A. E. STEVENS.

AUTOPHONE SYSTEM.

APPLICATION FILED NOV. 6, 1908.

957,909.

Patented May 17, 1910.

6 SHEETS—SHEET 1.

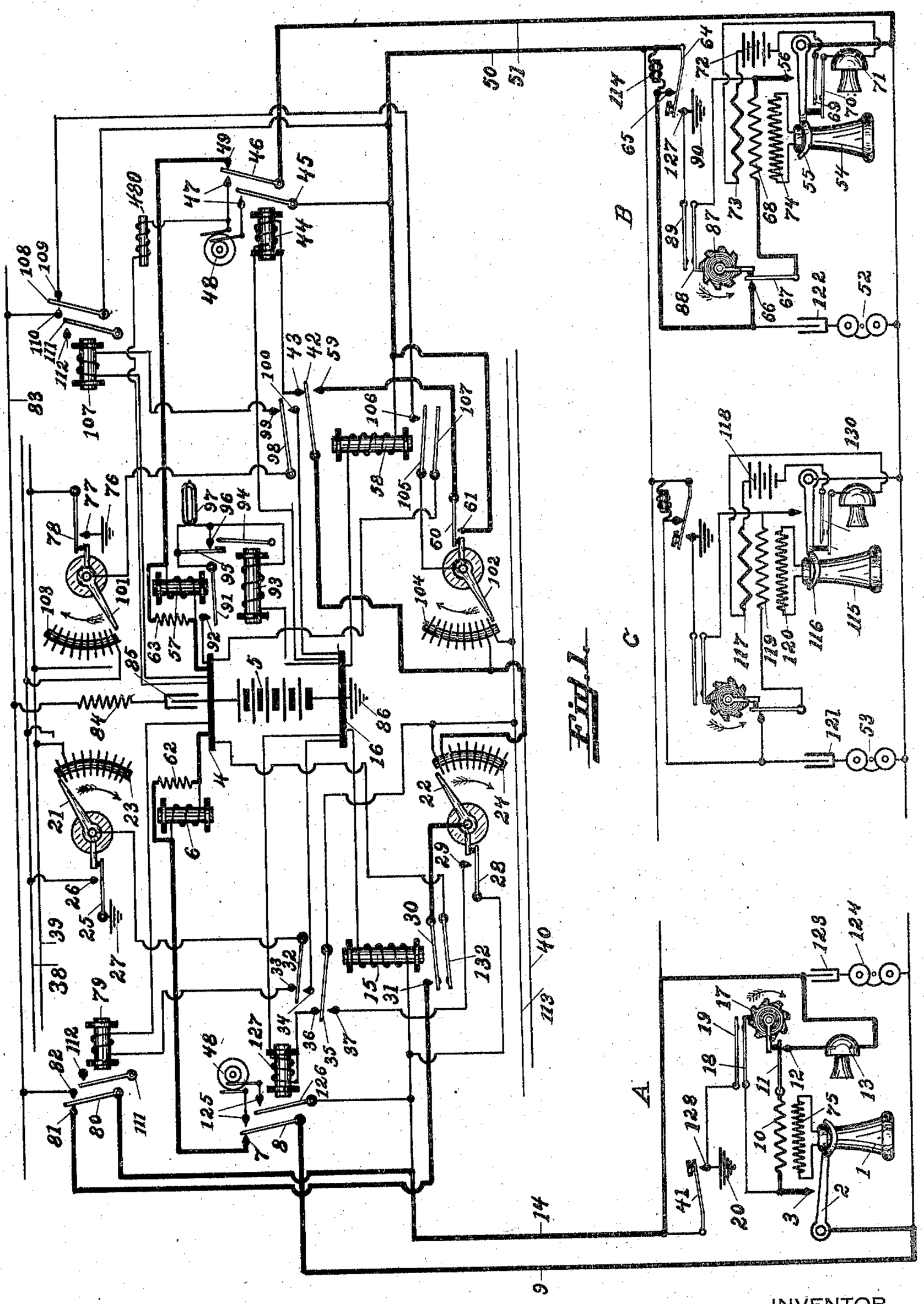

Fig. 1.

