G. DEAKIN.

TELEPHONE METER.

APPLICATION FILED OCT. 23, 1908.

1,045,820.

Patented Dec. 3, 1912.

4 SHEETS—SHEET 1.

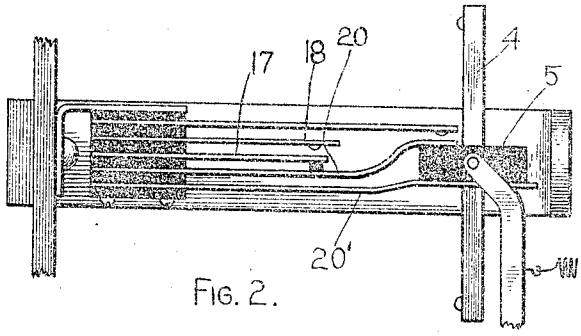


FIG. 2.




FIG. 1.

WITNESSES:

M. C. Campbell.

R. H. Gerard.

INVENTOR:

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BY McNeent & Miller

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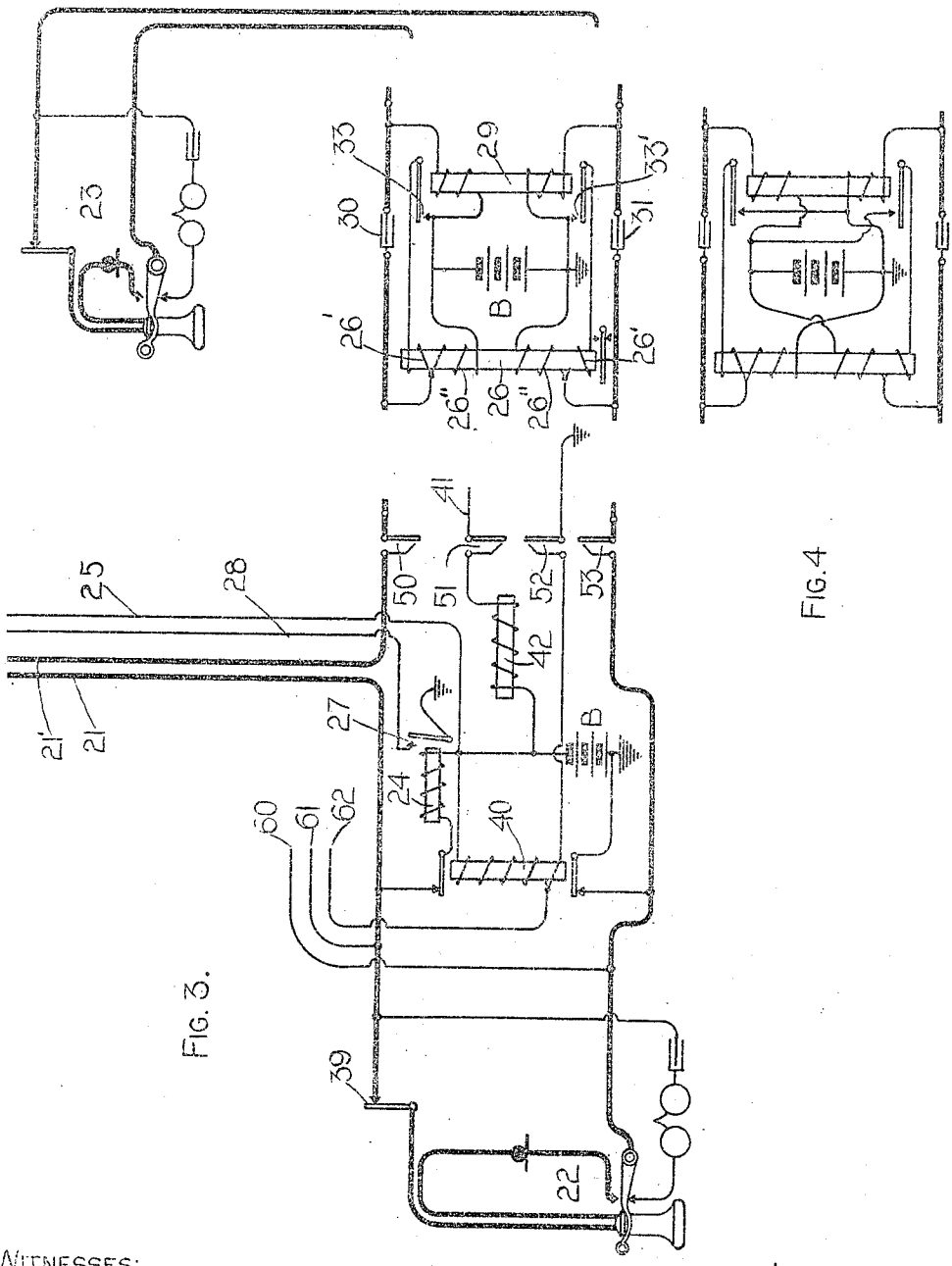


FIG. 3.

FIG. 4

WITNESSES:

