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B. STRYKER.

SELECTIVE SIGNALING FOR POLYSTATION TELEPHONE CIRCUITS.

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NO MODEL.

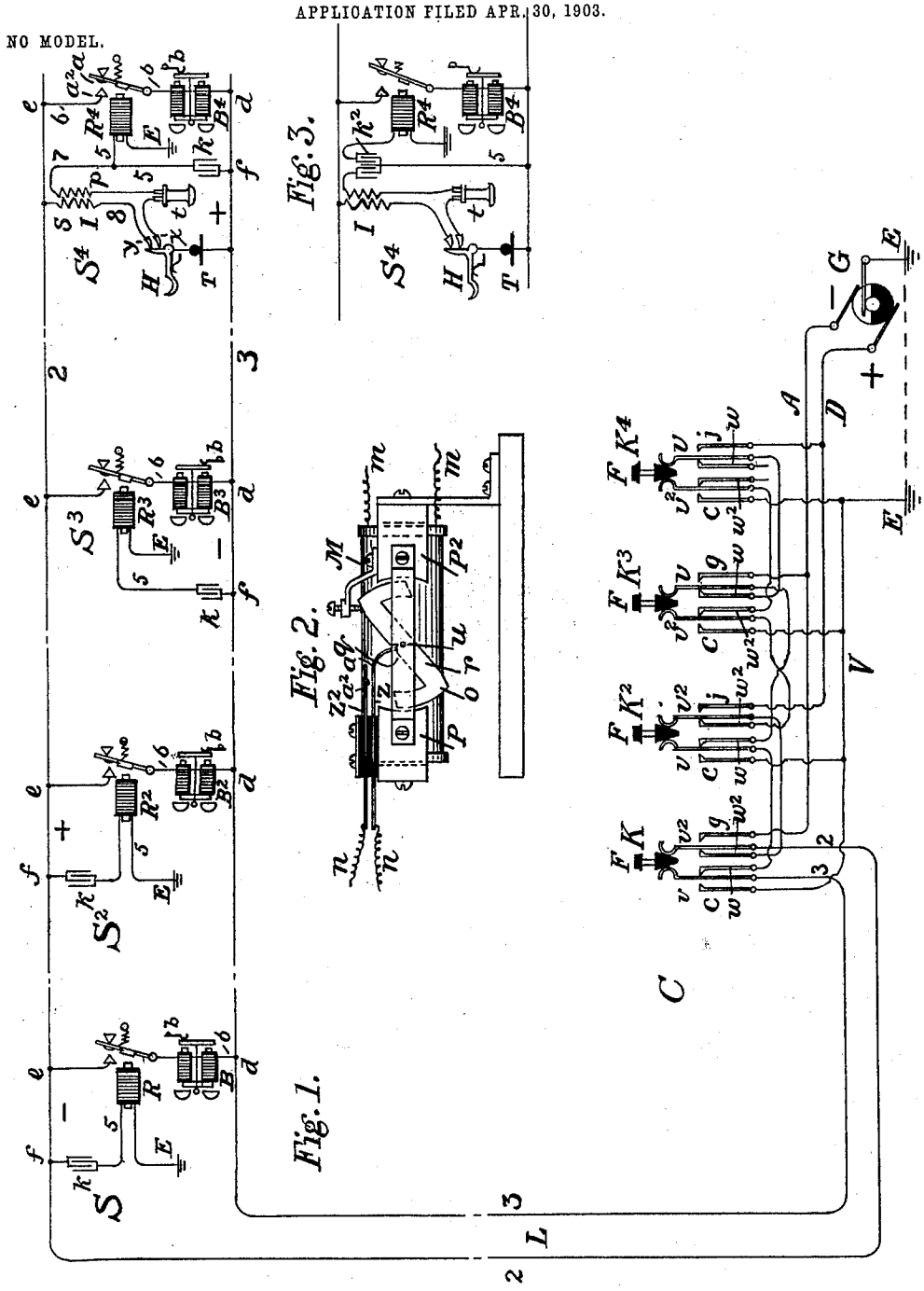

Fig. 1.

Fig. 2.

Fig. 3.

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No. 756,296. Patented April 5, 1904.

UNITED STATES PATENT OFFICE.

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SELECTIVE SIGNALING FOR POLYSTATION TELEPHONE-CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 756,296, dated April 5, 1904.

Application filed April 30, 1903. Serial No. 155,017. (No model.)

