

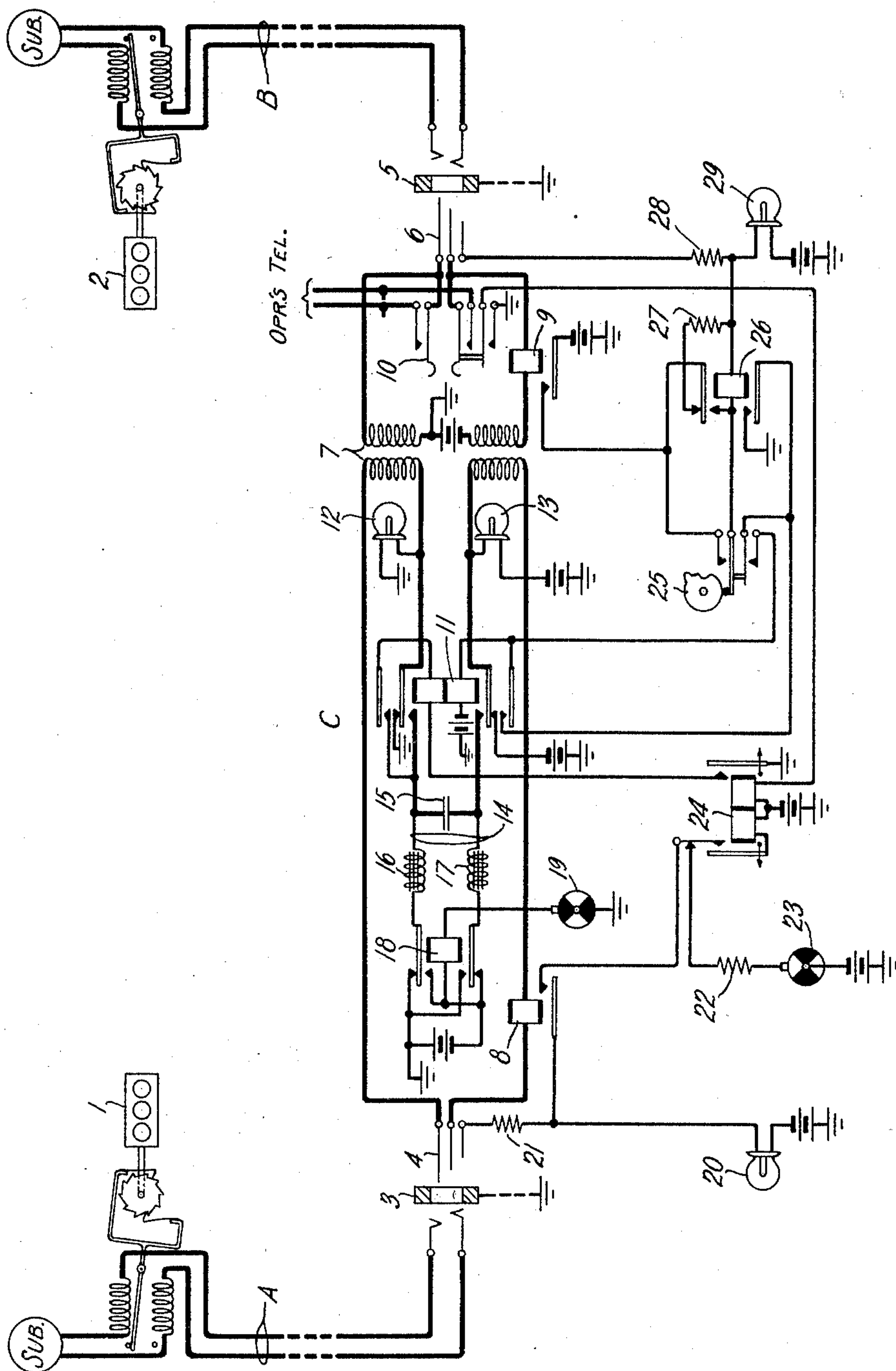
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone exchange systems and particularly to systems in which the service rendered to subscribers is measured by meters located at their substations.

Its object is to secure a simplified and improved meter operating and controlling mechanism which safeguards the subscriber against overcharges.

Service charging systems have been suggested in which a source of meter operating current, which is periodically reversed by a timing device, is connected at the central office to the subscriber's line during the conversational period to cause successive actuations of the meter. In these systems provision is made whereby the current source may be connected to the subscriber's line only when the reversing device is in a given condition. This precaution is taken to guard against the false operation of the subscriber's meter.

