Dec. 8, 1931. F. C. BISBEE 1,835,003

TELEPHONE SYSTEM

Filed March 20, 1929

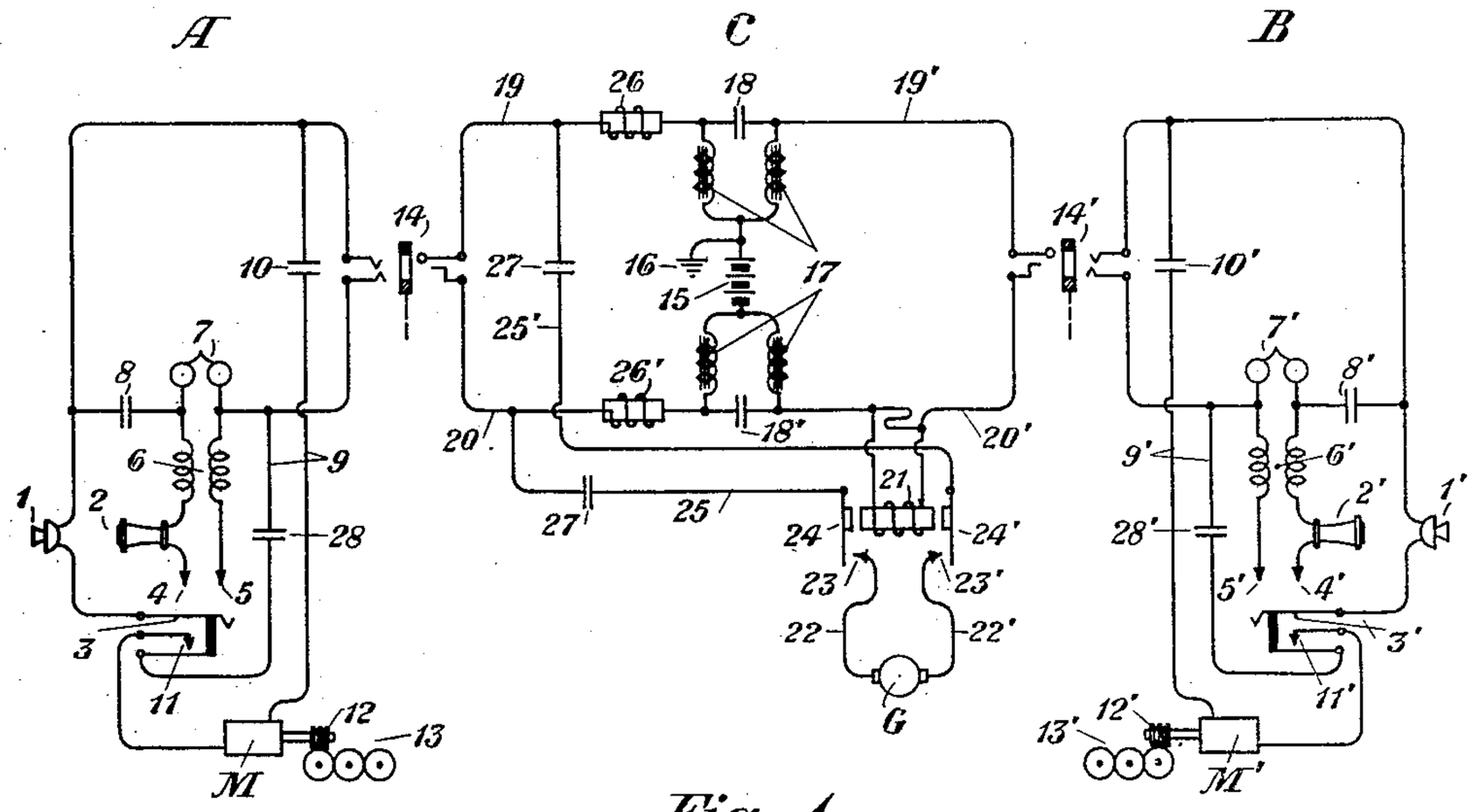

Fig. 1

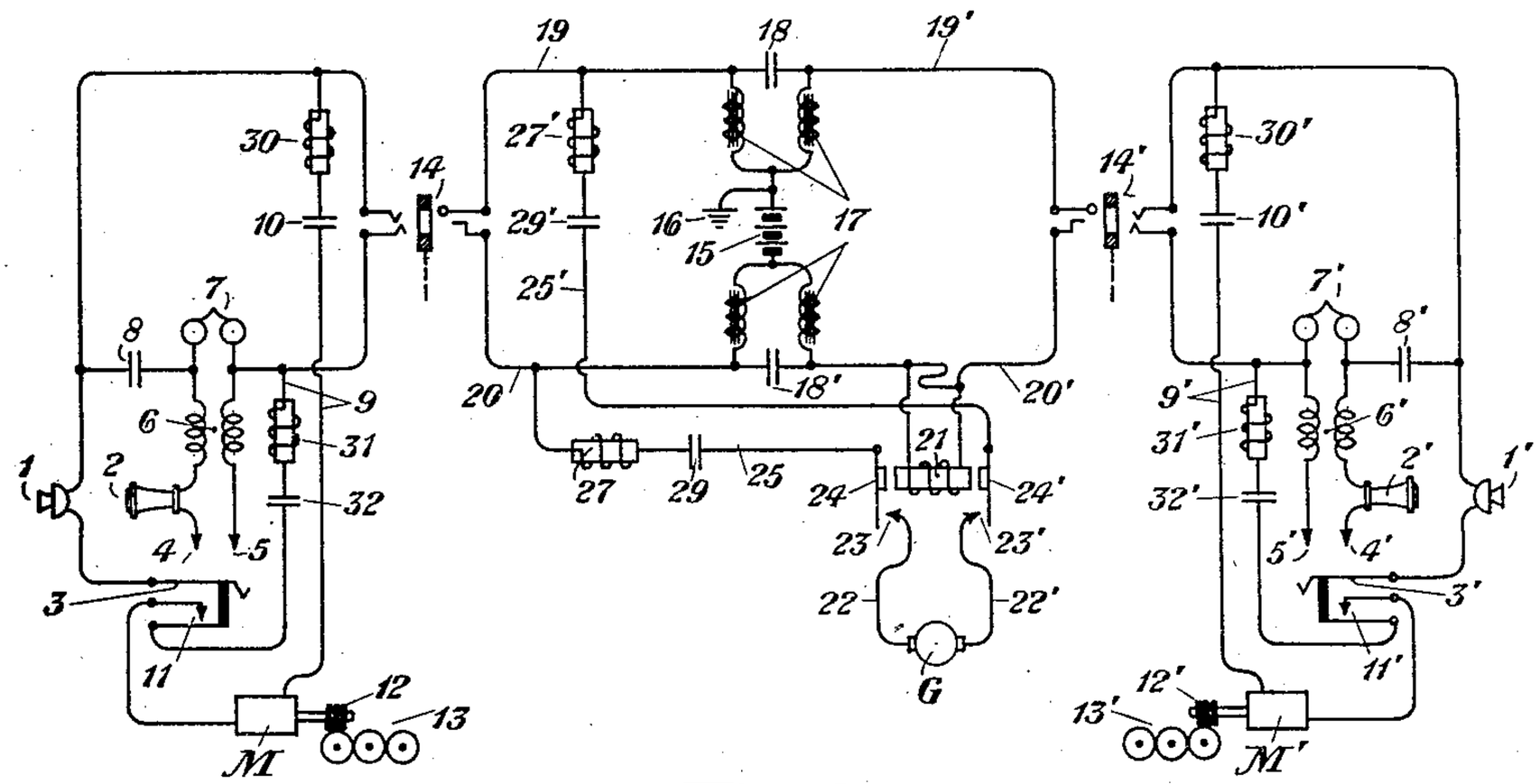

Fig. 2

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UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

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This invention relates to telephone systems and more particularly to telephone metering systems in which the subscriber is charged for the length of time his telephone is in use.

