various control keys with one key for each station which may be called, and with additional keys to permit manual control of the talking and ringing operations.

The keyboard assembly **50** is connected by means of a number of leads to the terminals of a commutator assembly **118**, which is part of the motor assembly unit **52**. The motor assembly unit is connected to the chassis assembly **58**, and is effective to connect and disconnect the various circuits at the proper times depending upon the control exerted by the units of the chassis assembly. The motor assembly unit **52** is provided with a constant speed motor **120**

which drives a shaft 122 (shown partly in broken lines) through a worm gear unit 124. When a station is to be called, motor 120 rotates shaft 122 two complete revolutions, and during the first of these revolutions a "dialing" signal, or a set of "dialing" impulses, is transmitted to the central selector relay, which "dialing" impulses correspond to the station being called. The central selector relay thereupon connects the calling station to the called station and during the second revolution of shaft 122, a "ringing" signal is transmitted over the circuit set up to the called station, and this "ringing" signal identifies the calling station so that the party being called knows who is calling.

The "dialing" signal is produced by the combined action of the commutator assembly 118 and a cam 128 with its associated switch 142, and the "ringing" signal is initiated by a cam 129 and its associated switch 148. A control cam 132 controls the completing of the "dialing" and "ringing" circuits so that the circuit of switch 142 is first closed and the circuit of switch 148 is held open so that the "dialing" operation is performed; and then the circuit of switch 148 is closed and the circuit of switch 142 is opened so that the "ringing" operation is performed. Control cam 132 also stops the operation of motor 120 when the "ringing" signal has been completed. Cams 128 and 129 are keyed directly to shaft 122, and cam 132 is rotatably mounted on the shaft and is mechanically connected thereto through the gear assembly shown in Figure 3. This gear assembly drives cam 132 with an intermittent motion, and cam 132 completes one revolution at the time shaft 122 completes its two revolutions.

Motor assembly unit 52 is provided with a normally energized relay 10 which is deenergized to permit the carrying on of the "dialing" and "ringing' operations when one of the keys is pressed. A control relay 24 is also provided which performs a number of control functions including the control of the starting and the continued operation of motor 120.

As indicated above, shaft 122 rotates two complete revolutions during the "signaling" operation, there being one revolution during which the calling station is being connected to the called station, and there being one revolution during which a "ringing" signal is being transmitted to the called station. The mechanical connection for driving cam 132 is shown in Figure 3 with cam 132 loosely mounted on the shaft, and with a gear unit to transmit intermittent movement to the cam.

Accordingly, rigidly attached to cam 132 is a gear 320 which meshes with an intermediate gear 322 which is mounted to rotate freely on its shaft 324 which is parallel to shaft 122. Keyed to shaft 122 and adapted to mesh with intermediate gear 322 is a segment gear 326 which has teeth around one-half of its periphery. Thus, when shaft 122 rotates one revolution, gear 326 is engaging and rotating gear 322 during one-half of the revolution, or 180°, and during the other half of the revolution gear 322 remains stationary. Accordingly, cam 132 is rotated through 180° during each 360° movement of shaft 122, and at the end of each two revolutions of shaft 122, the elements return to the position of Figure 1. As previously pointed out, cam 132 operates a number of switches, and by using this type of drive for cam 132, the switches are opened and closed at a rapid rate and in the proper timed relationship. At the same time, the operating mechanism is compact and sturdy.

In this embodiment, the stopping of motor 120 is controlled by cam 132 so that the motor is stopped only when the cam reaches a predetermined position. Thus, each "dialing" and "ringing" cycle is started with cam 132 in the proper position, and any error which might appear in one cycle of operations is not carried into the next cycle of operations.

As indicated above, the keyboard assembly 50 is provided with a number of keys which are independently operable, and there is a separate key for each station to be called. Certain details of the construction of the keyboard assembly are shown in Figures 4, 5 and 6, though in Figure 5, certain of the elements are omitted to show the operating relationship between the other elements. A panel 260 is provided with a number of rectangular holes 267, and through each hole extends the front of a key 266 with the keys in alignment both vertically and horizontally. Each key bears a notation upon its face corresponding to the station which is called when the key is pressed, keys 266—1, 266—2 and 266—3 being marked "President," "Vice President" and "Superintendent" respectively. When the operator desires to talk to a particular person, he merely presses the name of that person, and the mechanism is automatically operated to provide the proper connection. It has been found that by providing this construction, the operator does not make errors in calling the wrong station, and at the same time, the call is completed in a minimum of time and without effort.

When one of the station keys is pressed to connect a station, the key is latched in its inner position by means of a latch mechanism, the details of which are shown best in Figures 5 and 6. Referring to Figure 6, at the right of panel 260 is a false front 261, and rigidly mounted in a hole in the false front is a sleeve-bearing assembly 265 through which the key shaft 263 extends. A coil spring 264 bears at the left against the head of the key and at the right against a flange on the sleeve-bearing assembly 265, and the key is therefore urged to the left, or outwardly, by the spring. Upon the right-hand end of shaft 263 is a cam collar 268 which has a cam flange 269 with beveled surfaces 270 and 271. Cam collar 268 is held in place by a plunger 274 which is threaded onto the end of shaft 263 and the right-hand end of which operates the key switch.

The left-hand side of beveled flange 269 is provided with an annular latch surface 280. Extending above each latch cam is a latch bar 130 which is rockably supported by a rockable bar 276. Latch bar 130 has a downwardly extending flange with a lower edge 281, and when the key is pushed to the right to the position shown in broken lines, the latch edge 281 rides up over cam surface 271 and down over surface 270 to the side of surface 280. When in this position, the key is securely latched, and the key is held in its depressed position until released. As shown in Figure 5, the rockable bars 276 are supported at their ends by brackets 283 (only one of which is shown).

Under some circumstances, a key remains in the depressed position after a call has been completed, and it is important that the pressing of a particular key release all of the other keys which are depressed. Accordingly, the latching mechanism is constructed so that the pressing of

a key releases all of the latches, and then the latching mechanism is effective to hold only the one key in the depressed position. Accordingly, all of the latch bars 130 are mechanically linked together by a latch release bar 302 which is pivoted to the left end of a latch release arm 300 extending from each of the latch bars. Thus, when any one of the keys is pushed inwardly, raising its latch bar, all of the latch bars are raised, and as a result, any key which has been held inwardly by its latch is released. When released in this manner, the initial movement of the latch lifts edge 281 (Figure 6) upwardly along surface 280, and when the edge 281 rides onto cam surface 270, the spring 264 urging the key to the left, assists in raising the latch bar.

