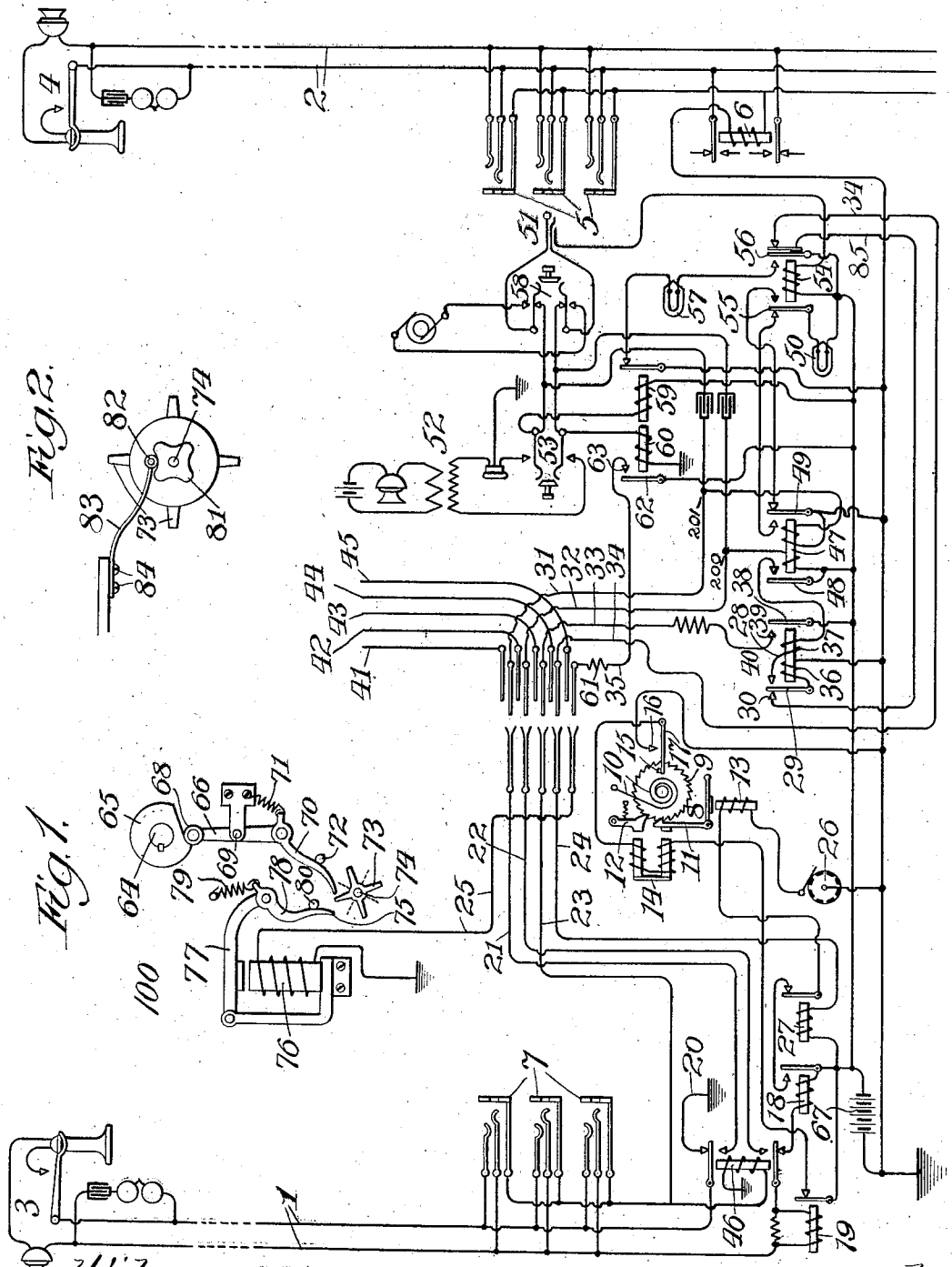
S. H. BROWNE.

