

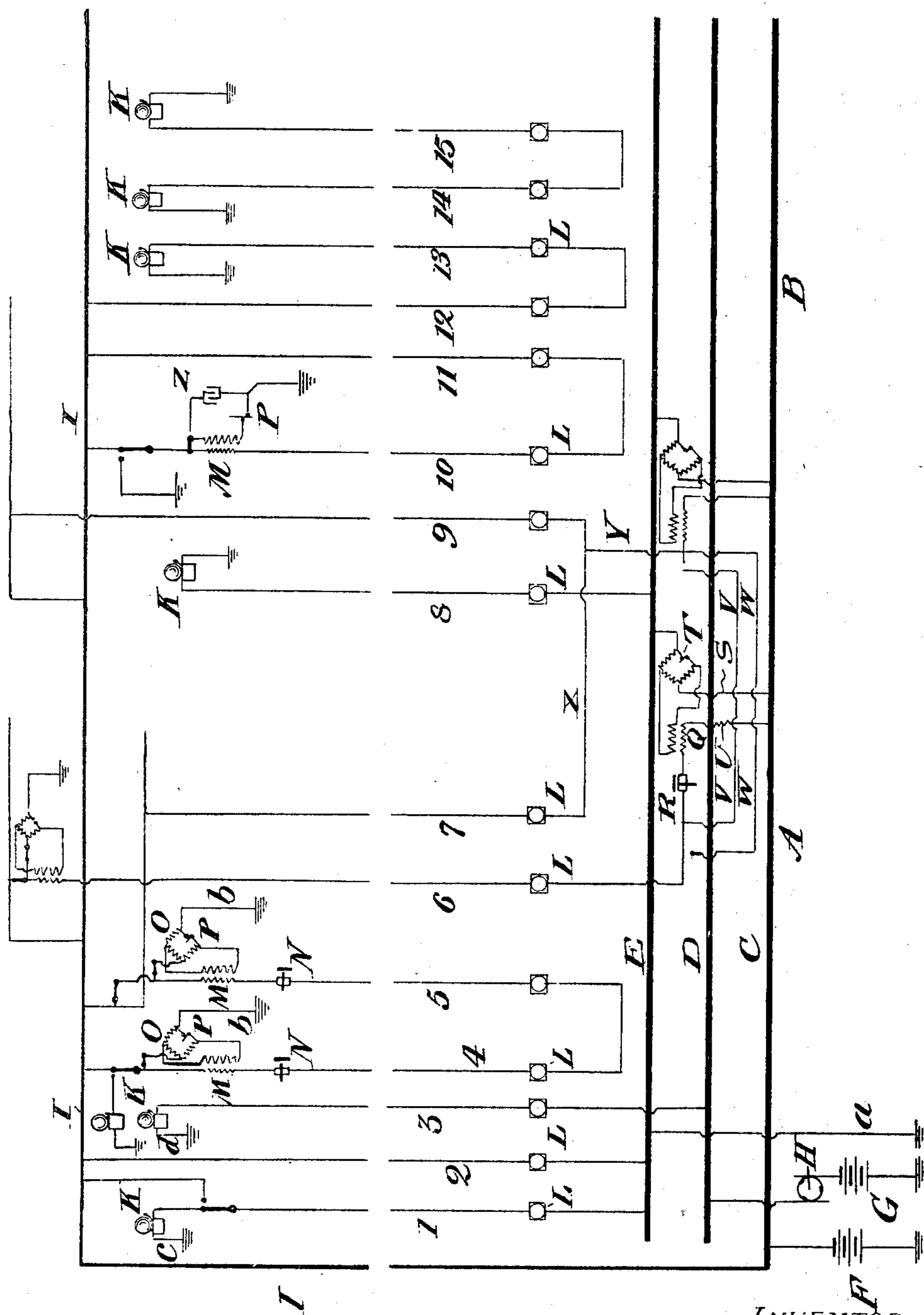
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Patented May 28, 1901.

