No. 824,206. PATENTED JUNE 26, 1906.

S. A. REED.

SELECTIVE SYSTEM.

APPLICATION FILED JAN. 23, 1905.

2 SHEETS—SHEET 1.

Fig. 2.

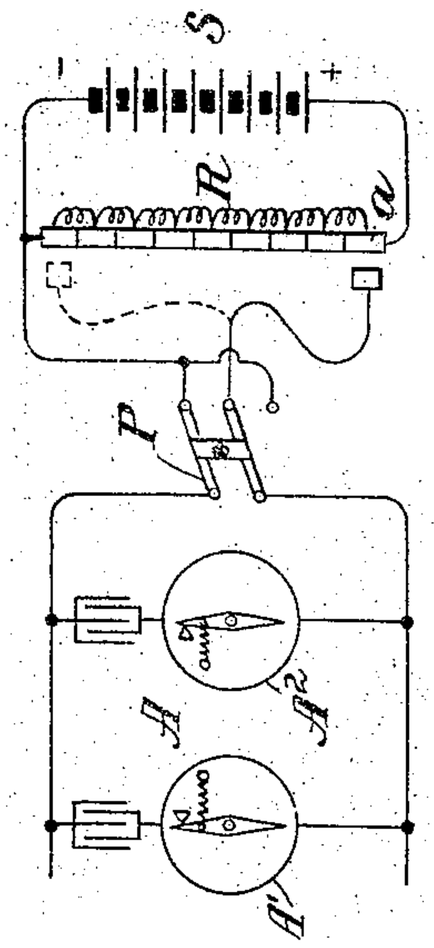


Fig. 4.

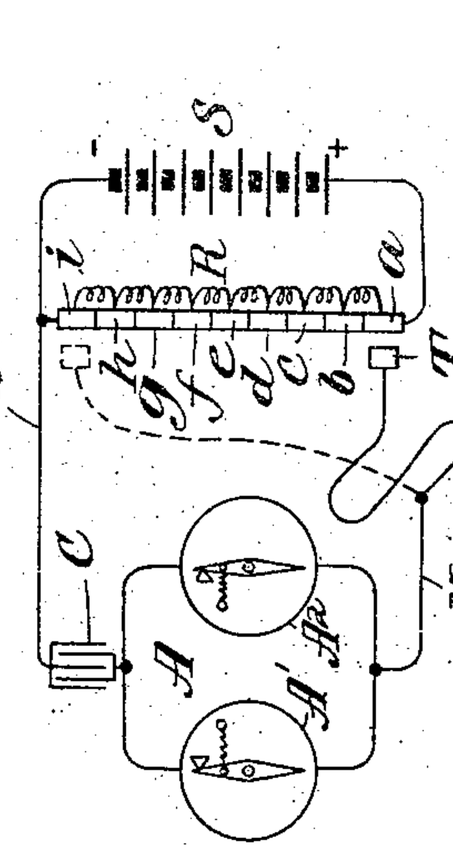
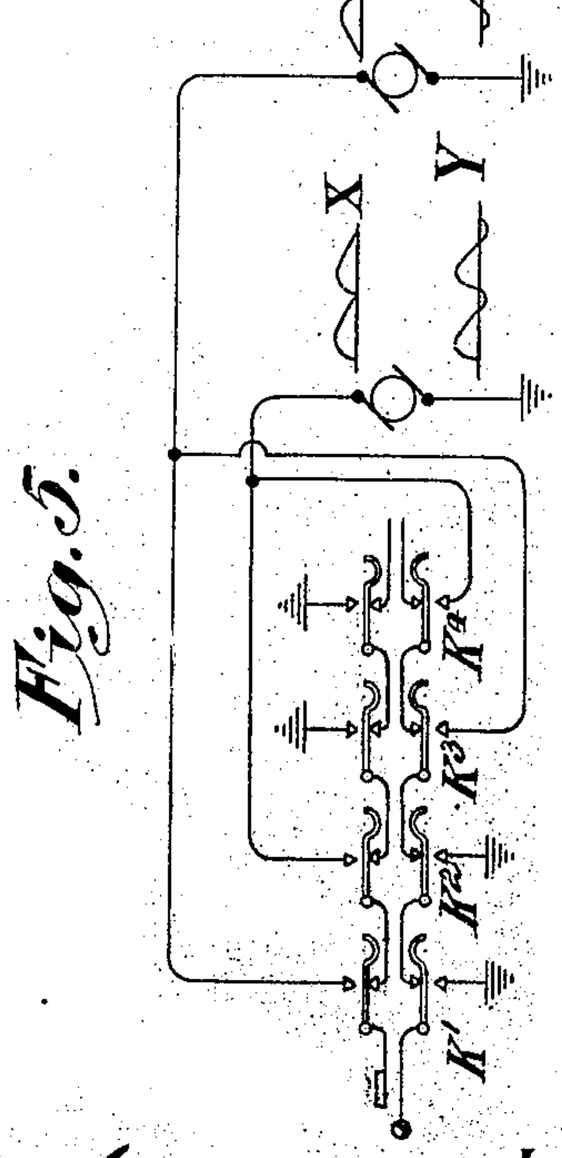