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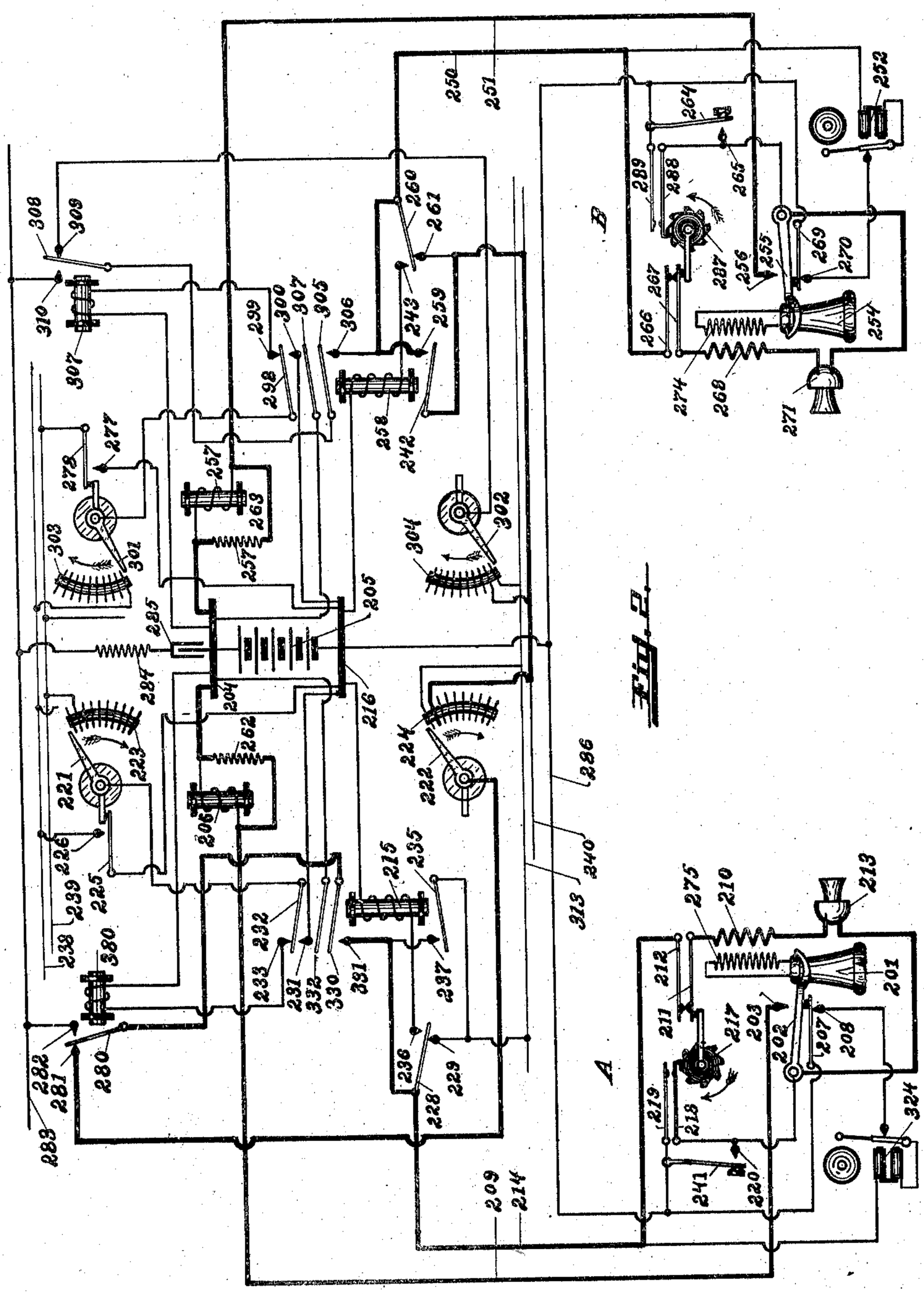

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6 SHEETS—SHEET 3.

