T. G. MARTIN.

MEASURED SERVICE TELEPHONE SYSTEM.

APPLICATION FILED DEC. 26, 1913.

1,243,749.

Patented Oct. 23, 1917.

2 SHEETS—SHEET 1.

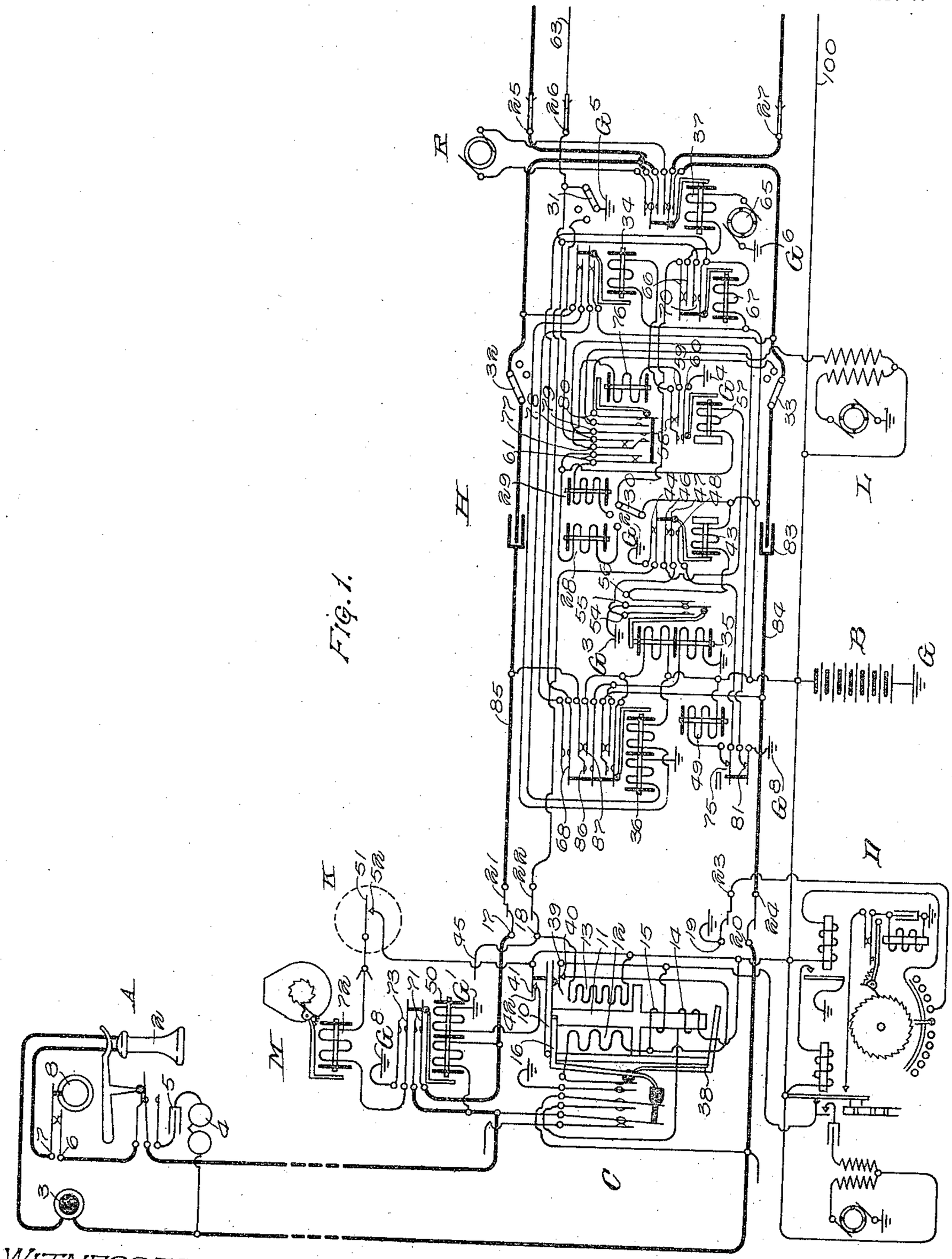

Fig. 1.

WITNESSES

Harry V. Hensley.

B. Parker

INVENTOR:

Talbot G. Martin

By Bulkley & Sweatt

ATTORNEYS,

T. G. MARTIN.

MEASURED SERVICE TELEPHONE SYSTEM.

APPLICATION FILED DEC. 26, 1913.

1,243,749.