Fig. 3.



Attest:
Edgworth Greene
H. G. Underwood

Inventor:
Sylvanus A. Reed
by Peirce & Crump Attys

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2 SHEETS—SHEET 2.

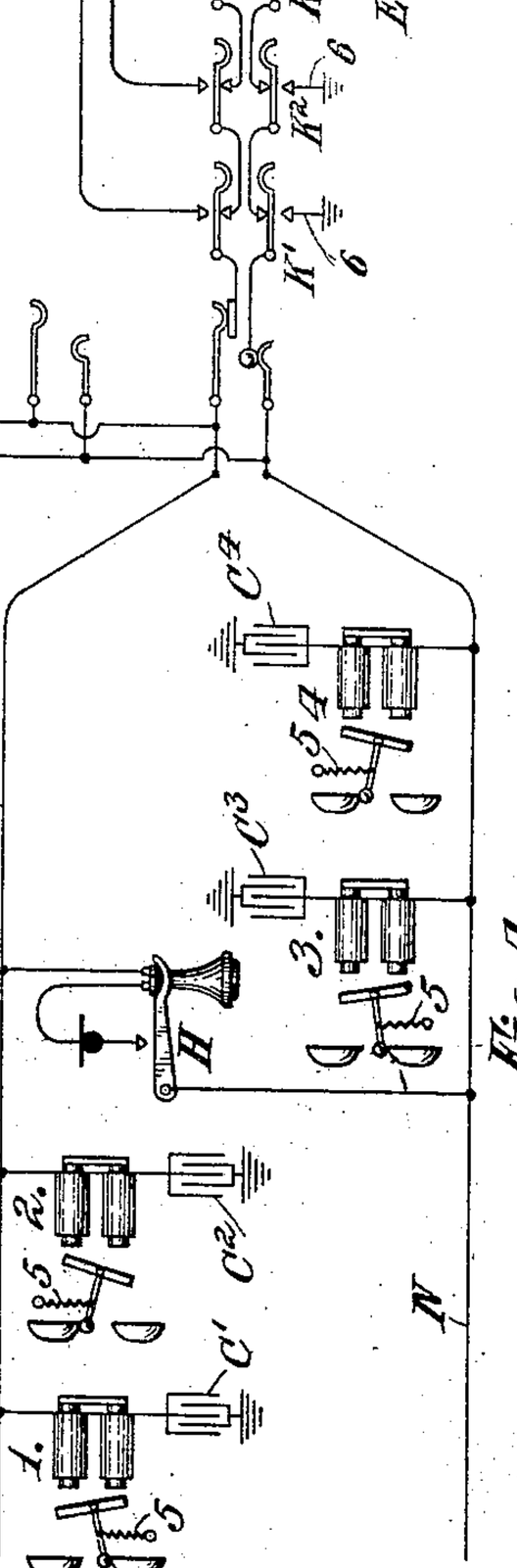

Fig. 3.