According to the the present invention an advantage over these prior systems is secured by providing a meter operating and controlling mechanism which may be connected to the subscriber's line at any time irrespective of the condition of the source of current supply. Provision is made, however, to prevent said source from being disconnected from and then reconnected to the subscriber's line while the direction of current is reversed. In this manner it is impossible for the called party to cause false operations of the calling subscriber's meter by repeatedly opening and closing the talking circuit.

A feature of the invention is a system in which the source of meter-operating current is connected to the calling subscriber's line, under control of the called subscriber, by means of a time-delay device which is independent of the timing device that causes the periodic reversals of said current to actuate the calling subscriber's meter. The time-delay device operates at a much faster rate than the current-reversing device and will immediately reconnect the current-supply source to the calling line should it be disconnected by an opening of the called line. By this arrangement, a called subscriber can-

not prevent the operation of the calling subscriber's meter by opening the line momentarily at a definite point in the cycle of operation of the current-reversing mechanism.

The drawing illustrates a portion of a telephone system in which the subscribers' lines appear at an operator's position. Two of these lines, A and B, are shown terminating in jacks 3 and 5 respectively, at the operator's position. The lines A and B are equipped respectively, with substation meters 1 and 2. These meters are arranged to operate at successive intervals during conversation in response to repeated reversals of current in the line. The central office circuits are so arranged that only the meter of the calling subscriber's line is actuated.

The operator's position is equipped with a number of cord circuits, such as the cord C, partly shown in detail in the drawing. A current reversal circuit 14 is provided in common to a number of cord circuits C. It is arranged to be associated with any particular cord circuit taken in use to supply current to the calling subscriber's line and to automatically reverse the direction of current flow in the line at successive intervals during the conversational period. The supply circuit 14 includes a source of current, a reversing relay 18, an interrupter 19, impedance coils 16 and 17, and a condenser 15.

The cord circuit C is provided with an individual relay 11 which serves to connect the supply circuit 14 through the left windings of the repeating coil 7 to the tip and ring conductors of the calling subscriber's line. Similar relays are provided for other cord circuits.

A detailed description will now be given of the manner in which the system operates. Assume that the subscriber of line A wishes to hold conversation with the subscriber of line B. The calling subscriber initiates the call in the usual manner and the operator responds by inserting the plug 4 of the cord circuit in the jack 3. When the plug is inserted in the jack, a circuit is completed from battery through the lamp 20, resistance 21, sleeve of the plug and jack to ground. At the same time another circuit is completed from bat-

tery, through the inner lower back contact of relay 11, lower left winding of the repeating coil 7, winding of relay 8, ring of the plug and jack, over the loop of the subscriber's line A and returning through the tip of the jack and plug, upper left winding of repeating coil 7 to ground at the inner upper back contact of relay 11. The relay 8 operates in this circuit and completes a circuit from battery through the interrupter 23, resistance 22, normal contact of relay 24, contact of relay 8 and thence to ground at the sleeve of the jack. Each time the interrupter closes, the circuit just traced is completed to battery and shunts the lamp 20. Therefore, the lamp 20 flashes under the control of the interrupter 23.

Next the operator manipulates her talking key 10 to connect her telephone set to the cord circuit and converses with the calling subscriber. The depression of the talking key 10 completes an obvious circuit through the right winding of relay 24. Relay 24 operates and locks in a circuit from battery through its left winding and front contact, contact of relay 8, to ground on the sleeve of the jack 3. Relay 24 at its normal contact opens the circuit of the interrupter 23 to discontinue the flashing of the lamp 20. The lamp is now completely shunted by the circuit traced through the left winding of relay 24 and, therefore, remains extinguished.

The operator, having obtained the number of the called line, seizes the plug 6 and inserts it in the jack 5. Following this she applies ringing current to the called line in the well-known manner. When the called subscriber answers, a circuit is completed from battery through the lower right winding of the repeating coil 7, supervisory relay 9, ring of the plug 6 and jack 5, thence over the loop of the called line B and returning through the tip contacts of the jack and plug through the upper right winding of repeating coil 7 to ground. The supervisory relay 9 operates and closes a circuit from battery through its contact, upper back contact of relay 26, resistances 27 and 28 to ground through the sleeve of the plug and jack. This circuit is in shunt of the circuit from battery through the lamp 29 and resistance 28 and consequently the lamp is prevented from lighting. As soon, after the operation of relay 9, as the interrupter 25 closes its upper contact, a circuit is completed from battery through the contact of relay 9, upper contacts of said interrupter, winding of relay 26, resistance 28 to ground. Relay 26 operates and locks in a circuit through its inner upper contact independently of the interrupter 25. As soon, following this, as the interrupter closes its lower contacts, a circuit is completed from ground through the lower contacts of relay 26, lower contacts of the interrupter, lower

winding of relay 11, to battery. Relay 11 operates and locks in a circuit from battery through its lower winding and lower front contact to ground at the lower contact of relay 26.