As indicated above, Figure 5 shows a latch release mechanism which is operated by the keyboard release relay 96. Accordingly, latch release bar 302 is provided with a transverse ridge 304, and movably mounted in cooperating relationship with respect to ridge 304 is a dog 306. Dog 306 hangs from the right-hand end of an armature 308 which is pivoted at its left-hand end to a base 310. A spring (not shown) normally holds the armature and the dog in the raised position, but when the solenoid 312 is energized, armature 308 is drawn downwardly, and the lower end of dog 306 swings in below ridge 304. Later when the solenoid is deenergized, armature 308 moves upwardly, lifting dog 306 and raising latch release bar 302. The raising of latch release bar 302 lifts all of the latch bars 130, and any keys which have been latched in their depressed positions are moved outwardly by their respective springs.

The privacy handset unit shown in Figure 2 is provided with a number of independently operating units which are as follows: a transmitter 200 and an associated earpiece 202; a manual ringing button 184 which is used to signal the called station; a dial 170 which is provided with a dial latch 176 which normally permits the winding of the dial but prevents the return of the dial; a dial spring (not shown) which tends to turn the dial clockwise toward a stop (not shown); a make-and-break contactor unit 171 which is operated by the rotation of dial 170; and a latch relay unit 172 which has a latch hook 174 engaging dial latch 176 and carried by an armature 178. Latch hook 174 is pulled to the right by the energization of a solenoid 173, and this movement releases dial latch 176 so that the dial may rotate freely.

In use, the dial latch is in the position shown, and the dial is manually rotated to a position corresponding to the particular station to be called, and the dial is held in this position by the dial latch. Solenoid 173 is then energized so that latch hook 174 is pulled to the right and dial latch 176 is thereby released. Dial 170 is automatically returned to its normal position by the dial spring, and during this return movement, the contactor unit 171 transmits the dialing signal to the central selector relay.

The connecting of the handset into the circuit is controlled by switch 43 having contacts 41 and 42. When the handset is at rest, its cradle 169 holds contact 42 out of engagement with contact 41, and when the handset is lifted for use, the cradle moves upwardly and switch 43 automatically closes. As pointed out elsewhere, the closing of switch 43 energizes privacy relay 38 (Figure 1) and also actuates the key latch release relay 96 shown in Figure 5. Subsequently, when the handset is replaced on cradle 169, the solenoid of relay 96 is deenergized so that any keys which are depressed on the keyboard are released. When desirable, the manual ringing button 184 may be operated to transmit a ringing signal to the called station. When solenoid 172 is energized, its armature 178 swings upwardly to thereby move contact 180 into engagement with contact 182. This permits the impulses from the dialing contact unit 171 to go out over the calling circuit.

Figures 7 to 10 show a multiple-unit contact assembly of the central selector relay which is sturdy in construction and which has a number of advantages in use. As shown best in Figure 7, a pair of angle bars 330 and 332 are provided, each having a plurality of supporting posts 334 rigidly attached thereto, and extending between these angle bars are arcuate bridge members 336 of insulating material. Supported by bridge members 336 are rods 338 each of which extends through a set of holes which are in alignment in the bridge members. The holes in each bridge member through which rods 338 extend are positioned along an arcuate line which is near the center line of the bridge member, and in radial alignment with each rod 338 is a contact clip 340. When assembled for use, a set of wires 342 is positioned as shown around the periphery of the bridge members and an insulated jumper 344 connects each of the contact clips 340 to one of the wires 342.

As shown in Figures 9 and 10, a pair of wipers 346 and 348 are provided for each of the bridge members 336, and when these wipers are rotated, wiper 346 moves along a line to engage contact clips 340 and wiper 348 moves along a line to engage rods 338. In practice, each rod 338 and its associated wire 342 is the calling circuit of a particular station to be called, and during the selecting operation, wipers 346 and 348 are swung clockwise by the "dialing" impulses with a step-by-step movement, stopping at the end of each movement in engagement with one rod and its associated contact clip. When the selecting operation is completed, the calling station is connected to a particular station depending upon the number of impulses in the "dialing" signal. Illustratively, wipers 346 and 348 are shown in Figure 9 engaging the first rod 338 and clip 340; after three impulses have been transmitted, the wipers are in the position shown in Figure 10, engaging the rod, designated 338', and the contact clip 340' corresponding to the wire designated 342'. If no further selecting impulses are transmitted, the calling station is connected to the station corresponding to rod 338' and wire 342'.

Referring again to Figure 1, for convenience, the various electrical lines have been given a single number, even though a break is made in the line at a jack or at a fuse, and during normal use any one line is at one potential throughout. Whenever a switch is provided, the line on one side of the switch is given one numeral and the line on the other side of the switch is given another numeral. In connection with keyboard assembly 50, the various key switches 108 have been given separate sub-numerals, —1, —2, etc., and the corresponding plungers 274 have been given subnumerals, —1, —2, etc. Likewise, the leads 348 connecting the switches and the corresponding contacts 146 of the commutator assembly 118 have been given sub-numerals, —1, —2, etc.

Under normal conditions, the solenoid 11 of relay 10 has one side connected through line 350 to terminal 8 of receptacle 60, and thus to the negative side of battery 12, and the other side of the solenoid is connecteed through line 352 to key switch 108—12. All of the key switches 108 are in series and have been designated 108—12 to 108—1, and the other side of key switch 108—1 is connected to line 354 which extends to terminal 1 of receptacle 60, which is connected to the positive side of battery 12. Thus, with all of the key switches closed, line 352 is connected through the key switches to the positive side of battery 12, and the solenoid 11 of relay 10 is connected directly across the battery.

This energizes the relay and holds armature 14 to the right so that contact 16 is out of engagement with contact 18. Contact 18 is connected to line 354 and thus to the positive side of battery 12, and contact 16 is connected through line 356 to the juncture 20 of two resistance units 21 and 22. When the "dialing" operation is to occur, one of the keys is pressed, thereby opening the corresponding key switch 108, and this breaks the circuit to solenoid 11 of relay 10 and de-energizes the relay with the result that armature 14 moves to the left and contact 16 engages contact 18. This carries current from line 354 through line 356 to the juncture of resistance units 21 and 22. At the right, resistance unit 22 is connected through a line 358 to one side of the solenoid 360 of relay 24 and the other side of the solenoid is connected directly to line 350 which extends to the negative side of battery 12. Thus, solenoid 360 of relay 24 is connected in series with resistance unit 22 directly across battery 12, and the solenoid is partially energized.

Resistance unit 22 has a resistance of 450 ohms, and the partial energization of solenoid 360 is sufficient to swing armature 26 counterclockwise to thereby operate through a dummy switch unit 361 and move switch contactor arm 28 to the right so that contact 30 is moved away from contact 32. Switch contactor arm 28 and contact 32 are connected to line 354, and contact 32 is connected through lead 362 to switch 34 of the privacy relay 38. The other side of switch 34 is connected through line 362 to the solenoid 364 of control relay 36, and the other side of solenoid 364 is connected to line 350. Thus, the control relay normally may be energized and the movement of contact 30 away from contact 32 prevents the energization of control relay 36 and, as will be explained below, this resets the mechanism to the normal starting position.

