No. 847,316. PATENTED MAR. 19, 1907.

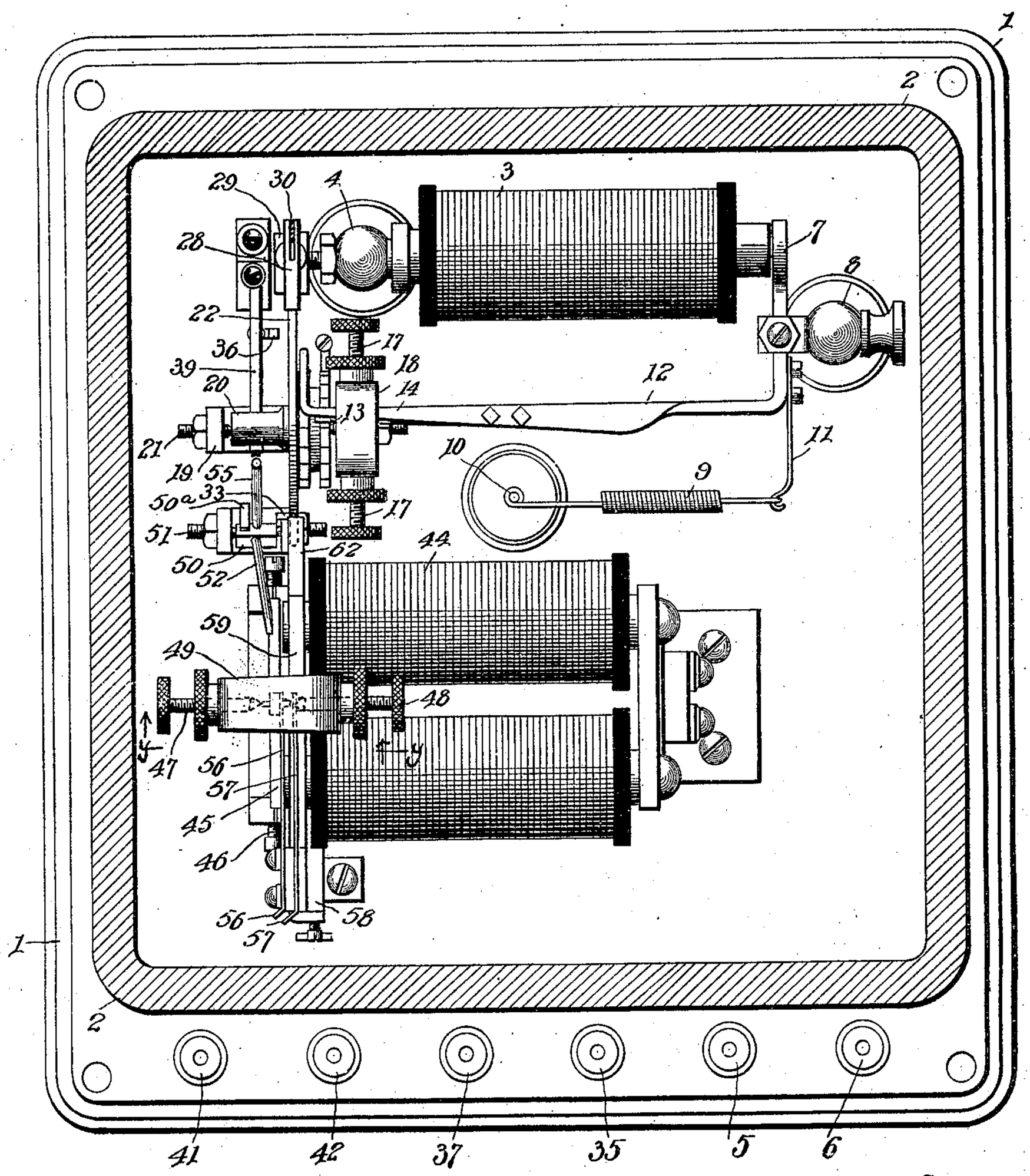
C. L. & T. P. CARR.

TELEPHONE SYSTEM.

APPLICATION FILED OCT. 10, 1904.

5 SHEETS—SHEET 1.

Fig. 1.

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5 SHEETS—SHEET 2.

Fig. 2.

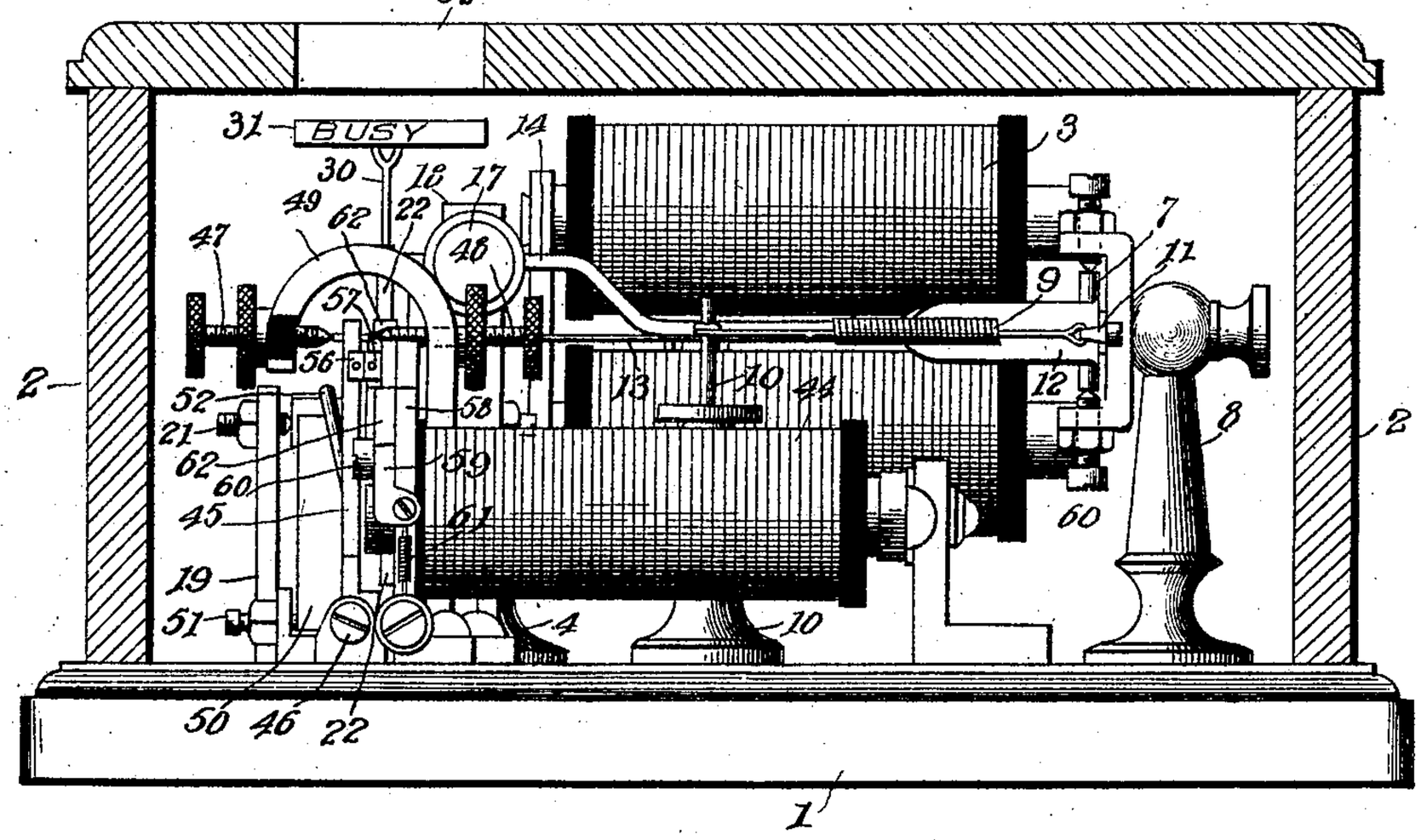
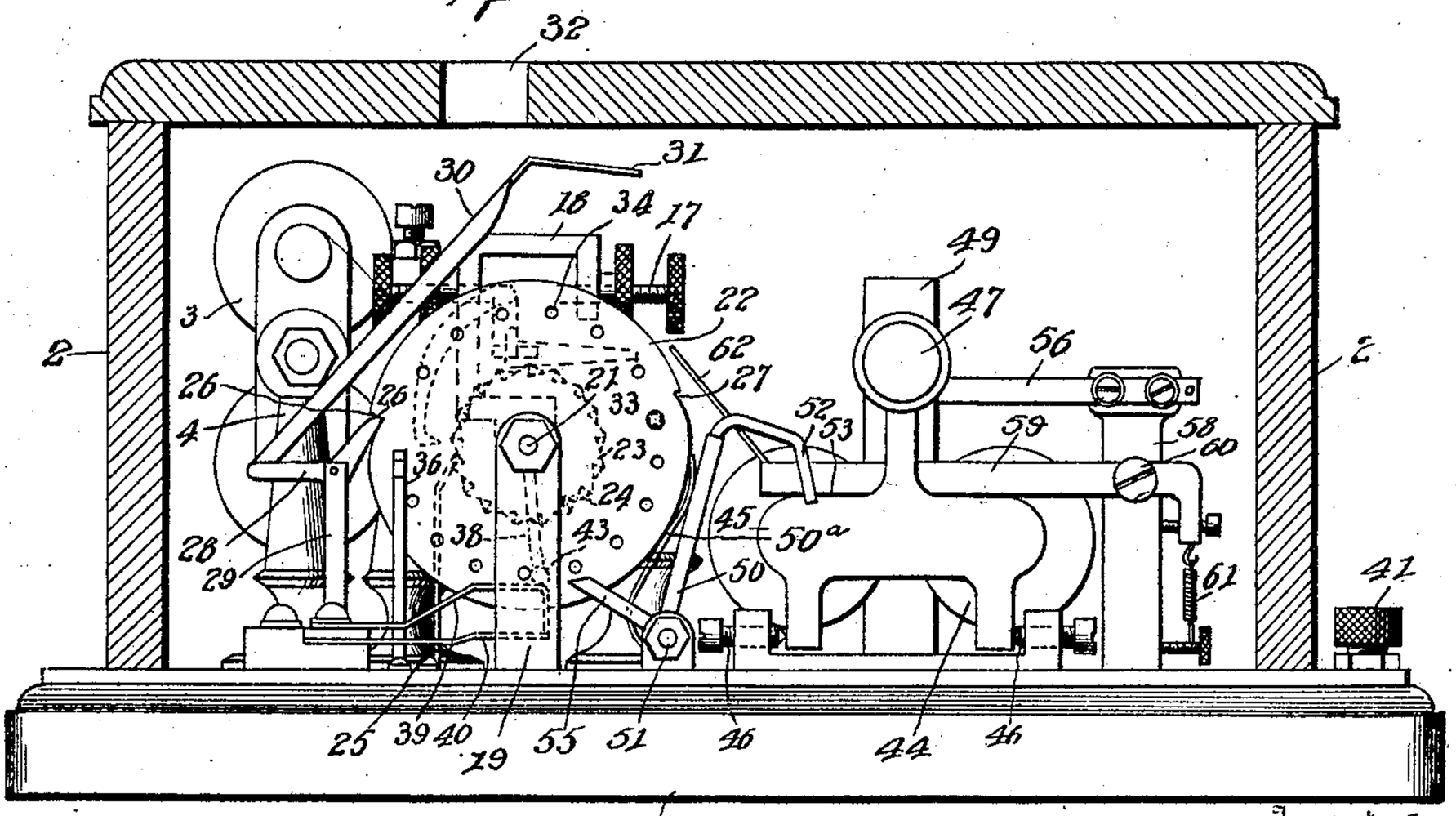



