A. D. T. LIBBY.

TELEPHONE SYSTEM.

APPLICATION FILED JAN. 9, 1911.

1,214,694.

Patented Feb. 6, 1917.

2 SHEETS—SHEET 1.

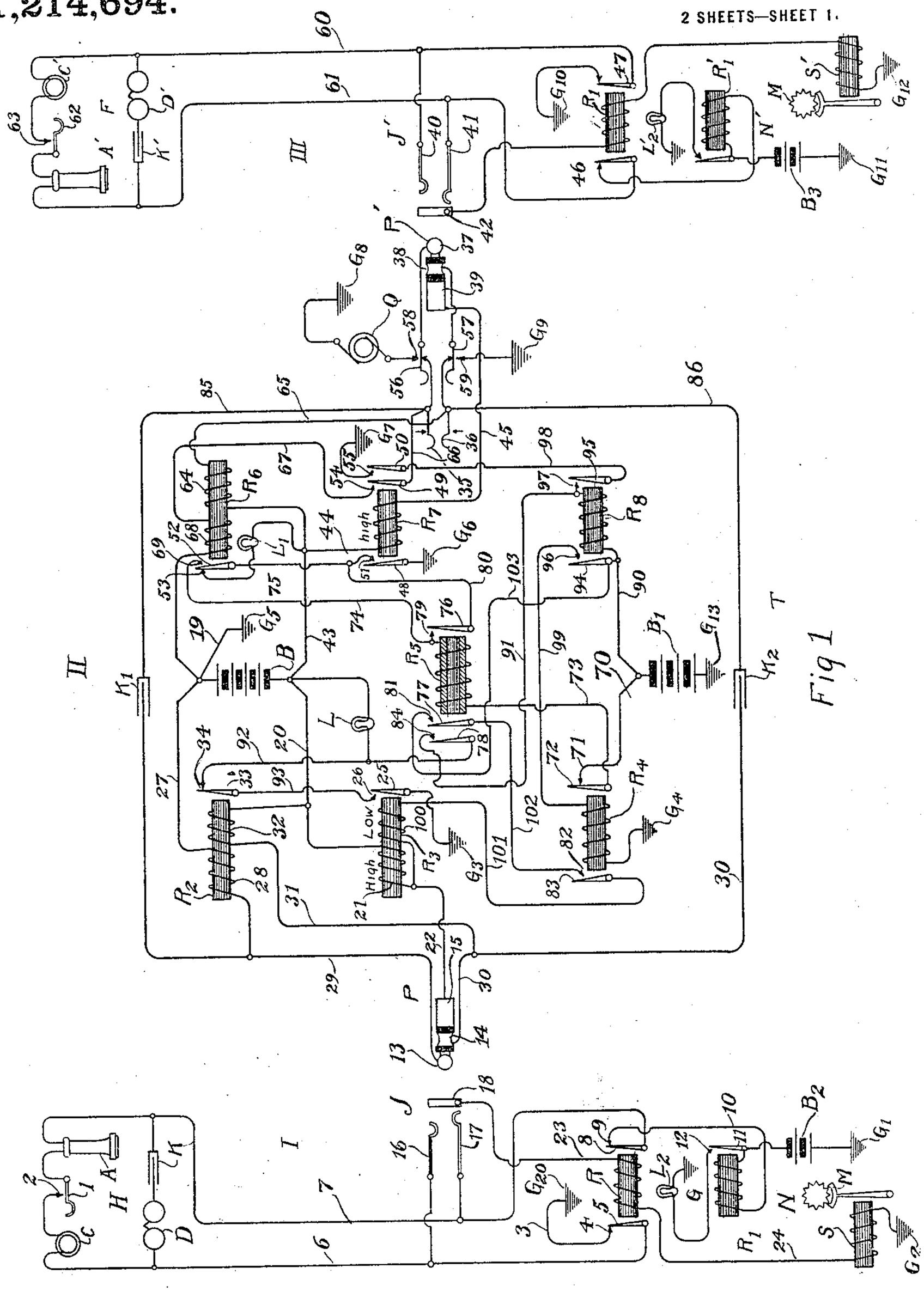

Fig 1

Witnesses
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Mary Malley

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His Attorney

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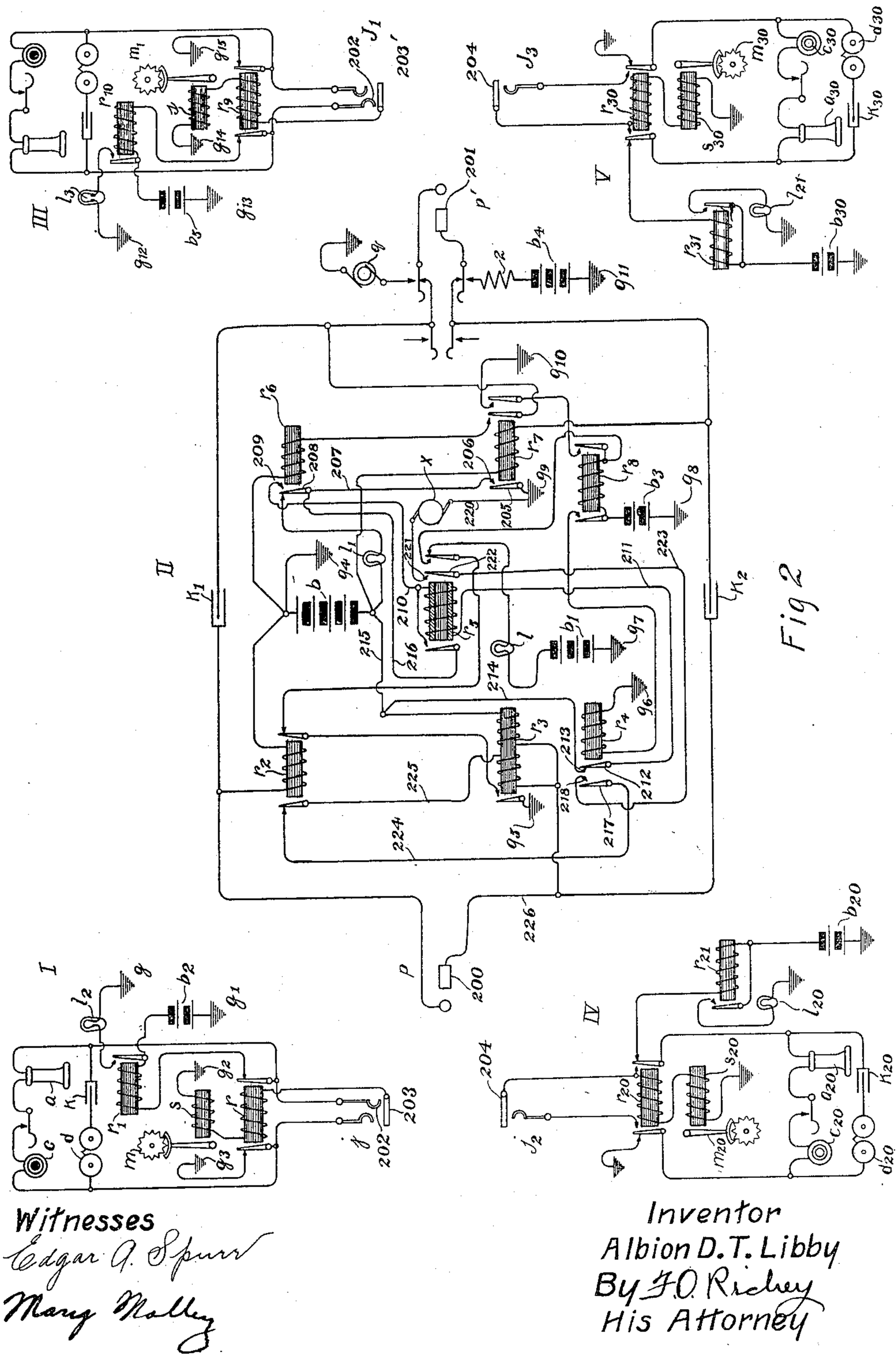

Fig 2

Witnesses

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UNITED STATES PATENT OFFICE.

ALBION D. T. LIBBY, OF ELYRIA, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

1,214,694. Specification of Letters Patent. Patented Feb. 6, 1917.

Application filed January 9, 1911. Serial No. 601,539.

To all whom it may concern:

Be it known that I, ALBION D. T. LIBBY, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Telephone Systems; and I do hereby declare the following to be a full, clear, and exact description of my invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to telephone systems and more especially to telephone meter systems in which a device is used for registering the number of calls made by a subscriber.

