

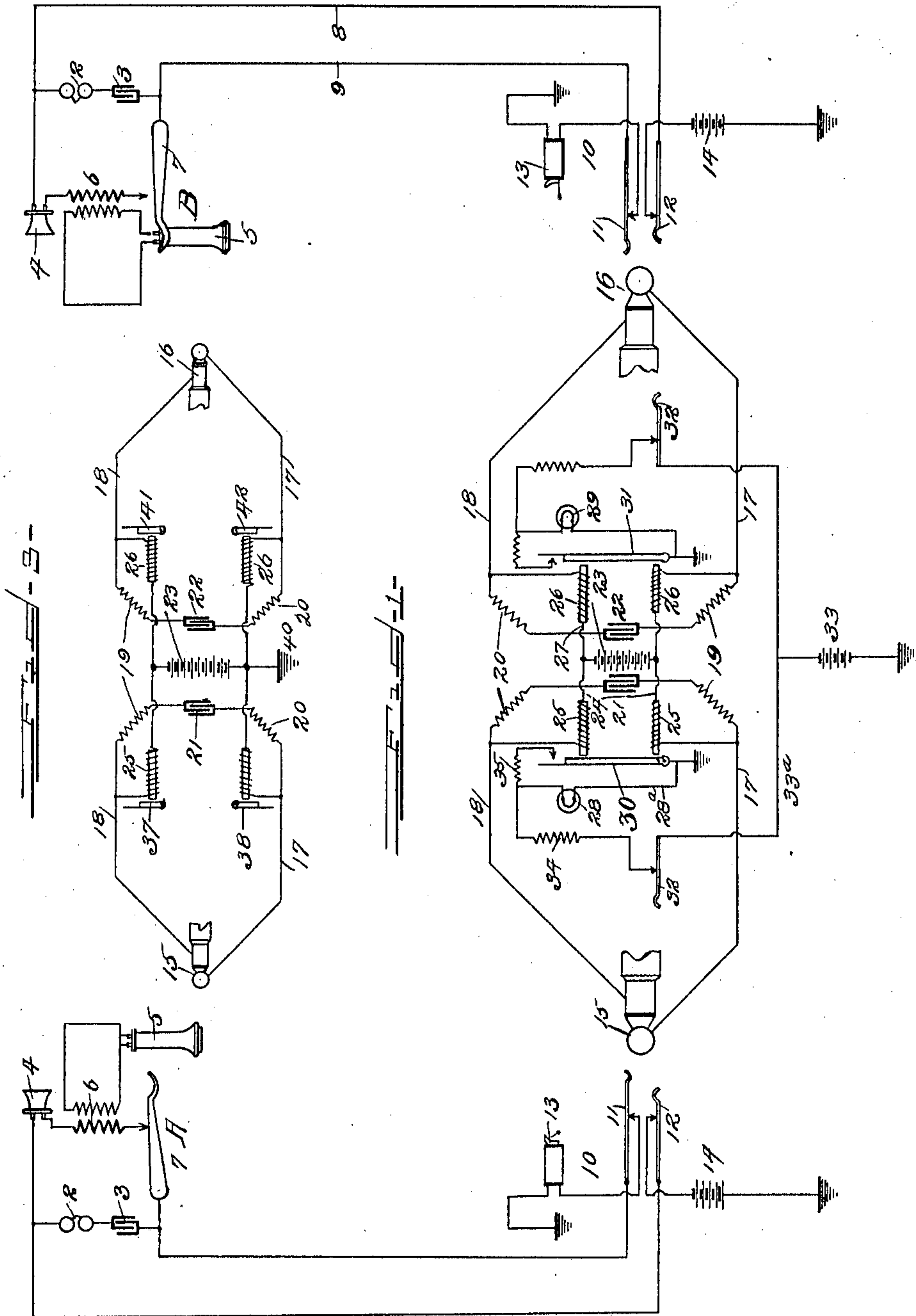
H. P. CLAUSEN.
TELEPHONE SYSTEM.

APPLICATION FILED MAR. 23, 1901.

Patented Aug. 13, 1912.

2 SHEETS—SHEET 1.

1,035,157.