To all whom it may concern:

Be it known that I, BURDETT STRYKER, residing at Washington, District of Columbia, have invented certain Improvements in Selective Signaling for Polystation Telephone-Circuits, of which the following is a specification.

This invention relates to selective signaling whereby any substation of a polystation telephone-line or main circuit may be called from the central station to the exclusion of the others, and concerns more particularly that branch of the subject which involves the combined employment of the two main conductors of the metallic or double-wire line-circuit and both directions of current. Such a system is described in Letters Patent of the United States No. 644,647, granted to George K. Thompson and Ernest C. Robes, and dated March 6, 1900. This patent contemplates a metallic circuit extending from a central station to four substations and at each substation has its polarized call-bell connected in a normally open branch extending from one of the main conductors to earth, the said branch at two of the stations being extended from one, and at the other two stations from the other main circuit-conductor. There is also at each substation a bridge between the main conductors and a sluggishly-acting relay connected therein, the said relay being placed in control of the associated incomplete bridge and adapted when operated to close the same and bring the bell into operative relation with the circuit, the bells in the two branches from each main conductor being constructed or adjusted to respond to intermittent currents of opposite direction, respectively. At the central station appliances are provided to transmit an intermittent current of either direction through the metallic circuit over either main conductor, and also over a grounded circuit formed in part of the particular main conductor so selected as soon as the substation-relay shall have operated to complete the ground branches thereof, at the same time grounding the other main conductor. Thus in the operation of the system the call-bell of any particular substation is rung by transmitting an intermittent current of appropriate sign or direction over the appropriate main conductor, the bell in the other earth branch of said conductor remaining quiescent for the reason that its operation requires currents of opposite direction, while the two bells at the other two stations in branches from the other main conductor are not rung, because they are shunted by the dead ground temporarilly attached by the central station transmitting appliances to the said other conductor. This system has gone into extended use and under normal and ordinary conditions has been and is in a high degree satisfactory. In certain localities, however, where the overhead trolley and earth-return system of electrical transit is extensively employed, it has been found that currents of considerable strength originating in the said trolley systems and acting under potentials ranging from six to sixty volts find access to the telephone-circuits by way of the earth connections temporarily attached thereto when the substation earth branches are completed for the operation of the bells, and that under these conditions it is difficult and sometimes impossible to maintain such an adjustment of the bells as is necessary to insure that each bell shall respond with accuracy and certainty to the currents intended for its operation and shall not respond at any other time or to any other current or currents. Under these circumstances it is manifestly desirable that the earth shall not form any part of the ringing or bell circuit proper; but I have ascertained that its employment in the operative circuit of the bell-controlling relay is substantially unobjectionable, particularly when a condenser is also interposed in the said relay-circuit.

The object of the present invention is to provide a selective signaling system of the same general type as that of the Thompson and Robes patent, No. 644,647, to which reference has been made, which while retaining the several meritorious features and characteristics of said system shall be practically free from its lia-

bility to interference from and disturbance by trespassing currents reaching the bell-circuit through substation earth connections.

Accordingly in the present invention the substation polarized bell is connected in an originally or normally incomplete, discontinuous, or open bridge between the two main conductors of a metallic telephone-circuit extending between a central station and from one to four substations, and at the same substation a relay connected (preferably together with a condenser) in an earth branch from one or the other of said main conductors controls the operation of said bell by the action of its armature, which when attracted completes the said normally open bridge, so that the bell may then be rung by appropriate currents traversing the bridge wherein it is connected. The relay branches at two of the substations extend to earth from one line conductor and those at the other two stations from the other main conductor, the two bells controlled by the two relays of each main conductor being oppositely polarized or oppositely biased in the manner disclosed by the United States Patent No. 239,134, granted March 22, 1881, to George L. Anders; or otherwise constructed or adjusted, so that one responds to intermittent currents of plus sign or positive direction and the other to similar currents of opposite sign or direction, transmitted over the main conductor with which their earth branches are more immediately associated, and through the metallic circuit for which the other main conductor serves as a return-line. The earth-branch relay is in any well-known way made sluggish or slow in demagnetization or mechanical operation, or both, and is thus adapted not only to respond to pulsatory or intermittent currents, but also to maintain its armature in position to close the associated bridge as long as such pulsations continue to traverse the earth branch, wherein the said relay is connected. I prefer to employ the relay shown and described in the hereinbefore-mentioned patent of Thompson and Robes, the same being a good example of the said slow-acting type and well adapted for the requirements of the present invention. An apparatus comprehending these characteristic features may be placed at each of the four stations of the main circuit and is operated in connection with means at the central station for transmitting at will intermittent or pulsatory currents of either direction or sign over either main conductor of the metallic telephone-circuit and at the same time grounding the central-station end of the other main conductor. When thus operated, both earth-branch relays directly associated with the appropriate main conductor are actuated and both of the corresponding station-bridges are closed; but one station-bell only will be rung, since the other one responds only to currents of opposite sign or direction.