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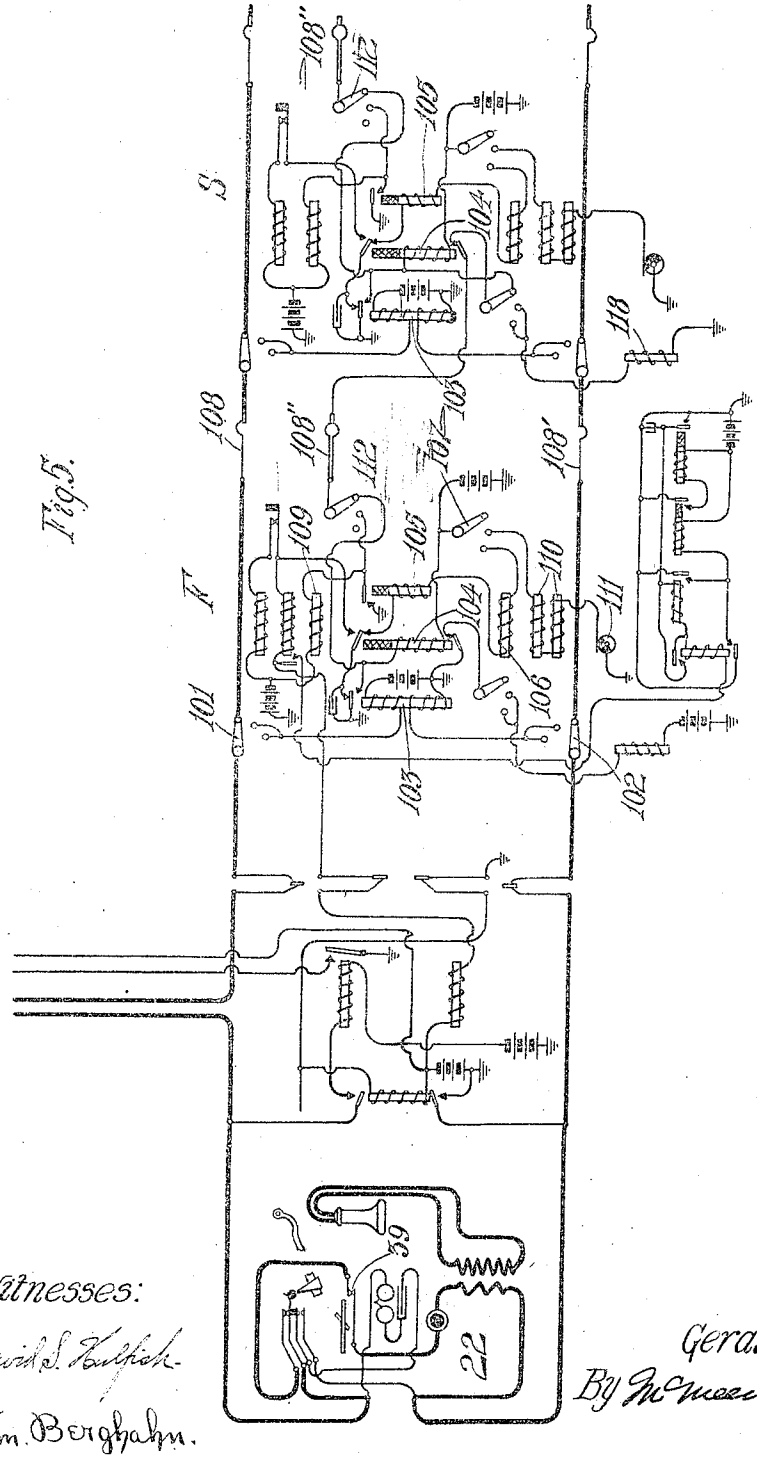
4 SHEETS—SHEET 3.

Fig. 5.




Witnesses:

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4 SHEETS—SHEET 4.

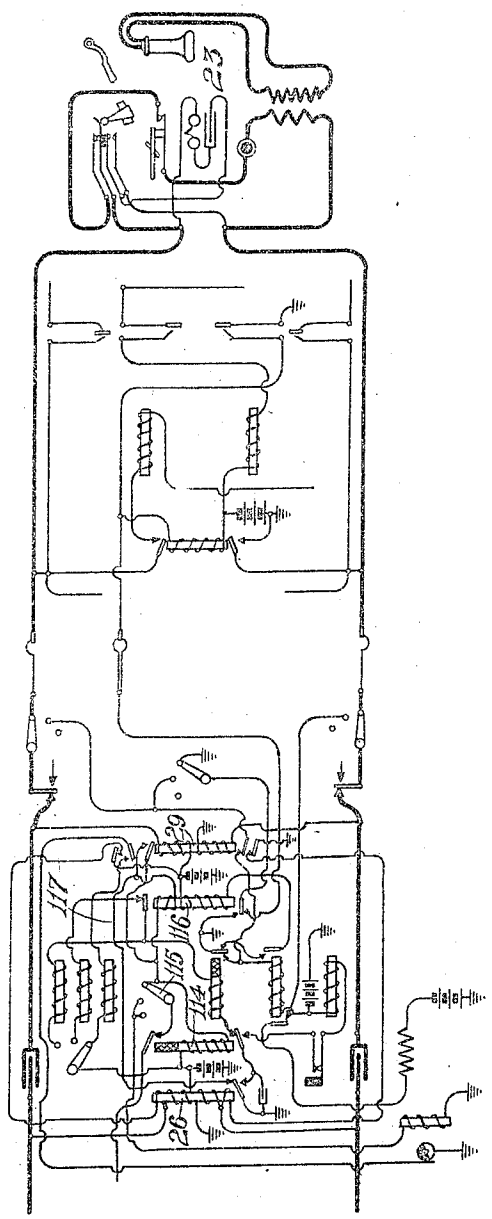


Fig. 6.

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Inventor:

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Attys.

# UNITED STATES PATENT OFFICE.

GERALD DEAKIN, OF OAKLAND, CALIFORNIA, ASSIGNOR OF ONE-HALF TO McMEEN & MILLER, OF CHICAGO, ILLINOIS, A COPARTNERSHIP.

## TELEPHONE-METER.

1,045,820. Specification of Letters Patent. Patented Dec. 3, 1912.

Application filed October 23, 1908. Serial No. 459,138.

*To all whom it may concern:*

Be it known that I, GERALD DEAKIN, a citizen of the United States of America, and a resident of Oakland, county of Alameda, and State of California, have invented a new and useful Improvement in Telephone-Meters, of which the following is a specification.

My invention pertains to electromagnetically controlled counting devices and is designed particularly for use in a telephone central office.

My invention pertains to the electromagnetic mechanism controlling a counting train and is adapted for use with any telephone meter system in which current of a predetermined strength and direction is passed over a wire at the time registration is desired.

In the preferred form of my invention I provide for registering when current of a predetermined strength and direction is passed over the wire; in the preferred form of my invention, the operating coil of the meter is removed from the wire when the current of the predetermined strength passes, whether the current be of direction such as to cause the operation of the counting train of the meter, or of the opposite direction.