WITNESSES

J. B. Weir
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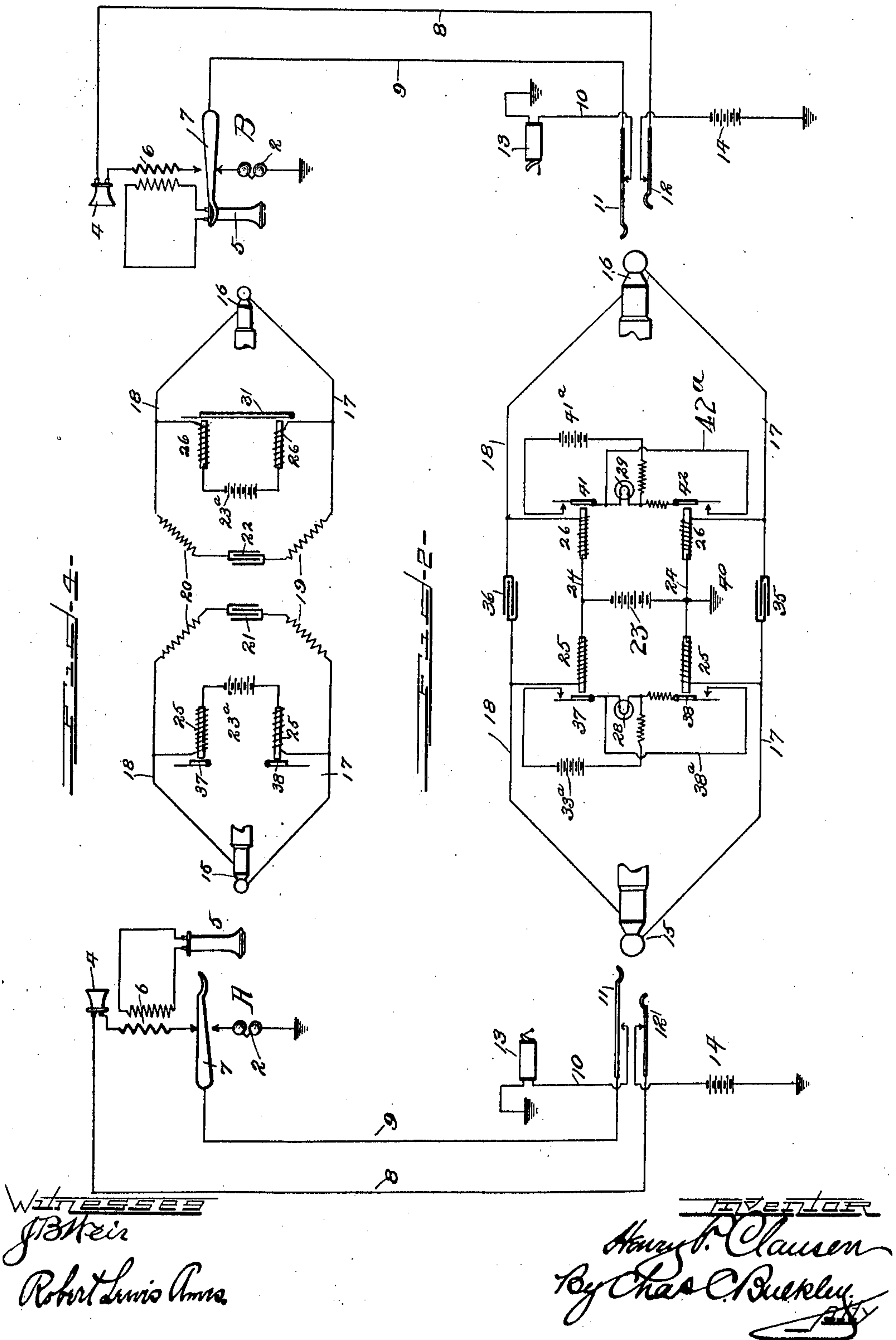
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UNITED STATES PATENT OFFICE.

HENRY P. CLAUSEN, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

1,035,157.

Specification of Letters Patent.

Patented Aug. 13, 1912.

Application filed March 23, 1901. Serial No. 52,480.

To all whom it may concern:

Be it known that I, HENRY P. CLAUSEN, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems and has special reference to those systems employing central sources of current supply.

It has for its objects the provision of improved central office apparatus and arrangements, whereby an even distribution of current to the several substations is obtained, and at the same time all the advantages of modern apparatus and improved methods are retained.