The relay 11 in operating connects the battery supply circuit 14 to the calling line. The lamps 12 and 13, which have tungsten filaments, are provided to prevent sudden change in the current in the subscriber's line while the contacts of the relay 11 are moving from one position to the other. When the inner back contacts of the relay 11 are broken the subscriber's line, instead of being opened completely, is now included in series with the lamps 12 and 13. The current flowing in these lamps heats their filaments, which have the characteristic of increasing their resistance as they become heated, thus producing a gradual decrease in the flow of current. An instant later the front contacts of the relay 11 are closed, and, assuming the relay 18 to be in the position shown, current from the source in the supply circuit 14 is applied to the subscriber's line in the same direction. By preventing sudden changes of current in the line while the supply circuit is connected thereto, objectionable noises are eliminated.

The circuit for supplying the subscriber's line with talking current may now be traced from battery, through the lower back contact of relay 18, impedance coil 17, inner lower front contact of relay 11, lower left winding of repeating coil 7 and thence over the subscriber's line and returning to the upper left winding of repeating coil 7, upper inner front contact of relay 11, coil 16, upper back contacts of relay 18 to the opposite pole of the battery. Conversation now takes place.

At the end of measured intervals during the conversation, the interrupter 19 causes the relay 18 to energize and release. For example, relay 18 may operate and remain operated for a fifteen-second period and then release and remain released for another fifteen-second period, this cycle being repeated. When the relay 18 operates it reverses the direction of current flowing from the source over the calling subscriber's line, thereby causing the operation of the polarized message meter 1. The choke coils 16 and 17 and the condenser 15 serve to prevent sudden changes of current in the line due to the reversal of direction.

At the end of the conversation the subscribers replace their receivers on the switch-hooks. When the called subscriber hangs up his receiver, relay 9 releases and in turn causes the release of relay 26. Relay 26 releases the relay 11, provided its upper winding is open, which in turn disconnects the reversing circuit 14 from the calling subscriber's line to prevent further operation of the meter 1.

If the calling subscriber first hangs up his receiver his line is opened at the switchhook contacts to render the meter operating circuit ineffective. The calling subscriber by hanging up his receiver also opens the circuit of supervisory relay 8 which in turn opens the holding circuit of relay 24. Relay 24 releases and the shunt is removed from the lamp 20. The lamp 20, therefore, lights and remains illuminated until the operator removes the plug 4 from the jack 3.

It will be noted that the circuit of the calling line is momentarily opened at the contacts of relay 18 on reversal of current. These interruptions although brief may result in corresponding releases of supervisory relay 8. Relay 8, upon releasing, opens the holding circuit of relay 24, but this latter relay being slow to release does not retract its armature during such brief interruptions.

It will be recalled that the relay 11 when energized and locked is under control of the relay 26 which in turn is under the control of the supervisory relay 9 and the sleeve contacts of the plug and jack. Should the called subscriber actuate his switchhook a number of times in succession, the relay 9 releases on each opening of the called line and releases the relay 26. Relay 26 in turn opens the holding circuit of relay 11. Under certain conditions if relay 11 is permitted to release the current in the calling line will be reversed thereby causing a false actuation of the subscriber's meter 1. For example, assume that the relay 18 is operated so that current in the subscriber's line is flowing in the direction opposite from what it flows when the relay 11 is in its normal position. If at this time the relay 11 is permitted to release due to the called subscriber flashing his switchhook, the calling subscriber's meter 1 will be operated falsely. To prevent such an improper operation of the meter 1, a holding circuit is provided for the relay 11 and may be traced from ground through the contact of relay 24, upper winding of relay 11, upper front contact of said relay through the coil 16, upper front contact of relay 18 to battery. Thus, if the lower winding of relay 11 is de-energized at a time when current in the calling line is reversed the relay is held in a circuit through its upper winding.

