

F. M. SLOUGH.
ELECTRICAL DEVICE.
APPLICATION FILED NOV. 8, 1915.

1,248,566.

Patented Dec. 4, 1917.
2 SHEETS—SHEET 1.

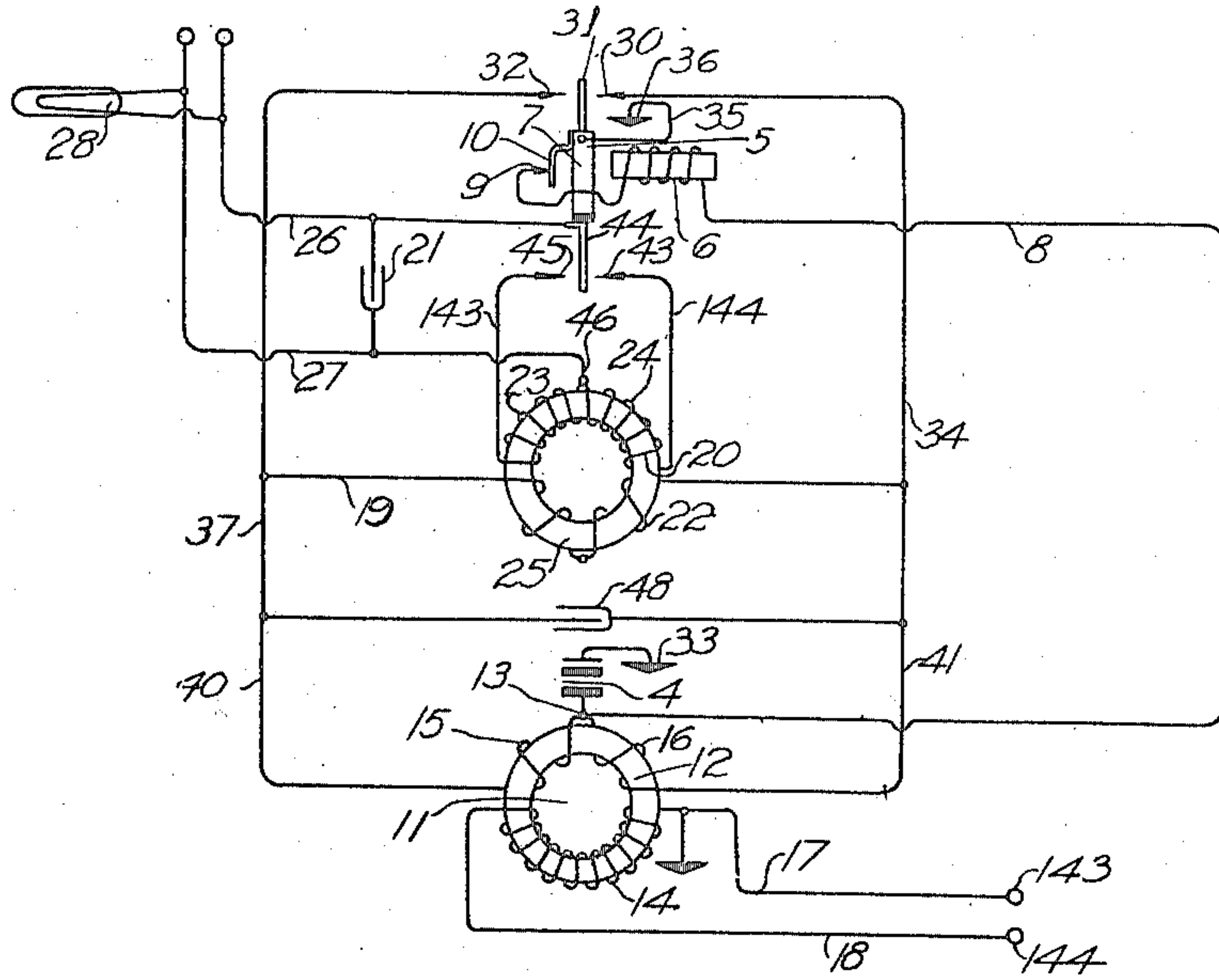


Fig-1

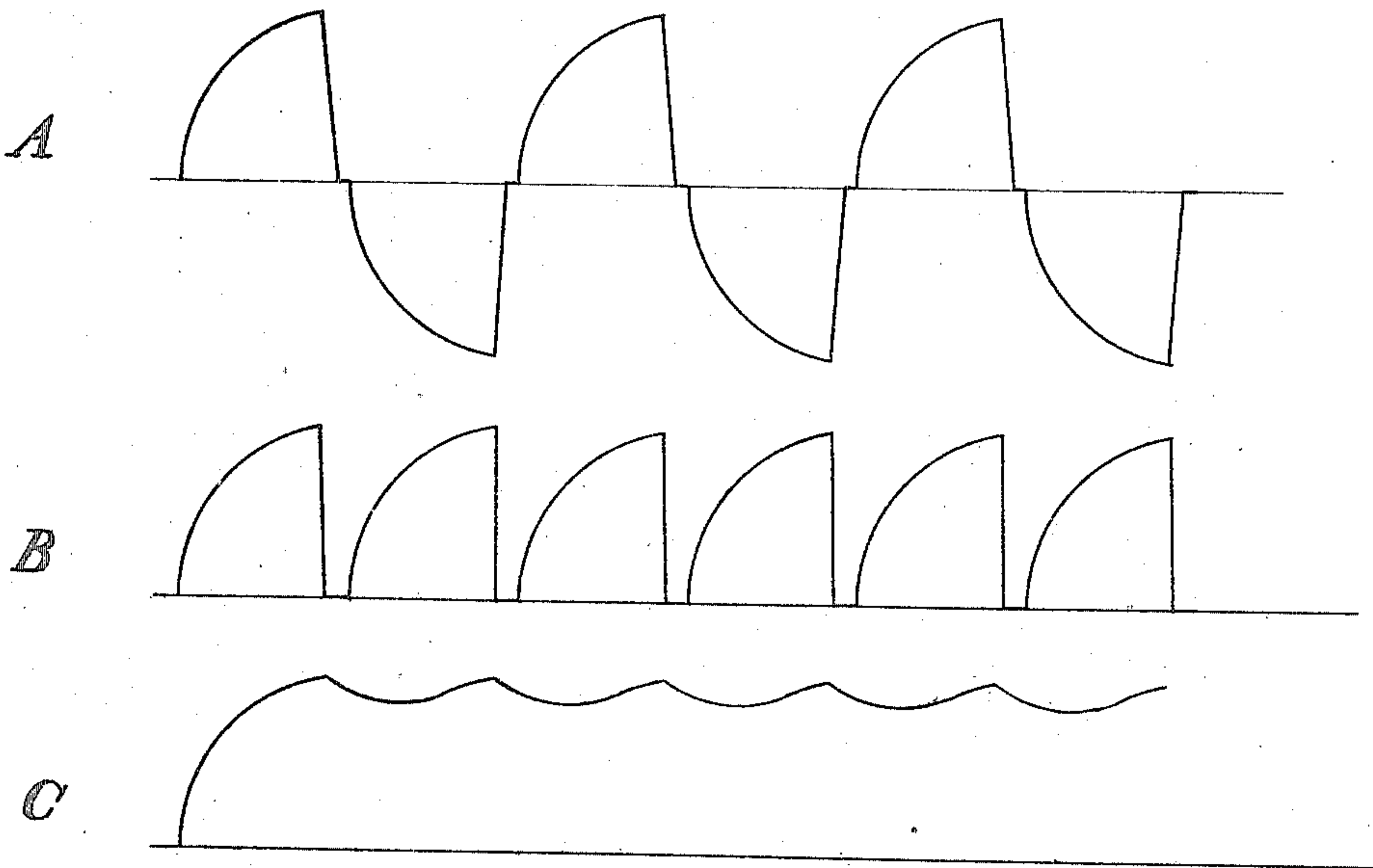


Fig-2

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2 SHEETS—SHEET 2.

Fig-3

Fig 4

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ELECTRICAL DEVICE.

1,248,566.

Specification of Letters Patent.

Patented Dec. 4, 1917.

Original application filed May 13, 1915, Serial No. 27,747. Divided and this application filed November 8, 1915. Serial No. 60,224.

To all whom it may concern:

Be it known that I, FRANK M. SLOUGH, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Electrical Devices; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to signaling systems and I aim to produce from a single source the various kinds of current employed in certain signaling systems. For example, by my invention I produce from a single source of low voltage direct current and employ in a signaling system both alternating current and direct current of higher voltage than the voltage of said source.