In the drawings which accompany and illustrate this specification, Figure 1 is a general diagram of a four-party telephone-line equipped with a selective signaling system comprising substation and central station apparatus arranged in accordance with my invention. Fig. 2 is a side elevation of a form of sluggish intermittent-current relay well adapted for use in association with the said invention, and Fig. 3 is a diagram of a slightly-modified arrangement for a single substation.

In Fig. 1, S S^2 S^3 S^4 are the stations of telephone-exchange subscribers, and are herein termed "substations."

C is the central station, and L is a metallic main or line circuit extending between the said central and substations and formed of the main direct and return conductors 2 and 3.

It is not considered necessary to show and describe the central-station switchboard and concomitant appliances, since these have no direct or immediate relation with the present invention.

At each substation the apparatus is substantially alike, but differently arranged, and comprises the signaling appliances and the telephone or talking devices. For the avoidance of unnecessary complexity the telephone instruments and their circuit connections are illustrated at one substation, S^4, only.

T is the telephone-transmitter; *t*, the receiver; I, the induction-coil; H, the hook or suspension-switch, and *k* the condenser concerned in the telephone-substation outfit, all arranged on a standard plan for central-battery working, the receiver, condenser, and the primary *p* of the induction-coil being connected in a shunt-circuit 7 round the transmitter and extending from point *x* of the hook-switch H to any suitable point *f* on main conductor 3. The said transmitter T and the secondary winding *s* of the induction-coil are in the telephone-bridge 8, which is open at point *y* of the switch, while the receiver hangs upon the hook of said switch, but closed when the receiver is removed therefrom. The said switch thus in a manner well understood controls the telephone connections.

E, wherever placed, indicates an earth connection.

B, B^2, B^3, and B^4 are the polarized electromagnetic call-bells, and R, R^2, R^3, and R^4 their controlling-relays at the several substations S, S^2, S^3, and S^4, respectively. Two of the said relays (shown as R and R^2) at substations S S^2 are in branches 5 from points *f* on the main conductor 2 to earth, and the relays R^3 and R^4 at the other two substations are in similar earth branches from like points *f* on the main conductor 3. In each earth branch there is a condenser *k*, which, as shown at substation S^4, may be the same condenser as that which when the switch H is operated is connected up in the shunt-circuit 7 in series with the telephone-receiver. The armature of each

relay carries or may constitute a movable electrical contact a, and the forward limiting-stop of said armature serves as a fixed contact a^2, coöperating therewith. The polarized bell at each station is in a bridge 6, extending between points e and d on main conductors 2 and 3, respectively, and leading through the armature and front stop-contacts of the associated relay. Since the said relays are normally unexcited, their armatures being therefore retracted to their back limiting-stops, the contacts a and a^2 are under normal conditions separated, and since the bell-bridges 6 lead through the said contacts they are manifestly maintained in an open, incomplete, or discontinuous state at all times, except when their associated relays become excited and, attracting their armatures, bring their contacts a and a^2 together. The said bell-bridges are thus each controlled by the earth-branch relay at the same station, and the said relay is virtually a switching-relay for its associated bridge.

The relay in virtue of the presence of the condenser k in circuit with it in the earth branch is not operated by a steady current flowing in the main conductor 2 or 3, but is readily responsive through said condenser to an intermittent current or rapidly recurring series of current pulsations traversing its coils, and acted upon by such a current operates by attracting its armature to the front stop a^2 and by the steady maintenance of such attraction as long as the transmission of such current continues. For an operation of this kind it is required that the relay shall be sluggish magnetically or mechanically, for since it must serve as a switch or circuit closer for the associated bell-bridge the retraction of the armature between the successive current impulses is not permissible. The required slowness of operation may be obtained in a variety of ways known to persons skilled in the art; but I have found the relays of the type and form shown in Fig. 2 to be convenient and suitable. The said relay is the same as that described in the aforesaid patent of Thompson and Robes. It has a single electromagnetic spool M and an iron core with overlapping polar extensions P P^2, between which the armature r is delicately suspended upon a fulcrum or arbor u, the said armature being Z-shaped and made slightly heavier at one end, o, to facilitate return to the resting position on the discontinuance of the operating current. The magnet-coil terminates in wires m for connection in the earth branch 5, and the local connections or normally separate bridge terminals a a^2 are represented by superposed but insulated springs z z^2, the former of which bears lightly upon a point q of the armature quite near to its center. The said springs z z^2 may be connected in the bridge 6 by conductors n.