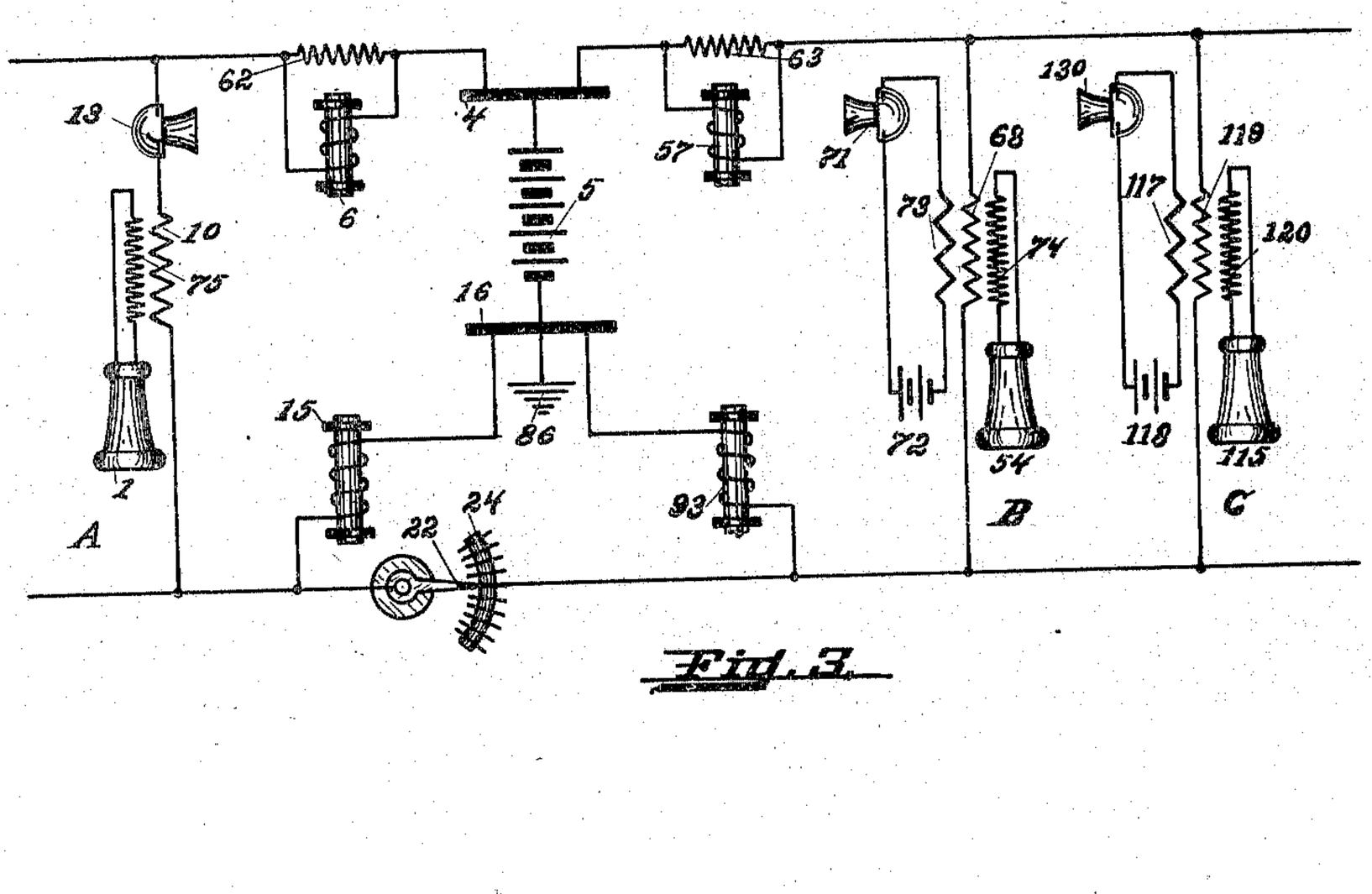


Fig. 3.