To the accomplishment of these and such other objects as may hereinafter appear, the invention consists in a system having the usual or any preferred arrangement of subscribers' or substation apparatus adapted for use in connection with a central source of current supply, line conductors extending from the substations to the central office and there connected as desired through line signals or annunciators with a source of current, and operators' connective means at the central office for connecting the subscribers' lines together for conversational purposes, the said connective means being inductively continuous to allow the passage of the fluctuations of current due to conversation, or "voice currents" as they are called, but are conductively discontinuous to prevent the passage therethrough of steady current. More specifically stated, the operators' connective means or cord circuit may be said to comprise two halves corresponding to each plug connected therewith, each half being connected through retardation coils with a central source of current or with the same source, and the two halves being joined together inductively as by condensers, repeating coils, or both, whereby the conversational currents are confined by reason of the retardation coils to the latter path, and the said coils are of such resistance that only the desired amount of battery current is allowed to flow out over the lines to the connected substations.

My invention also comprehends the use of such retardation coils as relays for any desired purpose, as, for example, to control

the operation of supervisory signals associated with the said cord circuits.

The invention further consists in the construction, arrangement, and combinations hereinafter described and particularly pointed out in the claims, reference being had to the accompanying drawings forming a part hereof, in which the same reference characters represent like parts throughout the several views, and in which,

Figure 1 is a diagrammatic view of two subscribers' lines terminating at a central office, and an operator's connective means thereat. Fig. 2 is a similar view showing condensers in the connective means to inductively connect the two parts, ends, or halves thereof, instead of repeating coils. Fig. 3 is also a diagrammatic view of an operator's cord-circuit similar to that of Fig. 1, but employing an armature for each of the retardation coils after the manner of Fig. 2, showing a modification of the invention; and Fig. 4 is a like view of a cord circuit showing two batteries instead of one, and the use of one armature for both coils or one for each.

Referring to Fig. 1, the subscribers' stations A and B are provided with the ordinary or desired apparatus used in connection with central sources of current supply, and, as shown, may comprise a bell 2 and a condenser 3 in a bridge of the line-circuit at the substation; a transmitter 4 in series in the line, together with the primary end of the induction coil 6; a receiver 5 and the secondary coil of the induction coil 6 and the telephone hook 7 adapted to open or close the line circuit through the transmitter; all of this apparatus being, as stated, of the usual or desired arrangement. From the substations, line conductors 8 and 9 lead to the central office and there terminate in spring-jacks 10 having tip and sleeve contact springs 11 and 12 which are normally connected through their resting contacts with the line annunciators or signals 13 and line signal batteries 14 to ground.

The operator's connective means at the central office comprises a cord-circuit having a pair of plugs 15 and 16 and known respectively as the answering plug and its connecting plug, the tips and sleeves of which are connected by the strands 17 and 18 and are adapted to engage with the correspond-

ing springs in the line jacks 10 in the usual way. These cord-circuits each comprise two halves, ends, parts or sections, connected with the plugs and being inductively connected, as by means of repeating coils 19 and 20, to permit the ready passage of fluctuating or voice currents. As shown in the drawings, this is accomplished by connecting the strands 17 and 18 belonging to the answering plug 15 through one winding of the repeating coil 19, the condenser 21, and a winding of the repeating coil 20. The other section of the cord-circuit is likewise completed through a winding of repeating coil 19, the condenser 22, and the other winding coil 20. This arrangement provides an inductive union or continuation of the two sections of the cord circuit, and one that is conductively discontinuous. Voice or fluctuation currents are thus enabled to readily pass from one section to the other.

In order to furnish current to the substation transmitters when the plugs are inserted in the jacks, a central source of current 23, which may be a storage battery, is provided which is connected by conductors 24 through retardation or impedance coils 25 to the cord circuit strands 17 and 18 connected with the answering plug 15; corresponding branches 27 leading from the said battery 23 to the strands 17 and 18, connected with plug 16, and including the impedance coils 26. These coils 25 and 26 are so constructed as to allow the proper amount of current to pass to successfully operate the substation transmitters and to prevent the passage of fluctuating or voice currents.

Supervisory signals associated with each plug are provided for the cord-circuit and are controlled by armatures 30 and 31 in shunts thereof, which are in turn subject to the influence of current in the line, the latter being determined by the position of the telephone hooks at the substations when the plugs are connected with the lines. Plug seat switches 32 are provided for each of the plugs 15 and 16, in the supervisory lamp circuits whereby the same may be extinguished during the normal condition of the system when the cord circuit is entirely disconnected and the plugs are in their seats. A battery 33 furnishes current to the said supervisory lamps, and resistances 34 and 35 are inserted in the main and shunt lamp circuits to adapt the currents to the lamps; and to prevent its waste when the shunt is closed.