It is an object of this invention to provide an improved telephone metering system in which maximum accuracy is attained in measuring the actual length of time the subscriber's telephone is in use and in which at the same time there is incurred minimum transmission loss, a minimum amount of noise in the talking circuit and minimum distortion of the voice signals.

The invention comprises in combination with a telephone system a synchronous alternating current motor bridged across each subscriber's lines, registering apparatus adapted to be operated by said motor, means located at the central office for superimposing on the calling subscriber's line alternating current of telephonically inaudible frequency to operate the motor in the calling subscriber's line, means located in the cord circuit for preventing the flow of said superimposed current in the called subscriber's line and the operation of the motor located therein, and means located in the generator leads and in the motor leads for preventing the passage therethrough of voice signals with resultant transmission loss.

In the drawings, Figure 1 represents diagrammatically a telephone circuit illustrating one embodiment of the invention in which alternating current of a frequency above the range of telephonic audibility is superimposed on the line to operate a synchronous alternating current motor. Fig. 2 represents diagrammatically a telephone circuit illustrating another embodiment of the invention in which alternating current of a frequency below the range of telephonic audibility is superimposed on the line to operate the motor.

In Fig. 1, there are shown two subscribers' stations A and B with subscribers' loops extending to the central office and terminating in the jacks 14 and 14′. As shown, A represents the station of the calling subscriber and B that of the called subscriber. The sub-stations comprise the usual transmitters 1 and 1′, the receivers 2 and 2′, the receiver hooks 3 and 3′, the contacts 4 and 4′ and 5 and 5′, respectively, the induction coils 6 and 6′, the ringers 7 and 7′ and the condensers 8 and 8′. In addition, there are located at the sub-stations synchronous alternating current motors M and M′ bridged across the subscribers' lines through leads 9 and 9′, respectively, condensers 10 and 10′ and 28 and 28′, respectively, and the contacts 11 and 11′. The motors M and M′ have driving shafts 12 and 12′ which, when rotated, drive the ratchet wheels 13 and 13′. In order to facilitate starting, these motors may be of the split-phase type or may have shaded pole pieces, if desired.

The cord circuit C of the central office is here illustrated as the impedance coil feed type. Obviously, a cord circuit of the repeating coil feed type may be used, if desired. The cord circuit shown comprises the usual current source 15, grounded at 16, a current supply bridge comprising impedance coils 17, capacities 18 and 18′, cord conductors 19, 19′, 20 and 20′ and supervisory relay 21. In addition, there is located at the central office an alternating current generator G which is adapted to generate alternating current of a frequency above the range of telephonic audibility. This current is adapted to be superimposed on the talking current, flowing in the calling subscriber's lines, through the leads 22 and 22′, the contacts 23 and 23′, the armatures 24 and 24′ and the leads 25 and 25′. The time when and during which this current is superimposed on the calling line is under the control of relay 21.

The expressions "telephonically inaudible", "above the range of telephonic audibility", and "below the range of telephonic audibility" as used in the description and claims should be understood as referring not only to frequencies which are normally inaudible to the naked ear of the listener but also to frequencies which are audible to the naked ear of the listener but which after being transmitted through the telephone system may not be audible to the ear of the subscriber.

In order to prevent the operation of the

motor located at the called subscriber's station, a pair of inductances 26 and 26′ are located in series with the cord conductors 19 and 20, respectively. These inductances are of such value, for example, of the order of .003 henries, as to permit the passage therethrough of voice frequency signals but prevent the passage therethrough of alternating current of a frequency above the range of telephonic audibility (the motor operating current). In addition, capacities 27 and 27′, which are located in series with the leads 25 and 25′, and capacities 10 and 10′, and 28 and 28′, which are located in the leads 9 and 9′, respectively, are provided in order to prevent undue transmission loss. These capacities are of such value, for example, of the order of .1 microfarads, as to permit the passage therethrough of alternating current of a frequency above the range of telephonic audibility but prevent the passage therethrough of voice frequency signals.