It should be noted at this time that switch 34 is held closed during this operation by the energization of privacy relay 38 which has one side connected through line 350 to the negative side of battery 12 and which has its other side connected through line 366 to terminal 40—3 of receptacle 40. As will be explained below, terminal 40—3 is connected through the privacy handset unit 62 (Figure 2) to terminal 40—1 (Figure 1) of receptacle 40 which is connected through line 368 to contact 45 of the switch assembly 136; with cam 132 in the position shown, contact 45 is in engagement with contact 44 which is connected through line 354 to the positive side of battery 12. In this way, privacy relay 38 is held energized and switch 34 is held closed.

To answer a call, control relay 36 is energized sufficiently to swing armature 68 to the left so as to move contact 64 into engagement with contact 66. Contact 66 is connected through line 370 to terminal 3 of receptacle 60 which, as pointed out above, is connected to the outgoing S-circuit, and contact 64 is connected through line 372 to the sensitive transmitter circuit. The sensitive transmitter circuit includes a three mfd. condenser unit 106, a choke-coil 104 and a microphone unit 98, all of which are connected through a line 374. The other side of the microphone unit 98 is connected through a line 376 to the adjustable tap 102 on the voltage divider unit 100, which is connected directly between lines 350 and 354. The other side of the choke coil unit 104 is connected to line 354 which is connected through terminal 1 of receptacle 60 to the positive side of battery 12.

The swinging of armature 68 also opens the circuit of the buzzer relay 90 by moving contact 70 away from contact 72, and the circuit of the privacy handset unit is closed by the movement of contact 70 into engagement with contact 74. Contact 72 is connected through line 380 to the buzzer relay 90 and contact 70 is connected through line 382 to terminal 2 of receptacle 60 which is connected to the outgoing L-circuit. Contact 74 is connected through line 384 to terminal 76 of the privacy relay 38 and also to terminal 40—6 of receptacle 40. Terminal 40—6 is connected as shown in Figure 2 through line 386 to the handset transmitter 200.

Control relay 36 also closes a circuit which provides the plate voltage to the amplifier unit 54 by swinging armature 67 to the right sufficiently to move contact 80 into engagement with contact 82, contact 80 being connected through line 390 to terminal 7 of receptacle 60 and thus to the positive side of battery 194, and contact 82 being connected through line 392 to the plate of the tube in the amplifier unit. The swinging of armature 67 to the right also moves contact 84 into engagement with contact 86 and this supplies field current to the loud speaker unit 56. That is, contact 86 is connected directly to the field winding of the loud speaker through line 393, and contact 84 is connected through line 394 to terminal 40—8 of receptacle 40 which is connected through the privacy handset unit 62 to terminal 40—1 and terminal 40—1 is connected through line 368, contacts 45 and 44 and line 354 to the positive side of battery 12. The other side of the loud speaker field winding is connected to the negative side of battery 12 through line 350.

One side of buzzer relay 90 is connected directly to line 350 and the buzzer relay is operated on incoming calls when it receives a signal through contacts 92 and 94. As indicated above, contact 92 is connected through line 380 to contact 72 and when control relay 36 is de-energized, contact 72 is connected through contact 70 to line 382 which is connected through terminal 2 of receptacle 60 to the L-circuit. Line 380 also extends to terminal 5 of receptacle 60 and is connected through this terminal to an auxiliary external buzzer (not shown). This external buzzer operates in parallel with buzzer relay 90 and is used as a "remote signal."

As indicated above, privacy relay 38 is energized when the handset of privacy handset unit 62 (Figure 2) is removed from the cradle 169, thus bringing contact 42 into engagement with contact 41. The energization of privacy relay 38 inserts the talking circuit of the privacy

handset in place of the talking circuit of the amplifier unit.

In this embodiment, the keyboard assembly 50 is provided with twelve key switches 108, but key switches 108—1 and 108—2 are provided with additional switch units and are used for other purposes. Accordingly, key switch 108—1 is provided with an auxiliary switch 110 which opens and closes with key switch 108—1, and when the key corresponding to this switch unit is pressed, a manual signal is transmitted over the line. Similarly, key switch 108—2 is provided with an auxiliary switch 112 which opens and closes with key switch 108—2 and when the key corresponding to this switch unit is pressed, the station is automatically connected to the general call line. This general call line is used to call a particular person when the caller does not know the station at which the person being called will answer.

An additional manual ringing switch 114 is provided to be used in transmitting a manual code ring to the receiving station. Switch 114 is normally open and has one side connected to line 394 and the other side connected to line 382. As indicated above, line 382 is connected to the L-circuit and line 394 is connected to terminal 40—8 of receptacle 40, and thus through the privacy handset unit of Figure 2 to terminal 40—1 of receptacle 40 and through line 368, contacts 45 and 44 and line 354 to terminal 1 of receptacle 60 which is connected to the C-circuit. A similar switch 116 is provided which is used in connection with the handset unit to remotely release the dial mechanism of the handset unit. Switch 116 has one side connected to line 362 and the other side connected through line 398 to the solenoid 364 of control relay 36. As explained above, line 362 is connected through contacts 30 and 32 of relay 24, and during the mechanical "dialing" operation contacts 30 and 32 are separated so that switch 116 is rendered ineffective.

In this embodiment key switches 108 and switches 110 and 112 are normally closed, and current flows through all or some of them depending upon the station being called. Thus the contacts carry current and do not corrode, and infrequent use of a particular key does not impair its condition.

Passing now to the motor assembly unit 52 and its operation, motor 120 is normally stationary, but when once started, it rotates shaft 122 through two complete revolutions to thereby carry on the "dialing" and signaling operation. During this procedure, control cam 132 actuates the switch assembly 136 to cause the various operations to be performed in the proper sequence. Cam 132 is rotated one complete revolution while shaft 122 is completing two revolutions, but the movement of cam 132 is intermittent, in this embodiment the drive being through the gear unit of Figure 3.

Cam 132 has four sections or segments designated A, B, C and D. These segments are contacted by a switch operating arm 134 which is spring pressed against the cam and which controls the positioning of the various contacts of switch unit 136. When the mechanism is idle, arm 134 engages segment A of the cam and when in this position, the only two contacts of switch assembly 136 which are engaged are 45 and 44. As indicated above, when contacts 44 and 45 are in engagement, line 368 is connected to line 354 which extends to the positive side of battery 12, and line 368 is connected to the privacy handset unit and to the manual ringing switch 114. Thus, the "dialing" operation may be carried on with the handset and the operator may use the manual ringing switch 114.