E. F. FROST.
TELEPHONE CIRCUIT SYSTEM.

(Application filed June 27, 1900.)

(No Model.)



WITNESSES:

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TELEPHONE-CIRCUIT SYSTEM.

SPECIFICATION forming part of Letters Patent No. 674,861, dated May 28, 1901.

Application filed June 27, 1900. Serial No. 21,764. (No model.)

To all whom it may concern:

Be it known that I, ELLIS F. FROST, a citizen of the United States, residing at Washington, District of Columbia, have invented certain new and useful Improvements in Telephone-Circuit Systems; and I do 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, reference being had to the accompanying drawing, and to the letters and figures of reference marked thereon, which forms a part of this specification.

My invention relates to telephone-circuit systems.

The object of my invention is to produce a telephone-circuit system which shall possess the merits of novelty in arrangement and combination of parts, of ease and cheapness of installation, of ease and flexibility in extension, and of simplicity and rapidity of operation.

My invention consists in a bus-bar; a source of electric energy one pole of which is connected to the earth and the other pole of which is connected to the bus-bar; an energy-supply line connected to the bus-bar, which supply-line may be branched, as desired, and which supply-line serves as a common return-line for all telephone-circuits; one or more telephone-lines normally grounded at both ends, but in contact with the supply-line when signaling the central office and when in use for talking purposes; various signaling and talking devices included in the telephone-lines, as desired; a bridge-circuit connected to the telephone-line and to the earth when the telephone-line is connected for talking, in one arm of which bridge is a microphone-transmitter balanced by appropriate resistance in each of the arms and in the cross-circuit or bridge-circuit proper of which is the primary winding of an induction-coil in inductive relation to the secondary winding of the induction-coil, which secondary winding forms a portion of the telephone-line; a receiving magneto-telephone in the telephone-line when connected for talking purposes; one or more local or operators' telephone-lines connected to the bus-bar, each containing the secondary winding of an induction-coil; a bridge-circuit connected to the bus-bar and to the earth, in one arm of which bridge is a microphone-

transmitter balanced by appropriate resistance in each of the other arms and in the cross-circuit or bridge-circuit proper of which is the primary winding of the induction-coil; a bus-bar connected to earth; a source of electric energy one pole of which is connected to earth and the other pole of which is connected through a circuit-breaker to a bus-bar, and one or more intercommunicating lines between the various operators' telephone-lines; and my invention further consists in one or more transfer-lines between the various sets of operators' lines.

Reference being made to the accompanying drawing, my invention is particularly described as follows:

A and B represent any two of any numbers of sections of the system at the central office. Three bus-bars C, D, and E are common to all the sections. A battery F has one of its poles connected to earth and the other pole connected to the bus-bar C. A battery G has one of its poles connected to earth, and its other pole is connected through a circuit-breaker H with the bus-bar D. The bus-bar E is connected to earth by the wire *a*. An energy-supply line I, this being also the common return-line for all the telephone-lines, is connected to the bus-bar C and is branched in any desired manner. When not in use, all subscribers' telephone-lines are connected to earth at the subscriber's station and to the bus-bar E at the central office. In each telephone-line appropriate signaling devices are included, as shown at K at the subscriber's station in lines 1, 3, and 8 and at L at the central office in lines 1 to 15, inclusive. For clearness the signaling devices are not shown in the other lines at the subscriber's station.

The line I serves two functions, one function that of a common return-line for the telephone-lines when connected to it at the subscribers' stations and to the bus-bar C, either directly or indirectly, through the operator's telephone-line, or when two telephone-lines are connected to it at the subscribers' stations and to each other at the central office another function, that of supplying a battery-current to each subscriber's station by reason of the connection of the line I to the battery F. At each subscriber's station there is appropriate mechanism for disconnecting the telephone-

line from the earth and for connecting it to the common return-line I and for connecting the talking apparatus in proper relation to the telephone-line, as desired—as, for instance, the switches shown in line 10. This switching mechanism forms no part of this invention.