I aim to produce a system in which it is impossible to operate the register more than once for each call, and in which the register will be operated once and only once every time a conversation is carried on.

As a second object, I aim to produce a system in which it is impossible to register a call against the called subscriber.

In some of the systems heretofore proposed, it is possible under certain conditions to produce disturbing current impulses in the subscriber's telephone. I produce a system in which this difficulty is obviated. In my system, the call is registered after the conversation is completed.

Many of the systems in the prior art which have accomplished one or more of the foregoing objects, does so by burdening the central station operator with partial control of the system. As the speed of the system depends upon the operator, it is of material importance to relieve her as much as possible. A system which burdens her with the operation of the meter, not only requires her attention in an effort to operate this meter, but taxes her memory with the fact that she must register such call after the conversation has been completed. I also obviate this objection by producing a meter system which operates automatically when the conversation is terminated. Another objection to the systems which I have named, is as follows: Sometimes the calling subscriber desires a second call and either does not hang up his receiver or takes it down again before the operator can register the call. In that event, it is necessary for the operator to instruct the subscriber to hang up his receiver to give her an opportunity to operate her meter controlling mechanism to register the call. This causes delay, confusion and controversy between the subscriber and the operator. Since my system operates automatically at the close of the conversation, I avoid this trouble.

The other objects of my invention and the invention itself, will be best understood from the following detailed description when taken in connection with the drawings, while the scope of the invention is more particularly pointed out in the appended claims.

Figure 1 is a diagram of one form of my circuit, in which I have used at the central station, what is known as a three conductor cord. Fig. 2 is a diagram showing my system with what is known as a two conductor cord.

Referring now to the drawings and more particularly to Fig. 1, at I. I show a telephone line which leads from a substation at H to a terminal J at a central station II. At III. I show a second line which leads from a substation F to a terminal J' at the central station II. T is a means for connecting the lines together for conversational purposes. I have shown a cord circuit which is the connecting means usually employed for this purpose. At R the cut-off relay of the line I. is shown, at R^1 the line relay and at L^2 the line lamp is shown. At N I show the service meter which consists of the mechanism M and the electro-magnetic means S for driving said mechanism. The substation apparatus at H consists of a receiver A and a transmitter C in a normally open bridge of the line. The signal D and the condenser K are in a normally closed bridge of the line.

In the illustration of line III. I have used the same reference characters primed, so that the character of the line III. will be clear from the description of the line I.

I have shown sources of current at B, B^1, B^2 and B^3. As a matter of fact, all of these may be the same source, such as the common battery of the system. This is located at the central station II.

The cord circuit consists of a pair of talking strands connected to an answering plug

P and calling plug P′ which are adapted to be inserted into the jacks J and J′ for the purpose of connecting the lines together.

L and L′ are supervisory lamps for guiding the operator. The circuit of the lamp L is controlled by relays R^2 and R^3. The circuit of the lamp L^1 is controlled by relays R^6 and R^7.

R^5 is a slow acting relay. R^4 and R^8 are special relays. The function of these relays will be clear from the description of the operation.

Q is a source of signaling current.