Fig. 3.

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5 SHEETS—SHEET 3.

Fig. 6.

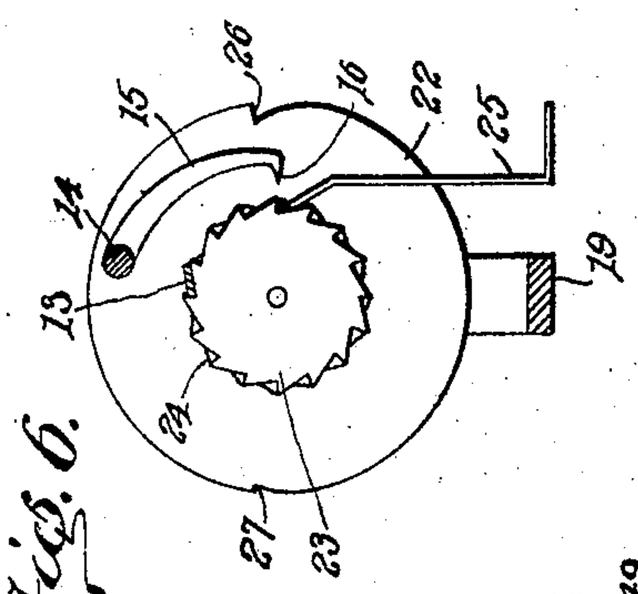



Fig. 8.

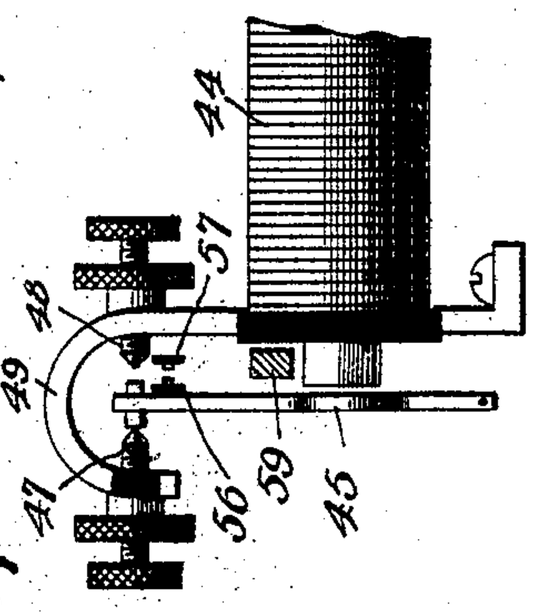



Fig. 7.

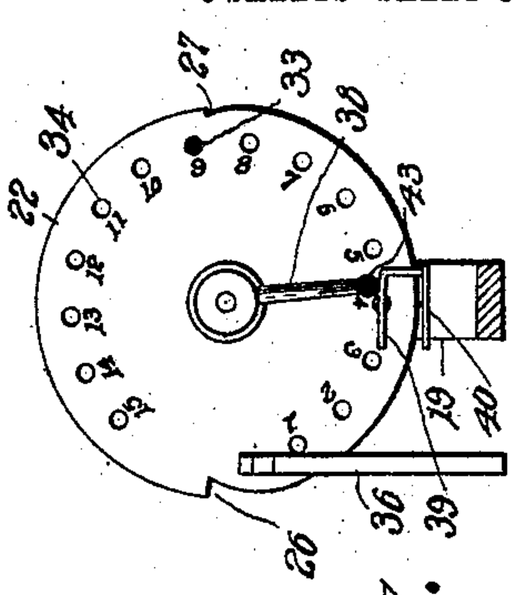



Fig. 4.

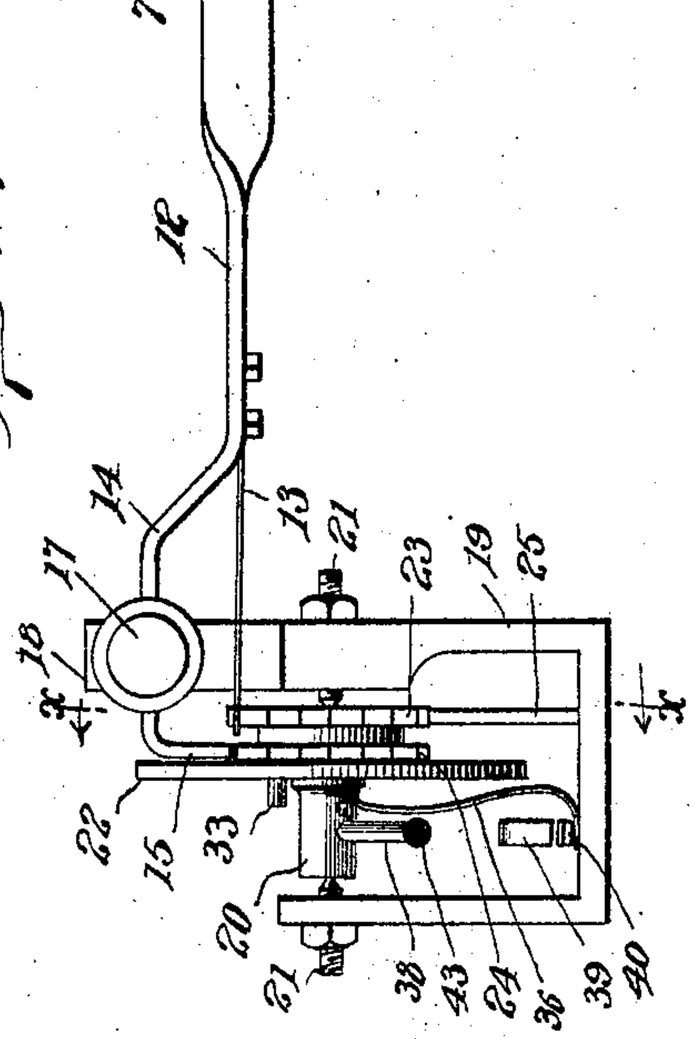



Fig. 5.

