F. C. UNGER.

TELEPHONE SYSTEM.

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1,022,713.

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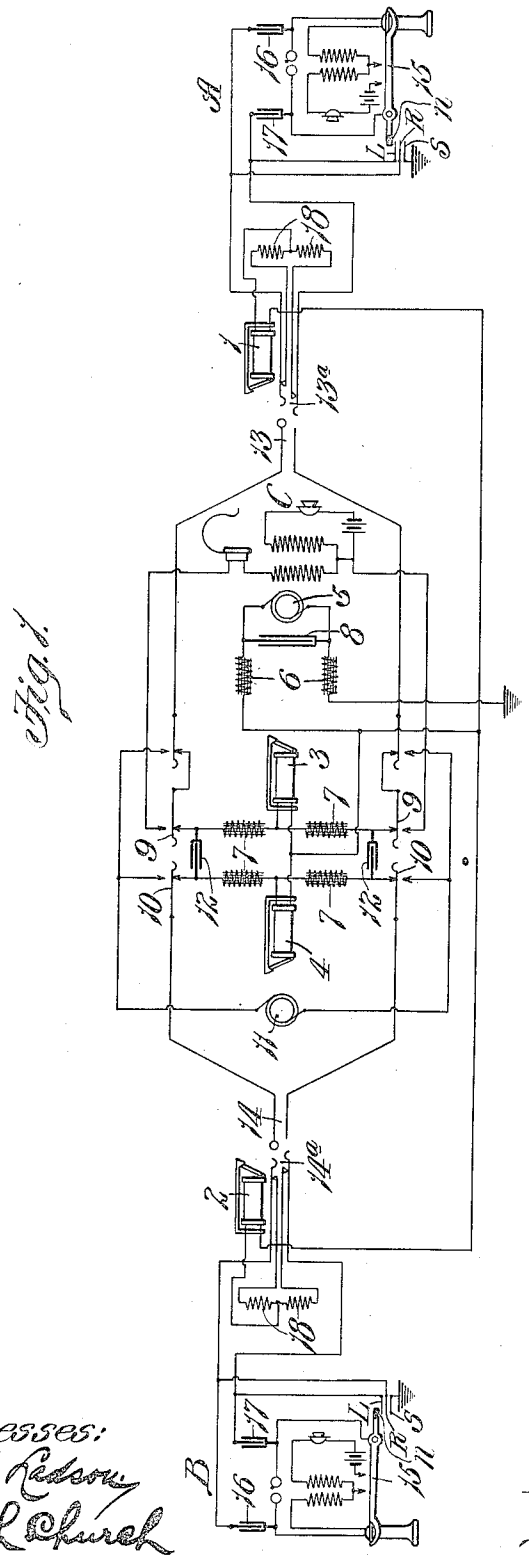

Fig. 1.

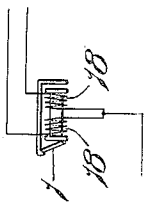

Fig. 3.

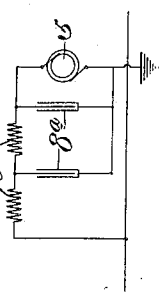

Fig. 2.

Witnesses:
Geo. F. Edson
Wells L. Church

Inventor,
Frank C. Unger.
By Paul Bakewell Atty.

UNITED STATES PATENT OFFICE.

FRANK C. UNGER, OF ST. LOUIS, MISSOURI.

TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, FRANK C. UNGER, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Telephone Systems, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to telephone systems, and particularly to local battery or magneto telephone systems such as are used in small towns and in the country.

In a magneto telephone system each subscriber's telephone is provided with a generator or ringing machine that the subscriber has to turn or actuate in order to operate his line-drop at the central exchange which notifies the central operator that the subscriber desires to talk to another subscriber. After the conversation is completed the subscriber who originated the call also has to operate the generator or ringing machine on his telephone so as to operate the clearing-out drop at the central exchange which notifies the central operator that the conversation is completed.

One object of my invention is to provide a local battery telephone system that comprises a generating device or machine at the central exchange for operating the subscriber's line-drops and the clearing-out drop, and a separate and distinct generating device or machine for ringing the bells of the subscribers' telephones, thereby producing a system in which the means used for signaling and supervision on the cord circuit is separate and distinct from the means used to operate the other signaling devices of the system, the signaling generator being preferably so constructed that its current is dissynchronous with the bells of the subscribers' telephones so that it will not interfere with same or with other devices on the circuit.