In operation, the subscriber A removes his receiver from the telephone hook, which closes the line circuit therethrough and through the transmitter and primary winding of the induction coil, and over the line-conductors 8 and 9 to the line-signal 13 and battery 14 at the central office. The opera-

tor, seeing the line-signal exposed, inserts the answering plug 15 in the spring jack 10 of subscriber A, which disconnects the line annunciator and the battery 14 from the line and restores the former. The removal of the plug 15 from its seat 32 closes the supervisory signal-circuit thereat from ground through the battery 33, conductor 33^a, plug-seat contacts, resistance 34, supervisory lamp 28, conductor 28^a, to ground again; but as the line circuit is closed at the substation, current from the main battery 23 flows out through the conductors 24, coils 25, and line wires 8 and 9, to the substation, operating the armature 30 which is acted upon by both coils 25, to close the shunt through its front contact about the supervisory lamp 28, thus extinguishing the same while the telephone at said substation is off its hook. Upon learning the number of the subscriber desired, the connection is completed by inserting the corresponding plug 16 in the jack of the desired subscriber, and ringing his bell by any suitable or usual means. The operator's telephone and the ringing generator are omitted for the sake of clearness, as they form no part of the invention, and any suitable means for this purpose may be used. Before the subscriber B responds, current from the main battery 23 is not flowing over the line and consequently the retardation coils 26 are not operated to draw up their armature 31 which remains retracted and allows current to flow through supervisory lamp 29 from the battery 33, to display the same, which remains so displayed until the subscriber B responds when armature 30 is drawn up and closes the shunt through its front contact about the lamp 29. The subscribers are now connected for conversational purposes, and a steady current is flowing from the battery 23 through the retardation coils 25 and 26, over the line circuits, to the substations to supply their transmitters; the said coils being of sufficient resistance to pass only the right amount of current to the lines to properly operate the transmitters and being of sufficient impedance or retardation to prevent short-circuiting the voice currents passing over the line-wires and cord strands, the said voice currents being repeated or passed on from one section or part of the cord-circuit to the other through the medium of the repeating coils 19 and 20. The variation of resistance of the line wires will make no substantial difference in the amount supplied to the transmitter since in any case it would be small as compared with that of the coils. At the termination of the conversation, when the receivers are placed upon the hooks, the line-circuits are broken at the substations, thus cutting off current from the coils 25 and 26 and allowing the armatures 30 and 31 to be retracted to open

the shunts about the supervisory lamps 28 and 29, which are at once lighted up, indicating to the operator that the conversation is ended. Current cannot flow across the cord-circuits through the repeating coils on account of the presence of the condensers 21 and 22. Withdrawing and returning the plugs to their seats opens the lamp circuits and extinguishes the same, and returns all parts to normal condition.

It will be noticed that three central batteries are shown, but it is well understood by those skilled in the art that they could be, and in practice probably would be, replaced by a single battery; also that any preferred line signaling device instead of that shown could be employed. Again, one armature for the two impedance coils may be replaced by an armature for each coil without departing from the spirit of my invention. Such a system is shown in Fig. 2, where substantially the same arrangement exists as in Fig. 1, except that at the subscribers' stations the signal bell is placed in a ground branch and at the central station the cord-circuit strands 17 and 18 are united through condensers 35 and 36, the latter constituting the further modification. The same arrangement, however, of main battery 23 and retardation coils 25 and 26 exists; but instead of one armature for both coils connected with one part of the cord circuit, each coil is provided with a separate armature, one of which armatures closes a local circuit containing the supervisory lamp and a battery therefor, and the other armature closes a shunt circuit about the lamp. In the operation of this arrangement, when the answering plug 15 is inserted in a line-jack in response to a call for a connection, the armatures 37 and 38 of the retardation coils 25 are operated, as was the case with the single armatures in the former instance; the one, 37, closing the circuit through the supervisory lamp 28 and battery 33^a, and the other, 38, closing the shunt 38^a about the said lamp, which, therefore, remains unlighted. Upon the insertion of the plug 16 to complete the connection of the subscriber B, the circuit is completed from ground 40 at the central station through the main battery 23, branch conductor 24, through one of the retardation coils 26, and strand 18 of the cord circuit to the sleeve contact of plug 16; thence by line 9 of the subscriber's line to ground at the sub-station through the signal-bell. This operates the armature 41 of the impedance relay 26, lighting supervisory lamp 29 associated with the said plug 16, from battery 41^a, and indicating to the operator that the subscriber has not yet responded. Upon his response, the other relay coil 26 connected with the said plug 16, is energized by current in the other conductor of the line, closing arma-

ture 42 upon its front contact to complete a shunt 42^a around the supervisory lamp 29, which is now extinguished.