Patented Oct. 23, 1917.

2 SHEETS—SHEET 2.

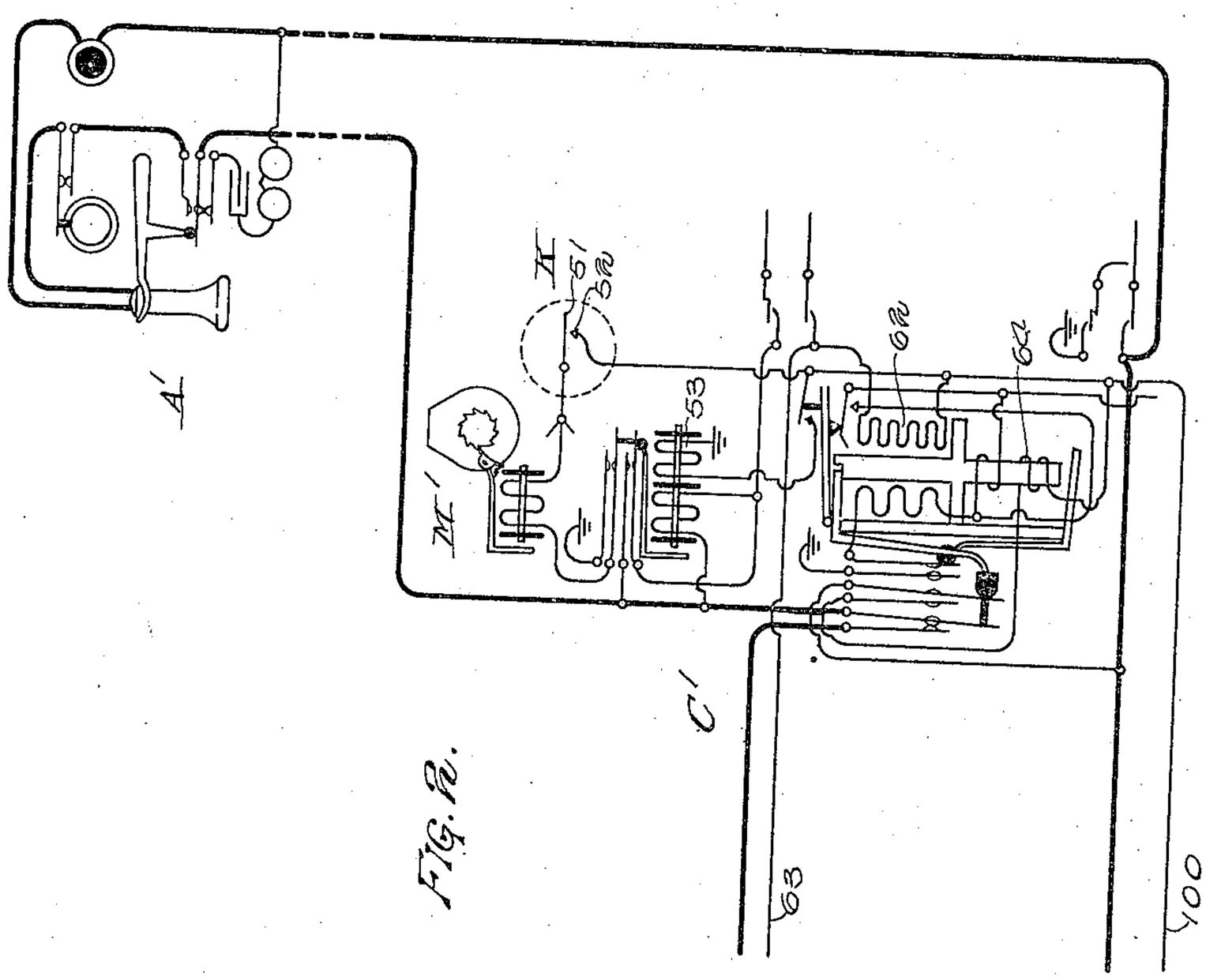

FIG. 2.

WITNESSES

Harry C. Hershey.

B. Glauber

INVENTOR:

Talbot G. Martin

By Dulkley & Sweetser

ATTORNEYS.

UNITED STATES PATENT OFFICE.

TALBOT G. MARTIN, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

MEASURED-SERVICE TELEPHONE SYSTEM.

1,243,749. Specification of Letters Patent. Patented Oct. 23, 1917.

Application filed December 26, 1913. Serial No. 808,852.

