Dec. 11, 1928. 1,694,934

G. BABCOCK

TELEPHONE SYSTEM

Filed March 6, 1926 3 Sheets-Sheet 1

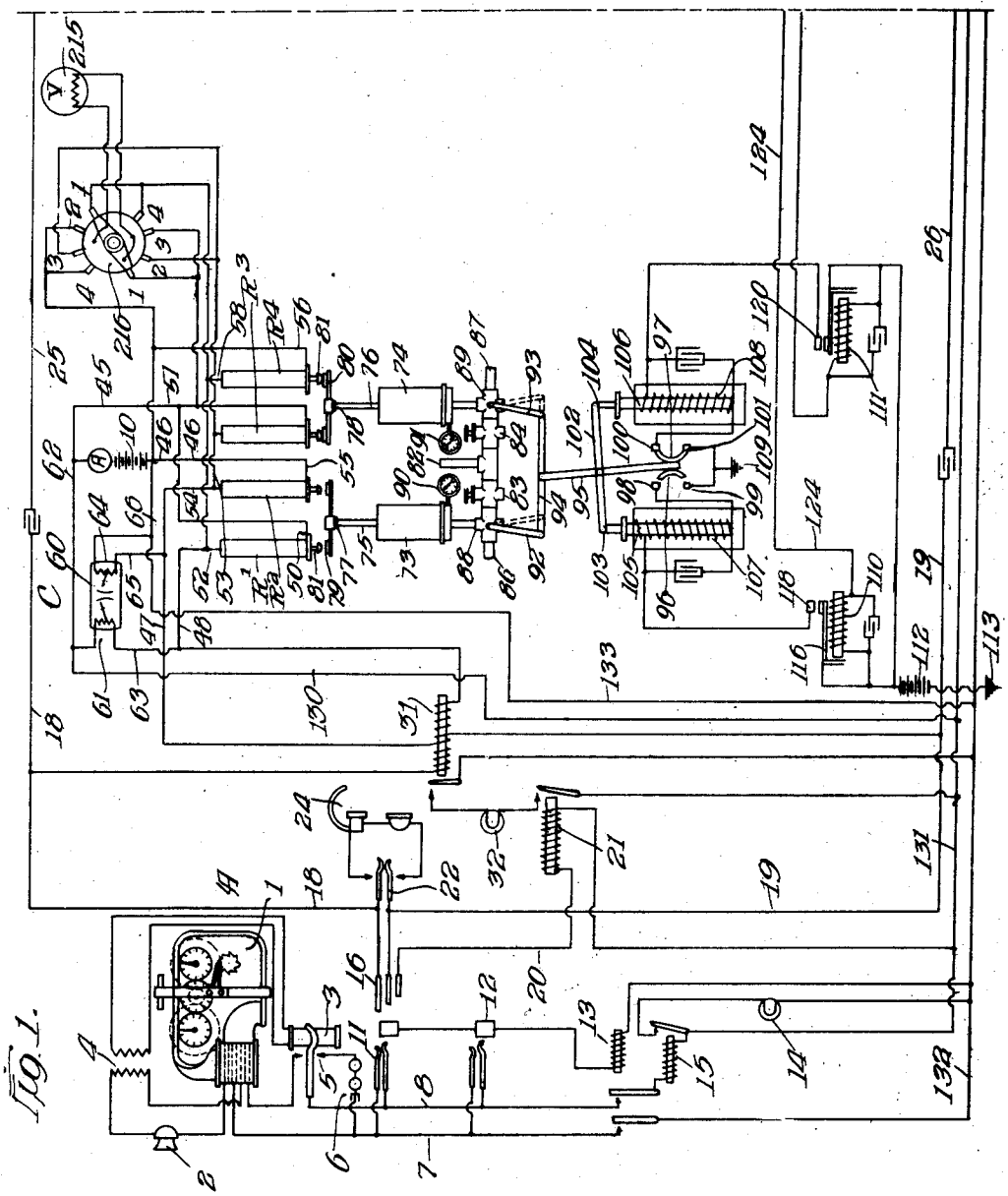


Fig. 1.