When a key is pressed, solenoid 360 of relay 24 is partially energized in the manner outlined above. The partial energization of solenoid 360 of relay 24 swings armature 26 to the right and moves contact 30 out of engagement with contact 32 and into engagement with contact 31. This connects the positive side of battery 12 through line 354, contacts 30 and 31, line 410, contacts 34 and 35, and line 408 to the motor. The other side of the motor is connected to line 350 which extends to the negative side of the battery, and the motor is therefore started.

Relay 24 also conditions the circuits for the impulsing operations. Accordingly, line 410 is also connected through resistance unit 154 and line 398 to solenoid 364 of control relay 36. Due to the presence of resistance unit 154 in the circuit, control relay 36 is only partially energized, and this partial energization is sufficient to swing armature 68 to the left, but it is insufficient to move armature 67 as armature 67 has only a small portion extending over the core of the solenoid. The swinging of armature 68 to the left moves contact 64 into engagement with contact 66 and contact 70 is moved away from contact 72 and into engagement with contact 74.

When motor 120 starts its operation, timing cam 132 is immediately rotated clockwise so that segment B is positioned below arm 134, and this moves contact 44 away from contact 45 and contact 140 is moved into engagement with contact 138. Contact 140 is connected to line 370 which, as pointed out above, is connected through terminal 3 of receptacle 60 to the outgoing S-circuit, and contact 138 is connected through line 400 to impulsing switch 142. The other side of impulsing switch 142 is connected through line 402 to a sliding contact 144 of the commutator assembly 118. Sliding contact 144 engages wiper 126 and as the wiper is rotated clockwise across contacts 146 a circuit is completed between each of the contacts and impulsing switch 142.

Impulsing switch 142 is closed by impulsing cam 128, and the cam 128 and wiper 126 are accurately positioned on shaft 122 with respect to each other. When wiper 126 is moving between the various contacts 146, impulsing switch 142 is open, but when wiper 126 is in complete engagement with each of the contacts, switch 142 is closed and then opened again. Thus, the impulsing is initiated by the impulsing switch.

Contact 148' is connected to line 354 which is connected through terminal 1 of receptacle 60 to the positive side of battery 12. Contact 146—1 is connected through line 348—1 to the juncture of switches 108—1 and 108—2, and contacts 146—2, 146—3, etc., are similarly connected through correspondingly numbered lines to the junctures of the other key switches.

As pointed out above, the key switches 108 are connected in series with one side of key switch 108—1 connected to line 354 so that when all of the switches are closed, the positive potential of battery 12 is carried through all of the switches and along all of lines 348 to all of the contacts 146. However, when one of the key switches is opened, this disconnects the lines 348 which are beyond it in the circuit from the bat-

tery and the corresponding contacts 146 are disconnected.

Illustratively, if key switch 108—3 is opened by the pressing of its key 266, lines 348—1 and 348—2 remain connected to line 354 and contacts 146', 146—1 and 146—2 remain connected to the battery while the remainder of the lines and the remainder of the contacts are disconnected. Thus, as wiper 126 moves over the top of contact 146', the closing of switch 142 initiates an impulse which is transmitted over the outgoing circuit. Switch 142 then opens and the wiper moves to contact 146—1 whereupon switch 142 momentarily closes again to send out a second impulse. A third impulse is sent out through contact 146—2, but the remainder of the contacts are disconnected and no further impulses are transmitted. In this way, the calling station will be connected to the called station which is identified by three impulses.

At the beginning of the second rotation of shaft 122, cam 132 is turned so that segment C engages arm 134, and this moves contact 140 away from contact 138 to thereby open the "dialing" circuit of switch 142. Simultaneously, contact 44 is moved into engagement with contact 45 and this connects line 354 to the ringing circuit as outlined above. The ringing switch 148 has one side connected to line 368 and has its other side connected through line 406 to switch 112, the other side of which is connected through switch 110 to line 382 which is connected through terminal 2 of receptacle 60 to the L-circuit. The ringing cam 129 is so shaped as to close switch 148 at the proper intervals to transmit a code ring to the station being called. Accordingly, cam 129 is provided with raised segments X, Y and Z, and when the cam rotates clockwise, a ringing signal is transmitted of one long ring and two short rings.

It will be noted that this ringing circuit is completed through switches 112 and 110 which are switches operated simultaneously with key switches 108—2 and 108—1, respectively. As indicated above, key switch 108—1 is used to call a station when it is desirable to ring manually and thus the motor unit carries on its usual operation except that the ringing circuit is open. Key switch 108—2 is used to answer a call on the general call circuit, which is a general line connecting all of the central selector relays and in this embodiment having its bus positioned in place of the first station. The station is connected to this general call circuit in the same manner as it is connected to the other station but no ringing signal should be transmitted. Accordingly, when the key corresponding to switches 108—2 and 112 is pressed, motor 120 carries on its usual operations, but the ringing circuit is held open so that there is no ringing signal.

At the end of the signaling cycle, cam 132 is moved so that its segment D engages operating arm 134 to thereby move contact 44 upwardly so that contact 45 is moved into engagement with contact 150, and contact 150 is moved into engagement with contact 152. Thus, line 354, which is connected to the positive side of battery 12, is connected through contacts 44 and 150 to line 408 which carries the potential of the positive side of the battery to motor 120, the normal circuit being from relay 24 through contacts 30 and 31, line 410 and contacts 34 and 35. By connecting line 408 directly to line 354, this normal circuit to the motor from the positive side of the battery may be broken without stopping the motor.

Contact 152 is connected to line 358 which, as indicated above, is connected to one side of solenoid 360 of relay 24. Solenoid 360 was initially only partially energized as it was connected in series with resistance unit 22 across the battery, and this partial energization was insufficient to raise armature 25 as armature 25 extends only a short distance over the top of the solenoid core. However, the connecting of line 358 directly to line 354 through contacts 44 and 150 fully energizes solenoid 360. When solenoid 360 is fully energized, armature 25 is swung to the left, thereby moving contact 21 into engagement with contact 23 and lifting contact 34 away from contact 35. By moving contact 34 away from contact 35, the above-recited circuit connecting line 408 to line 354 is broken and the motor receives power through contacts 150 and 44 in the manner outlined above.

As pointed out above, the initial energization of relay 24 as the motor was started resulted in the partial energization of control relay 36, the solenoid of the control relay being in series with resistance unit 154. However, when relay 24 is fully energized, and armature 25 moves contact 21 into engagement with contact 23, resistance unit 154 is shorted out of the control relay circuit, and the positive side of the battery is carried from line 354 through contacts 30 and 31, line 410, contacts 23 and 21 and line 398 directly to the solenoid 364 of control relay 36. This full energization of relay 36 lifts armature 67 and contact 80 is moved into engagement with contact 82 and contact 84 is moved into engagement with contact 86. This is effective in the manner outlined above to condition the transmitting and receiving circuits.