At the central office there is appropriate mechanism for connecting the various telephone-lines with each of the bus-bars C, D, and E, with each other of the same set or of any other set, or with the operator's telephone apparatus, as desired; but this mechanism forms no part of this invention.

At the subscriber's station when the subscriber's line is connected for talking purposes the subscriber's signaling device is cut out of the line, the line being connected to the common return or energy-supply line I, the secondary winding of the induction-coil M and the receiving magneto-telephone N being included in the line. Also connected to the line between the common return or energy-supply line I and the secondary winding of the induction-coil M is the microphone-transmitter circuit O. This microphone-circuit O divides into four arms, constituting the arms of a bridge, in one arm of which the microphone-transmitter P is included, the circuit being then connected to the earth by the wire *b*. The cross-circuit or bridge-circuit proper includes the primary winding of the induction-coil M.

At the central office for each operator there is an operator's telephone set consisting of a line connected to the bus-bar C and including the resistance U, the secondary winding of the induction-coil Q, and the receiving magneto-telephone R. A bridge-circuit is connected to the bus-bar C and divides into four arms, one of which contains the microphone-transmitter T, properly balanced by resistance in each of the other arms, this circuit being also connected to the bus-bar E, as shown. The cross-circuit or bridge-circuit proper includes the primary winding of the induction-coil Q. Connected to each operator's telephone-line and extending to each other operator's telephone-line are the intercommunicating lines V and W. Also extending between each and every set of telephone-lines are transfer-lines, only one, X, being shown in the figure. It is clear when all the lines are out of use that only the bus-bar C and the energy-supply or common return line I are in a state of static charge.

The operation of my invention is as follows: The lines when in their normal state—*i. e.*, when not in use—are connected at the subscriber's station to the earth, as at *c*, in line 1 and at the central office to the earth through the bus-bar E, the subscriber's and central-office signaling device being in the line. When a subscriber desires to signal the central office, he removes the line from its earth connection and connects it to the energy-sup-

ply or common return line I, as shown in line 2. The subscriber's signaling device may or may not be in the line. This connection permits the current to flow from earth to battery F, line I, line 2 to bus-bar E, to earth, or vice versa. This current-flow serves to operate the signaling device L of line 2 at the central office. When the operator at the central office desires to signal a subscriber, as shown in line 3, the operator disconnects the line from the bus-bar E and connects it with the bus-bar D. This connection permits the current to flow from the earth to battery G, the circuit-breaker H, bus-bar D, line 3 to earth at *d*, or vice versa, the signaling devices being included in the line. This current-flow serves to operate the signaling devices L and K, and thus call the subscriber. The circuit-breaker H is used if the subscriber's signaling device requires that the circuit be interrupted for its action. Otherwise the circuit-breaker H may be dispensed with, the battery G being connected direct to the bus-bar D or the battery G, and bus-bar D may be dispensed with, and the line may be connected to the bus-bar C, the current from the battery F operating the signaling devices L and K. When it is desirable that two telephone-circuits be connected for talking purposes, they are connected to the battery supply or common return line I at each subscriber's station and to each other at the central office, as shown in lines 4 and 5 and 10 and 11. When it is desirable that a subscriber talk to the operator at the central office, the subscriber's line is connected to the battery supply line or common return I and to the operator's telephone-line, as shown in line 6. When it is desirable that a line of one section be connected to a line of another section—as, for instance, line 7 of section A with line 9 of section B—for talking purposes, the subscriber of line 7 of section A disconnects his line from the earth and connects it to the battery supply or common return line I, and the central-office operator of section A connects the line 7 to the transfer-line X. Also the subscriber of line 9 of section B disconnects his line from the earth and connects it to the battery supply or common return line I, and the central-office operator of section B connects the line 9 to the transfer-line X. The line I is of a relatively low resistance to that of the telephone-lines, so that the electric currents of one telephone-line will not find their return-path over another telephone-line, thus avoiding what is technically known as "cross-talk." When the operator of section B, for instance, wishes to listen or converse with the two connected lines 7 and 9, the operator's telephone-line is connected to the two connected lines in derived or shunt circuit, as shown at Y. When one operator desires to converse with another—as, for instance, operator of section A with operator of section B—operator of section A connects her telephone-line to the in-