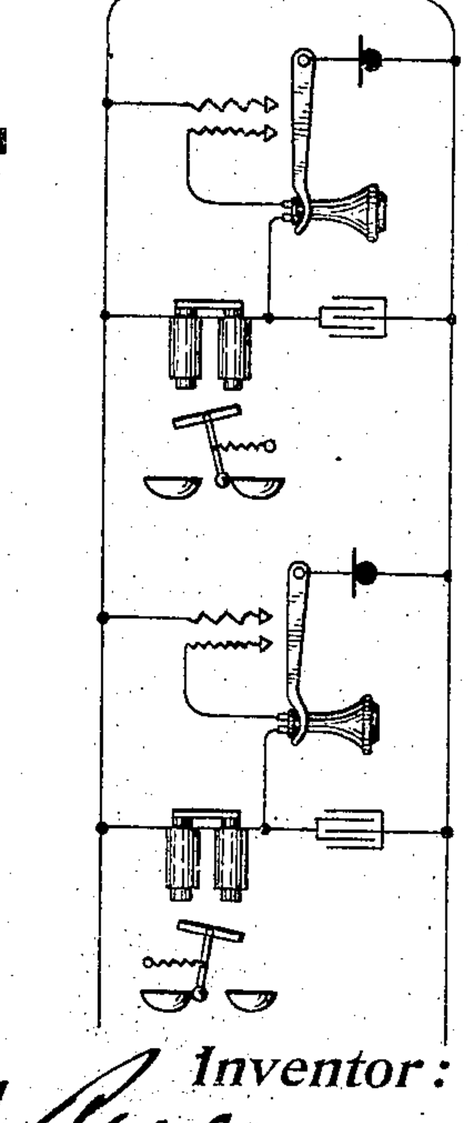

Fig. 4.

Fig. 6.

Attest:

Edgeworth Greene

H. G. Winslow

Inventor:

Sylvanus A. Reed

by Pettibone & Greene Attys.

UNITED STATES PATENT OFFICE.

SYLVANUS ALBERT REED, OF NEW YORK, N. Y.

SELECTIVE SYSTEM.

No. 824,206. Specification of Letters Patent. Patented June 26, 1906.

Application filed January 23, 1905. Serial No. 242,311.

To all whom it may concern:

Be it known that I, SYLVANUS ALBERT REED, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Selective Systems, of which the following is a full, clear, and true specification.

My invention relates to improvements in systems of electrical selective control capable of application with advantage to a variety of uses, and involves certain principles of operation which are specially applicable to selective telephone signaling on party-lines of the so-called "common-battery" type, wherein the line conductors are normally in open circuit, one of the primary objects of this invention being the production of selective signaling means for lines of this character, which will permit of the use of permanent ground branches from each conductor to contain the signal-receiving annunciators and is otherwise capable of application to open-circuit lines.

The principle of the invention and several modes of applying the same are hereinafter fully disclosed, and more particularly pointed out in the accompanying claims.

Referring to the accompanying drawings, Figures 1 and 2 are diagrammatic representations of the principle of my invention applied to simple selective use. Fig. 3 is an application of the same to an ordinary common-battery party-line. Fig. 4 is a modification in the means of potential control. Fig. 5 is a further modification; Fig. 6 a further application of the invention.

Referring to Fig. 1, the reference character A represents signal-receiving annunciator mechanism in diagram, the elements A′ A^2 whereof are of similar construction, but arranged to be operated, respectively, by currents of opposite polarity, this effect being produced by appropriately stopping the movable indices thereof, as shown, so that the one, A′, is free to swing to the left, and the other, A^2, to the right. The said indices are also held against their back-stops by a yielding force of definite tension, such as a small coil-spring which is applied to the indices so as to oppose their operation except by a sufficiently-strong current of the proper polarity. The annunciator mechanism is connected between the conductors G and M in series relation with a translating device or condenser C, which interrupts the conductive continuity of the circuit, and the two conductors lead, respectively, to one pole of the source of current S and to a movable contact T, which is adapted to have sliding successive contact with the series of contact-plates *a b c*, &c., of a rheostat R, connected with the poles of the said source. The rheostat, sliding contact, and the source constitute a means for impressing current upon the circuit which will bring about in the annunciator mechanism A an alternating current the composing opposite currents of which are relatively differentiated to be either superior or inferior in motor effect to the tension of the above-mentioned yielding force, and the said means is capable of manipulation so that either the plus or the minus currents will be superior, thereby enabling a selection to be made between the two elements A′ and A^2, which, as above explained, are respectively arranged to respond to currents of opposite direction. This manipulation may be explained as follows: If the contact T be first placed upon the rheostat R at the plate *a*, the condenser C becomes charged at a difference of potential substantially equal to the difference between the opposite ends of the rheostat, and the momentary rush of current which ensues through the annunciator mechanism A will have a definite polarity and a sufficient strength to overcome the bias tension of whichever index is arranged to respond to that polarity—say, for example, A′. If the contact just made should be broken and provided the line M has some capacity, it is obvious that a current of reverse polarity would ensue in the annunciator mechanism, which might actuate the index of the other element A^2, and even if the line has but a slight capacity it is plain that before we can repeat the operation of A′ to make an indefinite succession of strokes we must first wholly or partly discharge the condenser. If this is done by applying T directly to *i*, the reverse current ensuing at discharge would actuate A^2; but if, on the other hand, the contact T be slid along the rheostat successively over the plates *b c d*, &c., toward the opposite pole of the battery to the last plate *i* the charge on the condenser-surfaces will become gradually released—that is to say, the previously-existing difference of potential will be removed or approximately equalized at a rate more gradual than its establishment and the reverse current which ensues will be of weak strength compared to the other and incapa-