My invention is of especial use in connection with telephone signaling systems now pretty generally in use, where automatic ringing is employed. In such systems the ringing apparatus is automatically disconnected through the manipulation of the talking apparatus at the sub-station, when the subscriber responds, and unless the current is of a higher voltage than that ordinarily employed in the system for other purposes, the disconnection is sometimes a failure. By thus increasing the voltage from the source, I am enabled to insure a positive operation of the disconnect apparatus, without delicate adjustments or other objectionable and marginal safeguards. Moreover, my invention enables me to utilize the current from the common battery employed in the system and to utilize the portions of the pole changes already in use in the system, so that I can accomplish these desirable objects with the addition of but little mechanism to that which is practically always installed in exchanges where my invention finds its greatest use.

I also provide a novel connecting circuit, here illustrated as a cord circuit, whereby a calling subscriber's telephone may be connected to a called subscriber's telephone, such connecting circuit containing certain novel features incidental to the making of such connection, incidental to the breaking of such a connection, and to the recording

of the number of connections established by any operator by the means of such a cord circuit. Other features of this connective cord circuit relate to the signals involved, the connecting and disconnecting of the operator's telephone from the cord circuit during the act of making the connections required, the applying of the ringing current to the called line and its disconnection, these different operations being performed partly automatically and partly by the manual acts of the operator and the manual acts of the subscriber.

This application is a division of my application No. 27,747, filed May 13th, 1915.

Other objects of my invention and the invention itself will probably be better understood from a description of embodiments of my invention.

Figure 1 shows in detail the device by which the voltage of the current is changed.

Fig. 2 illustrates diagrammatically certain forms of current waves.

Fig. 3 illustrates diagrammatically a telephone system embodying my invention.

Fig. 4 illustrates a modification of the embodiment shown in Fig. 1.

To better explain my invention, I will refer first to the device illustrated in Fig. 1, where at 4 is shown a source of uni-directional, continuous current of a certain electro-motive force. At 5 is shown a circuit breaker, here including an electromagnet 6 and a vibratory member 7 which may consist of a reed and serve as the armature of the electromagnet 6. The electromagnet 6 is connected in a circuit including a conductor 8, the source of current 4 and a switch 9—10 controlled by the electromagnet. At 11 is shown a transformer consisting of a core 12 and a plurality of windings 13 and 14, the primary winding 13 being broken up into two windings 15 and 16. Each of the windings 15 and 16 is connected in a circuit including the source 4 and a switch controlled by the circuit breaker. The winding 14 is connected in a secondary circuit including the conductors 17 and 18.

The transformer which I have described is adapted to convert the intermittent current in the primary into alternating current in the secondary. Each of the windings 15 and 16 is also a secondary to the other of

said windings, and each is connected in a secondary circuit including the conductor 19. An alternating current will course through the conductor 19 and means is provided for converting the alternating current therethrough into uni-directional, continuous current. This means may include a transformer 20. The transformer 20 comprises a primary winding 22 in the conductor 19 and a secondary winding, here shown as two coils 23 and 24 connected upon the core 25 of the transformer. The secondaries 23 and 24 are connected to the conductors 26 and 27. The condenser 21 is bridged across these conductors and the conductors are connected to some electro-responsive device, such as a lamp 28.

The operation of the device illustrated in Fig. 1 is as follows: When the circuit, including the source 4 and the electromagnet 6, is closed, as illustrated in the drawing, the magnet 6 will be energized, attracting the member 7 and interrupting its own circuit at 9 and 10. When the circuit is interrupted, the reed will draw the member 7 back and close the circuit. This making and breaking of the circuit will continue in a well known manner at a periodicity determined by the natural rate of vibration of the member 7. At the same time, switches 30—31 and 31—32 will be opened and closed with the same frequency. When the switch 30—31 is closed, a circuit will be completed through the winding 16 as follows: ground 33—battery 4—winding 16—conductor 34—switch 31—30—conductor 35—ground 36, and when the switch 31—32 is closed, a similar circuit will be completed through the winding 15 and conductor 37, causing an intermittent current to flow through the winding 13 and inducing an alternating current in the winding 14 and the circuit including the conductor 17 and 18, according to a well known electrical principle. Moreover, each time the current flows through one of the windings 15 or 16, a current will be induced in the circuit, including both of these windings, the conductors 40, 41 and 19, and the winding 22 of the transformer 20. Alternating current will thus be induced into a circuit including the winding 22, in the form shown, of a voltage approximately twice as high as the voltage of the source 4.