Another object is to provide a local battery telephone system that comprises impedance coils or other suitable resistance devices bridged across the cord circuit and which are preferably incorporated with the clearing-out drop at the central exchange, said impedance coils or resistance devices being so designed that their transformer action will not cause the receivers of the subscribers' telephones to receive any current in case said receivers are thrown into a divided circuit or become affected by any inductive disturbance on the line.

Another object is to provide a system of the character above referred to in which the resistance devices that are bridged across the cord circuit have their middle contacts grounded so that any accumulation of static or induced electricity on the line will readily pass through the resistance devices and then to the earth through a condenser which is shunted around the signaling generating device, thereby causing the lines to be free from noise, from static accumulation and induced charges on the telephone circuit while talking, owing to the fact that the static accumulation and induced charges pass readily to the ground.

Another object is to provide a telephone system which is so designed that current of a pulsating or alternating character can be used for operating signals over very long lines. However, I do not wish it to be understood that my invention is limited to the use of a pulsating or alternating current for signaling purposes for direct current could be used for this purpose.

Another object is to provide a telephone system which is so designed that the signaling current affects both line wires equally and in the same direction and at the same time, thereby overcoming the possibility of the signaling current affecting the receivers of the subscribers' telephones.

Another object is to provide a telephone system comprising two impedance coils or other resistance devices bridged across the line circuit so as to cause the line-drop at the central exchange, rather than the bell of a subscriber's telephone, to operate in case either side of the line is grounded accidentally, it being preferable to use a double wound drop, which is so designed that there will be no transformer action between the two impedance coils which might cause the bells of the subscribers' telephones to ring in case same are thrown into a divided circuit by a ground on the line.

Another object is to provide a telephone system of the type referred to which is so designed that a signal can be transmitted to the line-drops over one or both limbs of the circuit and over a third conductor or the ground, thereby enabling both sides of the line to be used as one circuit and thus

cutting down the resistance of the circuit by one-half which is a very decided advantage on long lines.

Another object is to provide a telephone system of the type referred to that comprises condensers which separate one side of the cord circuit from the other, thereby permitting the talking current to pass through the condensers and preventing the signaling current from passing through the condensers so that the clearing-out drops are caused to operate individually.

Another object is to provide a telephone system having a circuit which is so arranged that means are provided for transmitting different frequences at the same time, whether they be pulsating or alternating, so that one will not interfere with the other. And still another object is to provide a telephone system having condensers at the subscribers' instruments which will prevent either the bells or receivers from being affected in case the subscribers' bells or receivers are thrown into a divided circuit or caused to become part of a divided circuit.

Figure 1 of the drawings is a diagrammatic view of a telephone system constructed in accordance with my invention; Fig. 2 is a diagrammatic view illustrating another method from that shown in Fig. 1 for increasing or varying the inductance in the circuit and also adding capacity to the circuit so that the current from the signaling generator will rise and fall gradually; and Fig. 3 is a diagrammatic view illustrating a double wound drop which can be used in place of the resistance devices in Fig. 1 that are bridged across the line-circuit and connected to the line-drops.

Referring to Fig. 1 of the drawings which illustrates the perferred form of my invention, A and B designate the telephones of two subscribers, and C designates the operator's telephone at the central exchange. The central exchange is provided with suitable signals such, for example, as line-drops 1 and 2, for the subscribers A and B, respectively, and also clearing-out drops 3 and 4 for both sides of the cord circuit which notify the central operator that the subscribers have completed their conversation and hung up their receivers. A signaling machine 5, which may consist of a generating machine or pole-changer, either manually or mechanically operated, is arranged at the central exchange, and resistance devices 6, preferably impedance coils built on large heavy iron cores, are connected in series with the circuit of said signaling machine 5. A condenser 8 is arranged across the circuit of said signaling generator, and said resistance devices are so arranged that the inductance of said devices and the capacity of the condenser 8 in the generating circuit causes the current of the generating machine 5 to rise and fall gradually. Separate and distinct resistance devices 7, preferably impedance coils, are bridged across the cord circuit at the central exchange, and the signaling generator 5 is connected in series with the clearing-out drops 3 and 4 and with the middle tap of the resistance devices 7. By arranging the impedance coils or resistance devices 7 in pairs across the cord circuit I divide the signaling currents into two equal parts and cause same to pass through the two windings in opposite directions, the two paths having about the same resistance. Consequently, the two limbs of the circuit are arranged in parallel for signaling currents and in series for talking or telephoning.