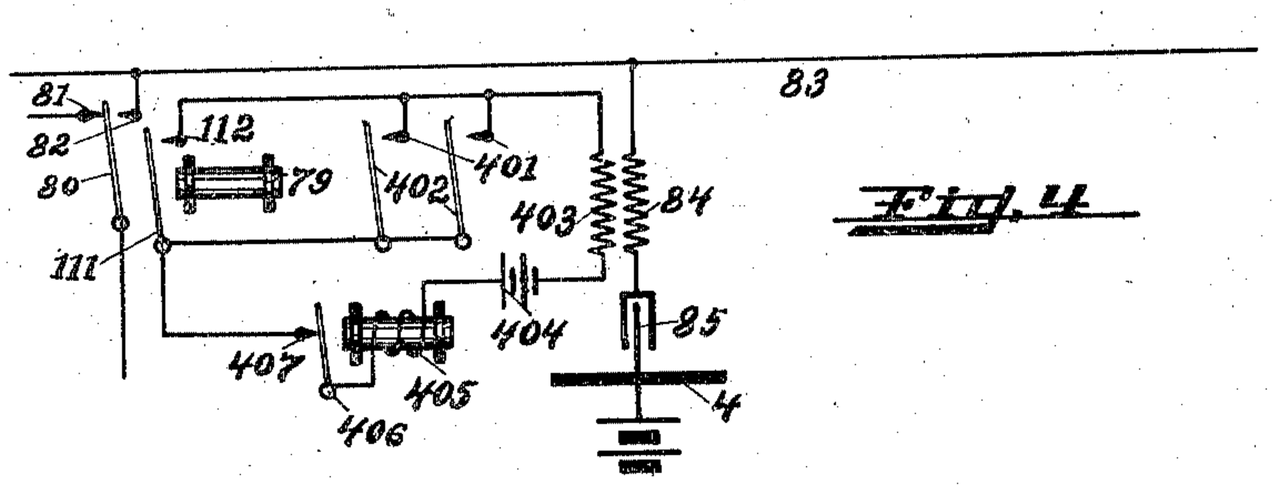
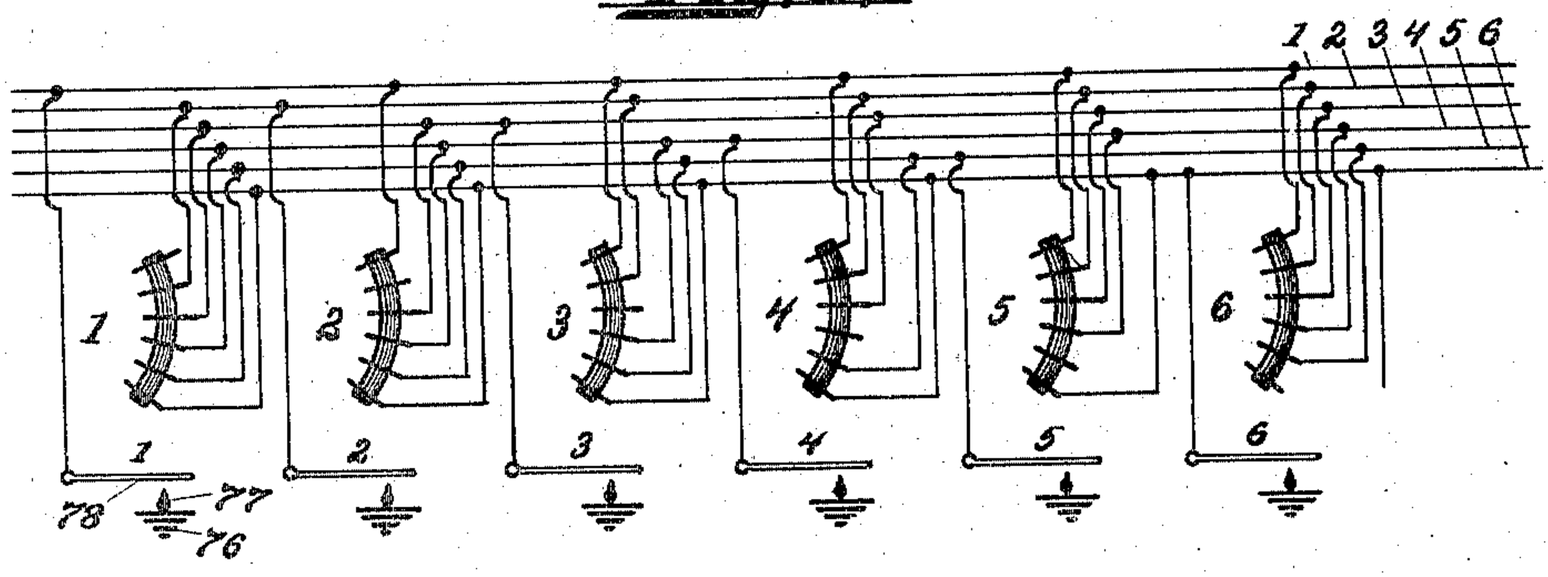


Fig. 4.

Fig. 5.



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6 SHEETS—SHEET 4.

Fig. 6.