The wave form of the current flowing through the circuit, including the winding 22, is illustrated at A in Fig. 2. Of course, it will be understood that this form may be varied according to the electrical constants of the circuits involved. The alternating current in the winding 22 will induce an electro-motive force into the windings 23 and 24, alternating from positive to negative polarity, such alternations being synchronous with the impressed pulsations of current through the primary windings 15

and 16. No current will flow through the circuits including these windings, except when the switches controlled by the magnet 6 in said circuit are closed. The contact 44 being carried upon the same reed as the contact 33 in the primary circuit, the contacts 44, 45 will be closed at the same time as the contacts 31, 32 in the primary circuit are closed. Also, whenever the contact 44 contacts with the contact 43, the contact 31 would also contact with the contact 30, there being exact synchronism between these sets of contacts as to their time of contact. Whenever, therefore, the circuit is closed between the contacts 31 and 32 in the primary circuit, the current flow from the positive to the negative pole of the source 4 will be in such a direction through the transformer winding 15 that an electro-motive force will be induced across the winding 23 of the transformer 20, the positive pole of which will be the point 46 intermediate of the two windings 23 and 24 and the negative pole of which will be the contact 45. This would cause the connector 26 to be of negative polarity and the conductor 27 of positive polarity. Again, when the vibrator contacts have advanced to the reversed position, namely, when the contact 31 is in contact with the contact 30, the direction of the current flow from positive side 36 of the source of current 4 would be such through the winding 16 of the transformer as to induce an electro-motive force across the winding 24 of the transformer 20, in which case again the point 46 would be the positive pole and the contact 43 would be the negative pole. Therefore, with the contacts 44 and 31 vibrating toward and from the magnet 6 in synchronism, uni-directional impulses of electro-motive force will be applied to the conductors 26, 27, the conductor 26 being the negative pole of the resultant electro-motive force and the conductor 27 being the positive pole. These uni-directional impulses of current charge the condenser 21 which is permanently connected across the conductors 26 and 27, this condenser in turn maintaining the electro-motive force, and causes it to be continuous, as shown at C of Fig. 2, rather than interrupted, as shown at B in Fig. 2, which would be the character of current induced were the condenser absent.

I may also provide a condenser 48 bridged across the vibrator contacts 30, 31 and 32 to suppress the sparking at these contacts and to assist in the production of a smooth waved current. The condenser 21, besides having the function previously described, has the additional function of preventing sparking at the contacts 43, 44 and 44, 45. It will be understood that the number of turns in the windings may be varied to produce any desired relation between the currents and electro-motive forces produced in the

various circuits. The windings 15, 16, 23 and 24 may all be placed upon the same core, if desired. The device illustrated in Fig. 1, thus modified, is shown in Fig. 4.

5 I show in Fig. 3 an embodiment of my invention. At A is shown a main station of a telephone system and at B, a telephone line. As is well understood, in practice a number of these lines lead to the main station and means are provided for connecting the lines together, such as a cord circuit. At C I have illustrated such portion of the cord circuit as I deem necessary to explain my invention. The line shown at B is what is
10 known as a party line, and is provided with a plurality of substations illustrated at D, E, F and G. I have illustrated the apparatus at one of these stations alone, though it is well understood that each station is
15 provided with signaling apparatus and talking apparatus. At 51 is shown such a signaling instrument as a bell, and at 52, a condenser in series therewith, both being bridged across the line. At 53 is shown a switch hook, at 54 a transmitter and at 55 a receiver, also bridged across the line. The line limbs are shown at 56 and 57, which lead to the main station.

At the main station switching means H
30 are provided for connecting the line and cord together and here consist of a jack J and a plug P, the line limbs terminating upon contacts of the jacks. A line signal 58, a line relay 59 and a cut-off relay 60 are
35 associated with the line B at the main station, in a well known manner. The plug is provided with contacts to cooperate with the contacts of the jacks, and the plug contacts are connected to conductors in the cord
40 circuit. The signal current producing apparatus is shown at K, K₁, K₂ and K₃. Means are provided for connecting the apparatus at K to the line, including suitable conductors, a ringing key L, a master key M
45 and a relay N. Means are provided for disconnecting the ringing current, which includes a relay O.