The interrupter 19, which causes the relay 18 to operate and release periodically, is driven at a comparatively slow rate. For example, it may be arranged to successively close and open the circuit of relay 18 at intervals of 15 seconds. The interrupter 25, however, which introduces the time-delay before the operation of relay 11, is driven at a much faster rate. Since these interrupters are independent of each other, the called party cannot defeat the charge for the ensuing 15-second interval by opening his line momentarily to release relay 11 just prior to

the reversal of current by relay 18. If he attempts to do so, the fast interrupter 25 will cause the reoperation of relay 11 to reconnect the source to the calling line after a short interval following the reclosure of the called line.

Although the invention is illustrated in connection with a manual telephone system it should be understood that it may be applied to systems employing automatic switches. Furthermore, numerous changes and alterations may be made in the circuits and equipment illustrated without departing from the spirit of the invention.

While the substation instrument has been shown in a diagrammatic manner, it will be understood that any suitable type of meter may be used. For example, a register of the general type shown in the patent to Thomson No. 1,121,953, dated December 22, 1914, is suitable.

What is claimed is:

1. In a telephone system, a telephone line and a current operated device therefor, a source of current, means for connecting said source to and disconnecting it from said line, a mechanism for repeatedly changing the flow of current from said source to cause the operation of said device, and means for preventing the disconnection of said source from the line when said changing mechanism is in a given condition.
2. In a telephone system, a subscriber's line and a service meter therefor, a source of current for supplying said line, means for connecting said source to and disconnecting it from the line, means for periodically changing the flow of current from said source to cause actuations of said meter, and means to prevent the source from being disconnected from the subscriber's line when said current changing means is in a given condition.
3. In combination, a subscriber's line, a service meter at the substation, a source of current for supplying said line, means for connecting said source to the line and for disconnecting it therefrom, means for repeatedly reversing the direction of the current flowing from said source to cause successive operations of the meter, and means for rendering said connecting means ineffective to disconnect the source from the line while the current flow is reversed.
4. In combination, a calling line and a meter therefor, a called line, means for interconnecting said lines, a source for supplying current to the calling line, means controlled by the called party for connecting said source to and disconnecting it from the calling line, means for repeatedly reversing the flow of current from said source to cause the operation of said meter, and means for preventing the disconnection of said source from the calling line while the current is reversed.
5. In a telephone system, a calling line

and a called line, a meter for the calling line, means for establishing a talking connection between said lines, a source of current, a relay for connecting said source to and disconnecting it from the calling line, means for periodically reversing the direction of current from said source to cause the operation of said meter, means controlled by the called party for operating and releasing said relay, and means independent of the called line for preventing the release of said relay while current is reversed.

6. In a telephone system, a calling subscriber's line and a meter therefor, a called line, means for interconnecting said lines, a source of current, means controlled by the called party for connecting said source to and disconnecting it from the calling line, means for causing a delay between the response of the called party and the connection of said source to the calling line, means for repeatedly reversing the current from said source to cause successive operations of said meter, and means for preventing the disconnection of the source from the calling line while current is reversed.

7. In a telephone system, a telephone line and a meter therefor, a source of current, a supply circuit connected to said source, a relay arranged while in its deenergized condition to connect said source to the line, said relay serving while energized to connect said supply circuit to the line, means for repeatedly reversing the direction of current in the supply circuit to cause actuations of said meter, and means for preventing the release of said relay when the current in the supply circuit is reversed.

8. In a telephone system, a calling line and a meter therefor, a called line, means for interconnecting said lines, a source for supplying current to the calling line, means controlled by the called party in answering for connecting said source to the calling line, means for repeatedly changing the flow of current from said source to cause the operation of said meter, and means independent of said current changing means for introducing a delay between the time the called party answers the call and the time when said source is connected to said calling line.

9. In a telephone system, a calling line and a meter therefor, a called line, means for interconnecting said lines, a source for supplying current to the calling line, means controlled by the called party in answering the call for connecting said source to the calling line, a mechanism including a constantly-driven interrupter for repeatedly reversing the direction of current from said source to operate said meter, and a second constantly-driven interrupter, the operation of which is independent of the operation of said first interrupter, for introducing a delay between the time the called party answers the call and

the time when said source of current is connected to the calling line.

10. In a telephone system, a calling line and a meter therefor, a called line, means for interconnecting said lines, a source for supplying current to the calling line, connecting means effective in response to the closure of the called line to connect said source to the calling line and effective in response to the opening of the called line to disconnect said source from the calling line, an interrupter driven at a given rate for causing repeated reversals of current from said source to operate said meter, and a second interrupter driven at a faster rate for operating said connecting means after a short interval following the closure of the called line.

In witness whereof, I hereunto subscribe my name this 13th day of January, 1928.

JOHN W. GOODERHAM.