Normally, as stated, the spring-contacts are separate from one another; but when the relay is excited by the passage through its coils of an appropriate current its armature swings into a position wherein its curved ends more nearly face the pole-pieces and in so doing slightly raises the spring z and establishes contact between the points a and a^2, thus closing the bridge. When such a relay as this is submitted to the action of an intermittent current, it will (even though a condenser be in series with it) under a wide range of the frequency of the intermissions attract its armature steadily to the position wherein the end o is elevated, and the points a a^2 are in contact and will maintain such position notwithstanding the recurrence of an intermission between each two current impulses. It is evident that this comes about by reason of the high electromagnetic and mechanical inertia of the device. The present invention is, however, not restricted to this or any other particular form of relay, and any relay capable of maintaining the steady and constant attraction of its armature during the passage of an intermittent current through its coils may be employed.

The bells B and B^4 at stations S and S^4, respectively, are constructed or adjusted to respond to intermittent currents of given or definite direction traversing the metallic circuit and their respective bridges, and in like manner the bells B^2 and B^3 will respond to similar currents of opposite direction or sign in the metallic circuit and their bridges. It will be seen that so far as the metallic circuit is concerned a current of positive direction or plus sign transmitted from the central station over main conductor 3 is the same thing as a like current of opposite direction or minus sign transmitted over conductor 2 to return by conductor 3. This is indicated in the drawings, where the similarly-adjusted bells B and B^4 of stations S and S^4 are respectively marked by the minus and plus signs and where also the bells at stations S^2 and S^3 are marked plus and minus, respectively.

The bells in a well-known manner may have the direction of current to which they are adapted to respond determined by springs b, giving a normal bias to their armatures, and in the drawings the direction of current to which each bell is designed to respond is indicated by the plus and minus signs, to which reference has been made. It will be seen that the biasing-springs b are arranged to press upon like ends of the bell-armatures at stations S S^4 and on the other end of the armatures at stations S^2 and S^3.

It is apparent that none of the bells can be actuated unless the earth-branch relay associated with it has first operated to complete or close the bridge wherein it is connected. It is also manifest that if the bridges 6 of stations S and S^2 be thus completed the bells B and B^2 may be operated selectively by sending an intermittent or pulsatory current of

minus sign for the operation of bell B or of plus sign to operate bell B^2, and in like manner that by closing the bridges 6 at stations S^3 and S^4, leaving those at stations S and S^2 open, the bells B^3 and B^4 can also be selectively rung according to the direction or sign of the ringing-current pulsations.

A ringing-current of either sign impressed directly upon the main conductor 2 and returning by way of main conductor 3 will operate the relays R and R^2 at stations S and S^2 and complete the bell-bridges at both, but will ring only that one of the two bells which is constructed or adjusted to the direction of the current, and in like manner a ringing-current of either sign transmitted over main conductor 3 to return by way of conductor 2 will operate the relays R^3 and R^4 and complete the bridges 6 at substations S^3 and S^4 and will ring the bell at one or the other of said stations, according to the direction of current transmitted; but the ringing-currents will not when transmitted over either conductor from the central station operate the relays in earth branches associated with the other or return main conductor, for the reasons that the ringing-current can only reach the relays of the said other conductor through the bell-bridges which have been established and that the act of transmitting the ringing-current over either main conductor also applies a dead ground or earth connection at the central station to the other main conductor, through which practically the whole of the current which otherwise might operate the relays in branches of said other conductor is shunted.

At the central station C any suitable means may be provided in association with the metallic circuit for transmitting an intermittent current of either polarity or direction over either main conductor at will. This is conveniently done by employing a generator G organized to deliver to the circuit-conductors pulsatory or intermittent currents of plus or minus sign, according as one or the other of the said conductors is brought into connection therewith. As is well known, such a generator may readily be constructed to deliver an impulse of either sign, as desired, during one-half of the revolution of its armature and when so employed to have the impulse of opposite sign and for the same revolution cut off. However, I am not in the practice of the invention restricted to the form or kind of generator indicated, it being obvious that a battery provided with any form of vibratory or periodic circuit-closer may readily, if desired, be substituted for a machine-generator.