During conversation current flows out from battery 23 through the retardation coils 25 and 26 in the proper proportions to energize the transmitters at the sub-stations, while the voice currents are repeated from one end of the cord-circuit to the other through the condensers 35 and 36, said coils 25 and 26 preventing their passage through the branches 24. At the termination of the conversation, when the receivers are returned to their hooks, current is cut off from the shunts about the supervisory lamps 28 and 29, which are thus again lighted, indicating the condition of the lines or the termination of the conversation to the operator, who thus restores the plugs and lines to their normal conditions. The supervisory signals thus indicate to the operator the condition of the lines at all times and avoid confusion and mistakes. No plug switches are required with this arrangement of circuits as in the former instance. The several batteries may be grouped together likewise. The described arrangement in this figure, as well as in the other figures, constitute parallel paths or branches in the cord circuit, an inductive path or branch to permit the passage of fluctuating or voice currents, but to prevent the passage of steady currents, and the other branches being for the reverse purpose. The inductive branches prevent the flow of steady current to but one substation, whereby the action of the supervisory signals is satisfactorily localized.

In Fig. 3, substantially the same arrangement as in Fig. 1 is shown. Instead, however, of a single armature for both retardation coils connected with one end of the cord circuit, separate armatures are provided therefor as in Fig. 2. The operation of these separate armatures is the same as in Fig. 2 and needs no further explanation. It will be readily understood, however, that in such case the battery must have the ground connection 40, as shown, and as employed in Fig. 1, and that the subscriber's bells must be grounded, as in said Fig. 2. In such case, then the operation will be the same as in Fig. 2, with the exception that the voice currents will be repeated from one end of the cord circuits to the other through the repeating coils 19 and 20, instead of through the condensers.

Fig. 4 indicates how separate batteries 23^a may be connected with each end of the cord-circuit instead of the single battery 23, as in the other figures, but the same retardation coils are placed between the batteries and the strands 17 and 18 of the cord circuit. These coils may all have either single armatures for two coils or separate armatures for each coil, as shown.

The exact electrical dimensions of the various parts are not essential, but I have obtained good results with a battery 23 of 40 volts, repeating coils of 80 ohms resistance, retardation coils of 150 ohms resistance, and corresponding other parts.

Whether the construction is of the character shown in Fig. 1, or that shown in Fig. 2, it is evident that the cord strands are divided, and that the inner end of each cord strand section connects with or terminates in a condenser. For example, in Fig. 2 the inner ends of the cord strands 17 and 18 connect with or terminate in the condensers 35 and 36. On the other hand, in Fig. 1, the inner ends of the cord strands 17 and 18 connect with or terminate in the condensers 21 and 22. Also, whether the construction is of the form shown in Fig. 1 or Fig. 2, it will be seen that each supervisory lamp has a normally open energizing or lighting circuit including but a single switch-point which is normally open, and which is closed by the act of making connection with a subscriber's line, regardless of whether the line is busy or idle; and in each construction, each supervisory lamp is provided with a normally open shunt or short-circuiting connection adapted to be closed while a subscriber is using his line, and then opened immediately upon the restoration of the subscriber's receiver to its switch-hook.

While the invention has been described with particular reference to the details of construction and arrangement, I would have it understood that it is not limited thereto as many and various changes may be made therein and still come within the spirit, but

What I claim and desire to secure by Letters-Patent is:

1. A common battery telephone system, comprising subscribers' lines free from operating grounds outside the central office, a spring jack for each line provided with two contacts permanently connected with the opposite sides of said line, an operator's cord circuit provided with plugs adapted for insertion in said jacks, each talking strand of the cord circuit being divided into two sections, condensers connected with the four inner ends of the cord strand sections, means for supplying current, four relay coils through which the current is supplied to the four sections of the talking strands and whereby current is supplied to the lines through the talking strands when the plugs are in the jacks.