In the preferred form of my invention, I provide a meter having an operating coil adapted to be included in a telephone line, the mechanism controlled by the coil being adapted to operate in either of two ways, depending upon the direction of the energizing current, the operation of the mechanism in one way producing a registration upon the counting train of the meter and removing the controlling coil from the telephone line, and the operation of the mechanism in the other way producing no registration upon the counting train of the meter, but removing the controlling coil from the telephone line.

For the purpose of explaining the operation of the device of my invention, I illustrate a portion of the circuits and apparatus of an automatic telephone exchange with a meter device associated therewith.

I show a system in which the device of my invention is associated with a subscriber's line and is adapted by the circuits and mechanisms of the central office to register one additional unit upon its counting train upon the first answering of a called line in response to a call originating upon the subscriber's line pertaining to the meter. I show further, means whereby lines for terminating calls are divided into two classes, the first class of which controls the meter of the calling line to register a unit upon a counting train when first answering a call, and the second class of which controls the meter in such manner as not to operate the counting train.

In an automatic telephone central office equipment of any of the types now widely used, a line entering the office branches into two paths, one of which passes to the multiple terminals of the connectors and carries all calls in which that line is a called line, and the second of which extends toward the selectors and remains idle or is disconnected during the continuance of calls terminating upon the line but carries the operating circuits of the line for all calls originating upon the line, the branch to the connector multiple remaining unused in such calls.

I install my improved meter in the call-forwarding branch of the subscriber's line, thus placing it in a position where it is inactive upon any connection in which the call-receiving branch of the line is used.

In the selectors or connectors I show relays and circuits whereby the answering of a called line will increase the current upon the calling line; I adjust my meter so as not to operate on the predetermined current value existing before the answering of the called line, and so as to operate upon the predetermined larger current value existing after the answering of the called line. I provide upon the operating parts of the meter two electrical contacts operated successively and having the following functions: The contact first operated closes an auxiliary circuit which controls the meter thereafter. The contact second operated removes the meter electrically from the line, leaving the line circuits clear and not modified or unbalanced during the conversation by reason of the presence of the meter in association with the line. To provide for unlocking the meter at the termination of the connection, that it may return to proper condition preparatory to registering upon an ensuing connection, I take the auxiliary or locking circuit through an electrical contact controlled by some unit of mechanism whose condition is

changed incidentally to setting up a connection and which remains in its changed condition throughout the continuance of the connection; by the return to normal condition of idleness of this unit of apparatus, the locking circuit is interrupted and the meter mechanism is restored. The apparatus unit selected would be the first automatic switch involved in the connection, and if that switch be individual to the meter's line, the meter's locking circuit may take a contact upon any relay armature or other moving part fulfilling the required conditions.

For controlling the current values upon the meter's line, I show a relay in circuit with the called line, having contacts upon its armatures to control the resistance of the circuit of the calling line.

To provide for the completion of connections with predetermined lines without involving the operation of the meter, I polarize the meter mechanism and show connecting units furnishing to the calling line current having a direction reversed as compared with the direction of the usual current intended to operate the meter. These connectors selecting lines of the free class shall have the reversed battery connections, and connectors selecting lines of the ordinary class shall have the direct battery connection adapted to operate the meter and its counting train.

In the drawings Figure 1 shows one embodiment of my invention; Fig. 2 a modification thereof; Fig. 3 the general circuits of an automatic central office suitable for operation in connection with my meter, the circuits shown being those used for the forwarding of calls of the regular class in which each answered call will operate the meter and its counting train; and Fig. 4 shows the connector circuits in which the reversed current is furnished to the calling line so as to operate the meter mechanism without operating its counting train upon the response of the called station to which calls are to be free; Figs. 5 and 6 taken jointly show the complete circuits of a telephone connection set up by means of an automatic central office of a type with which my improved meter is designed to operate; the four wires extending upward from Fig. 5 being found in continuation in Fig. 1 to complete the talking connection.

Referring to Fig. 1, the polarized relay and service meter shown therein is intended to combine the functions of a polarized relay and of a service meter, the line winding 15 being of low resistance and inductance and therefore being adapted to be included directly in a telephone circuit, and being at the same time of sufficient strength in creating an initial magnetic field to move the armature 4, to which the block 5 is rigidly attached, to lift the spring 20 by a movement of the block 5 and thus close the circuit between springs 20 and 19; it will be seen thus that the winding 15 is substantially a relay winding; its effect being to close the contact between springs 20 and 19, and this it will do regardless of the direction of the energizing current through the winding 15, since the movement of the armature 4 and block 5 in either direction will lift the spring 20.

Referring to the electromagnetic device, it will be seen that the two cores 14, together with the yoke-piece and two windings 15 and 16, form an electromagnet of horseshoe form. The association with this electromagnet of the permanent magnet 13 gives it the capability of acting in some cases as a polarized electromagnet capable of moving its armature in one direction for one direction of current, and in the other direction for the other direction of current flow. It is also evident that after the electromagnet has been caused to act as a polarized electromagnet it is then in position, when subjected to the strong magnetizing force of the winding 16, to act as a non-polarized magnet, the stronger field of magnetization set up by the winding 16 being capable of over-powering all polarizing effort of the permanent magnet.

The winding 15 is connected through conductors 21 and 21′ with the central office circuits of Fig. 3.

Referring now to Fig. 3, 22 is a substation which may institute a call by removing the receiver from the hook and so bridging the telephone set upon the line; 23 is a similar substation which may be called by substation 22; both are of a type of automatic telephone apparatus now in common use, as also is true of the remainder of the connecting units which I show and describe in connection with my invention herein. Upon the rising of the switchhook at substation 22, current from the battery B, or other source of central office current, flows through the trip magnet 24, the limbs of the line, the closed telephone circuit at 22 and again to the battery B. The trip magnet 24, being energized, closes all of the contacts shown respectively as 50, 51, 52, 53. These contacts are thus in common use in individual line switches of automatic telephone systems, and it is their regular office in such systems, as it is in Fig. 3, to extend the limbs of the calling line toward some idle connecting unit. Any of the usual methods whereby the individual switch containing trip magnet 24 selects and connects with the line to an idle connecting unit containing a bridged relay, such as 26, are satisfactory arrangements for the operation of my device.