With the said generator G, I associate four keys corresponding with the four sets of substation apparatus, respectively. K, K^2, K^3, and K^4 are the said keys and are all substantially alike in structure, though connected differently. Each, however, includes terminals v v^2 of the two main conductors, a terminal g of one pole of the generator G or j of the other pole of said generator, and an earth connection c. The line-terminal springs v v^2, representing, respectively, main conductors 2 and 3, are in resting contact with continuation contact-springs w and w^2, the said main conductors being thus continued, as shown, through all the keys. They may, however, be manipulated by the buttons F, and thus severed from said resting contacts and brought into operative contact with one or the other of the generator-leads or bus-conductors A and D and with the common ground connection V, respectively. Thus if the key K be operated springs v and v^2 are separated from the continuation-springs w and w^2, and consequently from the other keys, and establish connection with the grounding-spring c and the terminal spring g of the generator-main A, representing that pole of the generator which delivers impulses of minus sign, the other pole of said generator being grounded. Under these conditions main conductor 2 is brought into connection with the minus generator-pole and an intermittent current of minus sign is transmitted thereover, a resistanceless earth connection being simultaneously attached to main conductor 3. The relays R and R^2 at substations S and S^2 both respond and complete the bell-bridges 6 at said stations. The bell B at station S is operated and gives the call-signal; but the bell B^2 at station S^2 remains quiescent, being oppositely polarized or oppositely biased, and thereby made irresponsive to pulsations of minus sign and responsive to currents of plus sign. The bell-bridges at stations S^3 and S^4 remain incomplete, because any current which may possibly reach the main conductor 3, from which their relay connections are branched, is shunted directly to earth by way of said main conductor and the central-station earth connection c, applied thereto by the action of the key. In the same way the manipulation of the keys K^2, K^3, and K^4 effectuates the selective operation of the bells B^2, B^3, and B^4, pulsations of plus sign being transmitted by key K^2 over main conductor 2, while current impulses of minus and plus sign are transmitted over or impressed upon main conductor 3 by the keys K^3 and K^4, respectively, the earth connection c in each instance being at the same time temporarily applied to the other main conductor 2 or 3, as the case may be.

In my invention the bells and their circuits are freed from any direct connection with the earth at their respective substations, and, as experience has demonstrated, are thus no longer disturbed by the heavy currents which prior to the employment of said invention obtained access to the circuit containing the bell-magnets and interfered seriously with the successful operation of the bells.

When the receiving-telephone is off the

hook, as shown at substation S^4 in Fig. 1, it will be observed that there does occur a direct ground connection from one of the main conductors through the relay R^4, the same including the receiving-telephone *t*. I have ascertained, however, that the operation of the said receiver is not materially disturbed by noises accruing from the said earth connection and that any current reaching the receiver through the relay R^4 is so small as to be negligible. In locations or under conditions, however, where it may be desirable to avoid such a conductive earth connection entirely I employ a three-plate condenser k^2 and connect the same, as shown in Fig. 3, in the relay-branch circuit in such manner that a condenser is practically interposed between each main conductor and the earth connection of the relay branch, and consequently between the receiving-telephone and said earth connection.

It is apparent that it is not essential to my invention that there shall invariably be four substations connected with the metallic telephone-circuit and that the characteristic feature of the said invention—viz., the relay in an earth branch from one main conductor associated in a bridge controlled by said relay between the two main conductors—is also present when there may be but a single station or any number less than four connected with the said circuit.

Having thus fully described the said invention and its manner of operation, I claim—

1. A selective signaling apparatus for the substations of a polystation telephone-line or main circuit, comprising the conductors of said main circuit; a normally incomplete or open bridge between said main conductors; an earth branch from one of them; a polarized bell in said bridge constructed or adjusted to respond to current pulsations of definite sign only, when said bridge is closed; and a relay controlling the continuity of said bridge connected in said earth branch, and responsive by the steady and constant attraction of its armature to current pulsations in said earth branch and the main conductor to which the same is attached; substantially as set forth.

2. In a selective signaling apparatus for the substations of a polystation telephone-line circuit, the combination of the two main conductors of said circuit; a normally open or incomplete bridge between said conductors; and a polarized bell connected therein and adjusted or biased to be responsive to current pulsations of definite sign or direction; with an earth branch containing a condenser, extending from one of said main conductors; and a relay controlling said normally open bridge also included in said earth branch, and adapted to attract and maintain the attraction of its armature in response to the presence of current pulsations in said main conductor and earth branch; substantially as described.

