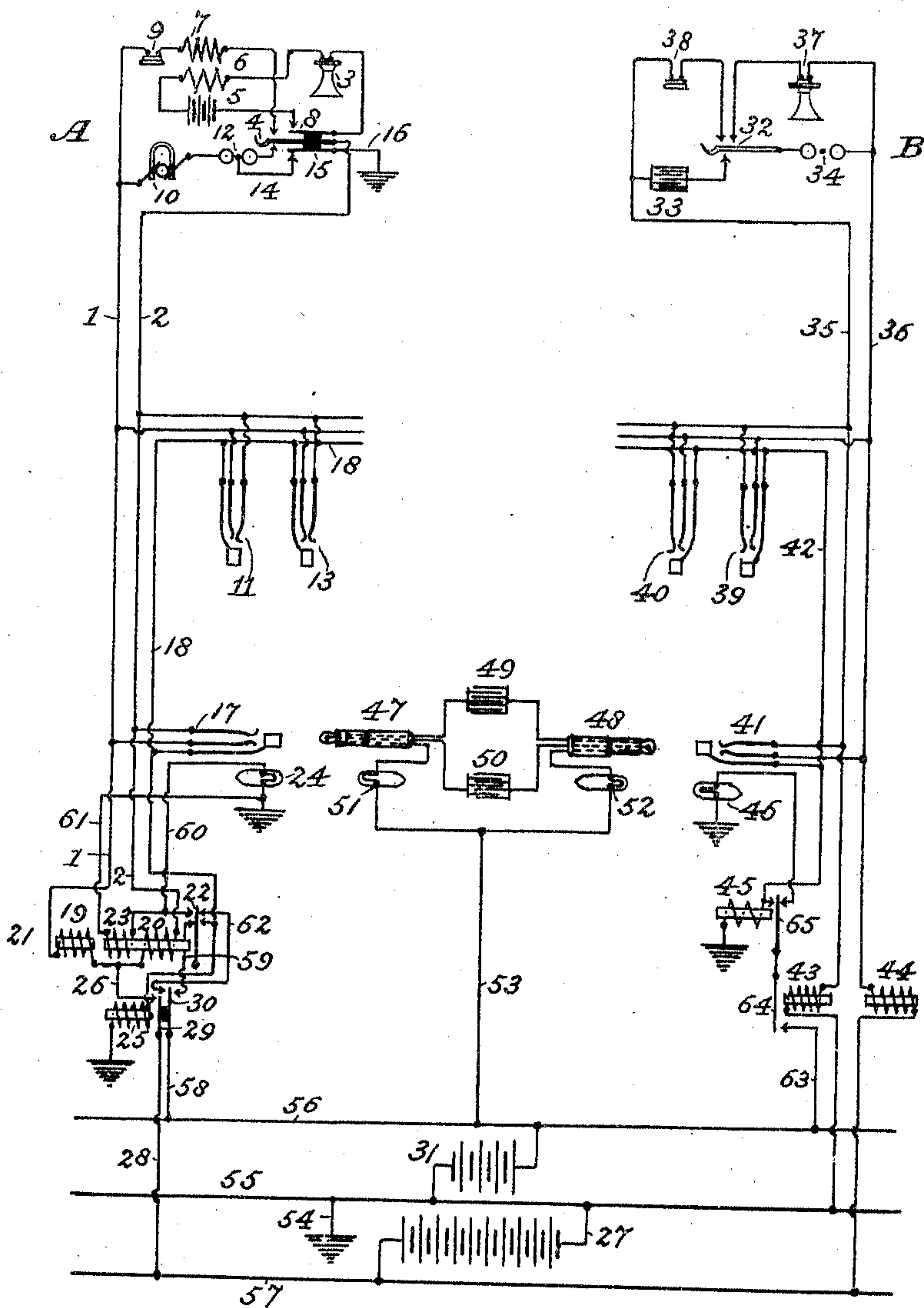


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A. EKSTRÖM.
TELEPHONE SYSTEM.
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TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 780,093, dated January 17, 1905.

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To all whom it may concern:

Be it known that I, ALFRED EKSTRÖM, doctor of philosophy, a subject of the King of Sweden and Norway, and a resident of Thulegatan 5, Stockholm, in the Kingdom of Sweden, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification, reference being had therein to the accompanying drawing.

Central-battery telephone systems with automatic calling of the exchange or central office as hitherto arranged have the inconvenience that the central battery is also connected with each subscriber's line while no conversation is taking place. As a consequence the lines must be extremely well insulated. If, for example, a line be connected to the earth or its branches be short-circuited, the calling-relay will be supplied with current and the calling-signal at the exchange will be actuated. Further, if there is a variable contact in the line, which easily happens in an air-conductor, this contact will act in the same manner as a microphone and give rise to a rattling noise in the receiver, whereby the transmission of the voice-currents is rendered difficult or even impossible. Therefore in the case of central-battery telephone plants in localities of large extent a single exchange or central office has never been employed, which made it necessary to use long lines for the substations located at a long distance from the exchange; but in lieu thereof several smaller exchanges with shorter lines have been employed, the said exchanges being connected together by trunk-lines. It is, however, obvious that such an arrangement is unsatisfactory as regards prompt attention. If, for example, a subscriber whose line enters one exchange wishes to be connected with another subscriber whose line is normally connected with another exchange, the conversation must be transmitted through a trunk-line between the said exchanges, and two operators must work together in order to establish the desired connection, and as a result the expedition is delayed.