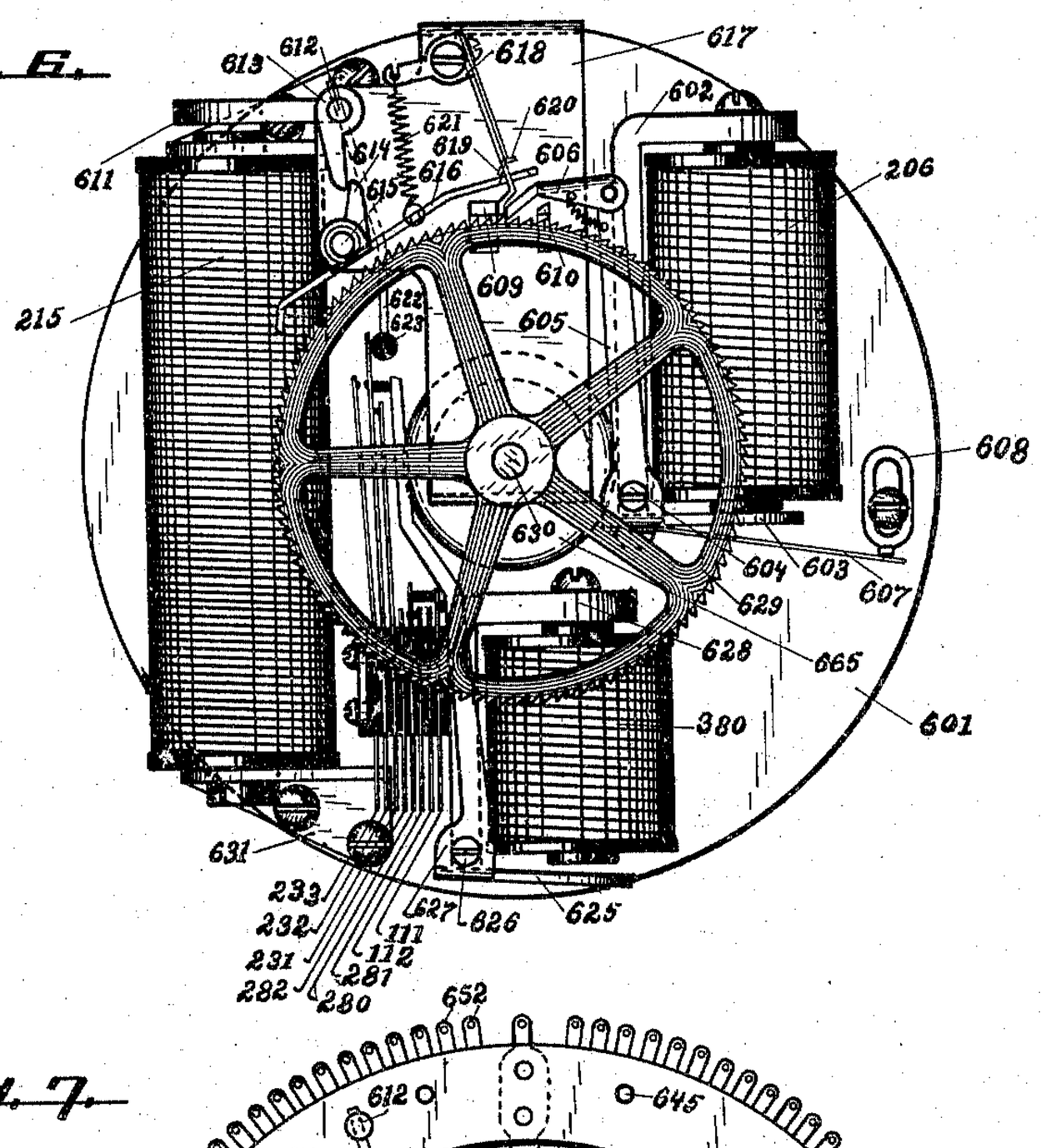
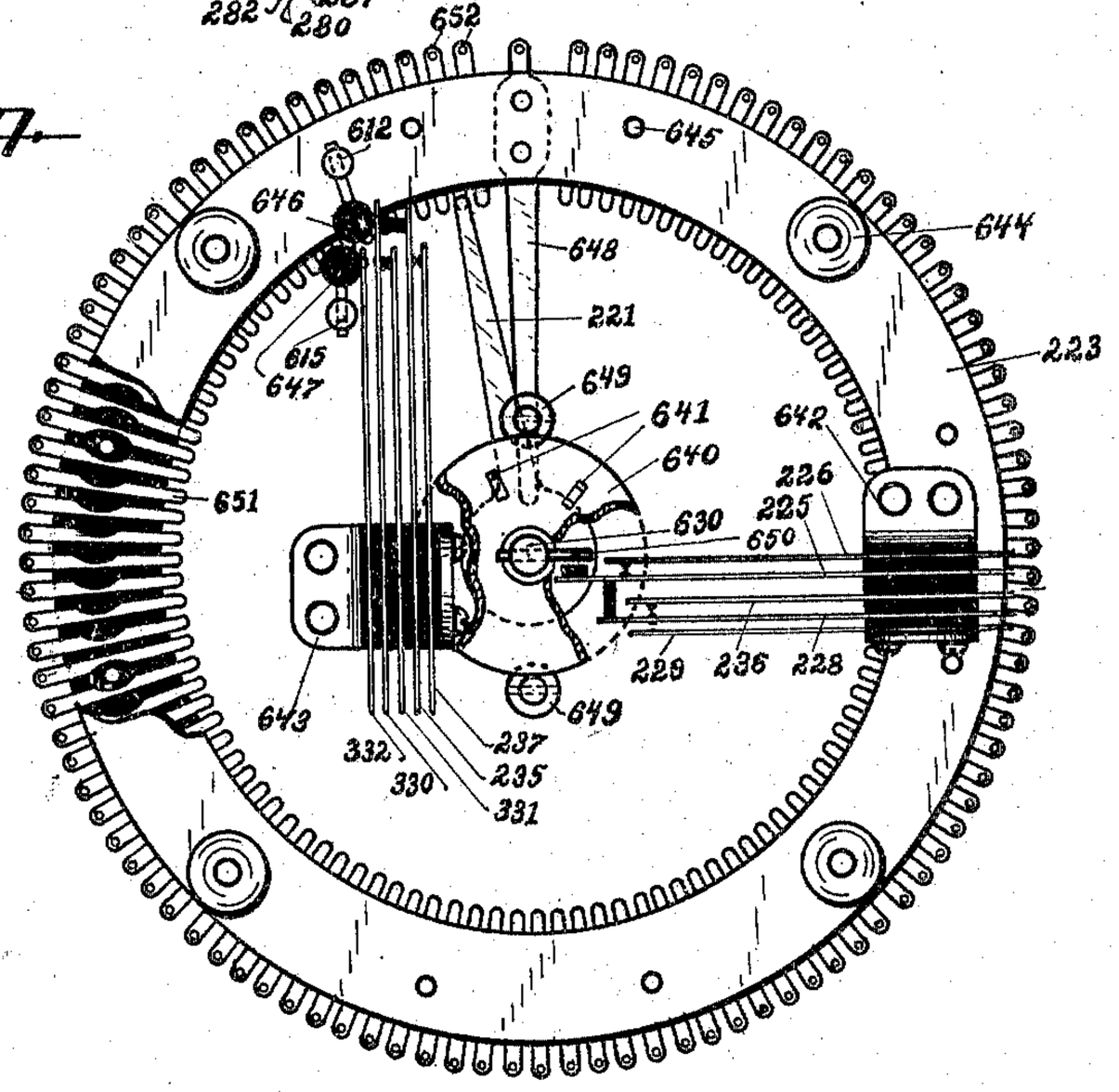