To all whom it may concern:

Be it known that I, TALBOT G. MARTIN, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented certain new and useful Improvements in Measured-Service Telephone Systems, of which the following is a specification.

My invention relates to improvements in measured service telephone systems, and more particularly to improved means for recording the actual time during which a talking connection between two subscribers' stations is established.

More particularly my invention relates to a time recording mechanism which is controlled by a clock mechanism so as to be intermittently operated at predetermined intervals of time, this recording mechanism being started in operation by the response of the called subscriber and the operation being stopped when the connection is released.

My present invention provides means for operating the meter by means of a reversal of current over the conductors of the talking circuit upon the response of the called subscriber.

My invention will be more clearly understood by reference to the accompanying drawings, in which, for the purpose of illustration, I have shown my invention in connection with an automatic telephone system of a well-known type, although, of course, it will be understood that my invention is not in any way limited to use in connection with any particular type of telephone system.

Figures 1 and 2 taken together show a complete circuit connection between a calling substation A and a called substation A^1 in a system embodying the principles of my invention.

The central office equipment shown herein comprises only the so-called line switches and connector switch, but it will be clearly understood by those versed in the art that so-called selector switches may be inserted in the system, thereby increasing the capacity of the exchange without departing from the principles of my invention. The said selector switches may be of a type similar to the selector switches shown in British patent to T. G. Martin No. 1419 of 1910.

The substation A shown herein may be of any suitable or approved type and comprises the usual receiver 2, transmitter 3, ringer 4 and condenser 5. Being a so-called automatic substation it is also provided with an impulse transmitter or calling device, which is herein represented by a pair of impulse springs 6 and 7 and an impulse wheel 8, which latter is assumed to be controlled through the medium of a finger hole dial (not shown) in such a manner that the impulse springs 6 and 7 may be momentarily separated a number of times corresponding to each digit of the number to be called.

The subscriber's individual switch C is of the general type of subscriber's switch shown in British patent to R. W. James No. 26,301 of 1906, being, however, of the particular type disclosed in the above-mentioned British Patent No. 1419 of 1910. This line switch comprises, among other details, a plunger (not shown) attached to the end of a so-called plunger arm 10 which is controlled by the magnet 11. The magnet 11 comprises four windings, namely, a pull-down winding 12, a cut-off or holding winding 13, a line winding 14 and an auxiliary winding 15. The core of the magnet 11 is so constructed that the magnetic circuit of the windings 12 and 13 is separate from that of the windings 14 and 15. The winding 12 operates both the plunger arm 10 and the cut-off armature 16, while the winding 13 is only strong enough to operate the cut-off armature 16 and to hold the plunger arm 10 in its operated position. When the plunger arm 10 is operated, the plunger is forced into a bank of contact springs, forcing the springs 17, 18, 19 and 20 into engagement with the springs 21, 22, 23 and 24, respectively. Although only one set of springs (17 to 24) is shown, each line switch is provided with a plurality of such sets, each set forming the terminal of a trunk line leading to a connector switch H. Each trunk line is connected in multiple with the corresponding springs of all the line switches of the group which is controlled by the master switch D. The master switch D is controlled by the subscriber through the medium of the line relay 14, as will be hereinafter more fully explained.

The master switch D is of the same general type as disclosed in British Patent No. 26,301 of 1906, referred to above, being, however, of the particular type disclosed in said

British Patent No. 1419 of 1910. The function of the master switch, as is well known, is to maintain the plungers of all the idle line switches in position to engage the terminal of an idle trunk line.

The connector switch H is of the same general type of connector switch as disclosed in United States Letters Patent No. 815,176, granted March 13, 1906, to Keith, Erickson and Erickson, the circuits, however, being modified to adapt the switch to operate in a system in which the central office apparatus is controlled by impulses delivered over the two sides of the line in series. The connector is provided with a shaft (not shown) carrying the wipers 25, 26 and 27, which shaft is controlled by the vertical magnet 28 and the rotary magnet 29. The usual side switch comprising the wipers 30, 31, 32 and 33 is controlled by the private magnet 34 in the usual well-known manner. The magnet 49 is the usual release magnet. The line relay 35 is connected with the calling line through the reversing springs of the so-called back-bridge relay 36. The ringing relay 37 is the means through which ringing current is applied to the called line.

The called substation A′, together with its individual switch C′, is similar in all respects to the substation A, together with its individual switch C.