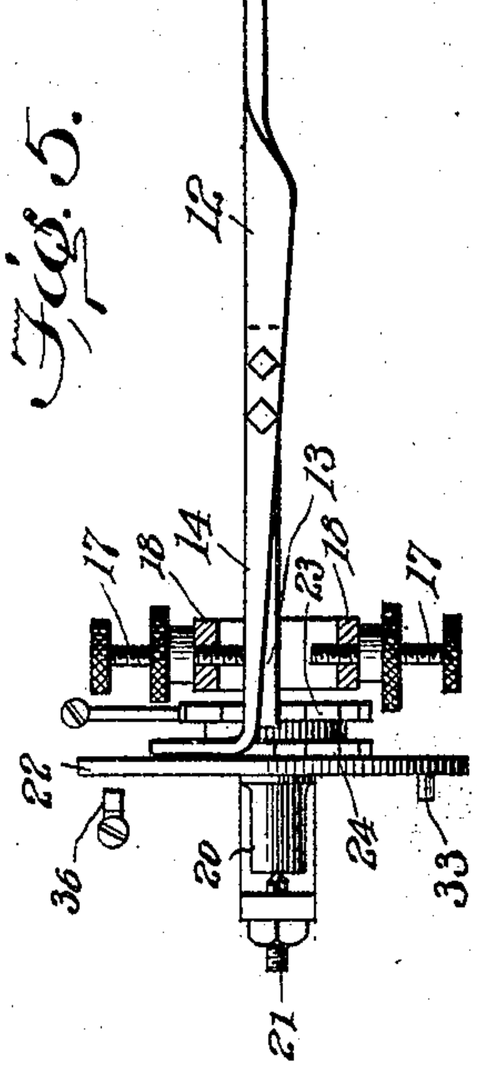
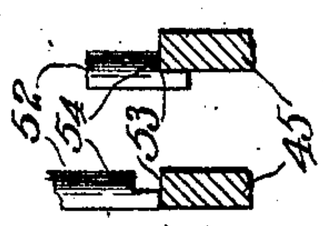



Fig. 9.

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5 SHEETS—SHEET 4.

Fig. 10.

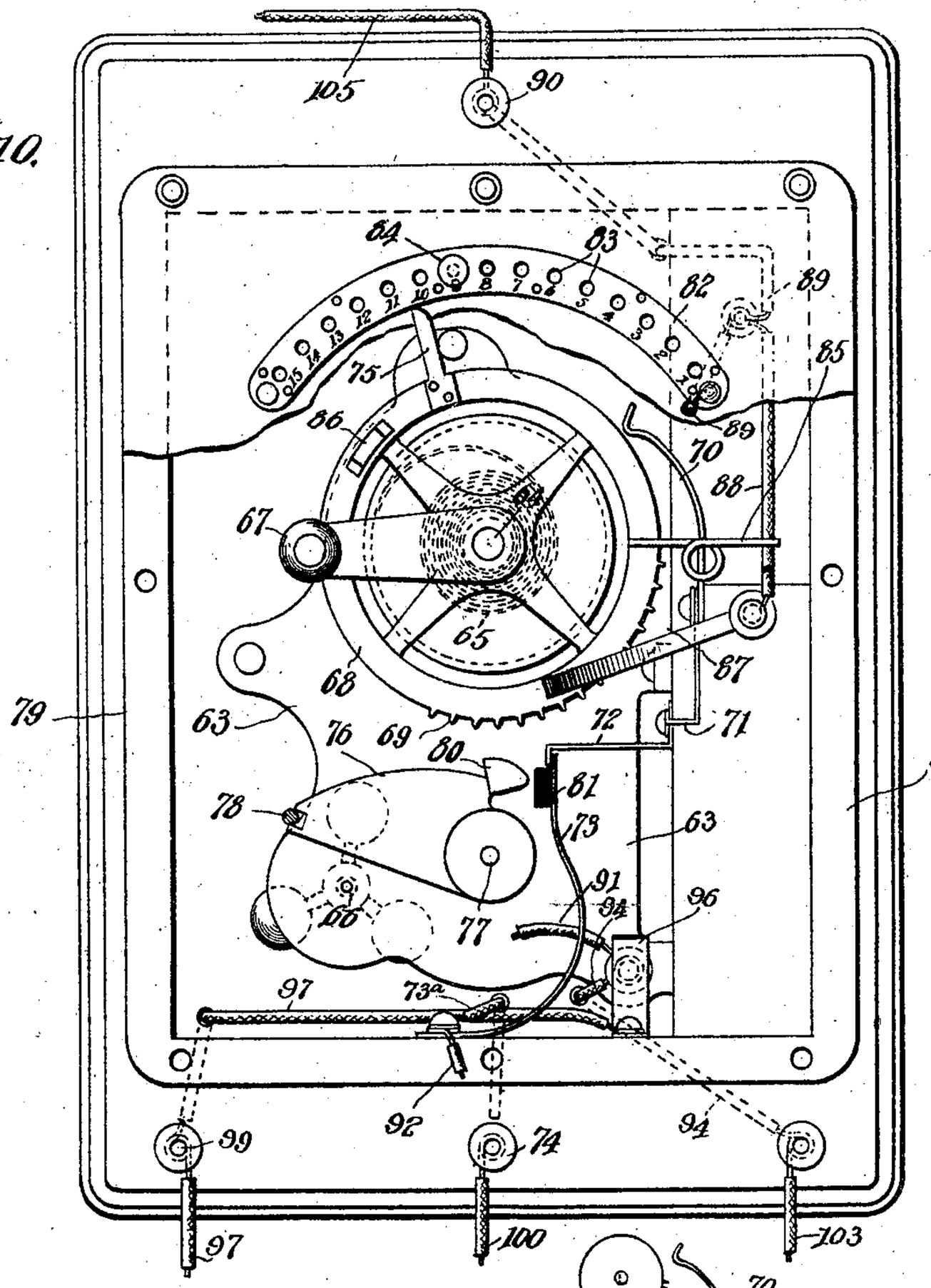
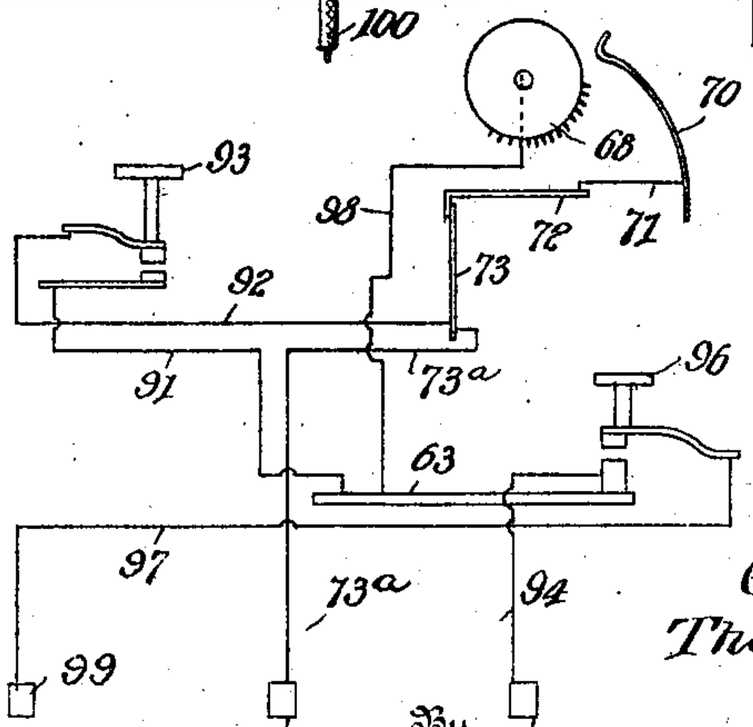



Fig. 11.