APPARATUS AND SYSTEM FOR MEASURING TELEPHONE SERVICE.

APPLICATION FILED JAN. 17, 1905.

938,039. Patented Oct. 26, 1909.



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UNITED STATES PATENT OFFICE.

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APPARATUS AND SYSTEM FOR MEASURING TELEPHONE SERVICE.

938,039. Specification of Letters Patent. Patented Oct. 26, 1909.

Application filed January 17, 1905. Serial No. 241,503.

To all whom it may concern:

Be it known that I, SIDNEY HAND BROWNE, a citizen of the United States of America, and resident of Pittsburg, county of Allegheny, and State of Pennsylvania, have invented a new and useful Improvement in Apparatus and Systems for Measuring Telephone Service, of which the following is a specification.

My invention pertains to mechanisms for measuring telephone service, or for counting telephone calls, in connection with lines which are equipped in whole or in part with automatic circuit changing devices.

In patent application Serial No. 222,645, filed by me August 29, 1904, there is disclosed a system for telephone exchanges wherein each telephone line has an automatic switch and multiple jacks, the jacks being used in the completion of calls to that telephone line, and the automatic switch being used in the completion of calls from that telephone line, it being the duty of said automatic switch to select an idle trunk whenever said line originates a telephone call, to hold said trunk during the ensuing connection, to disconnect automatically at the end of the connection, and at all other times to remain in its position of rest. Many other systems of switching circuits automatically are well known in the present practice of telephony, most of which use a selecting device pertaining individually to each line.

My invention provides a means for counting and recording with reasonable accuracy the total number of successful connections resulting from calls originating upon any one telephone line having an automatic switch as a portion of its equipment. The particular telephone line equipment (comprising as a part thereof an automatic switch) shown in the accompanying drawing and described in this specification, is of the same type as illustrated and described in my patent application above mentioned; my improved counting and recording means may of course be used in conjunction with other types of equipment.

In the drawings: Figure 1 shows the system of automatic switching disclosed in the patent application above referred to, with service meter added in accordance with my present invention; Fig. 2 shows a mechanical detail of the meter.

In Fig. 1, telephone lines 1 and 2 are equipped with substation telephones 3 and 4 respectively; telephone line 2 has multiple jacks 5, and a complete automatic switch equipment partly indicated at 6; telephone line 1 has multiple jacks 7, and a complete automatic switch equipment and meter, shown diagrammatically in detail. 8 is an automatic switch consisting of a fixed part and a rotary part; the rotary part carries moving contacts, or wipers, shown connected with conductors 21, 22, 23, 24, 25, is attached rigidly to ratchet wheel 9, and is always under tension of spring 10 which returns it to its position of rest and holds it there at all times except when controlled by pawls 11 and 12; magnet 13 actuates pawl 11 to advance ratchet 9 one step for each such actuation; pawl 12 holds ratchet 9 in the position determined by the actuation of pawl 11; magnet 14 removes both pawls 11 and 12 from control of ratchet 9 and spring 10 then returns the rotary part of the switch to its position of rest. Pin 15 is attached to ratchet 9 and when the rotary part of the switch is in its position of rest, pin 15 holds contact spring 17 away from contact point 16, but at the first step of ratchet 9 pin 15 permits the contact pair 16—17 to close, said contact pair then remaining closed until the release and restoration of the rotary part. The fixed part of switch 8 carries a plurality of sets of waiting contacts, such as the two sets shown opposite the set of wipers and connected to conductors 31, 32, 33, 34, 35, and 41, 42, 43, 44, 45; these sets of contacts are adapted to be successively engaged by the set of wipers forming terminals of conductors 21, 22, 23, 24, 25. When the rotary part of said switch is at rest, the wipers connected with conductors 21, 22, 23, 24, 25 are out of contact, as shown, but at the first step of ratchet 9 they are propelled into contact with waiting-contact-set connected with conductors 31, 32, 33, 34, 35; at the next step of ratchet 9 they leave these contacts and take a position in connection with waiting-contact set 41, 42, 43, 44, 45, and so on through a number of waiting-contact-sets. A plurality of waiting-contact-sets is provided, each such waiting-contact-set being fully equipped as shown in connection with waiting-contact set 31, 32, 33, 34, 35. All other parts of Fig. 1, excepting the meter 100, are represented by symbols readily recognized.