When these operations are completed, timing cam 132 is moved on to the position of rest as shown so that contacts 45, 150 and 152 are separated to thereby stop motor 120 and break the direct connection between solenoid 360 of relay 24 and line 354. However, solenoid 360 remains partially energized as it is still connected in series with resistance unit 22 and contacts 16 and 18 of relay 10 to line 354 and this partial energization is sufficient to maintain armatures 25 and 26 in their raised positions.

If a key is pressed so that the impulsing mechanism or motor unit 52 starts its operations and the key is then released, it is important that motor 120 continue to rotate until timing cam 132 is returned to its normal position of rest as shown. This result is insured by the provision of resistance units 21 and 22 which are connected in series and deliver partial current to solenoid 360 of relay 24 when motor 120 is energized. Thus, during the major portion of the impulsing cycle, if the key is opened so as to energize relay 10 and move contact 18 away from contact 16, power is delivered from line 354 through contacts 30 and 31, line 410, contacts 34 and 35, line 408 and resistance units 21 and 22 to line 358 and thence to solenoid 360. Even though the presence of these two resistance units in series with solenoid 360 cuts down the energization of the relay, the partial energization is still sufficient to hold armature 26 in the raised position. Later, when segment D engages operating arm 134, to connect line 408 directly to line 354, current will also tend to flow down through line 408 through resistance

units 21 and 22 to line 358, and solenoid 360 remains energized even though contact 152 is not engaged by contact 150.

The filament of the pentode amplifying tube 412 is heated by the twenty-five-volt, sixty-cycle alternating current source and has one side connected through line 414 to terminal 6 of receptacle 60 and thus to line 192; the other side is connected through line 354 to terminal 1 of receptacle 60 and thus to line 190. When desirable, the alternating current source may be dispensed with and the filament may be heated from battery 12. When this is to be done switch 418 is closed and the filament is supplied with its operating current through line 414, through the jumper line 416 and switch 418 from the negative side of battery 12, and from the positive side of the battery through line 354. The input to the amplifier providing the voice currents comes in through line 420 through the two mfd. condenser 422 to the primary of the input transformer 156 and the other side of which is connected through the common return line 354. The voice currents are induced in the secondary of the input transformer 156 and pass to the grid 164 of the pentode amplifying tube 412 and to the plate of the tube, and then through line 424 to the input of the loud speaker circuit. A spark gap 426 is provided from the secondary of the amplifying transformer 156 to the negative side of the power supply to dissipate induced stray currents. A one-hundred-ohm choke coil 428 is provided from the input line 420 of the amplifier to the common return line 354; this provides the input circuit with a positive polarity when it is connected into the operating circuit so that there is energizing current to the L-circuit of the selector. The one-hundred-ohm choke coil supplies plate current for tube 412, and causes the voice currents to flow through the two mfd. condenser.

The amplifier input line 424 extends to the power output transformer 158, the primary of which is connected to battery 194 which is of one hundred and twenty-five volts. An indicator is provided at the loud speaker unit in the form of a miniature neon-lamp 430 which is provided with a timing circuit to cause the neon-lamp to flash periodically when plate current is being supplied to the amplifier unit. The field coil 432 of the loud speaker has one side connected to line 350 and thus to the negative side of battery 12, and the other side of the field coil is connected through line 393 to contact 86 of control relay 36 and thus through contact 84 and line 394 to terminal 40—8 of receptacle 40. As has been explained in detail above, terminal 40—8 is connected to the outgoing C-circuit through terminal 1 of receptacle 60.

A volume control potentiometer 160 is provided which is connected across the secondary of the amplifying transformer 156 and which has a movable contact arm 162 which is connected to the grid 164 of the pentode tube 412. By swinging arm 162 from one end of the resistance unit to the other, the polarity of the grid is varied, thus affecting the volume.

A tone-control unit 167 is provided which includes a variable high resistance unit 166 and a one-tenth mfd. condenser 169 which are connected in series across the loud speaker output transformer 158. The movable contactor of the resistance unit 168 is moved to regulate the amount of resistance in the circuit, and in this way, the tone-control unit is adjusted to absorb the desirable amount of the higher audio-frequencies.

When the privacy handset unit of Figure 2 is used, the removal of the handset from cradle 169 permits contact 42 to move into engagement with contact 41. This connects line 366 (Figure 1) from receptacle 40—3 (see Figure 2) through line 436, contacts 42 and 41, line 438, terminal 48—1 of receptacle 40 (Figure 1), line 368 and contacts 45 and 44 to line 354 which is connected to the positive side of battery 12. As indicated above, line 366 is connected to the solenoid of privacy relay 38 and thus the closing of contacts 42 and 41 (Figure 2) energizes the privacy relay; line 366 is also connected to the keyboard release relay 96 so that this relay is energized. Subsequently, when the handset is replaced on the cradle, relay 96 is deenergized and any depressed keys on the keyboard are released in the manner pointed out above.

When it is desirable to dial manually and yet use microphone 98 and the loud speaker unit 56, the dial 170 of the privacy handset unit is used for this purpose. Accordingly, the dial is first set to the position corresponding to the proper dialing and switch 116 is then closed with the result that relay 172 is energized to release the dial and send out the signal. This energization of relay 172 occurs due to the fact that one side of the relay solenoid 173 is connected through line 440 to terminal 48—7 of receptacle 40 and thus through line 398, switch 116, line 362 and contacts 32 and 30 of relay 24 to the positive side of battery 12 through line 354. The other side of solenoid 173 is connected through line 442 to terminal 40—4 of receptacle 40 which is connected through line 350 to the negative side of battery 12.

The energization of relay 172 (Figure 2) moves latch hook 174 to the right to thereby release latch 176 and at the same time, armature 178 lifts contact 180 into engagement with contact 182. The releasing of latch 176 permits the dial spring to rotate dial 170 and thereby actuate the make-and-break contactor unit 171 and initiate the proper dialing impulses. The closing of contacts 180 and 182 permits the impulses to go out over the dialing circuit, the circuit from the make-and-break contactor unit being through line 444, contacts 180 and 182, line 446, terminal 40—2 of receptacle 40 and thus to the outgoing S-circuit through line 372, contacts 64 and 66 and line 370 to terminal 3 of receptacle 60. When the conversation is completed, switch 116 is raised manually, but if the operator fails to do this, the initiating of another call will release the latch on the switch.

At times, it is desirable to omit the use of the privacy handset unit and under these circumstances, the unit is disconnected at receptacle 40. A normally open switch 446 at receptacle 40 is closed when the handset unit is removed to provide the connection between terminals 40—1 and 48—8.

When the general call line is removed from the system, two additional contacts 146a and 146b of the commutator assembly 11C are energized by closing a pair of normally open manual switches 448 and 450. Also, at this time, line 382 is connected to line 406 by means of a jumper 452 and a normally open switch 454.