2. A telephone system comprising subscribers' lines free from operating grounds at the substations thereof, subscribers' hook switches adapted for opening and closing the line circuits, a spring jack for each line provided with two contacts permanently connected with the opposite sides of the telephone lines, an operator's cord circuit pro-

vided with plugs adapted for insertion in said jacks, a pair of condensers, a pair of repeating coils associated with said condensers, each talking strand of the cord circuit being divided into two sections, the inner end of each section terminating in one of said condensers, each section including a winding of one of said repeating coils, means for supplying current, four relay coils through which the current is supplied to the talking strands at each side of said repeating coils, whereby the lines receive current through both talking strands when the plugs are in the jacks, suitable supervisory signal devices adapted to be controlled by said hook switches through the medium of said relays.

3. In a telephone system, the combination of subscribers' lines free from operating grounds at the substations thereof, suitable subscribers' hook switches adapted for opening and closing the line circuits, a spring jack for each line provided with two contacts permanently connected with the opposite sides of the telephone lines, an operator's cord circuit provided with plugs adapted for insertion in said jacks, each talking strand of the cord circuit being divided into two sections, repeating coils for inductively connecting the two sections of each strand, condensers connecting the inner ends of the sections of one strand with the inner ends of the sections of the other strand, means for supplying current, four relay coils through which the current is supplied to said strands, and whereby the proper amount of current is supplied through the strands to the lines when the plugs are in the jacks, suitable supervisory signal devices adapted to be controlled by said hook switches through the medium of said relays.

4. In a telephone system, the combination of two substations equipped with common battery subscribers' telephone sets free from operating earth connections, each set involving a switch for opening and closing the line circuit, subscribers' lines leading from said substations, a spring jack provided with two contacts permanently connected with the opposite sides of the telephone lines, an operator's cord circuit provided with plugs adapted for insertion in said jacks, a pair of condensers associated with the cord circuit, each talking strand of the cord circuit being divided into two sections, the inner end of each section terminating in one of said condensers, means for supplying current, retardation coils through which the current is supplied to said strands, and whereby the proper amount of current is supplied through the talking strands to the lines when the plugs are in the jacks, armatures for said retardation coils, suitable supervisory signal devices adapted to be controlled by said hook switches through the

medium of said retardation coils and armatures.

5 5. In a telephone system, the combination of subscribers' lines free from operating grounds at the substations thereof, spring
jacks provided with two contacts permanently connected with the opposite sides of
the telephone lines, a pair of plugs having
contacts adapted to register with the con-
10 tacts of said jacks, a pair of condensers, talk-
ing strands connecting said condensers with
the contacts of said plugs, means for sup-
plying current, relay coils for connecting
the said means for supplying current with
15 the said talking strands, the said means for
supplying current thereby being normally
disconnected from the said lines, but adapt-
ed to supply current to the lines through the
talking strands when the plugs are in the
20 jacks, supervisory signals connected and
arranged to be controlled by said relay coils.

6. In a telephone system, the combination
of subscribers' lines free from operating
grounds at the substations thereof, spring
25 jacks provided with two contacts perma-
nently connected with the opposite sides of
the telephone lines, an operator's cord cir-
cuit provided with plugs adapted for inser-
tion in said jacks, each talking strand of the
cord circuit being divided into two sections,
30 a pair of condensers, the outer ends of the
said sections of the talking strands termi-
nating in the contacts of said plugs, the
inner ends of said sections of the talking
strands terminating in said condensers,
35 means for supplying current, relays having
their coils arranged to connect said means
for supplying current with the said talking
strands of the cord circuit, the source of cur-
rent thereby being normally disconnected
40 from the lines, but capable of supplying
current to the lines through the relay coils
and the talking strands when the plugs are
in the jacks, supervisory lamp signals hav-
45 ing circuits controlled by said relays.

7. In a telephone system, the combination
of subscribers' lines, subscribers' hook
switches for opening and closing the line
circuit, jacks provided with two contacts in
50 which the lines normally terminate at the
exchange, an operator's cord circuit pro-
vided with plugs adapted for insertion in
said jacks, inductive connections for con-
necting the opposite ends of the cord cir-
cuit, means for supplying current, two re-
55 lays having four coils adapted to connect
said means for supplying current with the
talking strands of the cord circuit at points
each side of said inductive connections, cur-
rent thereby being supplied to the lines
60 through said coils when the plugs are in the
jacks, supervisory lamps each having a nor-
mally open circuit adapted to be closed by
the act of removing one of said plugs from
65 its normal resting place, normally open

shunts around said lamps, said shunts being
adapted to be opened and closed by said re-
lays, and the said relays being in turn adapt-
ed to be controlled by said hook switches,
each telephone line being free from operat- 70
ing grounds at the substation thereof.