When it is desired to signal a substation, say the substation G, the plug P is inserted
50 into the jack J. A circuit is completed through the winding of the relay X, through the ground at 74, including the battery 75, contacting terminals of the plug and jack switch H, and cut-off relay 60, which latter
55 is energized, attracting its armatures and disconnecting the line signaling relay 59. The relay X is energized attracting its armature and closing a switch 129. This switch being closed, the lamp 62 will be lighted,
60 indicating to the operator that the called for subscriber's apparatus is in normal condition. The relay R which is controlled by the calling subscriber's apparatus, not shown, will have closed a switch 64—65.
65 After the insertion of the plug, the key L

is operated, at the same time operating the master key M and completing a circuit for the relay N as follows: ground at 70—contacts of M—conductor 71—relay N—conductor 72—contacts 63—73—contacts 64—
70 65, and contacts 129 to ground at 74 through the battery 75. The relay N will be operated, pulling down the armature 76 and completing a locking circuit for the relay N through the contacts 76—77. The relay N
75 will also attract the armatures 78 and 79, interrupting the strands of the cord circuit at 78—80 and 79—81 and completing the ringing circuit through the contacts 78—82 and 79—83. The circuit of the ringing current
80 will then be as follows: from ground at 90—through the secondary 14 of the transformer 11—through the periodically closed contacts of the interrupter 132—thence
85 through the contacts of the ringing key L—through the conductor 91—the winding of the relay O—contacts 82 and 78—over the line through the signal 51 at the substation—through the contacts 79—83—the conductor 92—the continuously charged con-
90 denser 21—the conductor 99—the battery 94—to ground at 95. The relay O is so constructed as to be insensitive to alternating currents, and if operated by these alternating
95 currents, only closes its contacts in a rapidly intermittent manner, the contacts not being closed long enough to deenergize the electromagnet of the relay N; during the ringing
100 period or until the time when the subscriber at G responds, alternating current will be thus applied through the relay O to the called line, ringing the bell intermittently. However, as soon as the subscriber at G
105 responds and completes the shunt through the switch 53 and the bridge of his substation set, of the signal bridge at said substation, there will be placed upon this circuit not only alternating signaling current, but also
110 uni-directional, continuous current from the apparatus illustrated at K, and the direct current of the battery 94 will cause the actuation of the relay O, which will attract
115 its armature 200 and complete a shunt 201 of the relay N for a sufficient interval to cause the deenergization of the same. As soon as N is deenergized, the armatures 78 and 79 will return to the positions illustrated in the drawing, thereby disconnecting the ringing current from the line.

I have in the lower right-hand corner of
120 Fig. 3 shown a symbolic representation of a magneto line and a portion of a cord circuit with which apparatus my invention may be employed, as will be understood from the previous descriptions.
125

As explained in connection with Fig. 1, the current taken from the device K is of a character suitable for causing the actuation of the relay O and is preferably of
130 higher voltage than the current from the

common source used in common battery systems and is preferably added to it, thus always insuring the action of the relay O, no matter how long the line be, or how many stations are on the same. With modern systems which employ the voltage of the common battery source, there is frequently trouble, due to the failure of such current to cause the actuation of relay O at the desired time, and consequently to insure successful operation of such systems, the length of the lines, as well as the number of substation thereon, are frequently limited. Long lines, as well as lines to which many substations are connected, are found, especially in small exchanges where it is most inconvenient to secure high voltage current. By the use of my invention, I provide means for successfully handling the automatic ringing in connection with such lines and utilize the sources of current which are ordinarily employed in such exchanges, at the same time discarding delicate adjustments and uncertain marginal safeguards.

It will be readily understood that my invention is capable of other uses, and that many variations may be made both from the modification illustrated and from the details thereof, without departing from the spirit of the invention.

I claim:—

1. In a telephone system, the combination of a main station, a substation, a telephone line leading from the substation to the main station, a substation set at the substation, including signaling and talking apparatus, signals at the main station, a common source of current for furnishing current to operate the signals at the main station and for talking purposes, means at the main station for operating the signal at the substation, a separate source of current for supplying current to operate the signal at the substation, automatic disconnect means for disconnecting said last named source from a telephone line controlled by the talking set of a subscriber, and means at the main station to increase the voltage of said last named source of current, and a circuit for connecting said last named means to the automatic disconnecting means.

2. In a telephone system, the combination of a main station, a substation, a telephone line leading from the substation to the main station, talking apparatus and signaling apparatus at the substation, signal devices at the main station, a source of current for supplying current for talking purposes and for operating the signals at the main station, means for actuating the signal at the substation, automatic disconnect mechanism for disconnecting said last named means from the substation, said disconnect means controlled by the talking apparatus at the substation and apparatus for operating said

disconnect mechanism, including said source of current and mechanism for increasing the voltage of the current therefrom.