Fig. 7.



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6 SHEETS—SHEET 5.

Fig. 8.

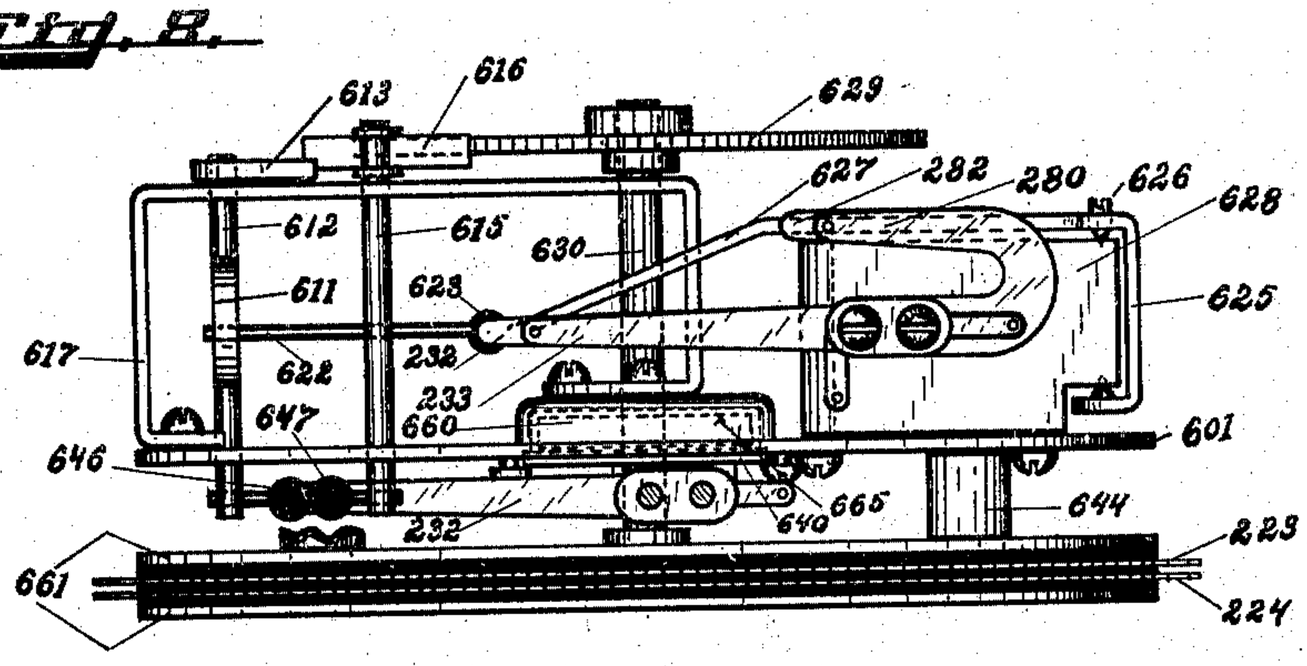


Fig. 9.