8. In a telephone system, the combination
with a telephone line free from operating
grounds at the substation thereof, of a source
of current and an electro-magnet bridged 75
between the two limbs of the talking circuit
thereof, a second electro-magnet and means
for energizing it, a switch at the substation
and a switch at the central station for con-
trolling the circuit through said electro- 80
magnets, a supervisory signal controlled by
the conjoint action of said electro-mag-
nets, repeating coils for inductively con-
necting said line with another line, said tele-
phone line provided with a jack having two 85
contacts permanently connected with oppo-
site sides thereof.

9. The combination with a telephone line
free from operating grounds at the substa-
tion thereof, of a source of electricity and a 90
pair of relay coils adapted to be bridged be-
tween the limbs of the talking circuit there-
of, a switch at the substation and a switch at
the central station for controlling the cir-
cuit through said relay coils, a signal 95
adapted to be controlled by the con-
joint action of said relay coils, and repeat-
ing coils for inductively connecting said
line with another line, each telephone line
provided with a jack having two contacts 100
permanently connected with opposite sides
thereof.

10. The combination with telephone lines
extending from subscribers' stations to an
exchange, of a cord circuit at the ex- 105
change provided with strands for forming
connections between two telephone lines, a
pair of relay coils corresponding to each end
of the cord circuit and included in bridge
thereof, a source of current for inclusion in 110
circuit with each of said pairs of relay coils,
a supervisory signal for each pair of relay
coils and jointly controlled thereby, switch-
ing apparatus for controlling the operation
of the relays, condensers each connected and 115
arranged to inductively connect one limb of
a line with the other limb of the same line
at the exchange, and repeating coils for in-
ductively connecting said lines, each tele-
phone line provided with a jack having two 120
contacts permanently connected with oppo-
site sides thereof, and each telephone line
being free from operating grounds at the
substation thereof.

11. The combination with a pair of tele- 125
phone lines free from operating grounds at
the substations thereof, of a repeating coil
to connect said lines for conversation, a pair
of circuit-controlling electro-magnets, one
connected in parallel with each winding of 130

said repeating coil, means for sending charging currents through said electro-magnets, a switch at each substation for controlling the circuit through the electro-magnet
5 corresponding to said line, supervisory signals controlled by the electro-magnets and means for rendering the windings of said repeating coil opaque to the passage of the charging currents, each telephone line pro-
10 vided with a jack having two contacts permanently connected with opposite sides thereof.

12. The combination with a pair of telephone lines free from operating grounds at
15 the substations thereof, of a repeating coil to connect said lines for conversation, a pair of signal-controlling electro-magnets bridged across the circuit one on either side of the repeating coil, means for sending
20 charging currents through said electro-magnets, a switch at each substation controlling the circuit through the electro-magnet corresponding to that line, a supervisory signal controlled by each magnet and a condenser
25 in circuit with each repeating coil winding to render the same opaque to the passage of charging currents, each telephone line provided with a jack, having two contacts per-
30 manently connected with opposite sides thereof.

13. The combination with two telephone lines free from operating grounds at the substations thereof, of a repeating coil to unite said lines for conversation, a con-
35 denser in the circuit of each winding of said repeating coil, a charging source of electricity and an impedance element bridged between the limbs of each of the connected telephone lines, each telephone line provided
40 with a jack having two contacts permanently connected with opposite sides thereof.

14. The combination with two telephone lines free from operating grounds at the substations thereof, of a repeating coil to unite said lines for conversation, and a
45 charging source of electricity and a signal-controlling electro-magnet bridged between the limbs of each of the connected telephone lines, said repeating coil windings being
50 opaque to current from said source, each telephone line provided with a jack having two contacts permanently connected with opposite sides thereof.

Signed by me at Chicago, Cook county, Illinois, this 21st day of March 1901.

HENRY P. CLAUSEN.

Witnesses:

ROBERT LEWIS AMES,
CHARLES C. BULKLEY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."