tercommunicating line W, or the operator of section B may connect her telephone-line with the intercommunicating line V. The resistance U in the operators' telephone-lines serves to prevent complete short-circuiting of an operator's telephone-line when connected with a subscriber's line. When a signaling device which requires an interrupted current to operate it is at the subscriber's station and the signaling device at the central office requires a constant current for its operation, then should a subscriber of one of two connected lines signal the central office in the usual manner—i. e., by connecting his line to the energy-supply line I, as shown in lines 12 and 13—only the central-office signal would respond. When two telephone-lines are connected together and the subscribers have restored their lines to the earth, the operator may, if desirable, connect her local telephone-line with the two connected telephone-lines by bringing the terminal of her operator's telephone-line into contact with the connected subscribers' lines.

In place of the bridge-circuits for the microphone P the microphone P in series with the primary winding of the induction-coil M is connected to the line and to the earth, a condenser Z being connected in shunt around the microphone P and the coil M, as shown in line 10.

I claim—

1. In a telephone-circuit system the combination with a plurality of subscribers' stations, a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, of a common return-line for said stations connected to the bus-bar.

2. In a telephone-circuit system the combination with a plurality of subscribers' stations, a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, and a common return-line for said stations connected to the bus-bar, of a bus-bar directly connected to the earth and indirectly connected to the first-mentioned bus-bar.

3. In a telephone-circuit system the combination with a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, a common return-line connected to the bus-bar, and a bus-bar directly connected to earth, of a telephone-line connected to the directly-grounded bus-bar and extending between the said bus-bar and the earth and means for connecting the bus-bars.

4. In a telephone-circuit system the combination with a plurality of subscribers' stations, a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, and a common return-line for said stations connected to the bus-bar, of a bus-

bar connected through a circuit-breaker with one pole of a source of electric energy the other pole of which is connected to earth and means for connecting the bus-bars.

5. In a telephone-circuit system the combination with a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, a common return-line connected to the bus-bar, and a bus-bar connected through a circuit-breaker with one pole of a source of electric energy the other pole of which is connected to the earth, of a bus-bar directly connected to the earth and means for connecting the said bus-bars.

6. In a telephone-circuit system the combination with a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, a common return-line connected to the bus-bar, a bus-bar connected through a circuit-breaker with one pole of a source of electric energy the other pole of which is connected to earth, and a bus-bar directly connected to the earth, of a telephone-line connected to the directly-grounded bus-bar and extending between the said bus-bar and the earth and means for connecting the said bus-bars.

7. In a telephone-circuit system the combination with a plurality of subscribers' stations, a bus-bar, a source of electric energy one pole of which is connected to earth the other pole of which is connected to the bus-bar, a common return-line for said stations connected to the bus-bar, and a bus-bar directly connected to earth, of a telephone-line connected to the common return-line and the directly-grounded bus-bar.

8. In a telephone-circuit system the combination with a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, a common return-line connected to the bus-bar, and a bus-bar connected through a circuit-breaker with one pole of a source of electric energy the other pole of which is connected to the earth, of a telephone-line connected to the last-mentioned bus-bar and to the earth and means for connecting the bus-bars.

9. In a telephone-circuit system the combination with a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, and a common return-line connected to the bus-bar, of two telephone-lines adapted to be connected to the common return-line and to each other, and means for completing the battery-circuit.

10. In a telephone-circuit system the combination with a plurality of telephone-lines, a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, and a common return-line connected to said bus-

bar, any two of the said telephone-lines adapted to be connected to the earth and to each other.

11. In a telephone-circuit system the combination with a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar and a common return-line connected to the bus-bar, of two telephone-lines adapted to be connected one of which is adapted to be connected to the common return-line and the other to the earth.