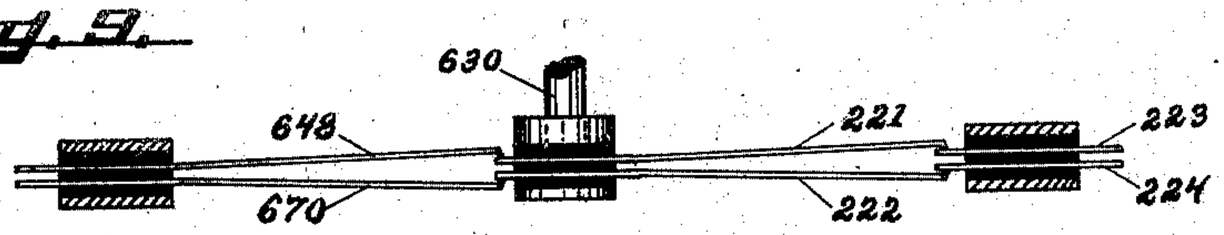
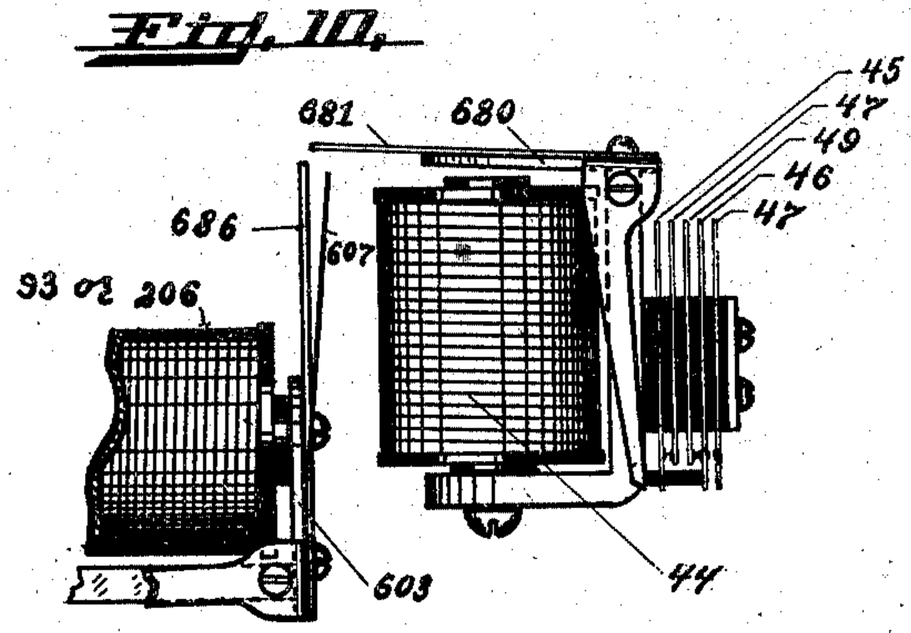


Fig. 10.



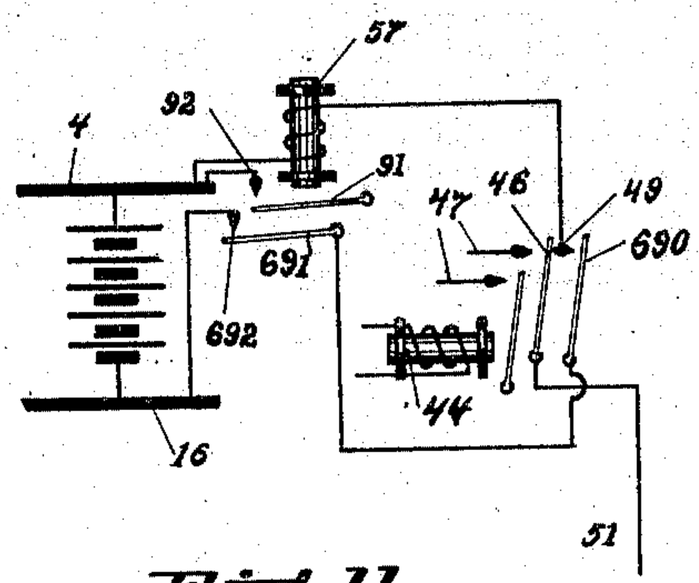


Fig. 11.