For the purpose of supplying battery current for operating the central office apparatus and for talking purposes there is shown a battery B having one terminal grounded. The usual busy signaling machine is shown at L.

Associated with the line switch C of the calling line is a time recording meter M controlled by the meter magnet 72. The circuit of this magnet is in turn controlled by the meter relay 50 and by a clock mechanism K. This clock mechanism is arranged so as to intermittently open and close the contacts 51 and 52 and in this manner control the connection of the magnet 72 to battery B. The relay 50 is a double-wound relay, the windings being so proportioned that it requires the energization of both windings in the same direction to attract its armature, said armature being unaffected by the energization of either winding alone, or by the energization of the two windings in opposition to each other. By this arrangement, when the meter relay 50 is operated upon the response of the called subscriber, in a manner to be hereinafter described, to close the circuit of the meter magnet 72, the clock mechanism K then operates to intermittently operate the magnet 72 and thus cause the meter to accurately register the time consumed by the established connection.

A general description of the apparatus having been given, in order to give a complete understanding of my invention I will now describe how the calling subscriber at the substation A may obtain connection with the subscriber at the called substation A′, and how the meter M will operate to register the length of time that the conversation is held. It will be assumed that the number of the called substation is 20.

Upon the removal of the receiver from the switch-hook at the substation A preparatory to making a call, an energizing circuit is closed through the line winding 14 of the individual switch C, thereby attracting the line armature 38. The armature 38, upon being attracted, closes a circuit through the pull-down winding 12 in series with the auxiliary winding 15. The pull-down winding 12, upon energizing, attracts the plunger arm 10 to force the plunger into the bank of springs 17 to 24, inclusive. It also operates the cut-off armature 16, thereby disconnecting the line winding 14 from the line. The armature 38 does not fall back immediately, however, owing to the fact that the winding 15 is still in series with the pull-down winding 12. Upon the plunger arm 10 being attracted, the springs 39 and 40 are brought together to short-circuit the auxiliary winding 15, making the same slightly slow acting. At the same time the springs 39 and 40 make contact, the springs 41 and 42 are brought together, closing a circuit through the right-hand winding of the relay 50, said circuit extending from ground G′ through the said winding and the contact of springs 41 and 42 to battery B, thence through battery B to ground G; but the armature of the relay 50 is unaffected by the energization of this winding alone. The armature 38 being slow to fall back allows sufficient time for a holding circuit to be closed in the switch ahead for the cut-off or holding winding 13. The engagement of the springs 17 and 20 with the springs 18 and 21, respectively, extends the subscribers' lines to the line relay 35 of the connector E. This circuit extends through the left-hand winding of the magnet 50, but does not operatively energize said magnet, as the two windings are acting in opposition to each other. The line relay 35 of the connector switch E is thereupon energized, closing a circuit through the slow acting relay 43. The relay 43, upon energizing, closes the above-mentioned holding circuit through the cut-off winding 13 of the line switch C. This circuit extends from ground G^2 through the contact of springs 44, bank springs 22 and 18 and the cut-off winding 13 to battery B. The winding 13, upon energizing, holds the cut-off armature 16 and the plunger arm 10 in their operated positions after the circuit of the pull-in winding is broken by the falling back of the line armature 38. A guarding ground potential is supplied to the connector private bank

contacts of the calling line as soon as the relay 43 is energized. This potential extends over the circuit just traced to the bank contact 18, thence over the conductor 45 to said private bank contact. The energization of the relay 43 also prepares a circuit for the vertical magnet 28 by bringing into engagement the springs 46 and 47 and opens the circuit of the release magnet 49 at the springs 47 and 48.