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5 SHEETS—SHEET 5.

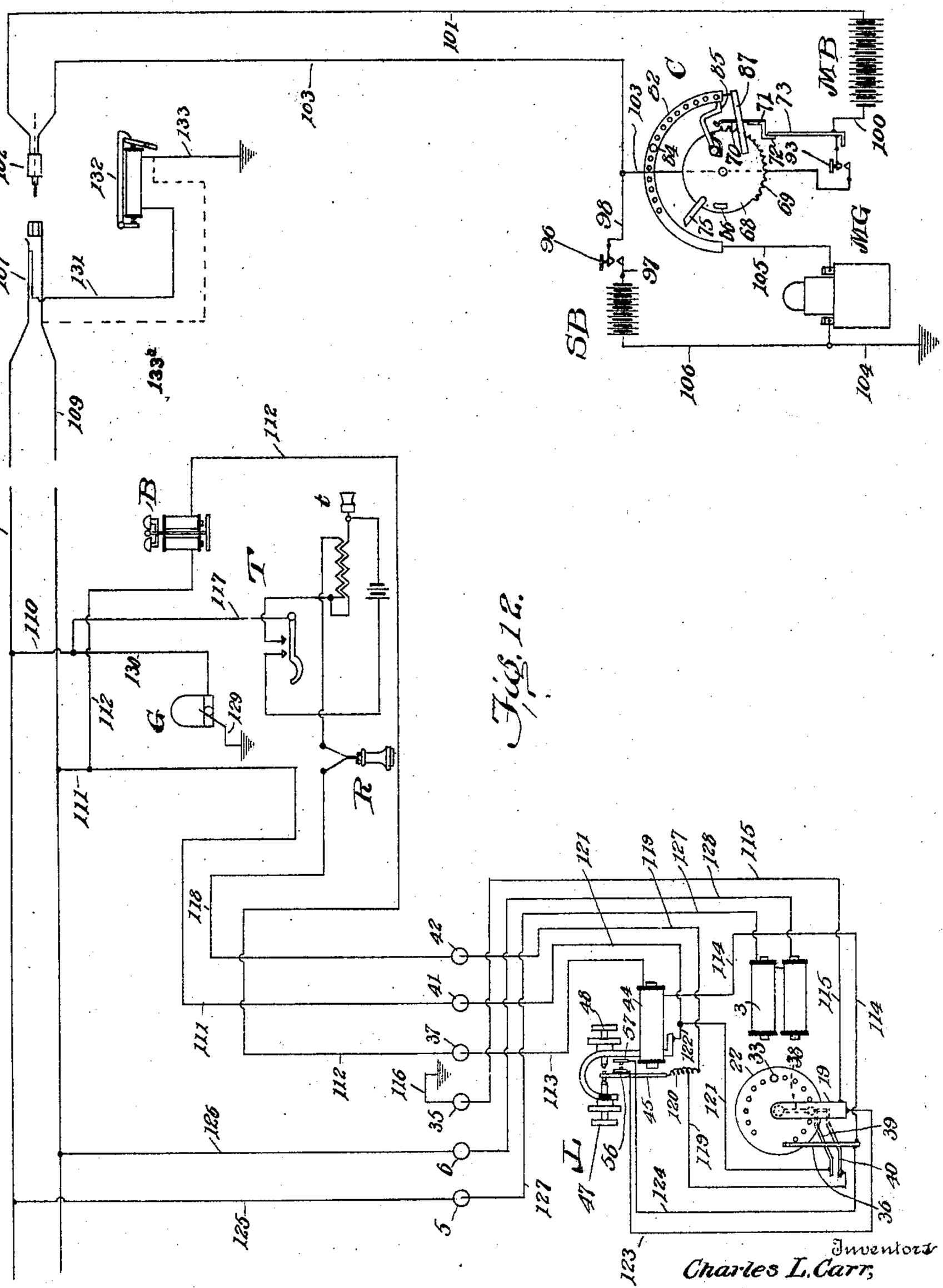


Fig. 12.

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE SYSTEM.

No. 847,316. Specification of Letters Patent. Patented March 19, 1907.

Application filed October 10, 1904. Serial No. 227,977.

*To all whom it may concern:*

Be it known that we, CHARLES L. CARR and THADDEUS P. CARR, citizens of the United States, residing at Yellow Springs, in the county of Greene and State of Ohio, 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.

This invention relates to telephone systems, and more particularly to that class of telephone systems or exchanges known as "party-lines," and has for its object to provide means whereby the objectionable features attendant upon the use of these lines as now ordinarily constructed may be done away with.

More specifically, the invention has for its object, first, to provide means whereby the central operator may call for or signal to any one or more of the subscribers on a party-line without calling up or signaling any of the other subscribers on that line; second, to cut out from telephonic connection all subscribers on the line other than the subscriber or subscribers so called from the central office; third, to provide a signal which will indicate to the parties thus cut off that the line is in use during the period of such use; fourth, to enable any party to ring into or signal the central office while the line is in use, and, fifth, to provide a simple efficient means for synchronizing or bringing to uniform position the step-by-step controlling mechanisms of the several stations or parties on a line.

To the end that these and other objects may be obtained by means of a simple, efficient, and rapidly-operating mechanism which may be readily applied to or used in connection with telephones now in use without any alterations in or additions to such telephones our invention consists in certain novel features, which we will now proceed to describe and will then particularly point out in the claims.

In the accompanying drawings, Figure 1 is an elevation, with the casing in section, of one of the instruments employed in connection with our system, the same being the instrument of which one is located at each subscriber's station. Fig. 2 is a view of the same from the lower portion of Fig. 1 with the casing in section. Fig. 3 is a view of the same from the left of Fig. 1 with the casing in section. Fig. 4 is a detail view of the step-up mechanism viewed from the same position as in Fig. 2. Fig. 5 is a detail view of this same mechanism from the same position as in Fig. 1 and partly in section. Fig. 6 is a detail sectional view taken on the line $x$ $x$ of Fig. 4 and looking in the direction of the arrows. Fig. 7 is a detail sectional view showing the opposite side of the controlling-disk from that shown in Fig. 6. Fig. 8 is a detail sectional view taken on the line $y$ $y$ of Fig. 1 and looking in the direction of the arrows. Fig. 9 is a detail view showing two positions of the relay-armature and its latch. Fig. 10 is a view of the transmitter or signaling instrument at the central station. Fig. 11 is a diagram of the battery and line connections of the transmitter, and Fig. 12 is a diagrammatic view showing the arrangement of the circuits of the system between the central office and one of the subscribers' stations on the line.

Before proceeding to the general description of the system we shall describe the controlling instrument forming a part of the system, one of which instruments is located at each subscriber's station. One form or embodiment of this feature of our invention is illustrated in Figs. 1 to 9, inclusive, of the drawings. We shall now proceed to describe the particular mechanism constituting this embodiment of our invention. It should be understood, however, in the first place that this particular instrument may be either mounted on the same base as the usual receiver, transmitter, and other parts of the ordinary telephone, so as to constitute a part of the set, or it may be mounted separately therefrom on the wall or any other suitable support at any desired distance from the subscriber's instrument. In the particular form of construction chosen for the purpose of illustration this instrument comprises a base 1 and a casing 2, the base supporting the mechanism and the casing inclosing it and being constructed in any way which will permit access to the mechanism by the proper parties. Upon this base there is mounted an electromagnet 3, shown in the present instance as supported from a post or upright 4 on the base 1. The coils of this magnet are connected to binding-posts or terminals 5 and 6. Coöperating with this magnet, which, for convenience may be referred to as the "step-up" magnet, is an armature 7, pivotally supported from a post 8, and having connected therewith a spring 9, which tends to hold the armature away from the poles of the magnet

3. This spring may be connected at one end to a post 10 on the base 1 and at the other end to an extension 11 from the armature 7. To said armature 7 is connected, so as to move therewith, an arm 12, which is provided with a spring-pawl 13, preferably in the form of a flat resilient strip of steel or the like. The arm 12 has an extension 14, the extremity of which is formed into a stop-arm 15, provided with a terminal tooth or projection 16.