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TELEPHONE SYSTEM

Filed March 6, 1926 3 Sheets-Sheet 2

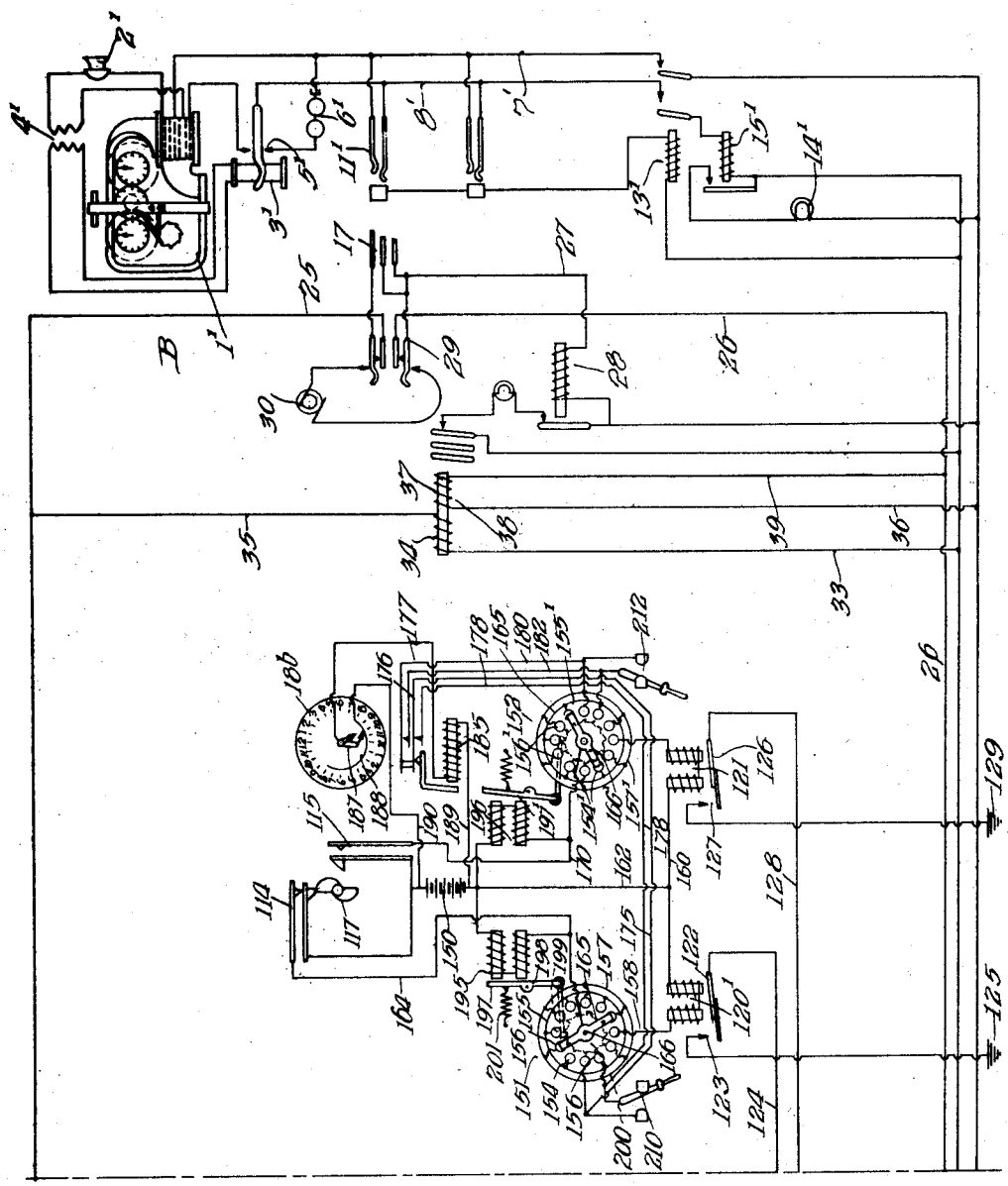


Fig. 2.

Witnesses:
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TELEPHONE SYSTEM

Filed March 6, 1926 3 Sheets-Sheet 3

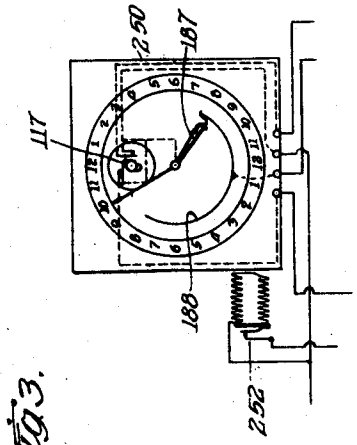


Fig 3.