ble of operating the index of A^2 against its bias tension. Thus by repeatedly stroking the rheostat upwardly in a similar manner the index of element A′ may be repeatedly actuated to the exclusion of the index of element A^2. Reversal of the direction of relative movement between the contact and rheostat will in like manner effect the operation of A^2 to the exclusion of A′, because such reversal results in a gradual establishment of the previous difference of potential between the opposed condenser-surfaces and an abrupt release, and the current corresponding with the establishment is insufficient to overcome the tension of the spring of element A′, while the abrupt release effects an operative reverse current for A^2. The distinction between an abrupt and a gradual change in the difference of potential between the opposed condenser-surfaces is that the latter is such a change as does not result in a cumulative force overcoming the resistance of the moving element of the annunciator—*i. e.*, its bias tension, inertia, and friction—while the abrupt change does result in a cumulative force which does overcome the said resistance. Instead of selecting A′ or A^2 by reversing the direction of relative movement between the contact and rheostat the same result may be secured by reversing the connections of line conductors G and M therewith or the polarity of the battery and continuing to stroke the rheostat in the same direction.

In Fig. 2 an arrangement of circuit is shown in which the conductors G and M are provided with a pole-changer P for this purpose. The elements A′ and A^2, which are here shown in series with separate condensers, are both capable of selective operation by a gradual establishment and abrupt removal of the difference of potential in the condensers, or vice versa, the difference in direction of the operating-current for each annunciator element being effected by the inversion of the connections. While this method of control is in some respects more simple than the method by reversal of the direction of relative movement, for the purposes of illustration herein I shall proceed to describe the latter method as applied to practical use, it being understood, of course, that in so far as the selective effect in the circuit is concerned the two methods are the same, and in Fig. 3 the first-described method of control is exemplified in a practical four-party telephone-line of the so-called "common-battery" or "open-circuit type." Referring to this figure, M and N are the ordinary line conductors, having the several usual subscribers' apparatus contained in normally open bridges between them, as shown at H. From each line conductor a pair of branches is legged to ground, the legs of each pair containing polarized oppositely-biased electric annunciators or telephone-ringers 1, 2, 3, or 4 in series, respectively, with condensers C′, C^2, C^3, or C^4, the tension of the bias springs 5 being set to resist the inferior currents of the alternating current which will traverse them. The line conductors terminate at the operating-station in the usual line-jacks, which may be connected in the ordinary manner with switching mechanism comprising a suitable number of keys for connecting either line conductor to the selective ringing apparatus to effect the selection.