12. In a telephone-circuit system the combination with a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, a common return-line connected to the bus-bar, and one of a set of telephone-lines connected to the common return-line and one of another set of telephone-lines connected to the common return-line, of a transfer-line connecting the two said telephone-lines.

13. In a telephone-circuit system the combination with a plurality of subscribers' stations, a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, of a branched common return-line for said stations connected to the bus-bar, and means for completing the battery-circuit.

14. In a telephone-circuit system the combination with a bus-bar, a source of electric energy one pole of which is connected to earth the other pole of which is connected to the bus-bar, and a common return-line connected to the bus-bar, of a local or operator's telephone-line connected to the bus-bar, and means for completing the battery-circuit.

15. In a telephone-circuit system the combination with a plurality of telephone-lines, a bus-bar, a source of electric energy one pole of which is connected to earth the other pole of which is connected to the bus-bar, a common return-line for said lines connected to the bus-bar, and a local or operator's telephone-circuit connected to the bus-bar, any of said telephone-lines adapted to be connected to the common return-line and to the operator's telephone-circuit, and means for completing the battery-circuit.

16. In a telephone-circuit system the combination with a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, a common return-line connected to the bus-bar, and two telephone-circuits connected to each other and to the common return-line, of a local operator's telephone-line connected to the bus-bar and to the two connected telephone-lines, and means for completing the battery-circuit.

17. In a telephone-circuit system the combination with a bus-bar, a source of electric energy one pole of which is connected to earth the other pole of which is connected to the

bus-bar, and two telephone-lines connected to the earth and to each other, of a local operator's telephone-line connected to the bus-bar and to the telephone-lines.

18. In a telephone-circuit system the combination with a plurality of telephone-lines, a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, a common return-line for said telephone-lines connected to the bus-bar, and a telephone-line adapted to be connected to the common return-line, of a bridge-circuit connected to the telephone-line and to the earth.

19. In a telephone-circuit system the combination with a plurality of telephone-lines, a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, and a local operator's telephone-line connected to the bus-bar, of a bridge-circuit connected to the bus-bar and to the earth.

20. In a telephone-circuit system the combination with a plurality of telephone-lines, a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, a common return-line for said telephone-lines connected to the bus-bar, any of the said telephone-lines adapted to be connected to the common return-line, of a bridge-circuit connected to any of the said telephone-lines and to the earth and in inductive relation to the said telephone-line.

21. In a telephone-circuit system the combination with a plurality of telephone-lines, a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, a common return-line for said telephone-lines connected to the bus-bar, any of the said telephone-lines adapted to be connected to the common return-line, of a bridge in circuit with a microphone-transmitter connected to any of the said telephone-lines and to the earth and in inductive relation to the said telephone-line.

22. In a telephone-circuit system the combination with a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the said bus-bar, and a plurality of operator's telephone-circuits connected to the said bus-bar, of an operator's intercommunicating line adapted to be connected to the said operator's telephone-circuits, and means for completing the battery-circuit.

23. In a telephone-circuit system the combination with a plurality of telephone-lines, a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, a common return-line for said telephone-lines connected to the bus-bar, any of said telephone-lines adapted to be connected to the said common return-line and the earth, of a

microphone, a condenser and an induction-coil the primary winding of which is in series with said microphone and shunted by the said condenser.

- 5 24. In a telephone-circuit system the combination with a plurality of telephone-lines, a bus-bar, a source of electric energy one pole of which is connected to the earth the other pole of which is connected to the bus-bar, a
10 common return-line for said telephone-lines connected to the bus-bar, any of said telephone-lines adapted to be connected to the

said common return-line, of a microphone, a condenser and an induction-coil the primary of which is connected in series with said microphone and shunted by the said condenser and connected to the earth and inductively to the said telephone-line. 15

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

ELLIS F. FROST.

Witnesses:

F. A. LEHMANN,
ROSANN SMITH.