For the sake of clearness I have omitted

from the trip magnet 24 the means by which the contacts 50, 51, 52, 53 are closed. I show in connection with the trip magnet however the armature and contact 27. Whenever the trip magnet 24 is energized, contact at 27 is closed, and this places ground upon the wire 28. No apparatus operates as a result of grounding the conductor 28 until a coöperating action shall have taken place.

The relay 29 is of similar character to the relay 26, both being in general the two relays customarily provided in a connector of an automatic telephone exchange, the regular office of such connector being to find and connect with a called line in the multiple of lines to which the connector has access. The relays 26 and 29 respectively furnish current for conversation to the substations 22 and 23. These relays as current supply bridges are counterparts of current supply bridges in manual switchboard connecting cords, and the condensers 30 and 31 similarly interrupt the connecting circuit so that direct current from the relay 26 may not pass to the substation 23 and vice versa. Further, relay 26 is that which is known in ordinary automatic practice as the "front bridging relay" of the connector, and the relay 29 is that which is known as the "back bridging relay" of the connector. The relay 29 may be of whatever resistance the ordinary features of the telephone systems require; the relay 26, however, has two pairs of windings, one high and the other low in resistance, a suggested resistance being 250 ohms each for windings 26′ and 2,000 ohms each for windings 26″. In connection with such resistances in the relay 26, the resistance of winding 15 may be 50 ohms. The balance of resistances, turns and potentials however shall be such that winding 15 shall not operate armature 4 when traversed by current through windings 26″ unassociated by current through windings 26′, but shall operate its armature to close the contact between springs 20 and 19 when current from battery B flows through windings 26′ and 26″ jointly and thence through winding 15. In the act of making a call, therefore, the subscriber at substation 22 closes his line at the switchhook and by means of the usual dial interrupts the line in series of impulses at 39. The closing of the line operates the trip magnet 24, grounds the conductor 28 at 27, and closes all the contacts 50, 51, 52, 53.

A description of the line switching device whose parts are shown at 24, 42, 50, 51, 52 and 53, will be found in the *Western Electrician* of January 11th, 18th and 25th, 1908. Relay 40 now is energized by current from battery B through 40 to ground at 52. Trip magnet 24 thus is cut off from the line, but as it has operated to trip or release mechanism to close contacts 50, 51, 52, 53, which contacts remain closed until released by the release magnet 42, so also it holds contact 27 closed as is usual in contacts associated with such tripping of individual automatic switches. The line from substation 22 now is closed through side switch arms 101, 102 to line relay 103, which is energized and attracts its armature. The attraction of the armature of 103 energizes release relay 104, which is so constructed that it responds only to current changes in its helix when the changed condition is maintained for a predetermined period. The impulse transmitter 29 now is operated by the subscriber to interrupt the line a predetermined number of times, the number of which is determined by the directory number of the desired line, each of these interruptions being very brief and the closure therebetween being also very brief. The durations of the interruptions and closures respectively, are such that relay 103 responds and relay 104 does not respond. By the device 39 relay 103 is permitted to release its armature for each circuit interruption, opening the front contact but not affecting relay 104 and closing its back contact which closes in successive closures, the circuit extending from earth through back contact 103, front contact 104, helix of 105, vertical magnet 106, side switch arm 107 and battery to earth. Relay 105 is so constructed mechanically that it attracts its armature upon the first of these impulses but does not release it between successive impulses; however, it releases its armature after the cessation of the last impulse. Vertical magnet 106 has responded to each impulse and has effected the moving of selecting switch brushes or wipers 108, 108′, 108″, as required in systems of the general type described in the publication above referred to. By the attraction of armature of relay 105 circuit was closed from earth through that armature, through helix in the private magnet 109 and through battery to earth, energizing private magnet 109, during the series of impulses and deënergizing it after the series and after the release of relay 105. The deënergization of private magnet 109 moves all side switch levers to the middle position. In this position relay 103 is held energized over the line circuit, holding relay 104 energized also. A circuit is established from battery through switch arm 107, rotary magnet 110 and interrupter 111, beginning the rotation of brushes 108, 108′, 108″. When the first set of waiting trunk contacts is engaged, circuit is closed, if the trunk be busy, from battery through private magnet 109 of the first selector F, switch arm 112, wiper 108″, contact of relay 104 of the second selector S of the busy trunk, switch arm 113, switch arm 112, wiper 108″ over the trunk conductor, through armature

of relay 114 of the connector C in Fig. 6, switch arm 115, upper winding of relay 116, conductor 117, through contact and armature of front bridging relay 26 to earth, energizing private magnet 109. This energization of private magnet 109 continues so long as busy trunks are passed over by the wiper 108'' but as soon as an idle trunk is found, relay 104 of the selector of that trunk being released, the circuit of 109 is discontinued, and by the release of magnet 109 the side switch arms of the first selector F are advanced to the third position, that being the position shown in the drawing. By the advancement of the side switch arms to the third position, relay 103 of the second connector S is energized and relay 104 also, continuing the energization of release magnet 104 of the first selector F through the circuit from battery, helix of 104 of F, switch arm 112, brush 108'', armature of relay 104 of second selector S, switch arm 113 to its first contact, and through supervisory relay 118 to earth. The two relays 104 of F and 104 of S are in multiple in this circuit. The second selector S is controlled in identically the same manner by a second series of breaks at the controlling device 39, and connection is established thus from substation 22 to connector C of Fig. 6. The impulses caused by the breaking of contact 39 at the substation now operate relay 26 of the connector and by mechanism which is disclosed in the publication above referred to, the connector responds to such impulses by moving its line wipers to find the called line.