My invention has for its object to make it possible to use a single exchange or central

office even in the case of telephone plants of great extent. The subscribers' lines are arranged in such a manner that a pure central-battery system is used within the district located next to the central office, whereas the substations located at a greater distance from the central office are arranged according to the local-battery system with magneto-generators at the substations for transmitting the calling-signals and with automatic clearing-off signals at the central office. The arrangements and connections at the central office are such as to allow of the different kinds of lines entering the same switchboard and being handled there in precisely the same manner, so that the operator does not perceive any difference whatever when attending one or the other kind of subscriber.

The drawing illustrates a manner of carrying out my invention, two subscribers' lines being shown that can be handled at the same switchboard, one of the said lines being arranged with local battery at the substation and magneto-generator for calling, the other being arranged with central battery and automatic signal-sending device.

A is the subscriber's station arranged with local battery.

1 and 2 are the line-wires leading from the subscriber's station to the exchange or central office.

3 is the transmitter or microphone, and 4 is the lever or switch-hook carrying the telephone-receiver.

5 is the local battery.

6 and 7 are the two windings of the induction-coil.

9 is the receiver or telephone.

10 is the magneto-generator of signaling-current, and 12 is the signal-bell whose middle point is grounded through conductor 14, spring 15, and earth-conductor 16 as long as the telephone-receiver hangs upon its hook, so that the latter is maintained in its lower position.

When the switch-hook is in its upper position, the receiver and the secondary winding of the induction-coil are included in the ordinary manner in the line-circuit, whereby a circuit for the local battery is completed through

battery 5, induction-coil 6, transmitter 3, and spring 8. When, however, the switch-hook is in its lower position, the magneto-generator 10 and the signal-bell 12 are included in the line.

At the exchange or central office the line divides to the connecting-jacks 11 13 and answering-jack 17. The test-springs and thimbles of the spring-jacks are connected together through the conductor 18. Interposed between the line-wires 1 and 2 are the inductive resistances 19 20, one of which, 20, is constructed as a relay. Surrounding the core of the said relay 20 is a second coil 23, connected in parallel with the calling-lamp 24. Leading from the wire connecting the two coils 19 and 20 to one contact-anvil of a relay 25 is a wire 26. The relay 25 is connected with the test-conductor 18 and provided with two armatures 29 30, one of which, 29, is connected with one pole of the central battery 27 and the other, 30, with one pole of the signaling-battery 31. The other poles of the two batteries are grounded through the earth-conductor 54.

B is the subscriber's station arranged according to the central-battery system. When the switch-hook 32 is in its lower position, the condenser 33 and signal-bell 34 are included in the line. When, on the contrary, the lever or hook 32 is in its upper position, the microphone or transmitter 37 and the telephone-receiver 38 are switched into connection with the line, the signal-bell 34 being then connected in parallel with the transmitter 37. In the same manner as described with respect to substation A the line-wires leading from substation B divide to connecting-jacks 39 40 and to the answering-jack 41, the test-springs and thimbles of the said jacks being connected together by a wire 42.

Interposed between the battery 27 and each limb of the line are inductive resistances 43 44, respectively, for preventing the voice-current from being short-circuited through the battery 27, one of the said resistances 43 being constructed as a relay.

45 is a cut-off relay connected at one side with the earth and at the other side with the test-conductor 42.

46 is a lamp announcing the call from substation B. The arrangement of the central battery-line from the substation B does not form any subject of the present application, but is shown merely to illustrate the coöperation of the two systems.

47 48 are two connecting-plugs belonging to a cord. (Shown in diagram in the drawing.) Interposed in the two conductors of the cord corresponding to the branches of the line are condensers 49 50. The third conductor, which is connected, through the wire 53, with the battery 31, includes the clearing-out signals 51 52, one for each plug.

The operation of the system described is as

follows: The subscriber at substation A wishing to call the exchange rotates the inductor of the magneto-generator 10, while the lever or switch-hook 4 remains in its lower position. The alternating current generated passes through the resistance 19 and the relay 20 at the exchange. The relay being energized attracts its armature 22, thus completing the following circuit, designated No. 1: earth-conductor 54, conductor 55, battery 31, conductors 56 58, armature 30, conductor 59, armature 22, conductor 60, signal-lamp 24, and earth. The lamp 24 will then glow and announce the calling. At the same time a shunt-circuit is completed through the coil 23 and conductor 61, whereby the armature 22 is retained in its attracted position even when the alternating current has ceased to flow. The operator when inserting one of the plugs in the answering-jack 17 establishes the following circuit, designated No. 2: earth-conductor 54, battery 31, conductor 53, clearing-out signal-lamp 51, test-spring of the answering-jack, conductor 18, relay 25, and earth. The relay 25 being now energized attracts its armatures 29 and 30, whereby the circuit designated No. 1 is opened and the lamp 24 goes out. At the same time the following circuit, designated No. 3, is established: earth-conductor 54, battery 31, conductor 56, conductor 58, armature 30, conductor 62, armature 22, conductor 18, relay 25, and earth. It will be found when comparing the circuits 2 and 3 that the said circuits are common through the relay 25, but that the lamp 51 is connected in parallel with a circuit in which there is practically no resistance—*i. e.*, the clearing-out signal-lamp 51 is short-circuited and does not glow.