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AUTOPHONE SYSTEM.

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Patented May 17, 1910.

6 SHEETS—SHEET 6.

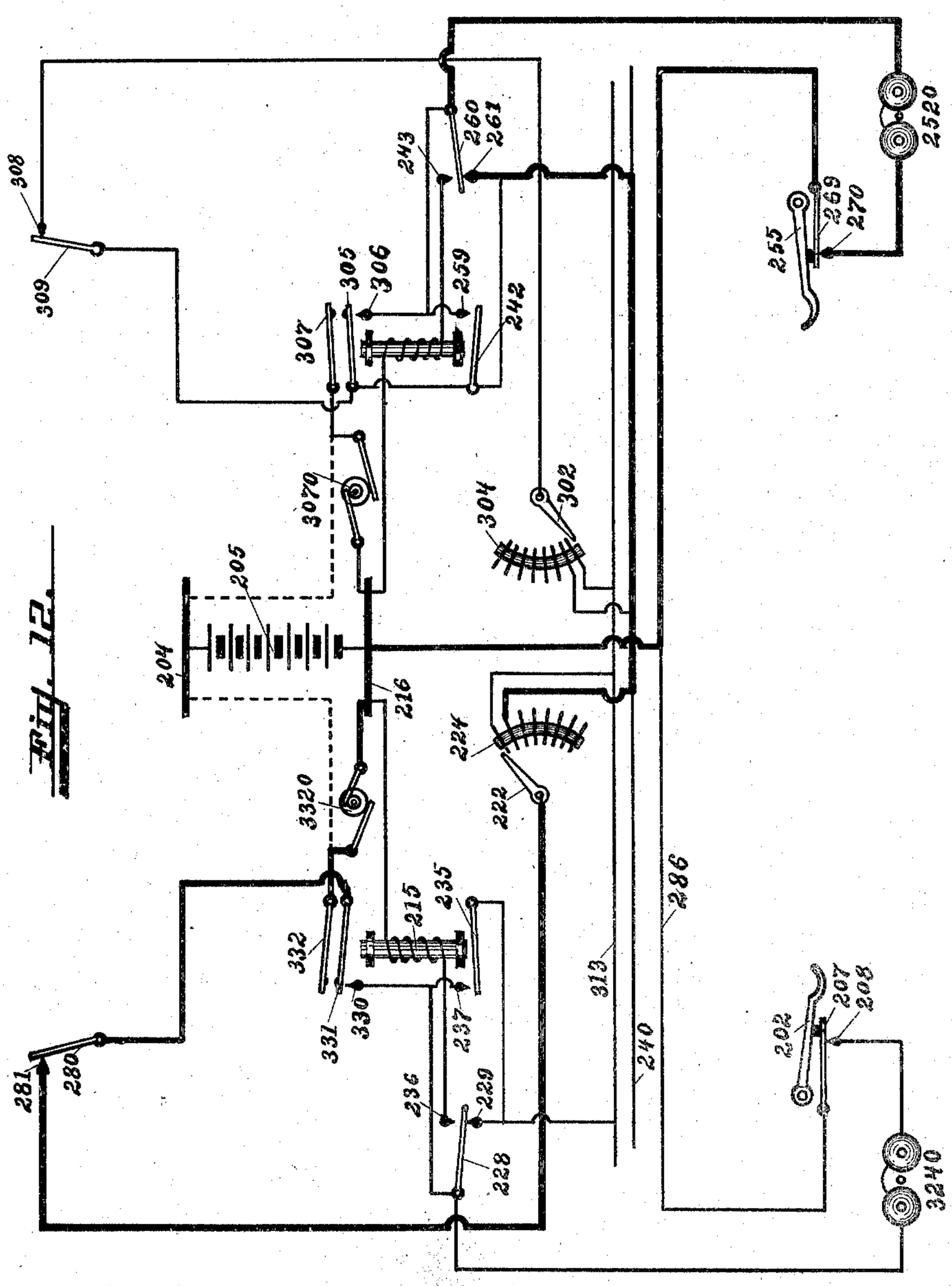

Fig. 12.

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UNITED STATES PATENT OFFICE.

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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 deenergized 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 or 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.