When the called line has been rung upon in the usual way and the subscriber responds at substation 23, the relay 29 is energized. The closing of contacts 33 and 33' places the windings 26' in shunt with the windings 26'' in relay 26, and as a consequence of this shunting an increased volume of current flows to the substation 22 through the relay winding 15. This permits to flow through 15 the strongest current which can flow through that winding but to strengthen any current is not sufficient to overcome the permanent magnetism of the metering device, and is sufficient only to attract one or the other of the ends of the armature 4, operating at the same time to repel the remaining end; for the attraction of both ends of armature 4 and for the movement of carriage 6, a strong current through winding 16 is required. Winding 15 operates armature 4 and closes contact 20—19 by attracting the lower end of armature 4, the direction of the current, from plus pole of battery B through 21', 15, 21, in the order mentioned, being proper to cause the attraction of that end of armature 4. This movement of the armature does two things: Spring 20 makes contact with spring 19 and arm 2 of counter 1 is advanced from position *c* to position *a* because of the rocking of armature 4 upon its pivot 7. Armature 4 is pivoted at 7 on carriage 6, which carriage is pivoted at 8 upon frame 9. The carriage 6 normally is held in position against adjustable stop 10 on frame 9 by tension of spring 12 which is attached adjustably to post 11. The ampere turns of winding 15 are insufficient to move carriage 6 against the tension of the spring 12, but the closing of the circuit through winding 16 (the circuit is B, 25, 16, 20, 19, 28, 27, earth) increases the magnetic flux to such an extent as to cause both cores to attract the armature 4, and to cause carriage 6 to swing on the pivot 8. The movement of the carriage 6 thus permits armature 4 to advance until it is in contact with both cores of the magnet; the counter arm 2 thus is advanced through link 3 from position *a* to position *b*. The mechanism of the counter 1 is such as to register one additional unit on its counting train by the movement of arm 2 from position *a* to position *b* and a registration thus is made upon the connection here considered. Further, as carriage 6 permits armature 4 to advance, the block 5 acts upon the inclined surface of spring 20 and lifts springs 20 and 18, causing spring 18 to rise and make contact with spring 17, thus short-circuiting line winding 15; spring 20 maintains contact with spring 19 and the relay thus remains locked and the line winding remains short circuited throughout the ensuing conversation.

The conversation having been finished, the hanging up of the receiver at substation 22 opens the line circuit, releasing relay 26 of the connector. In the usual way, through contact not shown in Fig. 3, the connector releases and returns to its normal position. In so doing a ground is placed on conductor 41, energizing release magnet 42. This magnet is the usual one of individual line switches in standard automatic systems and its office is to restore the individual line switch to normal condition, opening contacts 50, 51, 52, 53 and contact 27. As 27 opens, the magnets of Fig. 1 are no longer energized by either of their windings and so the armature 4 is released and returns to its normal condition and position of idleness as shown in Fig. 1, the counter arm 2 returning from position *b* to position *c*.

The conductors 60 and 61 are respectively the branches of the line leading to multipled connector contacts and it is over them that terminating calls are made to substation 22. The conductor 62 will be grounded by such a terminating call and so will operate the relay 40, thus removing the trip magnet 24 and the ground at battery B from the line while such a terminating call is in

progress. As the trip magnet cannot operate while relay 40 is energized and as no current flows through conductors 21', 15, 21, when the connection is made to substation 22 through conductors 60—61, no terminating call for substation 22 can operate the meter.

In Fig. 4 I show a connector circuit in which the relation of battery B to the line 26 is reversed. It is such a connector as would contain lines for whose terminating calls no charge is to be made on the meter of the calling line. The relay 26 of such a connecter will give current to the calling line in the direction tending to operate the armature 4 of the meter mechanism of Fig. 1 by attracting its upper end and repelling its lower end. Such an armature movement results immediately in the moving of the counter arm 2 from position *c* to position *b* without passing that arm first to position *a* and therefore without registering upon the counting train: such an armature movement results also in the lifting of the contact spring 20 and the closing of the contact of that spring at spring 19, closing circuit B, 25, 16, 20, 19, 28, 27, earth, resulting as before in the overpowering of the field of the permanent magnet by the increased electromagnetic field and the resultant attraction of both ends of the armature 4, pulling carriage 6 against the tension of spring 12 and closing contact between springs 17—18, short circuiting the relay or line winding 15 and leaving the meter mechanism locked dependent upon the continuance of circuit through contact 27, but without having registered upon the counting train.

The discrimination between a registered and a non-registered call originating from substation 22 is attained by operating the counter arm 2 from *c* to *b* and, upon release, from *b* to *c* as compared with operating it from *c* to *a*, thence from *a* to *b*, and upon release, from *b* to *c*, the movement of the arm from *a* to *b* being necessary for making the registration upon the counting train. The movement from *c* to *a* permits the driving pawl to engage the succeeding tooth of the ratchet of the counting train, the movement from *a* to *b* drives the counting train, and the movement from *b* to *c* or from *c* to *b* is unfruitful.

Armature 4 is placed upon carriage 6 (1st) for the purpose of obtaining a greater range of movement for the arm 2 controlling the pawl of the counting train, and (2nd) to obtain the greater power of the non-polarized attraction of the armature when driving the counting train through arm 2 and yet to retain the advantages of polarized control in initiating the armature action.

The armature thus has four positions, viz., (1st) a normal position of rest, (2nd) an intermediate position which may be recited as the position taken by the armature when its upper end is attracted and its lower end repelled, (3rd) an alternative intermediate position, which is the position taken when its lower end is attracted and its upper end repelled, and (4th) an ultimate position of attraction which is substantially in contact with both of the cores, the pivoted carriage yielding to permit the armature to take the fourth position. The arm 2, and therefore the driving pawl also, has four positions corresponding with the four positions of the armature 4, its second and fourth positions being not greatly different. It is seen that the armature always moves from its first to its fourth position, sometimes moving from its first to its second and then to its fourth position, and sometimes from its first to its third and then to its fourth position, and that it is possible to operate the counting train only when the armature moves from its third to its fourth position; to avoid the operation of the counting train electrical conditions are provided by which the armature may be moved from its first to its second and then to its fourth position.