3. In a telephone system, the combination of a main station, a telephone line leading to the main station, a substation set on the telephone line including talking apparatus and signaling apparatus, a source of current at the main station for talking purposes, apparatus for operating the signaling apparatus at the substation, mechanism controlled by the talking apparatus at the substation for disconnecting said substation signal operating apparatus from the substation signal apparatus, a circuit for said mechanism including said source of current and means in said circuit to increase the voltage of the current from said source.

4. In a telephone system, the combination of a main station, a telephone line leading to the main station, a substation set on the telephone line including talking apparatus and signaling apparatus, a source of current at the main station for talking purposes, apparatus for operating the signaling apparatus at the substation, mechanism controlled by the talking apparatus at the substation for disconnecting said substation signal operating apparatus from the substation signal apparatus, a circuit including said telephone line and means in said circuit to increase the voltage of the current from said source.

5. In a telephone system, the combination of a main station, a telephone line leading to the main station, a substation set on said telephone line including talking apparatus and signaling apparatus, a source of current, means to connect the source of current to the telephone line, means controlled by the talking apparatus at the substation for automatically disconnecting said source from said line, circuit connections for said source, including said line, apparatus in said connections for converting current from said source into alternating current of a higher voltage than the current from said source and means including said last named means for converting current from said source into continuous, uni-directional current of a higher voltage than the voltage from said source, said alternating current operating the signaling apparatus at the substation and said higher voltage, uni-directional, continuous current operating said disconnect apparatus.

6. In an electric system, the combination of an electric circuit, including an electro-responsive device, means for impressing upon said circuit a composite electro-motive force, said composite electro-motive force consisting of a plurality of superposed electro-motive forces of different characteristics, a source of electrical energy, apparatus for producing from said source an electro-motive force of a certain characteristic, and

apparatus including said first-named apparatus for producing from said source an electro-motive force of a different characteristic from that produced by the first named apparatus.

7. In an electric system, the combination of an electric circuit, including an electro-responsive device, means for impressing upon said circuit a composite electro-motive force, said composite electro-motive force consisting of a plurality of superposed electro-motive forces of different characteristics, a source of electrical energy, apparatus for producing from said source an electro-motive force of a certain characteristic, apparatus including said first-named apparatus for producing from said source an electro-motive force of a different characteristic from that produced by the first named apparatus, and means for connecting and disconnecting the electro-motive forces produced by said apparatus from said circuit.

8. In an electric system, the combination of an electric circuit, a plurality of electro-responsive devices in said circuit each responsive to an electric current of a different characteristic from that to which the other is responsive, a source of energy, apparatus for converting the current from said source into current of a character to which one of said devices is responsive, second apparatus including said first apparatus for converting the current from said source into current of a character to which said second electro-responsive device is responsive, and means for impressing current from each of said apparatuses upon said line contemporaneously.

9. In an electric system, the combination of an electric circuit, an electro-responsive device in said circuit responding to a current of a particular characteristic, a second electro-responsive device in said circuit responding to a current of a different characteristic, said second electro-responsive device controlling the continuity of said circuit,

a source of current, apparatus for converting current from said source into current of a characteristic to which said first named device is responsive, and apparatus including said first named apparatus for converting current from said source into current of a character to which said second named device is responsive.

10. In a telephone system, the combination of a circuit, a subscriber's talking set in said circuit, a subscriber's signal in said circuit, said signal responding to a current of a certain characteristic, an electro-responsive device in said circuit responding to a current of a certain and different characteristic, said electro-responsive device controlling the continuity of said circuit, a source of current, apparatus to convert current from said source into current adapted to operate the signal at the substation, apparatus including said first named apparatus for converting current from said source into current of a character adapted to operate said electro-responsive device, and means controlled by the subscriber's talking set for conditioning said circuit for the operation of said electro-responsive device by current from said last named apparatus.

11. In a telephone system, the combination of a circuit, a subscriber's talking set in said circuit, a subscriber's signal in said circuit responding to alternating current, a disconnect relay in said circuit responsive to a current of a different character, a source of current, apparatus to convert current from said source into alternating current to operate the signal at the substation, mechanism including a part of said apparatus for converting current from said source into current of a character adapted to operate said relay and means controlled by the subscriber's talking set for conditioning said circuit for the operation of said relay by the current from said mechanism.

In witness whereof, I have signed my name this 2nd day of November, 1915.

FRANK M. SLOUGH.