The calling subscriber now operates his calling device for the first digit 2 of the called number, whereby the substation impulse springs 6 and 7 are operated twice momentarily, each time breaking the circuit of the connector line relay 35. The relay 43 of the connector switch being slow acting does not deënergize during the momentary interruptions of its circuit by the line relay 35, and consequently, each time the latter relay deënergizes, an impulse is transmitted over the circuit extending from ground G^3 through the contact of springs 55 and 54, springs 47 and 46 of the relay 43, slow acting relay 57, vertical magnet 28 and the side switch wiper 30 (in first position) to battery B. The vertical magnet receives two impulses over this circuit and operates to raise the switch shaft and wipers to a position opposite the second level of bank contacts. The relay 57, which was included in series with the vertical magnet, remains in its energized position during the entire time that impulses are being transmitted through it and operates to close the circuit of the private magnet 34. This circuit extends from ground G^4 through the contact of springs 60 and 58 and the said relay to battery B. After the last impulse is delivered, the relay 57 opens the circuit of the private magnet 34, which, upon deënergizing, permits the side switch to advance from first to second position in a well-known manner. The movement of the side switch wiper 30 from first to second position transfers the battery connection from the vertical magnet 28 to the rotary magnet 29. The calling subscriber now operates his calling device for the last digit 0, in response to which the connector line relay operates to transmit ten impulses through the rotary magnet 29 in series with the relay 57, whereby the shaft and wipers are rotated onto the contacts of the desired line. This circuit extends from ground G^3 through the contact of springs 55 and 54, springs 47 and 46, relay 57, springs 61, rotary magnet 29 and the side switch wiper 30 (in second position) to battery B. If the called line is idle, the private magnet 34 deënergizes when its circuit is broken by the relay 57 after the last impulse is delivered to the rotary magnet 29. The deënergization of the private magnet 34 allows the side switch to advance one more position—that is, from second to third position. By the engagement of the side switch wipers 32 and 33 with their third-position contact points, and by the energization of the bridge-cut-off winding 62 of the line switch C′, the connection is completed with the called substation. The circuit for the bridge-cut-off winding 62 of the line switch C′ extends from ground G^5 through the side switch wiper 31 (in third position), private wiper 26, conductor 63 and the said cut-off winding to the battery lead 100. The said winding, upon energizing, operates to disconnect the line winding 64 of the line switch C′ from the line and to extend the line through to the called substation A′. A guarding ground potential is supplied to the connector private bank contact of the called line, which prevents the called line from being seized by some other connector switch. By the engagement of the side switch wiper 30 with its third-position contact point, the circuit of the ringing relay 37 is closed. This circuit extends from ground G^6 through the interrupter 65, relay 37, springs 66 and the side switch wiper 30 (in third position) to battery B. The ringing relay, upon energizing, disconnects the called line from the calling line and bridges the ringing generator R across the called line. The ringing relay is energized only intermittently through the medium of the interrupter 65. Upon the response of the called subscriber his line is provided with talking current through the back-bridge relay 36. The relay 36, upon energizing, closes the circuit of the ringer cut-off relay 67. This circuit extends from ground G^5 through the side switch wiper 31 (in third position), contact of the springs 68 and the relay 67 to battery B. The relay 67, upon energizing, interrupts the circuit of the ringer relay 37 at the springs 66 and closes a locking circuit for itself through the springs 70 independent of the springs 68. A further result of the energization of the back-bridge relay 36 upon the response of the called subscriber is the reversal of the connection of the windings of the line relay 35 to the conductors 84 and 85, whereby the direction of the current in the calling line is reversed, and consequently in the left-hand winding of the relay 50. This reversal of current in the left-hand winding of the relay 50 causes the two windings of this relay to now assist each other and to operatively energize the said relay, which upon energizing, closes the circuit for the meter magnet 72 and closes the contact of springs 71, whereby the left-hand winding of said relay is short-circuited. The relay is then held in its operated position by the right-hand winding alone, which, although it is not strong enough to operatively energize the relay, is strong enough to hold it when

in its operated position. The short-circuiting of the left-hand winding renders the meter magnet inoperative to any changes in the line current. The said circuit for the magnet 72 extends from ground G^8 through the contact of springs 73, meter magnet 72 and the springs 51 and 52 (controlled by the clock K) to battery B. This master clock K operates to intermittently open the springs 51 and 52 and this causes the intermittent operation of the meter M. The clock being adjusted so as to close these springs at predetermined time intervals, the meter operates to accurately register the time of the talking connection.

After the conversation is completed, the connection is released by the hanging up of the receiver at the calling substation in the usual manner and the magnet 50 deënergizes and the circuit of the meter magnet 72 is opened at the spring 73.

If the called line is busy, there will be a guarding potential upon the connector private bank contact, just as explained in connection with the line switch C. When the connector private wiper 26 engages this guarding contact, a busy signal is sent back to the calling line from the busy signaling machine L in the well-known manner. The subscriber, hearing the busy signal, replaces his receiver upon the receiver hook and thus releases the apparatus.

It will thus be seen that I have devised a very simple and efficient arrangement for measuring the length of time that a conversation is carried on. It will also be seen that the calling subscriber's register begins to operate only when the called subscriber responds, so that the subscriber is not charged with the time taken to set up a connection, or for the called subscriber to answer, but is charged only from the time that conversation begins.