In many existing automatic central offices the current impulses flowing through substation 22 when setting up the connection are of such strength that they would cause the operation of the armature 4. For such a central office equipment, I show a modified form of the meter mechanism of my invention, Fig. 2, showing the modified details which shall replace corresponding details in Fig. 1 when the device is applied for service in an exchange of this class. Spring 20' is an added mechanical spring for centering the armature 4 by pressing upon the block 5. Spring 20 is lifted only when armature 4 moves to its counting or third position. Between its center position and its non-counting or second position the armature 4 may move freely in response to the impulses over the calling line circuit which control the automatic central office apparatus to set up the desired connection. When the called line answers, a current in the reverse direction and of sufficient strength to operate the meter will attract the lower end of armature 4, lifting spring 20 and operating further as above described. When this modification from the preferred form of my invention is used, the line winding 15 of the meter mechanism is not removed from the line circuit on free or non-registering calls.

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

1. In a telephone meter, two magnet cores; an armature pivotally sustained with its two ends opposite the said two cores respectively; two windings, each common to both of said cores; a polarizing permanent magnet; circuits and apparatus for causing

either of said cores to attract one of the ends of said armature and the other of said cores to repel the other end of said armature; circuits and apparatus for causing the other of said windings to cause both of said cores to attract both ends of said armature simultaneously; a yielding pivotal suspension for said armature whereby both ends of said armature may be brought nearer to both of said cores at the same time; and a counting train associated with said armature and operable thereby, substantially as described.

2. In a telephone meter, two magnet cores; an armature pivotally sustained with its two ends opposite the said two cores respectively; two windings, each common to both of said cores; a polarized permanent magnet; circuits and apparatus for causing either of said cores to attract one of the ends of said armature and the other of said cores to repel the other end of said armature; a circuit for causing the other of said windings to cause both of said cores to attract both ends of said armature simultaneously, said circuit being closed by the movement of the armature resultant upon the attraction of one only of its ends; a yielding pivotal suspension for said armature whereby both ends of said armature may be brought nearer to both of said cores; and a counting train associated with said armature and operable thereby, substantially as described.

3. In a telephone meter, a counting train an armature controlling said counting train; a movable carriage upon which said armature is pivotally sustained; two cores for said armature; means for causing one of said cores to attract one end of said armature; and means associated with said armature for closing a circuit whereby the remaining core will be caused to attract the remaining end of said armature whereby the movement of said armature and carriage will result, substantially as described.

4. In a telephone meter, a counting train an armature controlling said counting train; a movable carriage upon which said armature is pivotally sustained; two cores for said armature; means for causing one of said cores to attract one end of said armature; means associated with said armature for closing a circuit whereby the remaining core will be caused to attract the remaining end of said armature whereby the movement of said armature and carriage will result; and an electrical switch disabling said first means upon the operation of said second means, substantially as described.

5. In a telephone meter, a counting train a pivoted armature controlling said counting train; a carriage sustaining said armature pivotally, said armature being free to move pivotally without moving said carriage and being free to move with its pivot by moving said carriage against its retracting spring; a pair of electrical contact springs associated with said armature and adapted to be closed by the movement of said armature upon its pivot; and a second pair of electrical contact springs associated with said armature and adapted to be closed by a movement of said armature with its pivot, substantially as described.

6. In a telephone meter, an armature; a movable carriage upon which said armature is pivotally sustained; two cores for said armature; means for causing one of said cores to attract one end of said armature; a circuit controlling the attraction of the remaining end of said armature; means associated with said armature for closing said circuit; whereby the remaining core will be caused to attract the remaining end of said armature whereby the movement of said armature and carriage will result; a counting train; a driving pawl for said counting train and controlled by said armature; the movement of the armature upon its pivot in response to the attraction of said first mentioned core resulting in the engagement of the next ratchet tooth by said pawl and the movement of said armature in response to the subsequent attraction of the second mentioned core and during the continuance of the attraction of said first mentioned core, resulting in the driving of said counting train by said pawl over a unit step of said counting train, substantially as described.

7. In a telephone meter, a counting train a pivoted armature for operating said train; a carriage sustaining said armature pivotally, said armature being free to move pivotally without moving said carriage and being free to move with its pivot by moving said carriage against its retracting spring; a pair of electrical contact springs associated with said armature and adapted to be closed by the movement of said armature upon its pivot; and a second pair of electrical contact springs associated with said armature and adapted to be closed by a movement of said armature with its pivot; a winding for moving said armature pivotally; a winding for moving said armature and carriage; a circuit including said second winding and said first pair of contact springs whereby the energization of said first winding will result in the energization of said second winding; and a circuit including said first winding and said second pair of contact springs whereby the energization of said second winding will result in the deënergization of said first winding, substantially as described.

8. In a telephone meter, a counting ratchet; a driving pawl; a permanent magnet, an armature pivotally sustained in the field of said permanent magnet and controlling said pawl; two magnet cores adapted to attract the ends of said armature respectively,

an attraction by one of said cores resulting in the movement of said pawl to engage the next tooth of said ratchet, and an attraction by the other of said cores the first attracted end of said armature continuing in an attracted position, resulting in the movement of said pawl in the other direction, substantially as described.

9. In a telephone meter, a counting ratchet; a driving pawl: an armature pivotally sustained in the field of a permanent magnet and controlling said pawl; two magnet cores adapted to attract the ends of said armature respectively, an attraction by one of said cores resulting in the movement of said pawl to engage the next tooth of said ratchet, and an attraction by the other of said cores the first attracted end of said armature continuing in an attracted position, resulting in the movement of said pawl in the other direction, a winding energizing said cores and included in a telephone circuit, and determining the end of said armature attracted dependently upon the direction of current in the telephone line, substantially as described.

10. In a telephone meter, a counting ratchet; a driving pawl normally positioned between two teeth of said ratchet; a permanent magnet; an armature pivotally sustained in the field of said permanent magnet and controlling said pawl; an electromagnet acting in conjunction with said permanent magnet to control the preliminary movement of said pawl; said electromagnet acting independently of said permanent magnet to determine the ultimate position of said driving pawl, substantially as described.