The reference characters 9 and 10 designate, respectively, the key of the listening circuit and the ringing key at the central exchange, and said central exchange is also provided with a ringing machine 11 which is separate and distinct from the signaling generator 5. The ringing machine 11 may be of any preferred construction but it is preferably so designed that it will ring only the bells of the subscribers' telephones. I also prefer to arrange condensers 12 across the cord circuit at the central exchange so as to cause the low frequency signaling current to operate the clearing-out drop only on that side of the cord circuit on which the signal is transmitted. Thus, when called-subscriber B takes his receiver off its supporting hook the clearing-out drop 4 at the central exchange will operate. The central exchange is, of course, provided with the usual plugs 13 and 14 for the subscribers A and B, respectively, and contacts 13^a and 14^a with which said plugs coöperate. Each subscriber's telephone is provided with line springs L R and a grounded contact S, which springs are normally separated, and the hook switch 15 is provided with an insulated part N that closes the contacts L, R and S for an instant when the hook switch moves in either direction and thus causes a ground to be thrown on either or both sides of the line for an instant, the signaling generator 5 at the central exchange being grounded. Condensers 16 and 17 are arranged in the circuits of the subscribers' telephones, as shown in Fig. 1, which offer a very high resistance to low frequency current; and resistance devices 18, preferably impedance coils, are also arranged across the line circuit, as shown in Figs. 1 and 3. Consequently, if a ground is thrown on either side of the line, the line-drop or clearing-out drop at the central exchange, rather than the subscriber's bell or receiver, will be operated, owing to the fact that the accidental ground causes the bell or receiver of the subscriber's telephone to be thrown into a divided circuit. This is a very desirable fea-

ture in a telephone system for if there is a ground on either side of the line the subscribers can converse as the current from the signaling generator does not interfere with the talking circuit.

In Fig. 2 I have illustrated another way of increasing or varying the inductance in the circuit and also varying or adding capacity to same, the circuit shown in said figure comprising inductance coils 6^a arranged in series in the signaling generating circuit and condensers 8^a arranged across said circuit, the advantage of such an arrangement being that enough impedance coils and condensers can be provided to cause the current to rise and fall gradually.

Having described the general construction of my improved telephone system, I will now describe the operation of same. If the subscriber A wishes to talk to the subscriber B he removes the receiver of his telephone from its supporting hook thereby causing a ground contact to be made over either or both limbs of the circuit. This causes a current to pass through either one or both of the resistance devices 18 and through the subscriber A's line-drop at the central exchange. The operator then inserts the plug 13 in the coöperating contacts 13^a and then opens the listening key 9, the insertion of the plug 13 in the coöperating contacts 13^a causing the resistance devices 18 and line-drop to be disconnected from the circuit. After ascertaining the number of the subscriber to whom A desires to talk, the operator closes the listening key 9 and inserts the plug 14 between its coöperating contacts 14^a, at the same time ringing the subscriber B's bell by means of the ringing key 10. When the called-subscriber B removes the receiver of his telephone from its supporting hook, the clearing-out drop 4 associated with the calling side of the cord circuit will operate and thus notify the central operator that the circuit is taken and that the conversation has started. When the subscribers have completed their conversation and hung up the receivers on their telephones the clearing-out drops 3 and 4 associated with the different sides of the cord circuit, will be exposed or operated by the current which the signaling generator 5 produces in the cord circuit.

The impedance coils and condensers arranged in the signaling circuit in the manner described, oppose any rapid change in the strength of the current so that the current wave or sine wave assumes a smooth wave form with no peaks. This is a very desirable feature in a telephone system because the current will not cause any inductive disturbance in the subscribers' receivers while they are talking.