Disregarding for the present the meter 100, the operation of the system is as follows: To make a call, substation 3 removes receiver from hook, closing the circuit of the substation telephone, giving path for current, from battery 67, through relays 18 and 19, line and substation telephone, to ground 20; energization of relay 18 gives path for current through magnet 13 and interrupter 26; the closure of this circuit at 26 results in the energization of magnet 13; contact of conductors 21, 22, 23, 24, 25 with 31, 32, 33, 34, 35 immediately follows, giving path for current from battery 67 through relays 27 and 28 as follows: battery 67, relay 27, conductor 24, conductor 34, armature 56, conductor 85, contact point 30, armature 29 and winding 36 of relay 28 to the other pole of the battery. This current energizes relay 27 to interrupt the circuit of magnet 13 to prevent the wipers from stepping farther and also energizes relay 28 to close its contacts 38—39 and 29—40, but contact 29—30 is mechanically such that its break is delayed until current also passes through winding 37 of the relay; the attraction of armature 38 of relay 28 gives path for current from the non-grounded pole of battery 67 to armature 38, contact 39, through conductors 33 and 23 to relay 46 and ground, thereby energizing relay 46, which by attracting its armatures breaks the circuit of relay 18 and places the two limbs of the line 1 upon conductors 21 and 22, giving path for current from battery 67 through elements 47, 32, 22, 1, 3, 1, 21, 31, relay 47 back to battery 67; by armature 48 path for current is given through winding 37, contact 40, armature 29, winding 36, effecting the break of contact 29—30 and release of armature of relay 27; prior to the release of relay 27, relay 18 had been released by operation of relay 46. The attraction of armature 49 sends current through lamp 50, located near plug 51, by the following path: from battery 67 to armature 49, armature 55, lamp 50 to the other pole of the battery. The telphone operator at telephone set 52 answers the call by a talking circuit established by operating key 53; this circuit is as follows: from the lower contact of key 53, to conductor 32, conductor 22 to one line—conductor 1, through substation telephone 3 to the other line—conductor 1, to conductors 21, 31, to the upper contact of key 53, through the central operator's telephone to the lower contact of the key. The central operator takes the order of the calling subscriber, tests a jack, as 5, of the line called for and inserts a plug 51 in the jack, giving path for current from battery 67 through relays 54 and 6; armature 55 is attracted and opens circuit of lamp 50, and armature 56 is attracted and closes circuit of lamp 57, causing lamp 57 to glow as a signal to the operator that the called party is not at his telephone. The circuit through lamp 57 is as follows: from one pole of battery 67 to armature 56, lamp 57, armature of relay 59 back to the other pole of the battery. The operator now rings the called station by means of the ringing key 58 and the answering of the called station and consequent closure of the circuit through the substation telephone gives a path for current from battery 67 through elements 59, 2, 4, 2, relay 60 to ground; energization of relay 59 opens the circuit of lamp 57, indicating to the operator that the called station has answered. The two subscribers are now connected for conversation over a metallic circuit between the sides of which battery 67 is bridged; this circuit extends from telephone at substation 3, by left-hand conductor of line 1 to conductor 22, conductor 32 including a condenser, sleeve contacts of plug 51 and jack 5, left-hand conductor of line 2 telephone at substation 4, right-hand conductor of line 2, tip contacts of jack 5 and plug 51, conductor 31 including a condenser, conductor 21 to right-hand conductor of line 1, to the telephone at substation 3. Battery 67 is bridged between the sides of this circuit by connections leading from point 200 through the left-hand winding of relay 47 to one pole of the battery, and from point 201 through the right-hand winding of relay 47 to the other pole of the battery. Both relay 59 and relay 60 will remain energized so long as the telephone at substation 4 is off the hook.