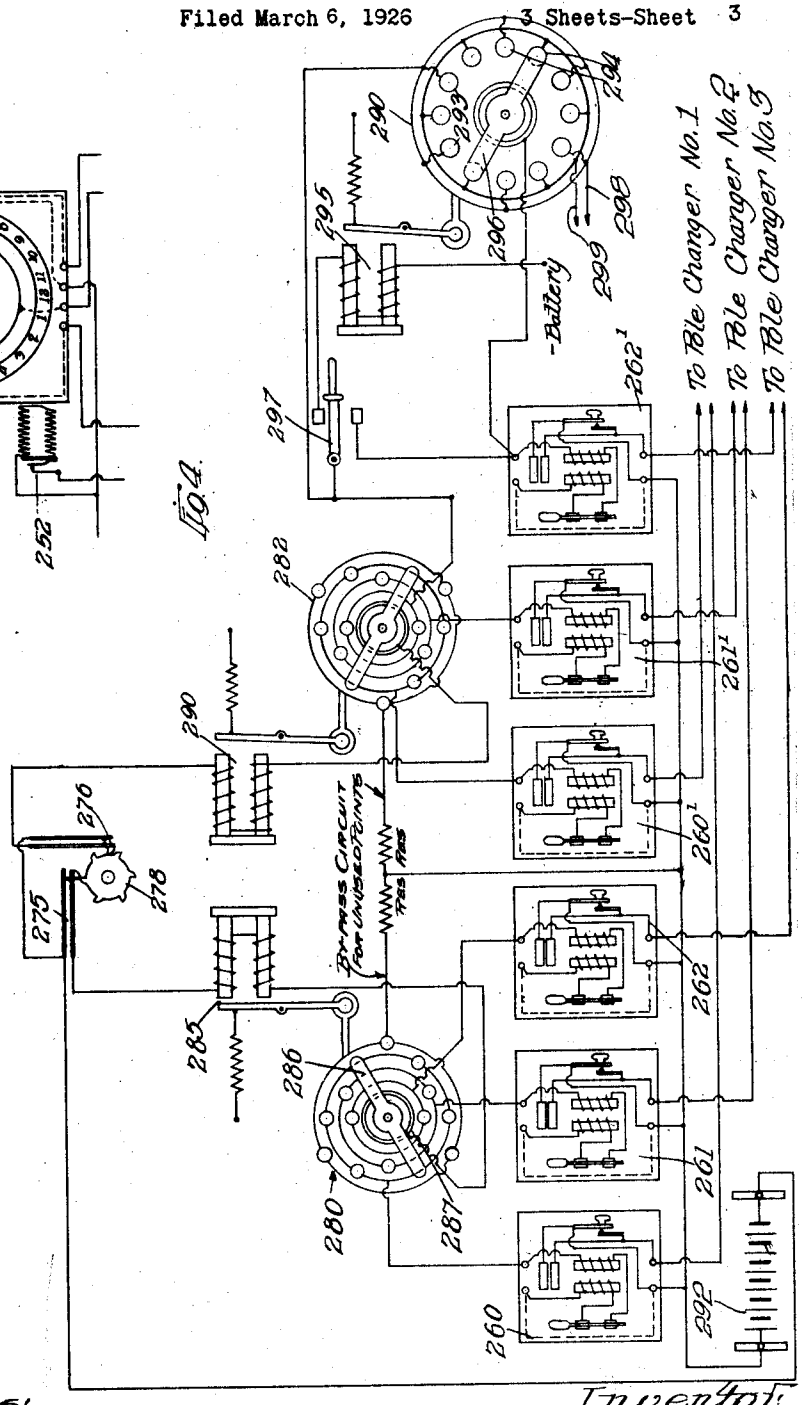


Fig 4.

Witnesses:
Harry A. L. White
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Patented Dec. 11, 1928. 1,694,934

UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed March 6, 1926. Serial No. 92,768.

My invention relates to telephone systems and more particularly to telephone systems employing means for giving metered service.

The present application is particularly directed to means for providing different rates and the provisions and manner for securing different rates particularly in a system in which the service is metered by periodic reversals of current, although it is to be understood that the invention may be employed wherever and in any manner desired.

Where a call has been recorded on the meter at the same rate, regardless of the time at which the call is made, the charge to the subscriber being based on the number of units metered, he has paid for calls at "off peak" load periods at the same rate as for calls during "peak" load or busy periods.

This discourages unnecessary calls and calls of unnecessary duration during "peak" load periods, which is desirable, and it is the object of my present invention to avoid any possible objection as discouraging social intercourse or visiting during the less busy periods.

According to my present invention I provide means for automatically changing the rate of reversals of polarity so that, for example, during the "peak" or busy load periods, say from 8 a. m. to 8 p. m., reversals of polarity on the calling line occur more frequently than during the remainder of the 24 hours.

The frequency of the reversal of polarity is decreased by changing the time interval of pole changer reversal. To do this I eliminate some, for example, every other one of the impulses to the relays controlling the solenoids and pole changers, so that only the impulses not eliminated reach the carbon contact relays controlling the solenoids and pole changer.

I also provide a multi-zone rate control with means for metering or charging at different rates in different zones or parts of the system and means for changing the rates in the different zones so that "night" or reduced rate service may be provided in any zone, as desired.

I provide means for delaying the circuit switching without interrupting the passage of the impulses from the clock contacts, for example 15 seconds or 30 seconds, according to the position of the control relay, whether closed or open, to the carbon contact relays controlling the solenoids of the pole changer, and by means of my present invention one time clock or other time control is adapted for controlling more than one time interval. I also provide for testing the solenoid controlling relay circuits and I make certain other provisions which will hereinafter appear.

In order to explain more fully to those skilled in the art how to construct and practice my invention, I shall now describe the same in connection with the accompanying drawings.

In the drawings:—

Figs. 1 and 2 are parts of a diagrammatic illustration of a telephone system embodying my invention (Figs. 1 and 2 are to be laid beside each other with Fig. 1 to the left and Fig. 2 to the right).

Fig. 3 is a detail view of the time control; and

Fig. 4 is a diagrammatic illustration of another telephone system embodying the invention.

As illustrated in Figs. 1 and 2, the system in connection with which I have illustrated a particular embodiment of my present invention, comprises the calling station A, called station B, and a connecting circuit C, located at a central switchboard.

At the subscriber's stations A and B, I have illustrated in conjunction with the usual telephone apparatus, call registering devices 1 and 1′, respectively, adapted to be operated by reversals of current. The particular meter or call registering device illustrated is described in my co-pending application, Serial No. 508,037, filed October 15, 1921. Any other suitable metering device operating upon reversals of current may be employed.

The meter described in my above referred to application is characterized by the use of two series coils connected in the two sides of the talking line and provided with suitable polarizing means and counteractuating mechanism, whereby a complete cycle of the reversal of current is required for the actuation of the counting mechanism.