11. In a telephone meter, a counting ratchet; a driving pawl normally positioned between two teeth of said ratchet; a permanent magnet; an armature pivotally sustained in the field of said permanent magnet and controlling said pawl; an electromagnet acting in conjunction with said permanent magnet to control the preliminary movement of said pawl; said electromagnet acting independently of said permanent magnet to determine the ultimate position of said driving pawl, said electromagnet comprising in part a winding included in a telephone circuit, and determining the attracted armature end dependently upon the direction of current in the telephone line, substantially as described.

12. In a telephone meter, a counting ratchet; a driving pawl normally positioned between two teeth of said ratchet; a permanent magnet; an armature pivotally sustained in the field of said permanent magnet and controlling said pawl; an electromagnet controlling said armature in conjunction with said permanent magnet to control the preliminary movement of said pawl; said electromagnet controlling said armature independently of said permanent magnet to determine the ultimate position of said driving pawl, substantially as described.

13. In a telephone meter, a counting ratchet; a driving pawl normally positioned between two teeth of said ratchet, and adapted to move preliminarily to engage the last engaged ratchet tooth or the next ratchet tooth; a permanent magnet; an armature pivotally sustained in the field of said permanent magnet and controlling said pawl; an electromagnet controlling said armature in conjunction with said permanent magnet to control the preliminary movement of said pawl; said electromagnet controlling said armature independently of said permanent magnet to determine the ultimate position of said driving pawl, substantially as described.

14. In a telephone meter, a counting ratchet; an armature having four positions, viz., (1st) a normal position of rest, (2nd) an intermediate position, (3rd) an alternative intermediate position, (4th) an ultimate position of attraction; means for moving said armature from its first to its second and then to its fourth position, or alternatively from its first to its third and then to its fourth position; and means for operating said counting train when said armature moves from its third to its fourth position, substantially as described.

15. In a telephone meter, a counting ratchet and a pawl therefor, means for moving said pawl into an ultimate position, and electromagnetic means for determining the operative connection between said pawl and said ratchet during said ultimate movement.

16. In a telephone meter, a counting ratchet and a pawl therefor, means for moving said pawl into an ultimate position, and electromagnetic means for determining the operative connection between said pawl and said ratchet during said ultimate movement, said electromagnetic means being rendered operative by the response of the called line in the then existing connection, substantially as described.

17. In a telephone meter, a registering device, a pivoted armature carriage; an armature pivoted upon said carriage and controlling said registering device; a pair of electromagnets attracting the ends of said armature alternatively to move said armature upon said carriage, and attracting said armature simultaneously to move said carriage and armature, substantially as described.

18. In a telephone meter, a pivoted armature carriage; an armature pivoted upon said carriage; a pair of electromagnets attracting the ends of said armature alternatively to move said armature upon said carriage, and attracting said armature simultaneously to move said carriage and arma-

ture; a counting train; a pawl for said train and driven by said armature, substantially as described.

19. In a telephone meter, a pivoted armature carriage; an armature pivoted upon said carriage; a pair of electromagnets attracting the ends of said armature alternatively to move said armature upon said carriage, and attracting said armature simultaneously to move said carriage and armature; a counting train; a pawl for said train and driven by said armature, said pawl resting normally between two ratchet teeth of said train and moving toward the last engaged tooth or toward the next tooth, dependently upon the direction of movement of the armature upon its carriage, and driven to its ultimate ratchet-driving position by the movement of said armature jointly with said carriage, substantially as described.

20. In a telephone meter, a pivoted armature carriage; an armature pivoted upon said carriage; a pair of electromagnets attracting the ends of said armature alternatively to move said armature upon said carriage, and attracting said armature simultaneously to move said carriage and armature; a counting train; a pawl for said train and driven by said armature; said pawl resting normally between two ratchet teeth of said train and moving toward the last engaged tooth or toward the next tooth, dependently upon the direction of movement of the armature upon its carriage, and driven to its ultimate ratchet-driving position by the movement of said armature jointly with said carriage; a winding upon said cores; a contact controlled to be closed by said armature in its movement in either direction upon said carriage; a circuit including said winding and said contact and adapted to move said armature and carriage whereby said armature and carriage move and said pawl is driven to its ultimate position consequent upon an initial movement of said armature in either of its two alternative directions upon its pivot on said carriage, substantially as described.

21. In a telephone meter, a pivoted armature carriage; an armature pivoted upon said carriage; a pair of electromagnets attracting the ends of said armature alternatively to move said armature upon said carriage, and attracting said armature simultaneously to move said carriage and armature; a counting train; a pawl for said train and driven by said armature; said pawl resting normally between two ratchet teeth of said train and moving toward the last engaged tooth or toward the next tooth, dependently upon the direction of movement of the armature upon its carriage, and driven to its ultimate ratchet-driving position by the movement of said armature jointly with said carriage; a winding upon said cores; a contact controlled to be closed by said armature in its movement in either direction upon said carriage; a circuit including said winding and said contact and adapted to move said armature and carriage, whereby said armature and carriage move and said pawl is driven to its ultimate position consequent upon an initial movement of said armature in either of its two alternative directions upon its pivot on said carriage; a second winding upon said cores and controlling the initial movement of said armature, substantially as described.

22. In a telephone meter, a pivoted armature carriage; an armature pivoted upon said carriage; a pair of electromagnets attracting the ends of said armature alternatively to move said armature upon said carriage, and attracting said armature simultaneously to move said carriage and armature; a counting train; a pawl for said train and driven by said armature, said pawl resting normally between two ratchet teeth of said train and moving toward the last engaged tooth or toward the next tooth, dependently upon the direction of movement of the armature upon its carriage, and driven to its ultimate ratchet-driving position by the movement of said armature jointly with said carriage; a winding upon said cores; a contact controlled to be closed by said armature in its movement in either direction upon said carriage; a circuit including said winding and said contact and adapted to move said armature and carriage whereby said armature and carriage move and said pawl is driven to its ultimate position consequent upon an initial movement of said armature in either of its two alternative directions upon its pivot on said carriage; a second winding upon said cores and controlling the initial movement of said armature; a permanent magnet whose field influences said armature and cores to determine the direction of the initial movement of said armature by the direction of current through said second winding, substantially as described.