When the subscriber after having finished the conversation replaces his telephone-receiver upon its hook, a circuit, designated No. 4, is established, as follows: earth-conductor 54, battery 27, conductors 57 28, armature 29, conductor 26, then in parallel through coils 19 and 20, line-wires 1 and 2, inductor 10, and hook 4, and the two windings of the signal-bell 12, and finally through conductor 14, spring 15, and earth-conductor 16. The relay 20 being energized attracts its armature 22, thus opening the circuit 3 or the short circuit about the clearing-out signal-lamp 51, which will then glow. The operator when removing the plug from the spring-jack opens the circuit 2, by which the clearing-out signal-lamp is extinguished, and the armatures 29 and 30 are allowed to return to their normal positions.

It will be found by comparing the operation of the central-battery line at the right-hand side of the diagram, especially with regard to the coöperation of the electrical apparatus and connections of the said line with the cord, that there is a complete reciprocity.

The subscriber at substation B when removing his hand-microphone from its hook

32 establishes a circuit for the central battery through the line-wires 35 36, whereby the relay 43 is energized and attracts its armature 64, the lamp 46 being then included in the following circuit, designated No. 5: earth-conductor 54, conductor 55, battery 31, conductors 56 63, armature 64, armature 65, lamp 46, and earth. Lamp 46 thus announces the call. The operator when inserting the plug in the answering-jack 41 completes the following circuit, designated No. 6: earth-conductor 54, battery 31, conductor 53, clearing-out signal-lamp 52, test-spring of the answering spring-jack, relay 45, and earth. The relay 45 being energized attracts its armature 65, thus completing a short circuit, designated No. 7, about the clearing-out signal-lamp 52, as follows: earth-conductor 54, battery 31, conductor 63, armatures 64 65, relay 45, and earth. When the conversation is finished, the short circuit 7 is broken in the same manner as before by the armature 64, returning to its normal position when the hand-microphone is replaced upon its hook. The clearing-out signal-lamp 52 will then glow. The operator when removing the plug opens the circuit (designated 6) whereby the lamp 52 is extinguished and the armature 65 returns in its normal position.

30 The difference between the two lines thus merely consists in a different construction and arrangement of the relays at the exchange and in the apparatus at the subscribers' stations being of a different type.

35 When it is desired to change the arrangement of a subscriber's line from one system to the other, it is thus only necessary to replace the relays and apparatus of the one kind by those of the other.

40 Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a telephone system, a central battery having one pole grounded, a relay 19, 20 constantly connected with the line and with the spring-jacks but normally disconnected from the central battery, means for connecting the pole of the battery not connected with the earth with the said relay, when a plug is inserted in the jack, the one branch or both branches of the line being thus connected, during conversation, through the said relay with the said pole of the central battery, the telephone apparatus at the subscriber's station,

when in reposing position the telephone-receiver hanging upon its switch-hook, having a branch of the line connected with the earth, whereby, when the conversation is finished, the telephone-receiver placed upon its hook, the said relay 19, 20, becomes active, and a signaling system controlled by said relay, substantially as described.

2. In a telephone system, a central battery having one pole grounded, a relay 19, 20 constantly connected with the line and with the spring-jacks but normally disconnected from the central battery, a relay 25, connected to be energized when a plug is inserted in a jack, thereby connecting the pole of the battery not connected with the earth with the first relay 19, 20, a clearing-out signal, a short circuit about the same, and means allowing that relay 19, 20, when the subscriber replaces the telephone-receiver upon its hook, to break a short circuit about the clearing-out signal, so that the latter becomes active, substantially as described.

3. In a telephone system, a central battery having one pole grounded, a relay 19, 20 constantly connected with the line and with the spring-jacks but normally disconnected from the central battery, a calling-signal actuated by said relay, means 23, for keeping the armature 22 of the relay 19, 20 attracted, after the signaling-current has ceased, a relay 25 connected to be energized when a plug is inserted in a jack, thereby connecting the pole of the battery not connected with the earth with the first relay 19, 20 and disconnecting the calling-signal 24 and at the same time disconnecting the means 23 for keeping the armature 22 of the line-relay 19, 20 attracted, whereby the armature of the line-relay 19, 20 returns to its reposing position, thus completing a short circuit for the clearing-out signal 51 in the cord, said short circuit being broken when the line-relay 19, 20 is again made active by the subscriber, after conversation, replacing his telephone-receiver upon its switch-hook, substantially as described.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ALFRED EKSTRÖM.

Witnesses:

AUG. SÖRENSEN,
CARL P. GERELL.