The calling station A comprises the usual transmitter 2, receiver 3, induction coil 4, hook switch 5, and ringer or call bell 6. The station is connected to suitable terminals at central over the line wires 7 and 8, which line wires are provided with connections to a central battery 10, for supplying normal polarity of current over the line. The line is provided at central with a suitable answering

jack 11 and multiple jacks, such as 12, connected through a suitable cut-off relay 13, in a manner well known in the art. The line to station A is provided with a suitable line signal 14 for signalling or indicating to the operator at the exchange that a connection is desired. The signal 14 is controlled or governed by a line relay 15.

The connecting cord circuit C with which the central operator is provided, includes an answering plug 16 and a ringing plug 17, for cooperation with the line and multiple jacks, in making connections and interconnections. The answering plug 16 is connected to the talking strands 18 and 19 and is provided with a third conductor 20 for controlling the actuation of the cut-off relay 13, and the sleeve relay 21. A listening key 22 for placing the operator's set 24 in communication with strands 18 and 19, is also provided. At the ringing end of the cord circuit, plug 17 is connected to talking strands 25 and 26 and is also connected to a third conductor 27, which serves to energize the line cut-off relay 13′ of the called line 7′, 8′ and the sleeve relay 28. The operator is provided with a ringing key 29, which is adapted for connecting a ringing generator 30, or other source of ringing current to the conductors of the called line.

While I have illustrated a 3-strand cord circuit in the particular embodiment of my present invention which I have elected to describe, it is to be understood that the invention is not limited in any manner to embodiment in a 3-strand cord circuit and that my illustration of the same is for the purpose of clearly showing the invention in as simple a manner as possible.

One end of the cord circuit C is supplied with battery from the central source 10 over suitable connections which will be described later. These connections include the answering supervisory relay 31, which, in connection with the sleeve relay 21, controls the supervisory signal 32. In a similar manner, battery is fed to the ringing end of the cord circuit from the central source 10 over suitable connections, in this case wire 33, winding 34 and conductor 35 to the tip strand 25, and from the other side of the battery, over wire 36, winding 37 of the supervisory relay 38, conductor 39, to the ring or sleeve strand 26 of the ringing end of the cord circuit C. The potential upon the ringing end of the cord circuit always remains in the same direction, due to the connections above described, so that no reversals of current upon the called line occurs, the calling line only being charged for the call.

The pole changer device or current converter comprises two pairs of compression resistances R^1, R^2 and R^3, R^4, between which battery is connected over the conductors 45 and 46. The terminals 47 and 48 of the pole changer lead to the talking strands 18 and 19, respectively, through the supervisory relay 31. The resistances shown are of the carbon pile type. The resistances R^1 and R^2 are mechanically compressed together and the resistances R^3 and R^4 are actuated together.

One terminal of the battery 10 is connected with the lower ends of the resistances R^1 and R^3 by way of conductors 45, 50 and 45, 51, respectively. The upper end of the resistance R^1 is connected by way of a conductor 52 with the terminal 48 of the pole changer. The upper end of the resistance R^3 is connected by way of conductors 53 and 54 with the terminal 47. The lower ends of the resistances R^2 and R^4 are connected to the opposite terminal of the battery 10 by way of suitable conductors 55 and 56, respectively. If the resistances R^1, R^2 and R^3, R^4, are all equal, there will be no difference of potential at the terminals 47 and 48. If the resistances R^1, R^2 are simultaneously compressed to reduce the value of the same, their terminal 47 will exhibit a strong positive potential, while the terminal 48 will exhibit a strong negative potential. In other words, when the resistances R^1, R^2 are simultaneously compressed, a current flow will be set out through the talking strands as follows: from battery 10, through conductors 45 and 50, resistance R^1 and out through the line by way of the conductor 52 and the terminal 48, back from the line through terminal 47, conductor 54, resistance R^2 and to battery 10 by way of conductors 55 and 46.

If, now, the pressure on the resistances R^1 and R^2 is relaxed or released and simultaneously the pressure on the resistances R^1 and R^3 is increased, the terminal 47 will exhibit a strong negative potential, while the terminal 48 will exhibit a strong positive potential. When the resistances R^3, R^4 are simultaneously compressed, the current flow out through the talking strand is as follows: conductors 45, 51, resistance R^3, conductors 53 and 54 out through the line by way of the terminal 47, and back through the conductors 52 and 58, resistance R^4 and conductors 56 and 46 to battery.

To enable the attendant to observe any out of balance conditions in the rheostats, a balance indicator 60 may be provided between the line feed and the battery. When resistances R^1, R^2, are simultaneously compressed, a flow of current is set up from battery 10, through the conductor 62 and the coil 61 of the indicator 60, which is now in parallel with the resistance R^4, out through the line by way of conductor 63 and back from the line through the coil 64 of the indicator, which is now parallel with the resistance R^2, to battery by way of the conductors 65 and 66. When the resistances R^3, R^4 are simultaneously compressed, a flow of the outgoing current will be set up through

R^3 and the coil 64 back to battery, while a flow will be set up through the coil 61, resistance R^4 and back to battery. In this case the indicator coil 61 is connected in a local circuit in series with R^3 and the indicator coil 64 is connected in series with resistance R^4. In the first instance, the voltage impressed upon the coil 61 is dependent upon the I R drop across the resistance R^1, and the flow through the coil 64 is similarly dependent upon the I R drop across the resistance R^2. In the second instance, the flow through the coils 61 and 64 will be dependent upon the respective values of the resistances R^3 and R^4, which are connected in series with said coils 61 and 64, respectively. In either case, any out of balance condition will be indicated so that it may be corrected.