The means for impressing appropriate current upon the line is shown herein as comprising a pair of rheostats R′ and R^2, each similar to that shown in the preceding figures, except that they are made in ring form to permit of relative rotation between them and their coöperating contact-brushes B′ and B^2, thereby mechanically producing a similar effect to the stroking of the rheostat above explained. The rheostats are stationary and connected in opposite sense between the two poles of a source S′ of direct current, so that the internal brushes B′ and B^2 may both rotate in the same direction within them, and yet produce with one rheostat the effect of a gradual establishment of the required difference of potential and with the other a gradual release of the same. One pole of the source—for example, the negative pole—is grounded. The brush B′ is connected by wire E to the keys K^2 and K^4, by means of which it may be connected to either line conductor M or N, and the brush B^2 is similarly joined by wire E^2 to the keys K′ and K^3 for a like connection. The arrangement of the rheostats as above described permits of their being arranged compactly side by side and the rotary brushes disposed upon the same interior shaft, which latter may be driven at a substantially constant speed by a motor or otherwise. The speed of the shaft which controls the rate of establishment or disestablishment of the difference of potential between the opposed condenser-surfaces is determined principally in relation to the tension of the bias springs of the annunciators, provided the inductance in the circuit is low, it being necessary that the rate of change be less than that which will produce an operative current; but this is not a delicate matter, and the brushes may rotate at a rate of speed high enough to produce a rapid oscillation of the selected bell-hammer without producing by a good margin an inferior current capable of actuating a non-selected ringer. In cases where the circuit contains considerable inductance it is found in practice that very rapid changing of the impressed current is apt to distort the wave characteristic to such an extent as to call for a compensating adjustment of some kind for preserving in the condensers the above-described effect of a gradual charging and abrupt discharging, or vice versa. It will of course be understood

that the annunciators 1, 2, 3, and 4 are each presumed to be located at one of the several substations of the line and that each such substation is provided with the usual talking-bridge and other telephone appurtenances, which it is not necessary to show or describe, the present drawings being essentially diagrammatic. The central office is supplied with the usual means for interconnecting subscribers' lines, &c., which also are not here shown, but may be applied to the diagrams in obvious manner.

In operation and assuming the line to be in its normal open circuit or unused condition and the rotary brushes constantly driven either one of the annunciators 1, 2, 3, or 4 may be selected and rung by the operating of the corresponding key K′, K², K³, or K⁴. Thus by the pressure of key K′ the line M is connected by the wire E² to the rotating brush B², which travels in the direction of the arrow from the positive end of the rheostat over the successive rheostat contact-plates to the negative end and from thence abruptly to the positive again. Since one pole of the source of current S′, as well as the annunciator branches of the line, are all grounded, it will be recognized that depression of key K′ has brought about the same circuit relations as are exhibited in Fig. 1, and the transit of the rotary brush B² abruptly from the negative to the positive contact-plate and around through the resistance to the negative plate again corresponds to the stroking of the rheostat of Fig. 1 in an upward direction, with the result that annunciator 1 is repeatedly operated by the abrupt establishment of gradually-removed differences of potential, annunciator 2 remaining unoperated, because it is oppositely biased to respond to superior currents of an opposite direction. Annunciators 3 and 4 being connected in a practically isolated line are not affected. When key K² is depressed, the line conductor M is joined by wire E to the rotary brush B′, and the effect is otherwise similar to that just described, save for the fact that this brush travels from the positive end of the rheostat abruptly to the negative end and then around through the resistance back to the positive end—that is to say, the difference of potential in the condensers on line M is now gradually established and abruptly removed, corresponding to a stroking of the rheotstat of Fig. 1 in a downward direction. The same operation may obviously be carried on with the line N by keys K³ and K⁴.

In order to provide against the contingency of one of the subscribers of the line removing his receiver from the hook during the ringing of one of the lines and the consequent confusion which would be caused by the interconnection of the two line conductors, a short-circuit branch 6 is provided to the ground, to be controlled by each of the keys K′, &c., so that when any key—for example, K′—is operated to connect the line M with the operating apparatus it at the same time connects the other line N directly to the ground, thereby short-circuiting the ringing impulses which might otherwise cross the subscriber's closed talking-bridge and enter the annunciators 3 and 4.