The movements of the arm 12 are limited by contact-screws 17, arranged on opposite sides of a yoke or loop 18, through which the extension 14 passes. This yoke is mounted on a support 19, rising from the base 1, and in this support there is mounted a shaft 20, preferably supported by bearing-screws 21 at its ends. This shaft 20 carries the controlling-disk 22 and also two reversely-arranged ratchet-wheels 23 and 24, coöperating, respectively, with the feed-pawl 13 and stop-arm 15. The arrangement of these parts is such that the feed-pawl 13 extends over and successively engages with the teeth of the ratchet-wheel 23 to impart to the shaft 20 and controlling-disk 22 a step-by-step forward motion, while the stop-arm 15, moving in unison with the pawl 13, comes into contact successively with the teeth of the ratchet-wheel 24 at the end of each complete feed-stroke of the pawl 13, thereby arresting the motion of the shaft 20 and disk 22 and preventing overthrow or motion in a forward direction beyond the prescribed limit.

25 indicates a detent-pawl which engages with the teeth of the ratchet-wheel 23 and prevents reverse movement of the parts.

The controlling-disk 22 has a periphery which is circular or cylindrical in form, except that there are formed in said periphery two notches 26 and 27, the former of which controls the busy-signal, while the latter cooperates with the synchronizing mechanism hereinafter described. The busy-signal comprises a lever 28, pivotally mounted on a post 29 in a position such that one end of said lever bears upon the periphery of the disk 22. To the other end of said lever there is connected an arm 30, extending toward the front of the casing and provided at its free extremity with a plate or other signal device 31, which lies opposite a sight-opening 32 in the casing when the lever 28 bears upon the cylindrical portion of the periphery of the disk 22. In the present instance we have shown this plate as having the word "Busy" placed thereon, so that this word will show through the sight-opening at all times except when the lever 28 is resting in the notch 26, which latter position is that assumed by the parts when the line is not in use. In the present instance the parts are so arranged to cause the contact between lever 28 and disk 22 to be maintained by gravity.

The disk 22 is provided with a selective contact, preferably in the form of a pin or projection 33, extending outward from the side of the disk opposite to that on which the ratchet-wheels are located. It will be understood that this pin is located at a different point in the controlling-disk of each of the instruments upon a given line. We prefer to provide each disk with a series of apertures 34, spaced equidistantly to correspond to the distance between the teeth of the ratchet-wheel 23, so that the pin 33 can be placed in any desired aperture of any disk, thus permitting any instrument to be adapted to any station. In the present instance we have shown an instrument adapted for use on a party-line containing fifteen subscribers' stations, and there are therefore fifteen apertures 34, the pin being placed in aperture No. 1 at station No. 1, and so on throughout the series. In the particular instrument illustrated the pin 33 is in aperture No. 9, and the instrument is set for use at station No. 9 of the line. The number of teeth in the ratchet-wheel 23 is greater by two than the number of apertures in the disk for the purposes hereinafter set forth. The pin 33 and disk 22 are in electrical connection with each other and with the ground, preferably through the support 19, which is connected to a binding-post or terminal 35, which latter is in turn connected to a suitable ground.

36 indicates a contact-arm located adjacent to the lateral face of the disk 22, which carries the pin 33, its position being such that the pin 33 will come into contact with said arm during the intermittent revolution of the disk. The contact-arm 36 is electrically connected to a terminal or binding-post 37, which latter is in turn connected with the call-bell of the subscriber's station and with the main line in the ordinary manner hereinafter set forth.

One of the rotating parts, preferably the shaft 20, is provided with an arm 38, serving both as a circuit-closer and as a trip device in the manner hereinafter set forth. In this former capacity it serves when the controlling-disk 22 is in its normal position with the line not in use to close the circuit between two contact-arm 39 and 40, which arms are electrically connected to terminals or binding-posts 41 and 42, which are the terminals of the talking-circuit. In the present instance we have shown the arms 39 and 40 as resilient arms, the arm 39 having its end bent down so as to lie above but slightly separated from the arm 40 when said arm 39 is free. The arm 38, when the disk 22 is at rest in its normal position, bears upon the arm 39 and holds it in contact with the arm 40. In this construction the arm 38 acts mechanically only, forming no part of the

electric circuit, and is therefore provided with a terminal insulated portion 43, preferably in the form of an insulating-ball or the like.

44 indicates a second electromagnet supported on the base 1 and provided with an armature 45, which is pivotally supported at its lower end on trunnion-screws 46 and is in electrical connection with the binding-post or terminal 42. The vibrations of this armature are limited by contact-screws 47 and 48, mounted in a yoke or frame 49, which is electrically connected with the terminal or binding-post 41. The parts are so insulated that contact between the armature 45 and screw 47 does not close the circuit between the posts 41 and 42, while contact between the armature 45 and screw 48 does close said circuit. The coils of the electromagnet 44 are electrically connected with the terminals or binding-posts 35 and 37. This electrical connection is normally open and is adapted to be closed by the contact of the pin 33 with the arm 36, thereby connecting the magnet 44 with said binding-posts, and consequently with the ground and with the ringing or signaling circuit, and when a current is passed through said coils from the ringing-circuit the armature 45 is attracted and contacting with the screw 48 closes the talking-circuit at said contact.

In order to hold the armature in position to maintain its contact with the screw 48, we employ a latch, consisting of an arm 50, pivoted at 51 on the base 1 and having a finger 52, which normally rests on a shoulder 53 of the armature 45. A spring $50^a$ moves the latch 50 toward the armature 45. The arrangement of these parts is such that when the armature 45 is in contact with the screw 47 the latch is lifted and its extremity rests on the top of the shoulder or upper surface 53 of the armature 45, as shown in the detail view to the left of Fig. 9. When the armature 45 is attracted by the magnet 44 and comes into contact with the screw 48, then the latch falls until a shoulder thereof (indicated at 54) comes into contact with the top or shoulder 53 of the armature 45, as indicated in the detail view to the right of Fig. 9. When the parts are in this position, the extremity of the latch lies back of the armature and holds it in contact with screw 48 until the latch is tripped or lifted. This tripping or lifting is effected by the arm 38, the extremity of which comes into contact with an arm 55, arranged in its path and connected to the arm 50, so as to move in unison therewith. The armature 45 is spring-actuated, so as to maintain its contact with the stop-screw 47 when free to move into contact with the same. The armature 45 also serves as a circuit-closing device by bringing into contact with each other two resilient contact-arms 56 and 57, supported on a post 58 from the base 1, from which post they are insulated, as well as from each other. The free ends of these arms are located in the path of the armature 45, from which they are insulated, and are so arranged that when said armature is drawn into contact with the screw 48 the contact-arm 56 is caused to bear against and make electrical contact with the arm 57. As a matter of convenience the resilient arm 56 performs the function of a spring to move the armature 45 toward the contact-screw 47 and to this end remains in insulated contact therewith throughout its range of motion. The contact-arms 56 and 57 are respectively in electric connection with the terminals 35 and 37, preferably by connecting the arm 56 with the support 19 of the controlling-disk 22 and by connecting the arm 57 with the contact-arm 36.

In addition to the armature 45 the magnet 44 also controls a second armature 59 in the form of a bar pivotally mounted at 60 on the post 58 and extending over the poles of the magnet 44, from which it is held away by a spring 61. This armature 59, which is the synchronizing-armature, is provided with a spring pawl or dog 62, preferably in the form of a flat resilient strip of steel or the like, so arranged as to bear upon the periphery of the disk 22 when the armature 59 is attracted by the magnet 44. The notch 27 in the periphery of the controlling-disk 22 is so formed as to present an abrupt stop-shoulder to the end of the pawl or dog 62, and when said pawl or dog is in contact with the disk rotation of the disk can only proceed until the pawl drops into the notch 27, whereupon further rotation of the disk will be prevented.