The arrangement for actuating or compressing the pairs of resistances, comprises a pressure cylinder 73 for the rheostats R^1, R^2 and a pressure cylinder 74 for the rheostats R^3, R^4. Piston rods 75 and 76 connected at their inner ends to suitable pistons within the cylinders 73 and 74, respectively, are adjustably connected at 77 and 78 with rheostat actuating shoes 79 and 80. Actuation of the respective rheostats is had by engagement of these actuating shoes with the insulated buttons 81 thereof. The supply of compressed air or other suitable motive fluid from the common intake 82 to the cylinders 73 and 74 is regulated by suitable adjustable pressure regulators or pressure reducing valves 83 and 84. The conduit 82 may communicate with any suitable source of pressure. The conduits 86 and 87 provide exhaust outlets for exhausting the pressure from the chambers 73 and 74, while suitable valve members 88 and 89 control the flow to and exhaust from the respective pressure chambers. The pressure chambers 74 and 73 may be provided with suitable pressure gauges 90 and 91, respectively.

The blocks 77 and 78 through which the rods 75 and 76 are connected to the actuating shoes 79 and 80 may be adjustable along the respective shoes so that any out of balance condition in the rheostats may be quickly and conveniently adjusted by moving the block along the actuated shoes to the desired position. The actuation of one pair of resistances relative the other may be varied by regulating the pressure admitted to the chambers 73 and 74 by means of the regulators 83 and 84 and the degree of actuation of any resistance relative the other resistance of the same set may be adjusted through the connections 77 and 78.

The actuating arms 92 and 93 for controlling the valves 88 and 89, respectively, are connected at their free ends to the opposite ends of a link 94, which link is connected by a pin joint at its center to the upper end of an actuating lever 95. A pair of bridging contact fingers 96 and 97 carried by the opposite end of the bar 95, are adapted for bridging terminals 98, 99 and 100, 101 of a valve controlling circuit. The lever 95 is pivotally mounted centrally and is rigidly joined to a cross bar 102. The cross bar 102 is connected at its opposite ends through suitable links 103, 104 with the plungers or cores 105, 106 of a pair of solenoid windings 107, 108. The terminals 99 and 101 are grounded at 109. The circuits through the solenoid windings 107 and 108 are controlled by a pair of time controlled relays 110 and 111. The windings of the relays 110 and 111 are connected at one end to a battery or other suitable source 112, which source is grounded at 113.

The circuits through the relays 110 and 111 are controlled by a time controlled circuit controller which operates to automatically energize the relays 110 and 111 at different intervals or periods at different times of the day to meter the service over the calling line at different rates at different times, for example, at a higher rate during the "on top peak" or during the loaded or busier part of the day, and at a lower rate during the "off peak" periods or before and after the busier parts of the day.

The time controlled circuit controller comprises a two throw cam 117 mounted, for example, upon the second shaft of a suitable clock and two pairs of cam contacts 114 and 115 which are alternately closed by engagement of the diametrically opposite cam portions of the wheel 117 with the cam trips on the contact springs or arms. The two throw cam 117 completes a rotation every 60 seconds, which means that the horizontal contacts 114 above the cam are closed every thirty seconds and, likewise, the vertical contact springs 115 to the right hand side of the cam are closed every thirty seconds, the vertical contacts 115 being substantially 90° clockwise from the horizontal contacts 114 and the closing of the vertical contacts occurring fifteen seconds after the closing of the horizontal contacts.

The impulse or closing of the contacts 114 (about one-half second) energizes the carbon contact relay 120′ and similarly the impulse of the contacts 115 energizes the contact relay 121. Energization of the relay 120′ actuates the armature 122 to close the contacts 123 and thereby complete the circuit from battery 112, through the winding of the relay 110 and by way of conductor 124 to ground at 125. Similarly, energization of the relay 121 actuates the armature 126 to close the contacts 127 and thereby complete the circuit from battery 112 through the winding of the relay 111 and by way of conductor 128 to ground at 129.

Energization of the winding 107 causes movement of the plunger 105 inwardly, thereby swinging the bar 95 about its pivot

to admit pressure to one of the cylinders, for example cylinder 73, and exhaust the other cylinder 74, thereby compressing the resistances R^1, R^2 and releasing the pressure upon the resistances R^3, R^4. This movement of the bar 95 moves the contact 96 out of engagement with the contacts 98 and 99 and the contact 97, and the contact 97 into engagement with the contacts 100 and 101, selecting the circuit through the winding 108 which circuit is closed at the contacts 120 by engagement of the cam wheel 117 with the contacts 115. The circuit through the winding 107 is closed by engagement of the cam wheel 117 with the contacts 114, as will be explained. Completion of the circuit through the winding 108 swings the bar 95 in the opposite direction to compress the other pair of resistances R^3, R^4 and selects the circuit through the winding 107.