As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter here-

inbefore set forth, or shown in the accompanying drawings, is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In apparatus of the character described, a contactor assembly comprising, a supporting frame construction formed by a pair of spaced parallel frame members and a plurality of bridge members of insulating material extending in parallel relationship between said frame members, a plurality of contactor rods rigidly supported in parallel relationship and substantially parallel to said frame members with all of said rods positioned substantially along a plane which is a segment of a cylinder and with said rods thus providing arcuately extending rows of contacts, and auxiliary contactor means rigidly carried by said bridge members with a row of auxiliary contacts along each bridge member with the axis of the arcuate row of auxiliary contacts substantially coincident with the axis of said segment of a cylinder.

2. In apparatus of the character described, a contactor assembly comprising, a supporting frame construction formed by a pair of spaced parallel frame members and means to rigidly support said frame members, a plurality of arcuate bridge members of insulating material extending in parallel relationship between said frame members, a plurality of elongated contactor members rigidly supported by said bridge members in parallel relationship and positioned substantially on a plane which forms a segment of a cylinder which plane intersects each of said bridge members along an arcuate line which arcuate line has its axis substantially coincident with the axis of the bridge member.

3. In an automatic telephone system in which a plurality of stations may communicate with each other and in which intercommunication is completed by a central selector mechanism including a central selector relay and wherein said plurality of stations includes an executive station, the combination with said relay of an impulsing mechanism at said executive station to produce a variety of impulse designs in accordance with which said central selector relay connects the calling station to the proper called station, said impulsing mechanism being mounted behind a front panel and comprising, an impulsing unit which is capable of producing a selected number of impulses of predetermined characteristics, and means connecting said impulsing unit to a line which extends to said central selector relay and including a switch structure and a plurality of operating keys to operate said switch structure, said keys being adapted to be individually operated to thereby determine the number of impulses to be produced by said impulsing unit, said keys being positioned to be operated from said front panel and each of said keys having a key surface upon which appears a notation corresponding to the station which is connected in response to the actuation of the key.

4. In an automatic telephone system in which a plurality of stations may communicate with each other and in which intercommunication is completed by a central selector mechanism including a central selector relay and wherein said plurality of stations includes an executive station, the combination with said relay of an impulsing mechanism at said executive station to produce a variety of impulse designs in accordance with which said central selector relay connects the calling station to the proper called station, said impulsing mechanism being mounted behind a front panel and comprising, an impulsing unit which is capable of producing a selected number of impulses of predetermined characteristics, means connecting said impulsing unit to a line which extends to said central selector relay and including a switch structure and a plurality of operating keys to operate said switch structure, said keys being adapted to be individually operated to thereby determine the number of impulses to be produced by said impulsing unit, said keys being positioned to be operated from said front panel and each of said keys having a key surface upon which appears a notation corresponding to the station which is connected in response to the actuation of the key, a motor-operated impulsing unit which is controlled by said keys, an auxiliary manual impulsing unit to permit manual dialing of a station to be called, and an auxiliary key means to render said auxiliary manual impulsing unit effective and to simultaneously render said motor-operated impulsing unit ineffective.

5. In a telephone system having a plurality of transmitting and receiving stations in which one station is automatically connected to another, a signal switch mechanism comprising: a rotatable shaft; a switch-operating cam rigidly mounted on said shaft; a wiper rigidly mounted on said shaft and positioned to successively engage a plurality of contacts when said shaft is rotated; a control cam mounted to be rotated by the rotation of said shaft and having four distinct segment portions designated as first, second, third and fourth segments; a switch assembly unit including, a cam follower member which engages said control cam and assumes a position corresponding to the four segments of said control cam, a first switch unit which is held closed when said second segment engages said follower member, and a second switch unit which is held closed when said third segment engages said follower member; and circuit means including, a circuit which is completed by the closing of said first switch unit to connect said wiper in the outgoing circuit so that an impulsing signal is produced to designate the station being called, a second circuit which is completed by the closing of said first switch unit to cause said switch-operating cam to be effective when said follower member engages said second segment, circuit means to form an interlock circuit when said first segment moves out of engagement with said follower member to insure the continuance of the delivery of power to said shaft, and means responsive to the engagement of said follower member by said fourth segment to stop said shaft when said control cam is returned to its initial position.

6. In an automatic telephone system in which a plurality of stations may communicate with each other and in which interconnection is completed by a central selector mechanism including a central selector relay, and wherein said plurality of stations includes an executive station, the combination with said relay of an impulsing mechanism at said executive station to produce a variety of impulse designs in accordance with which said central selector relay connects the calling station to the proper called station, said impulsing mechanism comprising, an impulsing unit which is capable of producing a selected number of impulses of predetermined characteristics, and means connecting said impulsing unit to a line which extends to said central selector

relay and including a plurality of key switches which are connected in series and which are adapted to be individually operated to thereby determine the number of impulses to be produced by said impulsing unit, and a plurality of keys including a key associated with each of said key switches, which key has a key surface upon which appears a notation corresponding to the station which is connected in response to the key being actuated.

7. In a telephone system having a plurality of transmitting and receiving stations in which one station is automatically connected to another, a signal switch mechanism comprising: a rotatable shaft; a first switch-operating cam rigidly mounted on said shaft; a second switch-operating cam rigidly mounted on said shaft; a control cam rotatably mounted on said shaft having four distinct segment portions designated as first, second, third and fourth segments; means imparting an undulant movement to said control cam and deriving its power from said shaft; a switch assembly unit including, a cam follower member which engages said control cam and assumes four distinct positions corresponding to the four segments of said control cam, a first switch unit which is held closed when said third segment engages said follower member, a second switch unit which is closed when said second segment engages said follower member, and third and fourth switch units which are held closed when said fourth segment engages said follower member; and circuit means including, a circuit which is completed by the closing of said second switch unit to cause said first switch-operating cam to be effective when said second segment engages said follower member, a second circuit which is completed by the closing of said first switch unit to cause said second switch-operating cam to be effective when said follower member engages said third segment, and means to form an interlock circuit when said first segment moves out of engagement with said follower member to insure the continuance of the delivery of power to said shaft and to maintain said interlock until said cams are returned to their initial positions.

8. In an automatic telephone system in which a plurality of stations may communicate with each other and in which interconnection is completed by a central selector mechanism including a plurality of central selector relays, said central selector mechanism including a contact assembly and a plurality of pairs of wipers each pair of which is part of one of said central selector relays and is adapted to be moved in step-by-step fashion to successively engage the various pairs of contacts of said contact assembly, said contact assembly comprising a pair of angle-bars between which are mounted a plurality of bridge members of insulating material and a plurality of rods extending parallel to said angle-bars and rigidly supported by said bridge members, the combination with one of said relays of an impulsing mechanism at one of said stations to produce a variety of impulse designs in accordance with which the pair of wiper arms assume a position on said contact assembly.