The rheostat shown herein as comprised of a series of insulated contact-plates successively connected by resistance-coils is so constructed that the jump in resistance from one plate to another is so slight that although more or less sudden in occurrence the change of potential difference which it effects in the translating devices is ineffectual. The contact-brushes should be of ample contacting area to bridge the insulation between the plates, so that at no time in its transit will the condenser-circuit be broken until the end of the rheostat is reached, at which point the insulation may be extra wide for purposely producing a break. Instead of the structural wire resistance-rheostat indicated the same can obviously be supplanted by a homogeneous strip of some difficultly-conducting material and the contact, which could then be of any area, could travel upon it. In this case it is obvious that the establishment and disestablishment of the condenser charges would be still more gradual than in the form shown. Furthermore and inasmuch as the opposed condenser-surfaces in the circuits shown require only to be connected, respectively, with variable points at a potential gradient, it is possible to utilize the internal potential gradient of a battery of connected cells, and thereby obviate the use of the rheostat. In Fig. 4 the outline of this arrangement is indicated, in which the source S² has one terminal connected with the conductor G and the double contact T′ is adapted to engage successively with contacts connected with the successive elements of the battery. In this case the contact T′ is double and its two insulated components are mutually connected through appropriate resistance, so as to prevent the short-circuiting of adjacent cells as the contact passes over them. Obviously this form of control can be adapted to circular arrangement, as in Fig. 3, so that the contact T′ may become a rotary double-contact brush.

As a further modification and simplification of the means for impressing appropriate current upon the line a driven current generator or generators may be employed instead of the batteries and sliding contacts. Such generator, however, must be properly constructed or adjusted with respect to the conditions present in the line to produce the effect, above fully described, of an abrupt establishment and gradual removal of the condenser charges, or vice versa, and either one generator may be employed with means for

reversing its connection with the line, as already explained, or two generators driven in opposite senses may be employed without the means for such reversal. The latter arrangement in its application to a four-party line is outlined in Fig. 5, wherein one generator is adjusted to effect an abrupt establishment and gradual removal of the condenser charges, and the other the reverse, with appropriate connections, as in Fig. 3, for connecting either generator to either line conductor. The wave form of the current impressed upon the circuit by these generators under simple line conditions will be about as shown by X X′ in Fig. 5, or it may be an alternating current similar to that indicated by Y Y′ in the same figure; but in case of great inductance in the line or of high frequency of the impressed current, or both, it will necessarily assume a quite different form, as already suggested, which may not be as symmetric as shown in Fig. 5.

A further application of the invention is shown in Fig. 6, wherein the annunciators are bridged in series with condensers between the line conductors and are capable of selection in the same manner as was described with reference to Fig. 1, the connections being clearly indicated in the drawings. With this arrangement a two-party selective line is produced wherein the line conductors are conductively isolated from each other, and either of the polarized oppositely-biased annunciators in the bridges may be operated with the same apparent effect as though operated by a pulsating current in a conductively-continuous line.

The invention is capable of various other modifications to adapt it to familiar telephone construction; but inasmuch as features of the proportions and adjustments of the various parts to produce the most efficient results are matters depending entirely on the conditions to be found in the particular system to which they are applied the same must be left to the judgment and skill of the practical electrician.

Having described my invention, what I claim, and desire to secure by United States Letters Patent, is—

1. A signaling system, comprising a circuit and two oppositely-biased electromagnetic annunciators connected in multiple relation therein and each in series with a condenser, in combination with a means of impressing current upon said circuit to charge and discharge the condenser-surfaces abruptly and gradually, the current in the annunciators due to the abrupt charging or discharging being effectual to overcome the bias tension thereof and that due to the gradual charging or discharging being ineffectual for that purpose, and means for reversing the direction through the annunciators of the current due to the abrupt charging or discharging.

2. In a selective system, a circuit including two oppositely-biased electromagnets and a translating device interrupting the conductive continuity of said circuit, in combination with means for selectively impressing current on the circuit through said translating device to produce in the electromagnets an alternating current whereof the currents of opposite polarity are relatively differentiated in motor effect, and means for selectively causing the current of one polarity to be superior and the other to be inferior to the bias tension of any electromagnet.

3. In a selective system, a circuit including signal-receiving annunciator mechanism arranged to be selectively operated by currents of relatively opposite direction and provided with yielding means opposing such operation, and a condenser or condensers in series with said mechanism, in combination with means for charging and discharging the condensers to produce in said mechanism relatively differentiated currents of alternately-opposite direction and means for selectively causing the current of one direction to be superior and the other to be inferior, in motor effect, to the tension of said yielding means.

4. In a selective system, a circuit including two polarized electromagnets, oppositely biased with respect to current of one direction, condensers in series relation therewith and means for impressing current upon said circuit adapted to change the difference of potential between opposed condenser-surfaces at a rate of change predetermined to correspond to a strength of current in said electromagnets which is ineffectual to overcome the tensions of their respective biases.