3. The combination of a main metallic telephone-circuit extending between a central station and a plurality of substations; a normally discontinuous or open bridge between the conductors of said circuit at each of two of said substations; an electromagnetic bell in each bridge organized to be responsive to and actuated by intermittent or pulsatory currents, of plus and minus sign respectively; a branch to earth from one of the conductors of said main circuit at each of the said two substations, and a condenser included therein; and a relay or electromagnetic switch also contained in each of the said earth branches, and adapted to control the continuity of the associated normally open bridge; whereby either of the said two bells may be selectively operated from the central station; substantially as described.

4. The combination in a system of selective signaling, of a main metallic telephone-circuit extending between a central station and four substations; a branch including a condenser extending at each of two of said substations from one, and at each of the remaining two substations from the other of the main conductors of said main circuit, to earth; a slow-acting relay or electromagnetic switch in each of the said earth branches; a normally incomplete bridge between the two conductors of said main circuit at each substation, each such bridge having its continuity controlled by the associated earth-branch relay at the same station; and a polarized electromagnetic bell connected in said bridge at each station, and biased or adjusted to respond to intermittent or pulsatory currents of definite direction, the two bells associated through their relays with each main conductor being oppositely adjusted or polarized, and made thereby respectively responsive to currents of different or opposed direction traversing the said metallic circuit; substantially as described.

5. A system of selective signaling, comprising a main metallic telephone-circuit extending from a central station to four substations; an earth branch at each substation containing a switching-relay and a condenser, two of the said branches being associated with one, and two with the other of the main conductors of said metallic circuit; a normally open bridge between the said main conductors at each substation, each such bridge controlled by and adapted to be closed by the action of the associated switching-relay; a polarized bell for each substation connected in the said bridge thereof, each bell being biased or adjusted to respond to intermittent or pulsatory currents of definite direction, and each two bells whose relays are associated with the same main conductor being biased or adjusted oppositely, and thereby made respectively responsive to

current impulses of opposed direction alternatively transmitted over the said conductor; and means as indicated at the central station, for transmitting an intermittent current or series of current impulses of either direction over either main conductor, to operate the relays in the earth branches thereof, and the bell associated with one of said relays; substantially as described.

6. The combination in a selective signaling system, of a metallic or double-conductor main telephone-circuit extending between a central station and four substations; an earth branch of said circuit at each substation, two of the said branches being associated with one, and two with the other of the main conductors of said metallic circuit; a condenser, and a slow-acting switching-relay connected in each substation earth branch; a normally incomplete or discontinuous bridge between the said two main conductors at each substation controlled by the said switching-relay and adapted to be closed by the action thereof; a polarized bell connected in each such substation-bridge, two of said bells being biased or adjusted for responsiveness to intermittent or pulsatory currents of one direction, and the other two for like currents of opposite direction in said metallic circuit; and means as indicated at the central station for impressing upon either main conductor intermittent currents of either direction, and for simultaneously attaching a ground connection to the other main conductor; whereby the bridges controlled by both relays associated with either main conductor be completed, and the bell in a predetermined one of the said bridges may be operated; substantially as set forth.

7. The combination in a selective signaling system, of a metallic or double-conductor main telephone-circuit extending between a central station and four substations; an earth branch of said circuit at each substation, two of the said branches being associated with one, and two with the other of the main conductors of said circuit; a condenser, and a slow-acting switching-relay connected in each substation earth branch; a normally open or discontinuous bridge between the said two main conductors at each substation leading through the switch-contacts of the associated switching-relay at said substation, and thus having its continuity controlled by said relay; a polarized bell connected in each such substation-bridge, two of said bells being biased or adjusted for responsiveness to intermittent or pulsatory currents of one direction and the other two for like currents of opposite direction in said metallic circuit; a source of signaling-current at the central station having one pole grounded, and adapted to deliver intermittent currents of either direction to either of two terminal conductors; and a signaling-key at said central station for each substation-bell, adapted when operated to connect the appropriate main conductor with the appropriate terminal conductor of said source, and to connect the other main-circuit conductor directly to earth; whereby the bridge at the desired substation may be closed by intermittent currents of either direction traversing the appropriate main conductor and substation earth branch, and the bell contained in said bridge operated by like currents of appropriate direction traversing the metallic circuit closed through said bridge; substantially as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 23d day of April, 1903.

BURDETT STRYKER.

Witnesses:
EDUARD J. ANDERSON,
WALTER S. ANDERSON.