9. In apparatus of the character described, a contact assembly comprising, a pair of frame members rigidly supported in spaced parallel relationship, a plurality of arcuate bridge members of insulating material extending in parallel relationship between said frame members and having a common axis which is parallel to said frame members, a plurality of contact rods rigidly supported by said bridge members in parallel relationship with respect to said common axis and substantially on a plane which forms a segment of a cylinder, and a plurality of contact clips attached to each of said bridge members and insulated from said contact rods.

THEODORE N. SAATY.

July 8, 1941. T. N. SAATY 2,248,899

TELEPHONE SYSTEM

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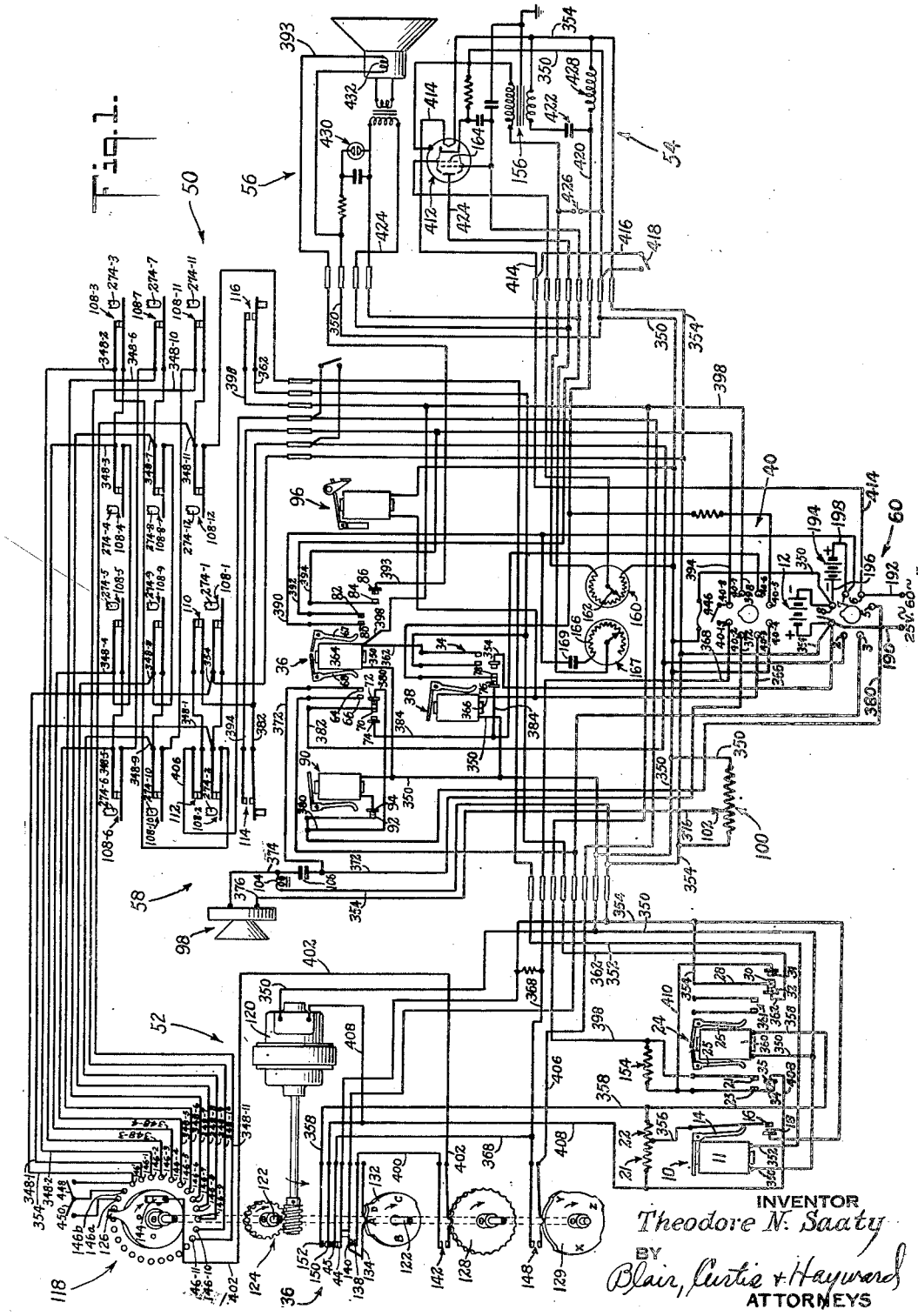

INVENTOR
Theodore N. Saaty
BY
Blair, Curtis & Hayward
ATTORNEYS

July 8, 1941. T. N. SAATY 2,248,899

TELEPHONE SYSTEM

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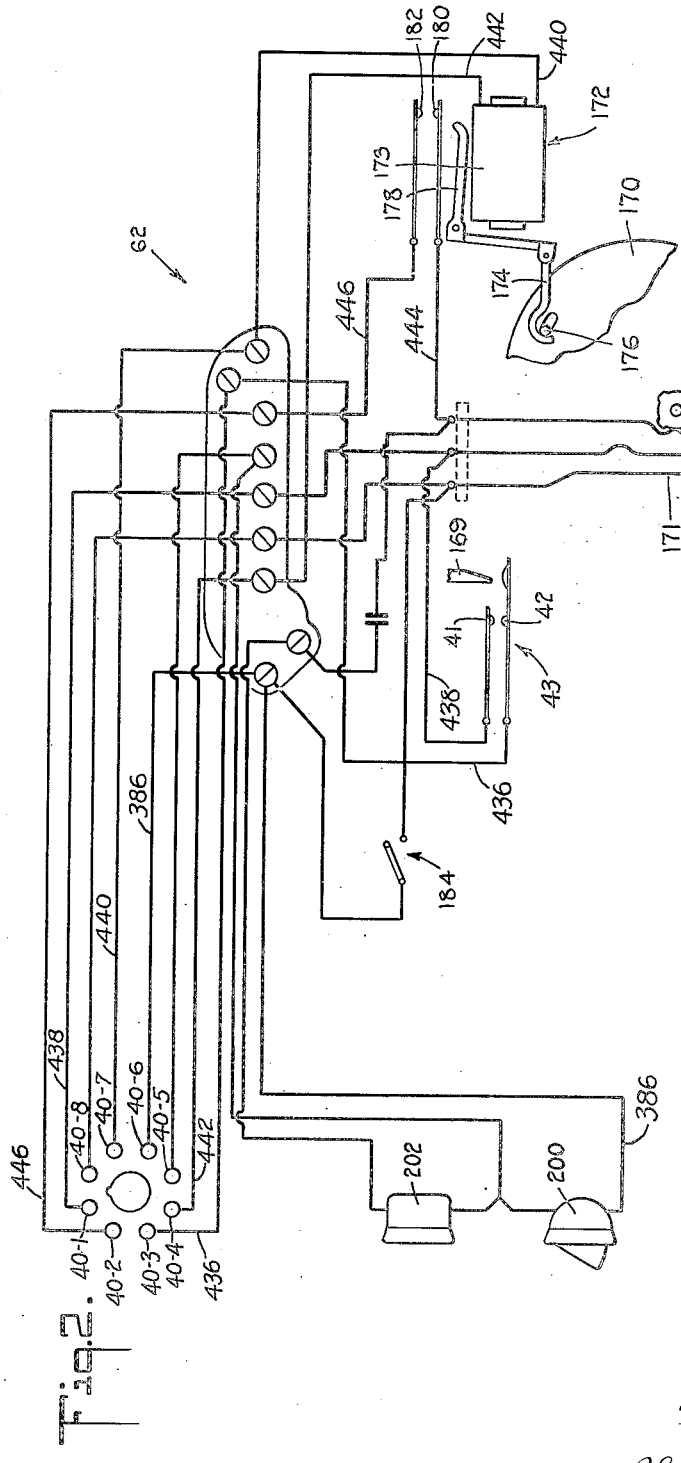

Fig. 2.