Upon the completion of the conversation, hanging up of receiver and breaking of circuit through substation 4 will release relay 59 reëstablishing the previously traced lighting circuit of lamp 57, thereby causing the latter to glow as a disconnect signal to the operator; hanging up of telephone and breaking of circuit through substation 3, will release relay 47 which, with relay 54 remaining energized, will cause lamp 50 to glow also as a disconnect signal to the operator. The circuit which thus causes lamp 50 to glow extends from one pole of the battery 67 through armature 49, back contact of said armature to front contact of armature 55, armature 55, lamp 50 to the other pole of the battery. Upon disconnection of the plug 51 the release of relay 54 will extinguish both lamps 50 and 57. Hanging up of receiver and breaking of circuit through substation 3 also releases relay 19 which thus gives path for current from battery 67 through magnet 14 and contact 17—16 back to battery; energization of magnet 14 releases the rotary part of the switch 8, by return of which contact 17 16 is opened and all parts are at rest, awaiting another call from line.

If prior to another call originated by the line 1, a call be completed for the line 1, the

insertion of a plug in one of the jacks 7 will energize relay 46 and remove all the automatic equipment from the line without having operated any part of it other than the relay 46. If, when line 1 had called as above, the trunk equipment associated with conductors 31, 32, 33, 34, 35 had been in use by some other subscriber, no circuit would have existed from conductor 34 to ground since the contact 29—30 would have been open, and relay 27 thus would not have been energized; interrupter 26 would then have alternately opened and closed the circuit of magnet 13, stepping the rotary part of the automatic switch forward until an idle trunk was encountered, whereupon circuit to ground from conductor 24 would have resulted in action as above outlined. After the disconnection of a calling line from the selected trunk, the trunk, as that having conductors 31, 32, 33, 34, 35, cannot receive another call until after plug 51 has been disconnected from jack 5, as until after such disconnection relay 54 will remain energized and circuit between conductors 34 and 85 and therefore between conductor 34 and ground, will be interrupted between the contact parts on the armature 56 of relay 54.

In connection with equipment as above required in the normal operation of the circuit as described, I add the wiper connected with the conductor 25, the waiting contacts connected with conductors 35, 45, etc., the conductor 35, including resistance 61, the relay 60 mentioned above but not forming a necessary part of the invention in the patent application above referred to, and the meter 100.

In the meter 100, which is connected with the selective switch by the conductor 25, the cam 65 is mounted rigidly upon a shaft 64 of the automatic switch 8; rock arm 66 has a fulcrum at 69 and carries at one end the friction roller 68 adapted to engage the periphery of cam 65 and at the other end the pawl 70; the spring 71 returns to position both the rock arm 66 and the pawl 70; the fixed pin 72 serves as a guide to pawl 70. Star wheel 73, rigidly mounted upon shaft 74, is adapted to turn the primary wheel of a counting or registering train of wheels of any well known type, the details of the counting train not being shown. The star wheel 73 is shown with only four teeth or spurs, and with such a design a revolution of 90 degrees would be necessary to record one unit upon the counting train. By the first movement of the rotary part of the automatic switch 8, the cam 65 acts upon the rock arm 66, moving it to a position whereby the pawl 70 advances the star wheel 73 a little less than one-half of its required step, and brings the spurs to the position indicated by the dotted lines 75, in which position the pawl 70 remains until the return to normal of the automatic switch 8. Magnet 76 with armature 77 carrying pawl 78 held by spring 79 and guided by fixed pin 80 is in position to engage a spur of the star wheel 73 when that wheel is in the position indicated by the dotted lines, and upon the answering of the station upon the called line, with consequent energization of relay 60 and the closing of its armature contact, as already explained, a circuit is formed giving path for current from battery 67 through 62, 63, 35, 61, waiting contact, wiper, 25 and winding of magnet 76 to ground, energizing said magnet, attracting its armature and by means of pawl 78 propelling the star wheel 73 through the remainder of the step begun by pawl 70. In this position the star wheel 73 remains, regardless of action of armature 77 caused by the motion of the switch hook at substation telephone 4, since pawl 78 by reason of pin 80 cannot swing to the right a distance sufficient to engage the next succeeding spur of the star wheel. Upon discontinuance of the conversation and consequent return of the automatic switch 8 to its position of rest, the cam 65 permits rock arm 66 and pawl 70 to return to their position of rest, by which pawl 70 is brought into position to engage the next succeeding spur of star wheel 73.