In connection with the controlling instruments, which we have just described, and one of which is located at each subscriber's station, we employ at the central station a controlling instrument which may be conveniently referred to as a "transmitter." This instrument is shown in plan view in Fig. 10, and comprises in its preferred form a suitable motor, preferably a spring-motor, of which the frame is indicated by the reference-numeral 63, the main shaft by 64, the spring (shown in dotted lines) by 65, the governor (also shown in dotted lines) by 66, and an operating handle or crank on the main shaft by 67. This motor operates a contact-wheel 68, which is preferably mounted directly upon the motor-shaft 64, so as to rotate in unison therewith. It is provided with a number of contacts less by one than the number of ratchet-teeth in the ratchet-wheels 23 of the subscriber's-station instruments, the number of contacts on the wheel 68 being sixteen in the present instance. They are shown in the form of teeth 69, located on the periphery of the wheel. Coöperating with them is a contact-arm 70, preferably of resilient material, with which the

teeth 69 successively come into contact as the wheel 68 rotates. The contact-arm 70 is electrically connected, as by a wire 71, with a contact-arm 72, with which a resilient contact-arm 73 is normally in contact, said arm 73 being connected by a wire 73[a] to a terminal or binding-post 74, which is in turn connected to the main battery. The wheel 68 is provided with a projecting arm 75, which is adapted to engage with a lever 76, pivoted at 77 on the frame 63 and adapted to control the governor 66 so as to stop and start the motor. For convenience of manual operation the lever 76 is provided with a handle 78 at its free end, which extends up through a slot in the top of the casing 79 of the transmitter. To coöperate with the projection 75 the lever 76 is provided with a projection 80, arranged in the path of the projection 75. In the path of this projection 80 the contact-arm 73 is arranged, being preferably provided with an insulated contact-block 81. After each operation of the transmitter it comes to rest with its arm 75 in contact with the projection 80 and with the lever 76 thrown over from the position shown in Fig. 10, so that said projection is in contact with the block 81, and the arm 73 is pressed back or away from the arm 72, while the lever is thus in position to lock the motor against movement. This may be considered the normal position of the transmitter, in which case its operation is effected by moving the wheel 68 to the position shown in Fig. 10, thereby winding the spring 65, this movement of the wheel 68 having no circuit-making effect, since the circuit is broken between the arms 72 and 73. The lever 76 may be then moved to the position shown in Fig. 10, thus closing the circuit between the arms 72 and 73, and at the same time releasing the motor, which brings the wheel 68 back to its first position; but it is obvious that the wheel 68 may be turned back to the position shown in Fig. 10 after each operation and held there by the lever 76 ready for the next call. The position of the parts shown in Fig. 10 is that which they assume at the beginning of the return or effective movement of the wheel 68, the lever 76 being in release position and the wheel being assumed to be just starting on its effective stroke.

On the outer face of the top of the casing 79 there is located a metallic plate 82, containing a number of holes 83 equal to the number of instruments on the line and to the number of apertures 34 in the controlling-disk 22 of the system—in the present instance fifteen. These apertures also extend down through the cover of the casing and are adapted to receive one or more removable plugs 84, one of which is shown in position in aperture No 9 of the plug-plate 82. When one of these plugs or pins is inserted in an aperture in the plug-plate, it extends down into the interior of the transmitter and into the path of a yielding arm 85, mounted on and electrically connected with the wheel 68. The wheel 68 is further provided with a raised contact-surface 86 of considerable length, with which coöperates a resilient contact-arm 87, which does not contact with the wheel, but with which the raised contact-surface 86 engages during the rotation of the wheel as it passes under the arm 87. The arm 87 and plate 82 are electrically connected, as by means of wires 88 and 89, to a terminal or binding-post 90, which is in turn connected to an alternating-current generator of the type usually employed for ringing-circuits, said generator being grounded in the manner hereinafter described.

Between the wheel 68 and the battery-terminal 74 there is a shunt-circuit around the contacts 69 70 and 72 73, (indicated by wires 91 and 92,) said shunt-circuit being normally open, but being adapted to be closed by means of a key or push-button 93, mounted in the cover of the casing 79. The wheel 68 is electrically connected, as by the frame 63 and a wire 94, to a terminal or binding-post 95, which latter is connected to the switchboard-plug, as hereinafter set forth. The transmitter is further provided with a key 96, preferably in the form of a push-button, mounted in the cover of the casing 79 and controlling a normally open circuit by means of wires 97 and 94, the former of which leads to a terminal 99, which is connected with a grounded synchronizing-battery, as hereinafter set forth. In the diagram Fig. 11 the connection between wheel 68 and frame 63 is indicated by a line 98; but in practice the connection is from the wheel to its shaft and from the shaft-bearings to the frame.

In Fig. 12 of the drawings I have shown in the form of a diagram a central-station instrument and its connections, a local or subscriber's station instrument and its connections, including the subscriber's telephone, and so much of the intervening lines and switchboard as is necessary for a comprehension of the circuits. In this drawing the central-station instrument or transmitter is designated as a whole by the reference-letter C and the local instrument or controller is designated as a whole by the reference-letter L, the parts already described being designated by the same reference-numerals as in the figures already described. T represents the subscribers's telephone at the local station, comprising the receiver R, the transmitter *t*, the call-bell B, and local generator G. These parts are of any approved construction, since one of the features of our invention is that it is applicable to any standard bridge-telephone without any modification in the parts thereof by simply making the necessary connection. At the central station, MB represents the main battery, SB

represents the synchronizing-battery, and MG represents the main generator, which provides the alternating ringing-current. One terminal of the main battery is connected to the terminal 74 by means of a wire 100, while the other terminal of the main battery is connected by a wire 101 with the tip of the plug 102 of the transmitter. The contact-wheel 68 of the transmitter is through the terminal 95 connected by a wire 103 with the sleeve side of the plug of the transmitter. Of course the operator's telephone is suitably connected with the wires 101 and 103. The main generator has one of its terminals grounded by means of a wire 104, its other terminal being connected, through a wire 105 and the binding-post 90, to the plug-plate 82 and contact-arm 87. The synchronizing-battery has one terminal grounded by means of a wire 106, the other terminal being suitably connected, through the binding-post 99, with the wires 97 and 98, controlled by the key 96, to the binding-post 93 and line 103. The jack of the switchboard is indicated by the numeral 107, and the party-line wires leading therefrom are indicated by the numerals 108 and 109. Wires 110 and 111 lead from the line-wires to the subscriber's station instrument. A wire 112 leads from the line 111, connected to the sleeve side of the line, through the subscriber's signal-bell B, to the terminal 37 of the local controller L. From the post 37 the circuit extends through a wire 113 to the relay-magnet 44, thence by a wire 114 to the contact-arm 36. A wire 115 leads from the support 19 of the disk 22 to the binding-post 35 and thence by a wire 116 to the ground. The talking-circuit comprises a wire 117 from the wire 110 through the subscriber's telephone and thence by a wire 118 to the binding-post 42. From 42 a wire 119 extends to the contact-arm 40, with a branch 120 connected to the armature 45. From the contact-arm 39 a wire 121 leads to the binding-post 41, with a branch 122 electrically connected with the contact-screw 48. As already stated, the contact-arms 56 and 57 are respectively connected with the binding-posts 35 and 37, the latter through the coils of the relay-magnet 44. In the diagram a wire 123 leads from the arm 56 to the support 19, while a wire 124 leads from the arm 57 to the arm 36. Wires 125 and 126 lead, respectively, from the wires 108 and 109 to the binding-posts 5 and 6, which are connected with the coils of the step-up magnet 3 by means of wires 127 and 128, respectively. The local generator G has one terminal grounded by means of a wire 129, which is the only change made in the connections of the subscriber's instrument. The other terminal of the generator is connected, through a wire 130 and the wire 110, to the tip side of the main line. From the tip side of the jack 107 a wire 131 leads to a drop 132, from which a wire 133 extends to the ground. The dotted line 133[a] shows the connection between the drop 132 and the line 109 when an all-metallic circuit is employed.