5. In a selective system, a circuit including two polarized electromagnetic annunciators oppositely biased with respect to current of one direction, condensers in series relation therewith and means for impressing current upon the circuit adapted and controlled to change the difference of potential between opposed condenser-surfaces at rates of change predetermined to correspond to a strength of current in said annunciators which is alternately effectual and ineffectual to overcome the bias tensions thereof.

6. A selective system comprising a source of current, signal-receiving annunciator mechanism arranged to be selectively operated by currents of opposite direction and provided with yielding means opposing such operation and condenser-surfaces in series relation with said mechanism, in combination with switching mechanism controlling the current from said source to produce a charge of definite polarity upon either of the opposed condenser-surfaces and means for establishing or releasing such charge at a rate that will correspond to current in the said mechanism of insufficient strength to overcome the tension of the said yielding means.

7. In a selective telephone signaling system, two oppositely-biased polarized telephone-ringers and a source of current with connections for operating the same, comprising a translating device in series with each ringer adapted for translating the current energy of the said source into alternating currents for said ringers, in combination with means controlling the current energy supplied to said devices for causing either the plus or minus currents effected thereby to be inferior in strength to the bias tensions of said ringers.

8. A selective telephone signaling system, comprising a line conductor, a pair of oppositely-biased telephone-annunciators in multiple branches therefrom to another conductor or ground, condensers in said branches in series with the annunciators and means for impressing current upon the circuit adapted to change the difference of potential between the opposed condenser-surfaces at a rate of change predetermined to correspond to a strength of current in said annunciators which is alternately effectual and ineffectual to overcome the bias tension of either of them.

9. A selective telephone signaling system comprising two line conductors with open-circuit subscribers' apparatus bridged thereacross, a pair of polarized oppositely-biased annunciators legged from each conductor to a common conductor or ground, condensers in said legs in series with the annunciators, and a source of current, in combination with means for establishing or removing a difference of potential between the opposed condenser surfaces of either line conductor at such rate as will correspond to a strength of current in the annunciators insufficient to overcome the tension of their respective biases.

10. A selective system comprising a source of current and a rheostat connected between the poles thereof, annunciator mechanism arranged to be operated by currents of either polarity and provided with yielding means opposing such operation, condenser-surfaces in series relation to said mechanism and adapted to be connected in multiple relation to said rheostat, in combination with means for relatively shifting the point of communication between one of the opposed condenser-surfaces and said rheostat to control the rate of change of the difference of potential between the said opposed condenser-surfaces.

11. A selective system comprising a source of current and a rheostat of ring form connected between the poles thereof, two polarized and oppositely-biased annunciators provided with condensers in series therewith, in combination with connections between the opposed condenser-surfaces respectively to one pole of the source of current and to a contact engaging said rheostat, the said contact and rheostat being adapted for relative rotation whereby a difference of potential between the condenser-surfaces may be abruptly established and gradually removed or vice versa.

12. In a selective system, a ring-form rheostat and relatively rotary contact-brush engaging the successive contacts thereof and passing abruptly from one end of the same to the other, a source of current with its opposite poles connected respectively to the opposite ends of said rheostat, and two polarized oppositely-biased annunciators in series with condensers connected with said rheostat and brush and capable of selective operation by the impulses produced thereby.

13. In a selective system, a pair of oppositely-biased polarized annunciators, and condensers in series relation therewith, in combination with means to operate said annunciators involving a potential gradient with contacts in connection with successive points thereon, and suitable connections between the above-mentioned parts whereby the plus or minus currents from said condensers may be respectively caused to be inferior to the bias tensions of said annunciators.

14. The method of selectively operating either of two oppositely-biased ringers in a condenser broken circuit, which consists in impressing current on said circuit to change the potential difference in the condensers thereof at a rate of change appropriate to produce a cumulative current of sufficient motor effect in said ringers to overcome their bias tension, and at a rate of change corresponding to a current of opposite direction therein insufficient to overcome such tension, alternately, and controlling said impressed current to cause the currents of either direction in said ringers to be superior in motor effect to the bias tension thereof.

In testimony whereof I have signed my name to the specification in the presence of two subscribing witnesses.

SYLVANUS ALBERT REED.

Witnesses:

H. G. KIMBALL,

G. A. TAYLOR.