The functions of the apparatus and the apparatus itself will be best understood from the description of the operation, which is as follows: Suppose the subscriber H desires to converse with the subscriber F. The subscriber at H removes the receiver A from the switchhook 1. This switchhook is spring pressed upward, engages the contact 2 and completes the following circuit: ground at G^{20}—3—4— armature 5 of relay R—main conductor 6—C—2—1—A—main conductor 7—armature 8 of the relay R—10—relay R^1—battery B^2 to ground at G^1. Previous to the closing of the switch 1—2, direct current, which is the character of the current generated by the battery B, was prevented from flowing through this circuit by the condenser K. The relay R^1 will be energized over the circuit described, pulling up its armature 11 and closing the switch 11—12. A circuit will then be completed as follows: ground G^1—B^2—11—12—L^2—G. This will cause the illumination of the lamp L^2 which is placed before the operator adjacent to a jack of the line I. The operator then inserts the plug P into the jack J. The tip 13, the sleeve 14 and ring 15 of the plug engage respectively the tip spring 16, the sleeve spring 17 and the ring 18 of the jack J. A circuit is completed through the relay R as follows: G^5—19—B—20—coil 21 of relay R^3—22—15—18—23—R—24—S—G^2. The coil 21 is a high resistance coil, so that while current enough to operate relay R flows in this circuit, such current is not strong enough to operate the electromagnet S. The relay R draws up its armatures 5 and 8 cutting off the line lamp and relay and isolating the line from ground at G^1 and G^2. The relay R^3 will be energized over this circuit, pulling up its armature 25 and closing the switch 25—26 in the circuit of the lamp L. This lamp would be lighted over a circuit from G^3 to G^5, were it not for the fact that relay R^2 is operated simultaneously with relay R^3. Relay R^2 is operated over the following circuit: B—27—coil 28 of R^2—tip strand 29—13—16—6—substation set at H—7—17—14—30—31—coil 32—20—back to battery B. When energized, the relay R^2 pulls up its armature 33, interrupting the circuit of the lamp L at 33—34. The operator then throws her listening springs 35 and 36, bridging her head set (not shown) across the cord circuit and ascertains the desire of the calling subscriber. As in the case in question, if the called subscriber desires the subscriber F, which will hereafter be known as the called subscriber, the operator then tests the line III to learn whether or not that line is idle or busy. This testing means is well known and is not shown here. Assuming that the line III. is idle, the operator inserts the plug P′ into the jack J′, the tip 37, the ring 38 and the sleeve 39 of the plug P′, engaging respectively the tip spring 40, the sleeve spring 41 and the ring 42 of the jack J′. The following circuit is completed from G^5—19—B—43—44—high resistance relay R^7—45—39—42—R′—S′ to ground G^{12}. The current in this circuit will be sufficient to operate the relay R^1, but owing to the presence of the higher resistance relay R^7, the strength will be too weak to operate the electromagnetic device S^1, so that it will be impossible to operate the meter of the called line III. When energized, the relay R′ pulls up its armatures 46 and 47 cutting the line III off from ground as described in connection with line I. The relayl R^7 is also energized by current over this circuit, attracting its armature 48, 49 and 50. The armature 48 closes a switch 48—51 in the circuit of the lamp L^1. This lamp will be lighted over the following circuit: G^6—48—51—52—53—L^1—43—B^{19}—G^5. When the armature 49 is attracted, a switch 49—54 is closed in the circuit of one of the coils of relay R^6. When the armature 50 was attracted, a switch 50—55 was closed. The operator then throws the ringing springs 56—57 which engage the contacts 58 and 59 respectively, closing the signaling circuit as follows: G^8—Q—58—56—37—40—60—D′—K′—61—41—38—57—59 to G^9. The bell D′ is operated and the subscriber F takes the receiver A′ from the hook 62 which rises and closes the switch 62—63. The following circuit is completed by this act: B—43—coil 64 of relay R^6—65—38—41—61—substation set at F—60—40—37—66—49—54—67—coil 68 of relay R^6 back to battery B. Relay R^6 is energized interrupting the circuit of the lamp L^1 at 52—53 and closing the switch 52—69. The closing of this last named switch completes a circuit through the relay R^5 as follows: G^{13}—B^1—70—71—72—73—R^5—74—69—52—75—51—48—G^6. The relay R^5 is energized attracting the armatures 76, 77 and 78. When the armature 76 is attracted, a switch 76—79 is closed, completing a locking circuit of the relay R^5 through the conductor 80. The attraction of the armature 77 closes a switch 77—81 in the circuit of the service meter N. This circuit is still open at the contacts 82—83 of the relay R^4 so that the response of the called

subscriber conditions this circuit for operation. The circuit will not be completed and the meter operated until the switch 82—83 is closed. The attraction of the armature 78 closes the switch 78—84 in the circuit of the relay R^8. Conversation now takes place over the following circuit: from the substation H through 6—16—13—29—K^1—85—37—40—60—through the station F—61—41—38—86—K^2—30—14—17—7 back to the subscriber H. The battery is bridged across this line and supplies current for talking purposes.