In Fig. 2 is shown a detail of spring tension conditions upon the shaft 74 bearing the star wheel 75; the cam 81 has projecting lugs equal in number to the spurs of the star wheel, and similarly spaced, angularly. The spring 83, with friction roller 82, bears upon the periphery of the cam wheel 81, and tends to hold the shaft 74 from turning when the friction roller 82 is in the depression between two of the lugs; it tends to return the shaft when the shaft has been advanced by so small an angle that the friction roller has not passed the apex of the next succeeding lug, and propels the shaft forward to its next position of rest after the apex of any lug has been passed. The action of this cam and tension spring as applied to the action of the meter 100 is as follows: By the preliminary action of pawl 70, the star wheel is advanced from its position of rest, but not so far that the friction roller 82 reaches the apex of a lug of the cam wheel 81; therefore, if by reason of failure of the called line to energize the relay 60, the circuit is not closed to energize the magnet 76, and the shaft 74 is not advanced further by pawl 78, then upon the disconnection of the automatic switch and the return to its position of rest of the pawl 70, the spring 83 and friction roller 82 will cause the shaft 74 and the star wheel 73 to return to position of rest, without having in any way registered the unsuccessful call.

In present common battery telephone practice, it is customary to work the switch

hook to attract the attention of the operator for another call, and such operation of the switch hook will deënergize magnet 19, in the same way as when the receiver is hung upon its hook; magnet 19 thereupon releases its armature which closes circuit through magnet 14, releasing switch 8 and disconnecting the trunk, as already explained. The return movement of the movable part of switch 8 rotates cam 65 withdrawing pawl 70 to engage the next succeeding spur of star wheel 73 and thus effectually to register the succeeding call, if it be a successful one.

In a connection in which the telephone line 1 is the called line, the meter is entirely disconnected by the action of relay 46.

I do not wish to limit myself in all respects to the exact details shown and described. It is evident that the meter itself and the method of applying it to the particular telephone system in question may be considerably modified without departing from the spirit of my invention. It is also obvious that such a general type of meter as I have shown, and operating under the same general plan, might without further invention be applied to other telephone systems using automatic switches wherein the automatic selecting switch, either under the control of the calling subscriber or without his volition, serves to complete a preliminary step in the building up of a circuit between two subscribers.

What is claimed is:

1. In a telephone system, the combination of a telephone line; a selective switch for said line; trunk lines terminating in said switch; means for causing said selective switch to select automatically an idle trunk line; a meter connected with said selective switch; and electromagnetic means automatically operating said meter by a single energization to register only connections with other telephone lines.

2. In a telephone system, the combination of a telephone line; a selective switch for said line; trunk lines terminating in said switch and through which connections are adapted to be effected with other telephone lines; means for causing said selective switch to select automatically an idle trunk line; a meter connected with said selective switch; and means automatically operating said meter to register only those connections effected through said trunk lines which are answered at the telephones of the called lines.

3. In a telephone system, the combination of a telephone line; a selective switch for said line; trunk lines terminating in said switch; means for causing said selective switch to select automatically an idle trunk line; a meter connected with said selective switch; and means automatically operating said meter to register only connections with other telephone lines and rendering said meter inoperable to register more than once during the continuance of any one connection.