The windings of the relays 120′ and 121 are alternately connected across a battery or other suitable source 150. Interposed in circuit with the relay 120′ is a so-called "distributing switch" 151, and similarly interposed in circuit with the relay 120 is a similar distributing switch 152.

The purpose of the switches 151 and 152 is to change the time interval of pole changer reversal by changing the number of energizations of the relays 120′ and 121 per the rotation of the time controlled cam 117. The switch 151 comprises a group of contacts 154 connected by a conductor 155 and a second group of contacts 156 alternately disposed relative said first group of contacts 154 and connected by a conductor 157. The conductor 155 is connected by a conductor 158 to the winding of the relay 120′, the opposite end of which winding is connected by a conductor 160 to the winding of the relay 121, with a conductor 162 connecting the conductor 160 with one side of the battery 150. The opposite side of the battery 150 is connected through contacts 114 when said contacts are closed by the cam 117 with a conductor 164 connected to a conducting or contact arm 165 pivoted at 166 and movable successively into engagement with the contacts 154 and 156 to connect them and the conductor 164.

The distributing switch 152 is similar to the switch 151 and has similar alternately wired contacts, the parts of the switch 152 being designated by primed reference numerals corresponding to those of the switch 151. The conductor 155′ connecting the contacts 154′ of the switch 152 is connected through the relay 121 and conductors 160 and 162 to one side of the battery 150 and the other side of the battery 150 is connected through the contacts 115 and conductor 170 to the contact arm 166′.

The conductor 157 of the switch 151 is connected by a conductor 175 with a contact 176 of a switch 177 and the cooperating contact is connected by a conductor 178 with the conductor 155 connecting the contacts 154. The conductor 157′ of the switch 152 is similarly connected by a conductor 180 with another contact of the switch 177 and the cooperating contact is connected by a conductor 182 with the conductor 155′ connecting the contacts 154′.

The switch 177 is controlled by a relay 185 the energization of which is time controlled as by means of a clock 186.

The clock 186 is shown as provided with a contact arm 187 which makes one revolution every 24 hours, and this contact arm 187 engages a segment contact 188, say between the hours of eight p. m. and eight a. m. or at any other time during which it is desired to change the metering rate of the system. When the contact arm 187 is in contact with the conductor 188, a circuit is closed from one side of the battery 150 through a conductor 189 and through relay 185 and the cooperating clock contacts and a conductor 190 to the opposite side of the battery. Energization of the relay 185 by closing the clock circuit therethrough during the "off peak" or less busy times of the day, actuates the armature 192 to open the contacts of the switch 177 and thereby the circuits of the contacts 156 of the switch 151 and the contacts 156′ of the switch 152 so that when the contact arms 166 and 166′ of the distributor switches are moved into engagement with these contacts during this time, closing of the contacts 114 and 115 by the time cam 117 will not energize the relays 120′ or 121, so that during this time only every second impulse from the time controlled contacts will reach the carbon contact relays controlling the solenoids and pole changer. The time interval of pole changer reversals or the interval of polarity reversals on the calling line is thereby changed from 15 seconds to 30 seconds. That is, the number of reversals within a given time is thereby decreased to decrease the rate of registration upon the meter and thereby the rate of charge during the less busy parts of the day, that is, when the contact arm 187 is in contact with the conductor 188. The particular time that the rate is changed, the particular purpose of the rate of change, and the amount or duration of the change, may all be varied, of course, to suit any particular requirements.

For the purpose of advancing the contact arms 165 and 166′, one contact at a time every time their respective contacts 114 or 115 are closed and independently of whether or not the relays 120′ or 121 are energized by said closing, I connect a relay 195 between one side of the circuit of the switch 151 ahead of the switch and the opposite side of the battery 150 and a relay 196 between one side of the circuit of the switch 152 ahead of said switch and the opposite side of the battery

150. The relay 195 has an armature 197 pivoted at 198 and connected with a pawl 199 which cooperates with a ratchet 200 attached to the contact arm 165 to advance the arm from one of the contacts 154, 156, to the next contact 154, 156 by the back-acting movement of the armature 197, which movement is imposed by a spring 201. The back action of the armature 197 by the spring 201 thereby advances the arm 165 one contact and the movement of the armature 197 under the influence of the relay 195 when said relay 195 is energized, moves the pawl 199 to take over the next tooth of the ratchet so that the contact arm will be advanced another contact with the next back action of the armature.

The action of the relay 196 and its armature 197′ is the same when the other circuit is closed through the contacts 115.

Each of the distributing switches 151 and 152 may be provided with a hand switch 210 and 212, respectively. These switches are useful for test purposes in regular operation. Normally they stand open, and by closing them the switch 177 may be shunted out of circuit for test purposes, as desired.

To assist in adjustment of the various resistances or rheostats, an arrangement for indicating to the attendant the performance or operation of any of the individual rheostats is provided. This includes a suitable voltmeter 215, a selecting switch 216 for connecting either of the resistances R^1, R^2, R^3 or R^4 individually thereacross, and the necessary circuit connections therebetwen.