At the termination of the conversation, the subscribers restore their receivers to the hooks, interrupting the substation circuits. The interruption of the substation circuits of a called subscriber will break the circuit of the relay R^6, so that the break in the circuit of the lamp L^1 will be closed and this lamp energized. No effect will be produced upon the relay R^5 or the apparatus associated therewith since that relay is now energized over the locking circuit through the conductor 80. The interruption of the substation circuit of the calling subscriber, will, however, produce the following result: The relay R^2 will be deënergized allowing the contact 33 to fall back, engaging the contact 34, closing the switch in the circuit of the lamp L which lights. A circuit is also completed through the relay R^8 as follows: G^{13}—B^1—90—R^8—91—84—78—92—34—33—93—26—25—to ground G^3. Relay R^8 will pull up the armatures 94—95—closing the switches 94—96—and 95—97. The closing of the switch 95—97 will complete a locking circuit for this relay as follows: G^{13}—B^1—90—R^8—97—95—98—50—55— to ground G^7. The closing of the switch 94—96 completes the circuit through the relay R^4 as follows: G^{13}—B^1—90—94—96—99—R^4—G^4. The relay R^4 attracts the armatures 72 and 83. The circuit of the relay R^5 is interrupted at 71—72 so that this relay will be slowly deënergized, it being as described, a slow acting relay. The closing of the switch 82—83 completes the circuit of the register meter N and causes the actuation of the same over the following circuit: G^2—S—24—R—23—18—15—22—coil 100 of the relay R^3, which is a comparatively low resistance winding, 101—83—82—102—77—81—103—90—B^1 to G^{13}. The relay R^5 being a slow acting relay, the contacts 77 and 81 will not have been separated before the meter N is operated. The interval of time between the closing of the switch 82—83 and the opening of the switch 77—81 will be short so that a single impulse of short duration will pass through this circuit. The energization of the coil S will operate the mechanism M and the call will be registered. As will be plainly seen, this operation is independent of the central station operator, but on the contrary is controlled entirely by the subscriber, the system being conditioned for operation by the called subscriber and being actuated to cause the operation of the service meter by the calling subscriber. Should the calling subscriber desire a second call, he cannot defeat the operation of the meter system by immediately removing his receiver from the hook or by wiggling his receiver hook. Assuming that the called subscriber does not desire a second call immediately, the operator upon observing the illumination of the lamps L and L^1 will pull out the plugs P and P^1. The circuit of the relay R^3 and R^7 will be interrupted at the contacts of the answering and calling plugs respectively. The circuit of the relay R^8 will be interrupted at 50—51, the circuit of the relay R^4 will be interrupted at 94—96 and the system will be restored to normal.

The operation of the device shown in Fig. 2 and the apparatus employed in the system there shown, is very similar to that just described and I will not give a detailed description, but will indicate what I consider to be the principal distinction. In the line numbered I in the upper left hand corner, I have employed small reference letters to represent the parts upon which I employed the capital letters in Fig. 1. The line numbered III in the upper right hand corner of the figure is substantially the same as that shown at I. At IV. in the lower left hand corner of the drawing, I show a line which terminates in a two point jack. I here indicated the parts by small letters with a subindication 20. The line V. is similar to the line IV. and there I have employed subs 30. The cord circuit is shown at II. In this case I employ a two conductor cord which uses two point jacks. When employed with the jacks j or j' the sleeve 200 and 201 engage both the sleeve springs 202 and rings 203. When employed with the two point jacks of the lines IV and V, they engage a single contact 204. When inserted in these jacks, a circuit is completed, as previously described, through the service meter, electromagnets s^{20}— the relay r^{20}—jack and plug and this time over a talking conductor through the high resistance coil of the relay r^3—battery to ground. The current will be strong enough to actuate the relay r^3, but not strong enough to actuate the electromagnet s. When the called subscriber responds, the relay r^6 will be operated, completing the following circuit through the relay r^5—g^9—205—206—207—208—209—210—r^5—211—212—213—214—215—battery b and ground at g^4. The relay r^5 will be energized and the circuit of the meters will be conditioned for operation, said circuit being now closed at all points except the contacts of the relay r^4. This relay, will as described in con-

nection with Fig. 1, lock itself up through the conductor 216. When the subscribers hang up their hooks, the relays r^3 and r^4 will be energized as described in connection with Fig. 1. The relay r^4 will pull up the armature 217, closing the switch 217—218 and completing the circuit through a special source X which is of higher potential than the battery B. This circuit is as follows: ground g^0—220—X—221—222—223—218—217—224—225—the sleeve side 226—220, the relay r and electromagnet s. The flow of current in this circuit will be sufficient to operate the magnet s. It will be seen that this system realizes all the virtues of the system shown in Fig. 1 and in addition employs a two conductor cord instead of a three conductor cord as shown in Fig. 1, the service meter being here operated over a portion of the talking strands of the cord. The other features of this system are now so well understood that it will not be necessary to describe them here.