In a system of the character above described, the non-interference of the voice currents and signaling currents is not dependent upon such a wide difference in frequencies but it is due to the fact that the signaling current flows over both sides of the circuit in parallel and in the same direction, using the ground or a third conductor as a return, the voice currents being confined to the metallic circuits and flowing through the two sides of the circuits in series. This non-interference is also due partly to the fact that the condensers 16 and 17 at the subscribers' telephones allow the telephone currents or voice currents to pass through them but do not allow or offer very high resistance to the low frequency signaling current when the receivers are caused to be in a divided circuit on account of a ground on one side of the line.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A local battery telephone system comprising an alternating current generating machine at the central exchange for operating the line-drops and clearing-out drop, and a separate and distinct generating device for operating the bells of the subscribers' telephones.

2. A telephone system having a signaling generator and means for preventing the induced current from said generator from affecting the receiver of a subscriber's telephone in case said receiver is thrown into a divided circuit.

3. A telephone system having resistance devices bridged across the cord circuit, the coils of said resistance devices being wound on separate cores so as to reduce their transformer action to a minimum, and condensers arranged in the line circuit so as to prevent the receivers of the subscribers' telephones from becoming affected by any inductive disturbance on the line in case said receivers are thrown into a divided circuit.

4. A telephone exchange system comprising a signal-generating device at the central exchange, resistance devices bridged across the cord circuit, and a condenser arranged across the circuit of said signal-generating device.

5. A telephone exchange system, comprising a grounded signal-generating device arranged at the central exchange, resistance devices bridged across the cord circuit and having their middle contacts grounded, and a condenser arranged across the circuit of said signal-generating device.

6. In a telephone system, condensers in the subscribers' circuits and resistance devices bridged across the line circuit for causing the line-drop at the central exchange, rather than the bell of a subscriber's telephone, to operate in case either side of the line is grounded accidentally.

7. In a telephone system, resistance de-

vices at the central exchange and condensers arranged in the circuits of the subscribers' instruments and constructed in such a manner that they prevent either the bells or receivers of said instruments from becoming affected in case said bells or receivers are thrown into a divided circuit.

8. A telephone exchange system having a signal-generating machine arranged at the central exchange, resistance devices arranged in the circuit of said machine, and a condenser arranged across said circuit.

9. A telephone exchange system having a signal-generating machine arranged at the central exchange, resistance devices arranged in the circuit of said machine, a condenser arranged across said circuit, and a signal for the central operator arranged in series in the circuit of said machine.

10. A telephone exchange system having an operator's signal at the central exchange, a generating device or machine arranged in series with said signal, resistance devices arranged in series in the circuit of said machine, and a condenser arranged across the circuit of said machine.

11. A telephone exchange system comprising a pair of resistance devices bridged across the cord circuit at the central exchange so as to divide the signaling currents, an operator's signal at the central exchange, a signal-generating machine connected in series with said signal and with the middle tap of said resistance devices, and a condenser arranged across the circuit of said signaling machine.

12. A telephone exchange system comprising a pair of resistance devices bridged across the cord circuit at the central exchange so as to divide the signaling currents, an operator's signal at the central exchange, a signal-generating machine connected in series with said signal and with the middle tap of said resistance devices, a condenser arranged across the circuit of said signaling machine, and separate resistance devices arranged in the circuit of said generating machine.

13. A telephone system, comprising a plurality of condensers arranged in the line circuit of each subscriber's telephone so as to prevent said telephone from becoming affected by inductive disturbances on the line, and resistance devices arranged across the line circuit.

14. A telephone exchange system, comprising condensers arranged in the circuits of the subscribers' telephones, resistance devices arranged across the line circuit, line-drops at the central exchange incorporated with said resistance devices, a ringing generator at the central exchange for operating the bells of the subscribers' telephones, and a separate signal-generating machine at the central exchange for operating the signals at the central exchange.

15. A telephone exchange system, comprising condensers arranged in the circuits of the subscribers' telephones, resistance devices arranged across the line circuit, line-drops at the central exchange incorporated with said resistance devices, a ringing generator at the central exchange for operating the bells of the subscribers' telephones, a separate signal-generating machine at the central exchange for operating the signals at the central exchange, clearing-out drops at the central exchange, resistance devices bridged across the cord circuit at the central exchange, the clearing-out drops being connected to the middle tap of said last-named resistance devices, and a condenser arranged across the circuit of said signal-generating machine.

In testimony whereof I hereunto affix my signature in the presence of two witnesses, this twenty fifth day of February 1911.

FRANK C. UNGER.

Witnesses:
WELLS L. CHURCH,
GEORGE BAKEWELL.