I shall now describe briefly the operation of the particular system of Figs. 1 and 2. Assuming that the subscriber A desires to be connected to the subscriber B, the receiver 3 is raised, thereby completing a circuit from the battery 10 as follows:—

Battery 10, conductor 62, 130 and 131, line relay 15, line wire 8, through the instrument and meter at the station and back through line wire 7, conductors 132, 133, 66 and 46 to battery 10. Since the meter requires a complete cycle of current reversal, it is not now actuated. Line relay 15 being thus energized closes a circuit from battery through line signal 14, indicating to the operator at the exchange that a connection is desired. The operator thereupon makes connection with the answering plug 16, effacing the line signal and connecting the strands 18 and 19 to the line wires 7 and 8. Current of the prevailing polarity thereupon flows out over the talking strands 18 and 19. and over the line wires 7 and 8 and supplies current to the instrument at the sub-station A. The operator, through the medium of the listening key 22, communicates with the subscriber and receives the order for the desired connection, and assuming that the subscriber B is desired, selects and tests the terminals of said line and proceeds to make the connection. The ringing key 29 is actuated to project ringing current over the called line, and when the party B answers, current flows in normal direction over the line of the called party, and conversation between the parties may be carried on.

The time controlled cam 117 rotates continuously, successively closing the contacts 114 and 115 and thereby the circuit through the solenoid windings 107 and 108. The closing of these circuits is only momentary, sufficient to operate the valves 88 and 89, for example, and set the connecting piece or bridge carried by the bar 95 for closing the other circuit. The operation of the valves 88 and 89 in turn controls release of one set of resistances and compression of the other set. A complete cycle of change of polarity occurring in the calling line from positive to negative and back to positive, or vice versa, causes an actuation or registration upon the meter 1 at the calling station.

During the less busy or "off peak" periods of the day when the time controlled contact arm 187 comes into contact with the contact element 188, the relay 185 is energized and opens both branches of the switch 177 so that every other impulse of the carbon contact relays which actuate the solenoids are eliminated, the reversal of polarity being thereupon only one-half as frequent and the rate of registration upon the meter being only one-half as great as during the busier periods when the switch 177 is closed and each of the successive contacts of the distributing switches 151 and 152 act to transmit an energizing impulse to the rheostat solenoids.

It is to be understood, of course, that the motor coils of the back-acting distributing switches may be in series with the motor coils of the pole changer control relays; also, that a common source or battery may be employed for the entire system and that other variations and circuit connections are contemplated.

The showing of the time controlled contact cam 117 and the "night" or half rate control clock 186 in Fig. 2 is, as already pointed out, diagrammatic for the purpose of imparting a clear understanding of the invention. The contact cam 117 is preferably on the second hand of the clock 250 with the contact arm 187 mounted on the same clock as shown in Fig. 3 to make a rotation every twenty-four hours, for example. The "off peak" or "night" rate contact is shown at 188, as before, and the clock may be provided with an automatic clock winding motor 252.

In Fig. 4 I have shown a multi-zone rate control system. While the number of zone rates may be varied, the particular system shown has three pairs of relays 260–260′, 261—261′ and 262—262′, each pair controlling the solenoids of a pole changer as in Figs.

1 and 2. For example, as labeled, the relays 260, 260′ are connected to the solenoids of pole changer 1, the relays 261, 261′ to the solenoids of pole changer 2 and the relays 262, 262′ to the solenoids of pole changer 3. The relays 260, 261 and 262 are controlled by contacts 275, and the relays 260′, 261′ and 262′ by contact 276, which contacts 275 and 276 are controlled by a five-second time controlled contact closing cam 278.

The circuits of the contacts 275 have a distributing switch 280 and the circuit of the contacts 276 has a distributing switch 282. The switch 280 has a group of connected contacts for each relay 260, 261 and 262, the number of contacts in each group being different, so that the number of energizations or impulses to each relay 260, 261 and 262 per rotation of the cam 278, will vary according to the different zones. The pole changers are connected to the systems of the different zones, and the rate of metering or charge in each zone is different because of the different number of impulses per rotation to relays 260, 261 and 262, differing according to the particular rate of impulses in the particular zone of the calling party.

The distributing switch 280 has a back-acting relay 285 for advancing the contact arm 286 over the contacts of the several groups to connect the central contact piece 287 successively therewith. The switch 282 has a similar relay 290 for the same purpose. The battery or other source is indicated at 292. and an outer group of connected or wired contacts of each switch 280 and 282 is connected to the battery through a suitable resistance.

In operation, when contacts 275, for example, are closed, the relay 260, 261 or 262 connected with the contacts of the switch 280 with which the contact arm 286 is in engagement, is energized and the relays 260′, 261′ and 262′ are similarly energized to complete the cycle of reversal.

For the purpose of providing a "night" or half rate in conjunction with the multi-zone rates, I have shown a switch 292 connected between the switch 282 and the relay 262′ and provided with two groups of contacts 293 and 294 with a back-acting relay 295 for advancing the contact arm 296 over the contacts 293 and 294 and a switch 297 for connecting the relay 295 into and out of circuit. The contacts 293 and 294 are connected through conductors 298 and 299 with a relay or time controlled contact for eliminating or disconnecting one of the groups of contacts 293, 294 during the less busy periods of the day.

One clock in each embodiment controls more than one time interval rate. For instance, a clock with five second contacts will serve any number of pole changer control relays using the multiple of five seconds.