Fig. 2 of the drawing discloses a system in which, as hitherto stated, an alternating current of a frequency below the range of telephonic audibility is superimposed on the talking current in the calling subscriber's lines to operate a synchronous alternating current motor bridged across said line. As shown in this figure, the elements and the arrangement thereof are similar to those shown in Fig. 1, with the exception that in Fig. 2 the generator G is designed to generate alternating current of a frequency below the range of telephonic audibility and the motors M and M′ are designed to operate in synchronism therewith. Also, in this embodiment, in order to prevent the operation of the motor located at the called subscriber's station, the capacities 18 and 18′, which are in series with the cord conductors, are of such value, for example, of the order of 1 microfarad, as to permit the passage therethrough of voice frequency signals but prevent the passage therethrough of alternating current of a frequency below the range of telephonic audibility (the motor operating current) and in order to prevent undue transmission loss, filtering means including inductances 27 and 27′ and capacities 29 and 29′, respectively, are located in series with the leads 25 and 25′. Similar filtering means including inductances 30, 31, 30′ and 31′ and capacities 10, 32, 10′ and 32′, respectively, are located in the leads 9 and 9′, respectively, at each subscriber's station. The inductances and capacities in each filtering means are of such value that each filter is resonant to alternating current of a frequency below the range of telephonic audibility (the motor operating current) but is nonresonant to voice frequency signals.

The operation of the system as shown in Fig. 1 is as follows:

When the subscriber at station A removes his receiver from the hook to initiate a call, the operator in response to the signal establishes a connection to the central office in the well-known manner. At this time, the current flows from the positive terminal of the source 15, through the upper left impedance coil 17, the inductance 26, the cord conductor 19, the jack 14, out over the calling subscriber's loop, through the transmitter 1, the receiver hook 3, the contact 5, induction coil 6, back through the jack 14, the cord conductor 20, the inductance 26′ and the lower left impedance coil 17 to the negative terminal of the source 15. Although the contact 11 is closed when the receiver is removed from the hook, the motor M does not begin operating, for the generator G is not connected in the circuit at this time. After the connection has been completed through the cord circuit C to the station B of the called subscriber and when the called subscriber removes his receiver from the hook, the circuit including the relay 21 is closed. The closure of this circuit and the resulting energization of the relay 21 causes the latter to attract its armatures 24 and 24′ which establish connections with contacts 23 and 23′, respectively. The establishment of these connections effectively connects the generator G in the circuit of the calling subscriber's line and superimposes on said line an alternating current of telephonically inaudible frequency. The path traversed by this current includes the leads 22 and 22′, the contacts 23 and 23′, the armatures 24 and 24′, the leads 25 and 25′, the capacities 27 and 27′, the cord conductors 19 and 20, the jack 14, the calling subscriber's lines, the leads 9, the capacities 10 and 28, the contact 11, and the winding of the motor M. The motor M begins to operate, rotating the shaft 12 and the ratchet wheels 13 and continues to do so until one of the subscribers returns his receiver to its hook or the operator breaks the connection at the central office. The motor M being, operated by a superimposed, telephonically inaudible, alternating current, will run without humming and at a constant speed regardless of variations of the current flowing in the line and thus insure accurate time measurement. Furthermore, the operating current being of telephonically inaudible frequency, there will be no disturbance created in the talking circuit. The motor M′ located in the called subscriber's line will not be operated due to the fact that the inductances 26 and 26′ will prevent the motor operating current from passing into his line. The voice frequency signals are prevented from passing through the motors M and M′ by capacities 10 and 28 and 10′ and 28′, respectively, or through the circuit of the generator G by capacities 27 and 27′.