While I have shown these particular forms of my invention, I do not wish to be limited to the specific embodiments there shown, as it will be obvious to those skilled in the art that numerous and extensive departures from the forms and the details of the apparatus here shown may be made without departing from the spirit of the invention.

I claim:

1. In a telephone system, the combination of a central station, a plurality of telephone lines terminating at said central station, substations on said lines, means to connect said lines together for conversation, a service meter at the central station, a relay controlling said service meter and means to cause the operation of said relay at the termination of the use of the substation set and a locking relay under the control of said connecting means, said locking relay preventing the subsequent operation of said controlling relay.

2. In a telephone system, the combination of a central station, a plurality of subscribers' lines terminating thereat, means to connect said lines together for conversation, a service meter, electro-magnetic means controlling said meter, a slow acting relay, the actuation of said electro-magnetic means being adapted to open the circuit of the coil of said slow acting relay, whereby said relay is deënergized and to close a circuit through said service meter whereby the service meter will receive a single impulse to actuate the same.

3. In a telephone system, the combination with a plurality of telephone lines, means to connect said lines together for conversation, a service meter, a circuit therefor, a relay associated with said means, a locking circuit therefor, a second relay having normally closed contacts in said locking circuit, said relay also having normally open contacts in the service meter circuit, whereby the actuation of said second relay will close the circuit of the service meter and cause the operation of the same.

4. In a telephone system, the combination of a main station, a plurality of substation sets, telephone lines connecting the substation sets and the main station, a cord circuit at the main station including talking strands, a source of current associated with the cord circuit, switchboard plugs connected to the cord circuit, jacks connected to the lines, said plugs and jacks adapted to connect the cord to the lines, a service meter associated with said cord circuit, circuit conductors associating said meter and said source of current, a relay under the control of the subscriber adapted when actuated to connect said meter in circuit with said source whereby said meter is automatically actuated at the termination of the conversation, and means to prevent the actuation of said relay more than a single time for each conversation.

5. In a telephone system, the combination with a plurality of telephone lines, means to connect said lines together for conversation, a service meter, a relay controlling said meter, a locking relay associated with said means, a circuit for said locking relay initially under control of the called subscriber and thereafter under control of said first named relay and contacts of said two relays in the circuit of said service meter.

6. In a telephone system, the combination of a central station, a plurality of telephone lines terminating thereat, means to connect said lines together, subscribers' stations on said lines, a service meter associated with said system, a relay controlling said service meter and means for placing said relay first under contral of the called subscriber, subsequently under control of the calling subscriber and thereafter under the control of the connecting means.

7. In a telephone system, the combination of a main station, a plurality of substation sets, telephone lines connecting said sets and said main station, a cord circuit at the main station including talking strands, manually controlled switching means for connecting the cord circuit to the telephone lines, a source of current associated with the cord circuit, a service meter, means under the control of the called subscriber to condition said system for the operation of said meter, electrically actuated means under control of the calling subscriber for causing the operation of said meter, and an electromagnet under the control of said connecting means for preventing further operation of said meter until a new connection is made.

8. In a telephone system, the combination with a central station, of a calling telephone

line, a subscriber's switch for said line, a called telephone line, a subscriber's switch for said line, plug and jack switches at the central station for interconnecting the calling line with the called line, a meter associated with the calling line and a circuit therefor, said circuit including a source of current, a high resistance and a low resistance coil, means conditioned for operation by the called subscriber's switch to operate under the control of the calling subscriber's switch so as to place the low resistance coil in shunt with the high resistance coil and separate means under the control of the called subscriber's plug and jack switch, preventing a second operation of said means.

9. In a telephone system, the combination of a calling and a called telephone line, connecting means to connect said lines together for communication, a service meter in a local circuit associated with the calling telephone line, said connecting means adapted to place a source of current in circuit with said service meter, means conditioned for operation by the subscriber at the called line and made operative by the subscriber at the calling line for increasing the strength of current supplied to the service meter from said source, and means under the control of the connecting means associated with the called line for maintaining the service meter out of circuit with the current increasing means after said current increasing means has once been placed in circuit with said service meter.

In testimony whereof, I affix my signature in the presence of two witnesses.

ALBION D. T. LIBBY.

Witnesses:
E. A. SPURR,
D. A. GLOVER.