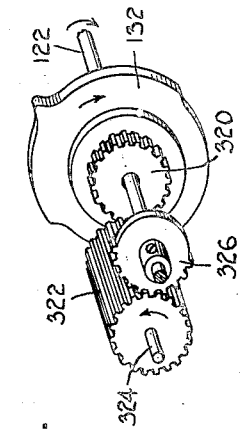

Fig. 3.

INVENTOR
Theodore N. Saaty
BY
Blair, Curtis & Hayward
ATTORNEYS

July 8, 1941. T. N. SAATY 2,248,899

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Fig. 4.

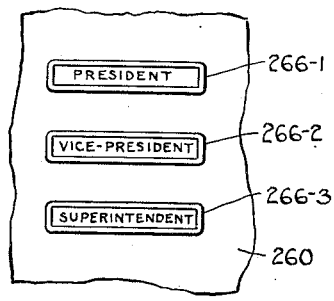


Fig. 5.

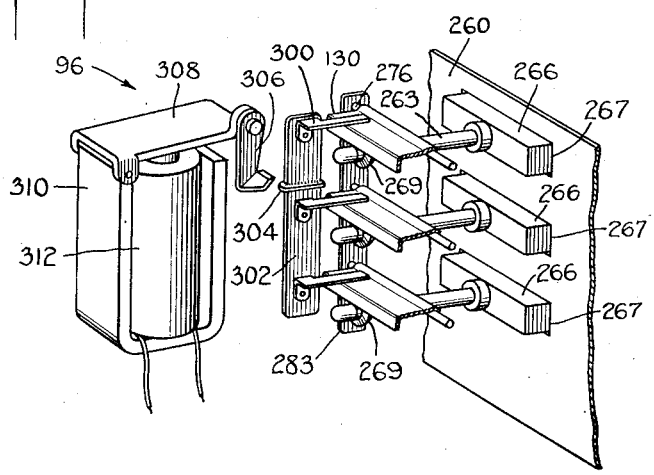
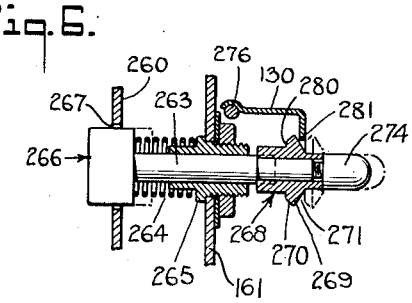


Fig. 6.



INVENTOR
Theodore N. Saaty
BY
Blair, Curtis & Hayward
ATTORNEYS

July 8, 1941. T. N. SAATY 2,248,899

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Fig. 7.

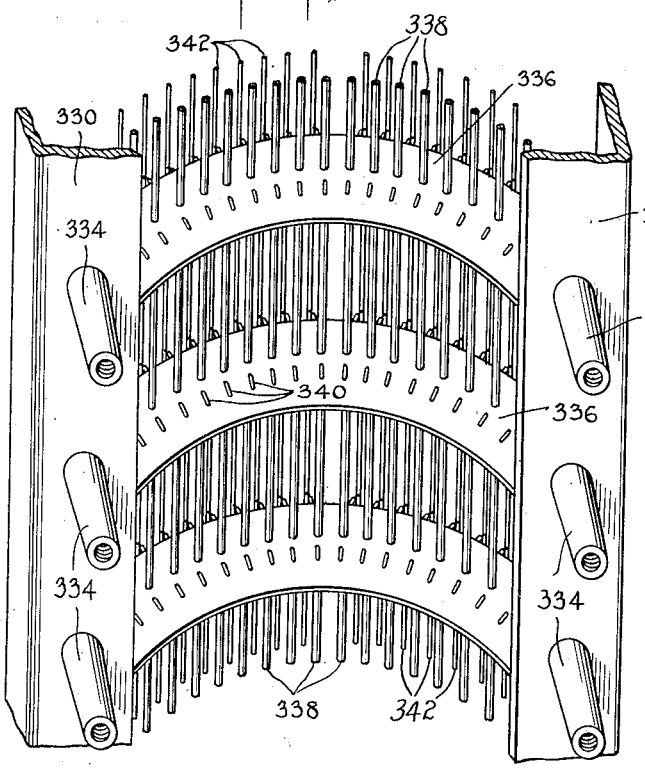


Fig. 8.

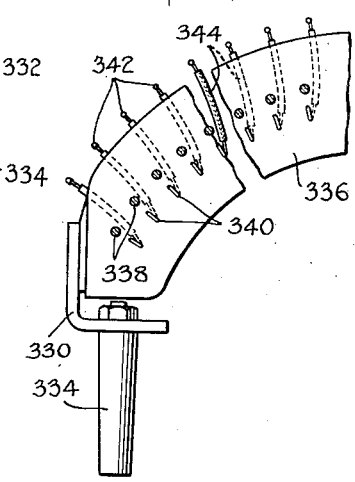


Fig. 9.

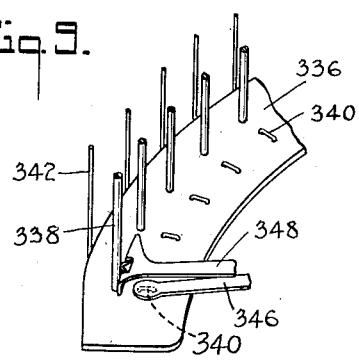
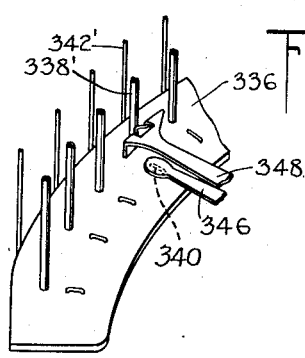


Fig. 10.



INVENTOR
Theodore N. Saaty
BY
Blair, Curtis & Hayward
ATTORNEYS