As shown and described, the generator is connected on one side of the cord circuit only since, in general, it is desirable to charge the

call to the calling subscriber only. It is obvious, however, that the same mechanism could be applied on the other side of the cord circuit or on both sides of the cord circuit, if desired. The generator G may be common to all of the cords of a given exchange or to a group of cords, or, if desired, may be supplied for each cord separately. Likewise, the association of the generator with the cord circuit may be under the control of other means than the relay 21 in such a manner that the operation of the motor will begin at any desired time during the connection.

While this invention has been illustrated in connection with a typical cord circuit used in manual operation, it is apparent that it is equally applicable to machine switching apparatus.

What is claimed is:

1. In a telephone system, subscribers' lines, an alternating current motor bridged across each of said lines, registering means adapted to be operated by said motor, connecting circuits including a source of current for establishing talking connections between said lines, and a generator adapted to superimpose on said lines alternating current of telephonically inaudible frequency to operate said motor, said motor being adapted to operate in synchronism with said generator.

2. In a telephone system, subscribers' lines, a synchronous motor bridged across each of said lines and responsive to alternating current of telephonically inaudible frequency, metering apparatus adapted to be operated by said motor, connecting circuits including a source of current for establishing talking connections between said lines, a generator adapted to superimpose on said lines alternating current of telephonically inaudible frequency to operate said motor, and means for preventing the passage of voice frequency signals through said motor and said generator and for permitting the passage therethrough of alternating current of substantially inaudible frequency.

3. In a telephone system, a calling line and a called line, a synchronous alternating current motor bridged across said calling line, recording means adapted to be operated by said motor, connecting circuits including the source of current for establishing talking connections between said lines, and generator means adapted to superimpose on said calling line alternating current of telephonically inaudible frequency to operate said motor.

4. In a telephone system, a calling line and a called line, a synchronous alternating current motor bridged across said calling line, connecting circuits including a source of current for establishing talking connections between said lines, a generator adapted to superimpose on said calling line alternating current of telephonically inaudible frequency to operate said motor, and means for preventing the passage of voice frequency signals and direct current through said motor and said generator and for permitting the passage therethrough of alternating current of telephonically inaudible frequency.

5. In a telephone system, a calling line and a called line, an alternating current motor bridged across said calling line, connecting circuits including a battery for establishing talking connections between said lines, a dynamo electric machine adapted to superimpose on said calling line alternating current of telephonically inaudible frequency to operate said motor, said motor being adapted to operate in synchronism with said dynamo electric machine, means for preventing the passage of voice frequency signals and direct current through said motor and said dynamo electric machine and for permitting the passage therethrough of alternating current of telephonically inaudible frequency, and means for preventing the passage of alternating current of telephonically inaudible frequency into said called line.

6. In a telephone system, a calling line and a called line, a synchronous alternating current motor adapted to be bridged across said calling line when the circuit of said calling line is closed, connecting circuits for establishing talking connections between said lines, a source of current for supplying talking current to said lines, a generator adapted to be connected in the circuit of said calling line and to superimpose on said calling line alternating current of a frequency above the range of telephonic audibility to operate said motor, said motor being adapted to to operate in synchronism with said generator, switching means controlled by the closure of the circuit of said called line for connecting said generator in the circuit of said calling line, inductance means in series with the circuit of said called line for preventing the passage of said superimposed generator current into said called line, capacitative means in series with said motor bridge for preventing the passage therethrough of voice frequency signals and direct current and for permitting the passage therethrough of said superimposed generator current, and means in series with said generator leads for preventing the passage therethrough of voice frequency signals and direct current and for permitting the passage therethrough of said superimposed generator current.

In testimony whereof, I have signed my name to this specification this 19th day of March, 1929.

FREDERICK C. BISBEE.