I claim:—

1. In combination, a calling line having a telephone set, a called line having a telephone set, a connecting circuit for interconnecting the lines for telephonic communication, means for reversing the polarity of current over said lines, a single registering device operated by reversals of current for registering the talking intervals over the talking line, and means for increasing said intervals during the idle parts of the day.

2. In combination, a calling line having a meter operated by reversals of current, a called line, a connecting circuit for said lines, variable resistance means for reversing the polarity of current over the calling line, electromagnetic means controlling said polarity reversing means, time controlled means governing the actuation of said electromagnetic means, and means for changing the effect of said time controlled means on said electromagnetic means to change the rate of polarity reversals over the calling line and the metering rate for the service over said line.

3. In combination, a variable resistance pole changer, a relay controlling said pole changer, a distributing switch controlling said relay, a second relay for operating said switch, and timing means controlling said second relay.

4. In combination, a controlling relay, means for imparting successive energizations to said relay, a telephone line, means for reversing the current over said line, a measuring device operated by the current reversals, and means for eliminating alternate energizations of said relay to increase the intervals between energizations and thereby the rate of reversals and the rate of operation of said measuring device.

5. In combination, a controlling relay, means for imparting successive energizations to said relay, said means including a distributing switch having a plurality of contacts, and means for eliminating alternate energizations of said relay to increase intervals between energizations, said means comprising a timing device and a relay controlled thereby and operable to open the circuits of alternate contacts of said switch.

6. In combination, a distributing switch having a plurality of contacts and a switch member movable into successive engagement therewith, time controlled means for advancing said switch member, and time controlled means for de-energizing alternate contacts of said switch.

7. In combination, a calling line, a called line, a connecting circuit for interconnecting said lines for telephonic communication, means operated by reversals of polarity of current for measuring the service over the calling line, means in the connecting circuit for reversing the polarity of current over said line, electromagnetic means controlling said polarity reversing means, a relay controlling said electromagnetic means, a dis-

tributing switch for imparting successive energizations to said relay, a timing device for said switch, and time controlled means for eliminating alternate energizations of said relay to decrease the rate of polarity reversals over the line.

8. In combination, a calling line, a called line, a connecting circuit for interconnecting said lines for telephonic communication, means operated by reversals of polarity of current for measuring the service over the calling line, means in the connecting circuit for reversing the polarity of current over said line, electromagnetic means controlling said polarity reversing means, a relay controlling said electromagnetic means, a distributing switch for imparting successive energizations to said relay, said switch having a plurality of contacts, a timing device for said switch, and time controlled means for de-energizing alternate contacts of said switch to decrease the rate of polarity reversals over the line.

9. In combination, a telephone line, a circuit connected to said line and including a pair of variable resistances, means for automatically alternately increasing one resistance with respect to the other to reverse the current over said line, a service measuring device operated by the current reversals, and means for changing the rate of operation of said resistance increasing means to vary the rate of registration upon said service measuring device.

10. In combination, a telephone line, a potentiometer circuit comprising two variable compressible resistances, terminals leading to said telephone line and connected to said potentiometer circuit, means for varying said resistances alternately, and means for changing the rate of operation of said resistance varying means.

11. In combination, a telephone line, a potentiometer circuit comprising two variable compressible resistances, terminals leading to said telephone line and connected to said potentiometer circuit, electromagnetic means for varying said resistances alternately, time controlled means governing the actuation of said electromagnetic means, and means for changing the rate of actuation of said electromagnetic means by said time controlled means.

12. In combination, a telephone line, a potentiometer circiut comprising two variable compressible resistances, terminals leading to said telephone line and connected to said potentiometer circuit, electromagnetic means for varying said resistances alternately to reverse the current over the line, time controlled means governing the actuation of said electromagnetic means, means for changing the rate of actuation of said electromagnetic means by said time controlled means, and a service measuring device operated by the reversals of current over the line.

13. In combination, a telephone line having a meter actuated by variations of current, a potentiometer circuit for supplying talking current to the line, said circuit including a pair of compressible variable resistances, means for alternately compressing said resistances, and means for varying the rate of compression of the resistances to vary the rate of operation of the meter.

14. In combination, a telephone line having a call meter adapted to be operated by reverals of current, means for supplying current to the meter, said means comprising a cord circuit having a pole changing device for supplying current to the talking strands of the cord circuit, said pole changing device comprising a pair of carbon piles adapted to be periodically compressed alternately, and means for varying the rate of compresison of said carbon piles.

15. In a telephone system, a talking line, means for supplying current periodically in reverse directions over said line, said means comprising a potentiometer circuit including a pair of non-interruptible variable resistances, a pair of electromagnets for alternately varying said resistances, a time controlled circuit controller for periodically actuating one of said electromagnets, a polarized circuit changer for determining the electromagnets to be actuated, and means for varying the rate of actuation of said electromagnets by said time controlled circuit controller.

16. In combination, a subscriber's line having a subscriber's station, non-interruptible means for reversing the polarity of current over said line, a service measuring device at the subscriber's station and operated directly by the reversals of current, said service measuring device dividing the talking interval into a number of units each separated from the succeeding unit by reversal of current over the line, and means for changing the rate of current reversals to directly change the rate of registration upon said measuring device at the subscriber's station.

In witness whereof, I hereunto subscribe my name this 27th day of February, 1926.

GARRISON BABCOCK.