With the instruments thus constructed and the circuits thus arranged let it be assumed that the subscriber at the local station wishes to call the central office. When the subscriber operates his generator, the circuit is from ground through 129, G, 130, 110, 108, 107, 131, 132, and 133 to ground again, thus operating the drop in the usual manner, calling the central operator, who inserts plug 102 in the jack 107. When the parts are in their normal position, as shown, the talking-circuit is from the subscriber's telephone through line 118, 119, 40, 39, 121, 111, 109, 107, 102, 103 and the operator's telephone, returning through 101, 102, 107, 108, 110, and 117 to the subscriber's telephone. The subscriber gives the number of his instrument and the number of the party to be called. If the party to be called is upon another line, the operator places the plug 84 in the hole in the plug-plate 82 corresponding to the number of the calling party's station. He thereupon operates the transmitter either by releasing the motor through the medium of the lever 76, if the parts are in the position shown, or first moving them to that position by means of the crank 67, thereby winding the spring 65. When the motor is released by moving the lever 76 to the position shown in Fig. 10, the wheel 68 is rotated and continues to rotate until the arm 75 comes into contact with the projection 80 and moves the lever 76 into a position such as to stop the motor through its control of the governor 66. During this rotation of the wheel 68 a series of electrical impulses are sent over a metallic circuit from the main battery as follows: through 100, 73, 72, 71, 70, 69, 68, 103, 102, 109, 126, 128 to each step-up magnet 3, returning through 127, 125, 108, 107, 102, 101 to the main battery. As each of the sixteen teeth 69 contacts with the arm 70 a current passes through the circuit just described and each step-up magnet 3 is energized, advancing each controlling-disk 22 one step through the armature 7, arm or lever 12, and pawl 13 and their associate mechanism. At the conclusion of this operation or partial rotation of the wheel 68 the projection 80 comes into contact with the projection 81 and so moves the arm 73 as to break the circuit at the transmitter. When this occurs, the disk 68 may be turned back to its original position, thus resetting the motor without affecting the controlling-disks at the subscribers' stations, since the circuit is broken between 72 and 73 and remains broken until the lever 76 is again moved to start the motor. As soon as the controlling-disks start upon their

movement of rotation the busy-signals at all of the stations are lifted into view and held in operative position until released by the central operator in the manner hereinafter described. As soon as the controlling-disks start upon their movement of rotation the talking-circuits of all of the telephones upon the party-line are immediately broken by reason of each arm 38 passing clear of the arm 39 and permitting said arm 39 to move out of contact with the arm 40. The full sixteen impulses given by the teeth of the wheel 68 cause all of the controlling-disks to stop just one step short of their original position shown in the drawings.

During the rotation of the wheel 68 the arm 85 thereof comes into contact with the plug 84 in hole No. 9 of the plug-plate. At the moment when this occurs the pin 33 of the controlling-disk 22 at the subscriber's station No. 9, which is the calling-station, is in contact with the arm 36. This closes the grounded circuit as follows: 104, main generator, 105, plug-plate 82, plug 84, arm 85, wheel 68, 103, 102, 107, 109, 111, 112 and the subscriber's bell B, 112, 113, the relay-magnet 44, 114, arm 36, pin 33, disk 22, support 19, 115, 116, to ground. This brief alternating current may produce a slight sound at the subscriber's bell B, but is not intended for signaling parties. It serves to energize the relay-magnet 44 and attract the armature 45, which immediately becomes locked by the fall of the latch 50 and closes the contact between the arms 56 and 57. The talking-circuit at the subscriber's station No. 9 is then established through 118, 119, 120, armature 45, contact-screw 48, 122, 121, 111, and thence in the manner already described. The talking- circuit remains broken, however, at all of the other subscribers' stations on the line. At the same time the ringing-circuit, which is broken as soon as the pin 33 moves from the arm 36, is established through the arms 56 and 57. As the wheel 68 continues to rotate, the contact-surface 86 thereof passes under the contact-arm 87, maintaining its contact for a considerable length of time, and the ringing-current is then established as follows: from ground at central through 104, main generator, 105, 82, 87, 68, 103, 109, 111, 112 and the subscriber's bell B, 112, 113, 44, 114, 36, 124, 57, 56, 123, 19, 115, 116 to ground. All of the other subscribers on the line now have their talking-circuits broken, only the calling subscriber being in telephonic connection with the central station, and the operator there located makes suitable connections through the usual switchboard with the party to be called. Assuming that the party to be called is upon the same line as the calling party, the operator at the same time that he inserts a plug in the number of plug-plate corresponding to the calling-party's station inserts another plug in the aperture bearing the number of the party to be called, and in this case it will be seen that the second party on the line is similarly put into telephonic communication and his bell is rung, so as to signal him and notify him that he is wanted. In case a call comes from another line for a station on the party-line the operator proceeds in the manner already described, putting the plug in the proper hole in the plug-plate and operating the transmitter so as to first cut out all parties on the line and then cut in the party to be called and ring his bell. It is understood, of course, that only the bell of the party thus called is rung, the ringing-circuit of the bells of the other stations being broken, as well at the talking-circuits, as soon as the controller-disks move from their normal position. As soon as the conversation is concluded the operator presses the button or key 93, and thus closes the shunt-circuit around the make-and-break mechanism of the transmitter. This closing of the key 93 sends a single impulse from the main battery over the metallic circuit already described through the step-up magnet 3, and thereby advances one step the ratchet-wheels 23 and disks 22. At all of the line-stations except that of the station which has just been in use the effect of this single and final advance is to cause the arms 38 to press the arms 39 down into contact with the arms 40 and again place all of the telephones in talking connection with the main office. At the station just in use, in addition to this result, the arm 38 in moving forward to this final or normal position comes into contact with the arm 55 of the latch 50 and raises said latch in such a way as to permit the spring to move the armature 45 out into its normal position. This breaks the talking-contact between 45 and 48 and also the contact between 56 and 57, restoring all of the parts to normal position, with the latch 50 resting on the armature 45, ready to again engage it when actuated to that end.

It will be observed in this connection that, while the construction and arrangement is such that only the signal-bell of the party to be called is actuated by the operator at central and only his telephone placed in operative connection, all of the other subscribers' telephones being cut out, yet it is possible for any of the other subscribers to signal the central office when the line is in use in connection with another station, since each subscriber's generator is grounded at his station and at the drop at the central station. This is of advantage in case of emergencies, where one subscriber keeps the line in use for a long time and another subscriber on the same line finds it imperative to get connection with the central office.

In practice it is found that from any one or more of a number of causes the controlling-

disks of the several stations do not always move in exact unison with each other, so that some of the disks become disarranged relatively to the others, thus effecting the accuracy of operation of the system. To remedy this defect, we have provided the synchronizing feature which has been already described and the operation of which is as follows: At any time when the controlling-disks have become disarranged or it is desirable to be assured that they are in proper relative arrangement this can be accomplished by the central operator, who closes the key 96. This establishes a grounded circuit through 104, 106, the synchronizing-battery, 97, 96, 98, 103, 102, 107, 109, 111, 112, 113, the relay-magnet 44, 114, and thence either through 36, 22, 19 and 115 to ground, or through the shunt-circuit, 124, 57, 56, 123, 19 and 115, according to the position of the parts. This strong battery-current imparts to the relay-magnet 44 power sufficient to attract and hold the synchronizing-armature 59 as long as the key 96 is kept closed. This brings the pawl or dog 62 into contact with the periphery of the controlling-disk 22 and holds it in contact therewith. Of course this operation occurs at each of the subscribers' stations along the line.

The operation of the transmitter, as hereinbefore described, serves to rotate the disks 22 to bring the pin 33 into contact with the arm 36 at each station successively, thereby closing the circuit through the magnet 44, and the alternating current passing through the same from the main generator attracts the armature 45, but not the synchronizing-armature 59. The attraction of the armature 45 closes the connection between the contacts 56 and 57, thereby completing the circuit through the magnet 44 by means of the shunt-circuit above described, and the strong current from the synchronizing-battery, which is passed though the same by closing the key 96, attracts the synchronizing-armature 59 and holds the same after the pin 33 has passed the arm 36 until the disk 22 has completed its revolution and the armature 59 at each station has been attracted. Holding the key 96 thus closed, the central operator closes and opens the key 93 a sufficient number of times to insure a sufficient rotation of all of the controlling-disks 22 to bring the notches 27 of all said disks into contact with the corresponding pawls 62. The disks will then be all in proper relative position, which position is the same as that in which they are left after each complete actuating motion of the transmitter—to wit, within one step of their normal position shown in the drawings. The operator then releases the synchronizing-key 96, which breaks the synchronizing-circuit and closes the key 93 once, thereby moving all of the controlling-disks to their normal position and placing the line in proper condition for use. This synchronizing operation consumes but a brief period of time and may be performed prior to each call, if deemed desirable.

It will be noted that, as already stated, the portion of the apparatus to be located at the subscribers' station can be used in connection with any standard bridge-telephone without in any way altering or adding to its structure, the only change in the telephone being the grounding of the generator. It will be further seen that no clock mechanism is employed and that the step-up devices rotate always in the same direction, so that the step-up magnet does not have to work against a spring or other "fly-back" device to return the disks to their normal position. Furthermore, all polarized magnets and reversing of currents are done away with, and the central-operator's work in selecting, calling, talking, and synchronizing is done over the usual two-wire circuit by the use of the usual main battery and main generator, operating, respectively, over a metallic circuit and a grounded circuit, in conjunction with a synchronizing-battery at the central station, operating over the same grounded circuit as the main generator.