23. In a telephone meter, a pivoted armature carriage; an armature pivoted upon said carriage; a pair of electromagnets attracting the ends of said armature alternatively to move said armature upon said carriage, and attracting said armature simultaneously to move said carriage and armature; a counting train; a pawl for said train and driven by said armature, said pawl resting normally between two ratchet teeth of said train and moving toward the last engaged tooth or toward the next tooth, dependently upon the direction of movement of the armature upon its carriage, and driven to its ultimate ratchet-driving position by the movement of said

armature jointly with said carriage; a winding upon said cores; a contact controlled to be closed by said armature in its movement in either direction upon said carriage; a circuit including said winding and said contact and adapted to move said armature and carriage whereby said armature and carriage move and said pawl is driven to its ultimate position consequent upon an initial movement of said armature in either of its two alternative directions upon its pivot on said carriage; a second winding upon said cores and controlling the initial movement of said armature; a permanent magnet whose field influences said armature and cores to determine the direction of the initial movement of said armature by the direction of current through said second winding; an electrical switch controlled by said armature and carriage when moving together and operating to discontinue the current through said second winding; substantially as described.

24. In a telephone meter, a pivoted armature carriage; an armature pivoted upon said carriage; a pair of electromagnets attracting the ends of said armature alternatively to move said armature upon said carriage, and attracting said armature simultaneously to move said carriage and armature; a counting train; a pawl for said train and driven by said armature, said pawl resting normally between two ratchet teeth of said train and moving toward the last engaged tooth or toward the next tooth, dependently upon the direction of movement of the armature upon its carriage and driven to its ultimate ratchet-driving position by the movement of said armature jointly with said carriage; a winding upon said cores; a contact controlled to be closed by said armature in its movement in either direction upon said carriage; a circuit including said winding and said contact and adapted to move said armature and carriage whereby said armature and carriage move and said pawl is driven to its ultimate position consequent upon an initial movement of said armature in either of its two alternative directions upon its pivot on said carriage; a second winding upon said cores and controlling the initial movement of said armature; a permanent magnet whose field influences said armature and cores to determine the direction of the initial movement of said armature by the direction of current through said second winding; an electrical switch controlled by said armature and carriage when moving together and operating to discontinue the current through said second winding; and disrupting means for the circuit including said first winding, substantially as described.

25. In a telephone meter, a pivoted armature carriage; an armature pivoted upon said carriage; a pair of electromagnets attracting the ends of said armature alternatively to move said armature upon said carriage, and attracting said armature simultaneously to move said carriage and armature; a counting train; a pawl for said train and driven by said armature, said pawl resting normally between two ratchet teeth of said train and moving toward the last engaged tooth or toward the next tooth, dependently upon the direction of movement of the armature upon its carriage and driven to its ultimate ratchet-driving position by the movement of said armature jointly with said carriage; a winding upon said cores; a contact controlled to be closed by said armature in its movement in either direction upon said carriage; a circuit including said winding and said contact and adapted to move said armature and carriage, whereby said armature and carriage move and said pawl is driven to its ultimate position consequent upon an initial movement of said armature in either of its two alternative directions upon its pivot on said carriage; a second winding upon said cores and controlling the initial movement of said armature; a permanent magnet whose field influences said armature and cores to determine the direction of the initial movement of said armature by the direction of current through said second winding; an electrical switch controlled by said armature and carriage when moving together and operating to discontinue the current through said second winding; and disrupting means for the circuit including said first winding, said disrupting means being external to the meter mechanism *per se*, substantially as described.

26. In a telephone meter system, two classes of telephone lines; a counting meter; an armature for said meter; a movable carriage upon which said armature is pivotally sustained; two electromagnets for said armature; means for causing one of said electromagnets to attract a predetermined end of said armature, the armature end attracted being determined dependently upon the class of telephone line called in the then existing connection, substantially as described.

27. In a telephone meter system, two classes of telephone lines; a telephone meter; an armature for said meter; a movable carriage upon which said armature is pivotally sustained; two electromagnets for said armature; means for causing one of said electromagnets to attract a predetermined end of said armature, the armature end attracted being determined dependently upon the class of telephone line called in the then existing connection; a counting train forming a part of said meter; and means for registering a unit upon said counting train dependently upon the identity of the armature end initially attracted, substantially as described.

28. In a telephone meter, a pivoted armature; two electromagnet cores positioned to attract the ends of said armature respectively; means for energizing one of said cores to attract one end of said armature; means subsequently operable for energizing the remaining core to attract the remaining end of said armature; the first attracted end of said armature continuing in an attracted position, and a counting train operated by said armature when so attracted, substantially as described.

29. In a telephone meter, a pivoted armature; two electromagnet cores positioned to attract the ends of said armature respectively; means for energizing one of said cores to attract one end of said armature and the second of said cores to repel said armature; means subsequently operable for energizing the said second core to attract the second end of said armature; the first attracted end of said armature continuing in an attracted position, and a counting train operated by said armature when so attracted, substantially as described.

30. In a telephone meter, a pivoted armature; two electromagnet cores positioned to attract the ends of said armature respectively; means for energizing one of said cores to attract the armature; an electrical circuit controlled by the armature and closed when the armature is thus attracted; said circuit when closed operating to energize said remaining core to attract the remaining end of said armature; and a counting train operated by said armature when so attracted, substantially as described.

31. In a telephone meter, a pivoted armature; two electromagnet cores positioned to attract the ends of said armature respectively; means for energizing one of said cores to attract one end of the armature and the second core to repel said armature; an electrical circuit controlled by the armature and closed when the armature is thus attracted, said circuit when closed operating to energize said second core to attract the second end of said armature; and a counting train operated by said armature when so attracted, substantially as described.

Signed by me at San Francisco, county of San Francisco and State of California, in the presence of two witnesses.

GERALD DEAKIN.

Witnesses:
JOHN H. GISH,
LLOYD MACOMBER.