4. In a telephone system, the combination of a telephone line; trunk lines; a selective switch for the telephone line and at which the trunks terminate; said switch being adapted in operation to automatically select and connect the telephone line to an idle trunk; a meter for said telephone line; and means associated with the selected trunk for controlling the operation of said meter.

5. In a telephone system, the combination of a telephone line; a selective switch for said line; trunk lines terminating in said selective switch; means for causing said selective switch to select automatically an idle trunk line; an electromagnetic device connected with the selected trunk line; and a meter for the telephone line adapted to be actuated consequent upon the operation of said electromagnetic device.

6. In a telephone system, the combination of a telephone line; a selective switch for said line; trunk lines terminating in said selective switch; means for causing said selective switch to select automatically an idle trunk line; a relay connected with the selected trunk line; and a meter connected with said selective switch and adapted to be actuated consequent upon the energization of said relay.

7. In a telephone system, the combination of a telephone line; a selective switch for said line; trunk lines terminating in said selective switch; means for causing said selective switch to select automatically an idle trunk line; a meter connected with said selective switch; another telephone line having a substation telephone; means for connecting said trunk with said latter telephone line; and means for actuating said meter upon the answering of a station upon said latter telephone line.

8. In a telephone system, the combination of a telephone line; a selective switch for said line; trunks terminating in said selective switch; mechanism and circuits for causing said selective switch to connect automatically said telephone line with an idle trunk; a meter pertaining to said telephone line; a relay in the selected trunk; circuits over which said relay may when energized give actuating current to said meter; another telephone line; a substation telephone connected with said latter telephone line; switching devices for connecting said trunk to said latter telephone line; and circuits whereby said relay will be energized upon the closing of the circuit through said substation telephone.

9. In a telephone system, the combination of a telephone line; a selective switch for said line; trunks terminating in said se-

lective switch; means for causing said selective switch to automatically select an idle trunk and connect said telephone line therewith; a meter connected to said selective switch and adapted to be actuated by current received from the selected trunk; means in connection with said selected trunk adapted to give actuating current to actuate the meter in a predetermined manner to register the connection, said meter thereby rendering itself incapable of further registering action during the continuance of the connection.

10. In a telephone system, a telephone line; an automatic switch connected with said telephone line and adapted to be moved by every call made by said line; a cam upon a moving part of said automatic switch; a pawl in operative connection with said cam; a counting train adapted to be moved one part of a unit step by said pawl; and another pawl electrically operated and adapted to move said counting train the remaining portion of the unit step, substantially as described.

11. In a telephone system a telephone line; a selective switch for said telephone line; trunk lines terminating in said selective switch; means for causing said selective switch to move to select automatically an idle trunk line; a cam upon a moving part of said selective switch; a pawl in operative connection with said cam; a counting train adapted to be moved one part of a unit step by said pawl; a relay connected with the selected trunk line; another pawl electromagnetically operated and adapted upon actuation to move said counting train through the remaining part of the unit step; an electromagnet to operate said electromagnetically operated pawl; and circuits by which said electromagnet will be energized consequent upon the energization of said relay, substantially as described.

12. In a telephone system, a telephone line; a selective switch for said line; trunk lines terminating in said selective switch; means for causing said selective switch to move to select automatically an idle trunk line; a cam upon a moving part of said automatic switch; a pawl in operative connection with said cam; a counting train adapted to be moved one part of a unit step by said pawl; a second pawl electromagnetically operated and adapted to move said counting train the remaining part of the unit step; an electromagnet operating said second pawl; another telephone line having a substation telephone; means for connecting the selected trunk with said latter telephone line; and means for energizing said electromagnet upon the answering of a substation telephone upon said latter telephone line, substantially as described.

Signed by me at Pittsburg, county of Allegheny, State of Pennsylvania, in the presence of two witnesses.

SIDNEY HAND BROWNE.

Witnesses:
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