While I have illustrated the registering devices associated with automatic switches in connection with an automatic telephone exchange system of a particular type, it is, of course, understood that my invention is not limited to use in such a system. The registering device may be employed with any suitable automatic system, and in its broader aspect my invention may be employed in connection with either manual or semi-automatic systems.

What I claim as my invention is:—

1. In a telephone system, a plurality of subscribers' lines, means for establishing connection between two of said lines, a service meter for the calling line, means for reversing the current in a portion of the talking circuit when the called subscriber answers, means having a winding in series with the talking circuit conductors controlled by said reversal of current for operating said meter, and for changing the relation of said last means to the talking circuit, another winding for said means controlled over a circuit individual to the calling line, and a clock mechanism for further controlling the operation of said meter.

2. In a telephone system, a plurality of subscribers' lines, means for establishing connection between two of said lines, a time recording meter associated with the calling line, means for reversing the current in the calling line upon the response of the called subscriber, means having a winding in series with the talking circuit conductors controlled by said reversal of current for initially operating said meter and for changing the relation of said last means to the talking circuit, another winding for said means controlled over a circuit individual to the calling line, and a clock mechanism for intermittently operating said meter at predetermined time intervals after said first operation.

3. In a telephone system, a plurality of subscribers' lines, means for establishing connection between two of said lines, a time recording meter associated with the calling line, a relay for controlling the operation of said meter, said relay having a plurality of energizing windings, means for initially energizing said windings differentially when connection is being extended to the called line, means for reversing the current in one of said windings upon the response of the called subscriber to thereby render said relay operative to operate said meter, a holding winding for said relay controlled over a circuit individual to the calling line, and a clock mechanism for further intermittently controlling the operation of said meter.

4. In a telephone system, a plurality of subscribers' lines, means including automatic selecting and connecting switches for establishing connection between two of said lines, a time recording meter associated with the calling line, means for reversing the current in the calling line upon the response of the called subscriber, means having a winding in series with the talking circuit conductors controlled by said reversal of current for initially operating said meter and for changing the relation of said last means to the talking circuit, a holding winding for said means individual to the calling line, and a clock mechanism for intermittently operating said meter at predetermined time intervals after said first operation.

5. In a telephone system, a plurality of subscribers' lines, means for establishing a talking circuit between two of said lines, a time recording meter associated with the calling line, a relay for controlling the operation of said meter, said relay having a plurality of energizing windings, one of said windings being in series with said talking

circuit, and another of said windings being permanently connected to one terminal of battery, means for initially energizing said windings differentially when connection is being extended to the called line, means for reversing the current in one of said windings upon the response of the called subscriber to thereby render said relay operative to operate said meter, a clock mechanism for further controlling the operation of said meter, and means for deënergizing said relay to render said meter inoperative when the connection is released.

6. In a telephone system, calling and called subscribers' lines, a time recording meter individual to each calling line, means for establishing a talking circuit between two of said lines comprising an automatic switch individual to a calling line and an automatic switch common to the calling lines, a relay for controlling the operation of said meter, an energizing winding for said relay controlled exclusively over a circuit local to said individual switch, another energizing winding for said relay including a portion of the talking circuit controlled by said common switch to thereby control the operation of said meter, and a clock mechanism for further controlling the operation of said meter.

7. In a telephone system, calling and called lines, a time recording meter individual to each calling line, means for establishing a talking circuit between two of said lines comprising an automatic switch individual to the calling line and an automatic switch common to the calling lines, a relay for controlling the operation of said meter, a winding for said relay energized over a circuit exclusive of said common switch, another winding for said relay controlled over a portion of said talking circuit, by said common switch to thereby control the operation of said meter, and a clock mechanism for further controlling the operation of said meter.

8. In a telephone system, a plurality of subscribers' lines, means for establishing connection between two of said lines including a link common to said lines, a time recording meter associated with the calling line, a relay for controlling the operation of said meter, said relay having a plurality of energizing windings, means for initially energizing said windings differentially when connection is being extended to the called line, means for reversing the current in one of said windings upon the response of the called subscriber to thereby render said relay operative to operate said meter, one of said windings controlled over a circuit exclusive of said link, and a clock mechanism for further controlling said meter.

Signed by me at Chicago, Cook county, Illinois, this 15th day of December, 1913.

TALBOT G. MARTIN.

Witnesses:
HARRY E. HERSHEY,
B. GARBER.