While we have described a construction constituting one embodiment of our invention, we do not wish to be understood as limiting ourselves to the particular embodiment chosen for purposes of illustration or to the particular details of construction hereinbefore described and shown in the accompanying drawings, as it is obvious that the invention may be embodied in other forms and that the details may be varied without departing from the principle of our invention.

Having thus fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a telephone system, the combination, with a central station, a metallic circuit including a source of direct current, and local stations having their instruments in said circuit, of a make-and-break device in said circuit at the central station, a step-up magnet in said circuit at each local station, a controlling device at each local station actuated by said step-up magnet, said controlling devices normally closing the talking-circuits and opening the same when moved from normal position, an alternating-current generator connected through one side of said circuit to ground at the central station and at each local station, said ground connections being through the local-station calling-signals, the controlling devices being provided with selective means for successively closing said ground connections at the local stations, separate and normally open shunt-circuits at each local station for the talking-circuit and

ground connection, a relay-magnet in each local ground connection for closing both of said shunt-circuits, said relay-magnet being operated by the alternating current from said generator and means at the central station for there closing the generator-circuit simultaneously with the closing of the ground connection of the selected local station, substantially as described.

2. In a telephone system, the combination, with a central station, a metallic circuit including a source of direct current, and local stations having their instruments in said circuit, of a make-and-break device in said circuit at the central station, a step-up magnet in said circuit at each local station, a controlling device at each local station actuated by said step-up magnet, said controlling devices normally closing the talking-circuits and opening the same when moved from normal position, an alternating-current generator connected through one side of said circuit to ground at the central station and at each local station, said ground connections being through the local-station calling-signals, the controlling devices being provided with selective means for successively closing said ground connections at the local stations, separate and normally open shunt-circuits at each local station for the talking-circuit and ground connection, a relay-magnet in each local ground connection for closing both of said shunt-circuits, said relay-magnet being operated by the alternating current from said generator and means at the central station for there closing the generator-circuit simultaneously with the closing of the ground connection of the selected local station to actuate the relay-magnet thereof to close the shunt-circuits, and for subsequently automatically closing the generator-circuit to actuate the calling-signal of said local station, substantially as described.

3. In a telephone system, the combination, with a central station, a metallic circuit including a source of direct current, and local stations having their instruments in said circuit, of a make-and-break device in said circuit at the central station, a step-up magnet in said circuit at each local station, a controlling device at each local station actuated by said step-up magnet, said controlling device normally closing the talking-circuits and opening the same when moved from normal position, an alternating-current generator connected through one side of said circuit to ground at the central station and at each local station, said ground connections being through the local-station calling-signals, the controlling devices being provided with selective means for successively closing said ground connections at the local stations, separate and normally open shunt-circuits at each local station for the talking-circuit and ground connection, a relay-magnet in each local ground connection for closing both of said shunt-circuits, said relay-magnet being operated by the alternating current from said generator, means for locking said shunt-circuits in closed position, means at the central station for there closing the generator-circuit simultaneously with the closing of the ground connection of the selected local station, and means at the central station for moving the controlling devices at each local station to normal position, said controlling devices being provided with means for unlocking the shunt-circuits upon their return to normal position, substantially as described.

4. In a telephone system, the combination, with a central station, a metallic circuit including a source of direct current, and local stations having their instruments in said circuit, of a make-and-break device in said circuit at the central station, a step-up magnet in said circuit at each local station, a controlling device at each local station actuated by the said step-up magnet and comprising a rotating member, said controlling devices normally closing the talking-circuits and opening the same when moved from normal position, an alternating-current generator connected through one side of said circuit to ground at the central station and at each local station, said ground connections being through the local-station calling-signals, the controlling devices being provided with selective means for successively closing said ground connections at the local stations, normally open shunt-circuits at each local station for the talking-circuit and ground connection, a relay-magnet in each local ground connection provided with an armature controlling both of said shunt-circuits, said armature being actuated by the alternating current, said relay-magnet being provided with a second armature which is unaffected by the alternating current, said second armature being provided with means for engaging and holding the rotating member of the controlling device in a predetermined position, means at the central station for there closing the generator-circuit simultaneously with the closing of the ground connection of the selected local station, a second battery adapted to so energize the relay-magnet as to operate the second armature, said second battery being connected to ground through the same side of the metallic circuit as the generator at the central station and at each local station, and means at the central station for closing the grounded circuit which includes the second battery, substantially as described.

5. In a telephone system, the combination, with a central station, a circuit including a source of direct current, and local stations having their instruments in said circuit, of a circuit-breaking device located in said circuit and provided with a number of con-

tacts greater than the number of local stations on the line, a step-up magnet in said circuit at each local station, a controlling device at each local station comprising a circuit-controlling member rotatable in one direction only, a pawl-and-ratchet mechanism whereby said step-up magnet actuates said controlling member, the ratchet being provided with a number of teeth greater than the number of contacts of the central circuit-breaking device, whereby, when said circuit-breaking device at the central station makes a complete operative movement, all of the controlling devices are moved beyond their circuit-closing positions, and means at the central station for closing said circuit, after the circuit-breaking device has operated, to advance the controlling devices at the local stations to their normal positions, substantially as described.

6. In a telephone system, the combination, with a central station, a metallic circuit, and local stations having their telephones in said circuit and calling-signals connected to one side thereof, said metallic circuit including a source of direct current and transmitting and selecting devices at the central and local stations respectively, one side of said metallic circuit being connected with an alternating-current generator and grounded at the central and local stations to operate the local-station signals, of a generator at each local station connected to ground and to the other side of the metallic circuit, said other side of said metallic circuit being connected at the central station through a calling-drop to ground, substantially as described.

7. In a controlling instrument for party-line telephones, a controlling member rotatable in one direction only, provided with selective means to close the signaling-circuit, and having a part which closes the talking-circuit only when the member is in normal position, and an electromagnet in the signaling-circuit provided with means for closing the talking and signaling circuits, said part serving to open said talking and signaling circuits when the controlling member returns to normal position, substantially as described.

8. In a controlling instrument for party-line telephones, a controlling member, and means for imparting thereto an incomplete step-by-step rotatory motion in one direction, said member having a selective contact to close the signaling-circuit and a part which closes the talking-circuit when the member is in normal position, an electromagnet in the signaling-circuit provided with means for closing the signaling and talking circuits, a latch for holding said circuits closed, said part acting to trip the latch upon the return of the controlling member to normal position, and means for completing the rotation of the disk, substantially as described.

9. In a controlling instrument for party-line telephones, a controlling member having a selective device to close the signaling-circuit, and means for closing the talking-circuit when in normal position, separate normally open shunt talking and signaling circuits, and an electromagnet in the signaling-circuit provided with means for closing said shunt-circuits when the signaling-circuit is closed by the controlling member, said controlling member having means for opening the shunt-circuits upon its return to its normal position, substantially as described.

10. In a controlling instrument for party-line telephones, an electromagnet located in a grounded circuit, an alternating-current generator and a direct-current battery, and means for connecting either said generator or said battery with said circuit, said magnet being provided with an armature actuated by the alternating current, and with a second armature actuated only by the battery-current, a rotating controlling member and means actuated by said second armature for arresting the controlling member in a predetermined position, substantially as described.

11. In a telephone system, the combination, with a central station, a metallic circuit including a source of direct current and local stations having their instruments in said circuits, of a make-and-break device in said circuit at the central station, a step-up magnet in said circuit at each local station, a controlling device at each local station actuated by said step-up magnet, said controlling device normally closing the talking-circuits and opening the same when moved from normal position, an alternating-current generator connected through one side of said circuit to ground at the central station and at each local station, said ground connections being through the local-station calling-signals, the controlling device being provided with selective means for successively closing said ground connections at the local stations, separate normally open shunt-circuits at each local station for the talking-circuit and ground connection, a relay-magnet in each local ground connection for closing both of said shunt-circuits, and means at the central station for there automatically closing the generator-circuit simultaneously with the closing of the ground connection of the selected local station, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

CHARLES L. CARR.
THADDEUS P. CARR.

Witnesses:
E. O. HAGAN,
IRVINE MILLER.