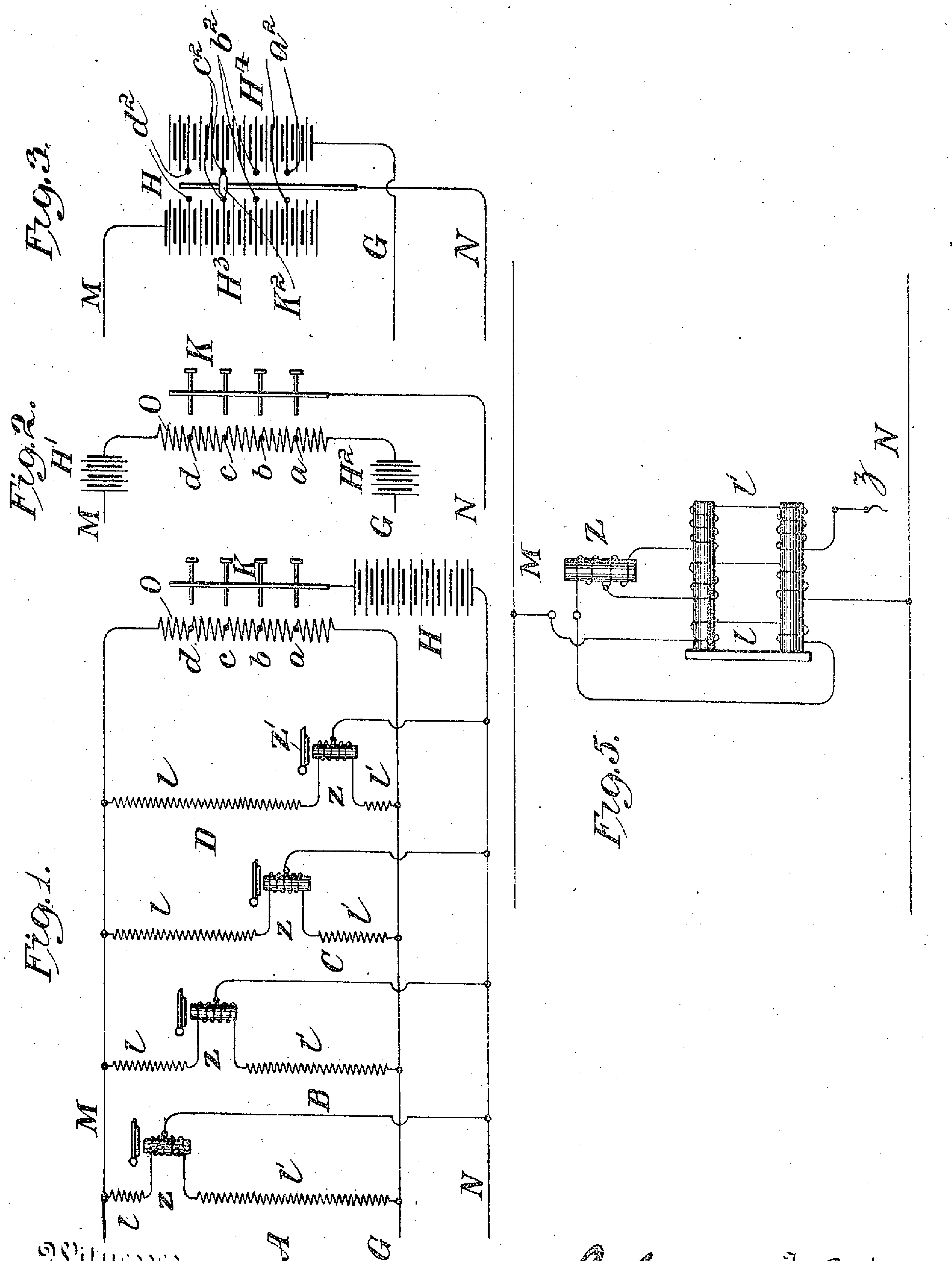
No. 829,429. PATENTED AUG. 28, 1906.

S. A. REED.

SELECTIVE SYSTEM.

APPLICATION FILED MAR. 13, 1903.

2 SHEETS—SHEET 1.



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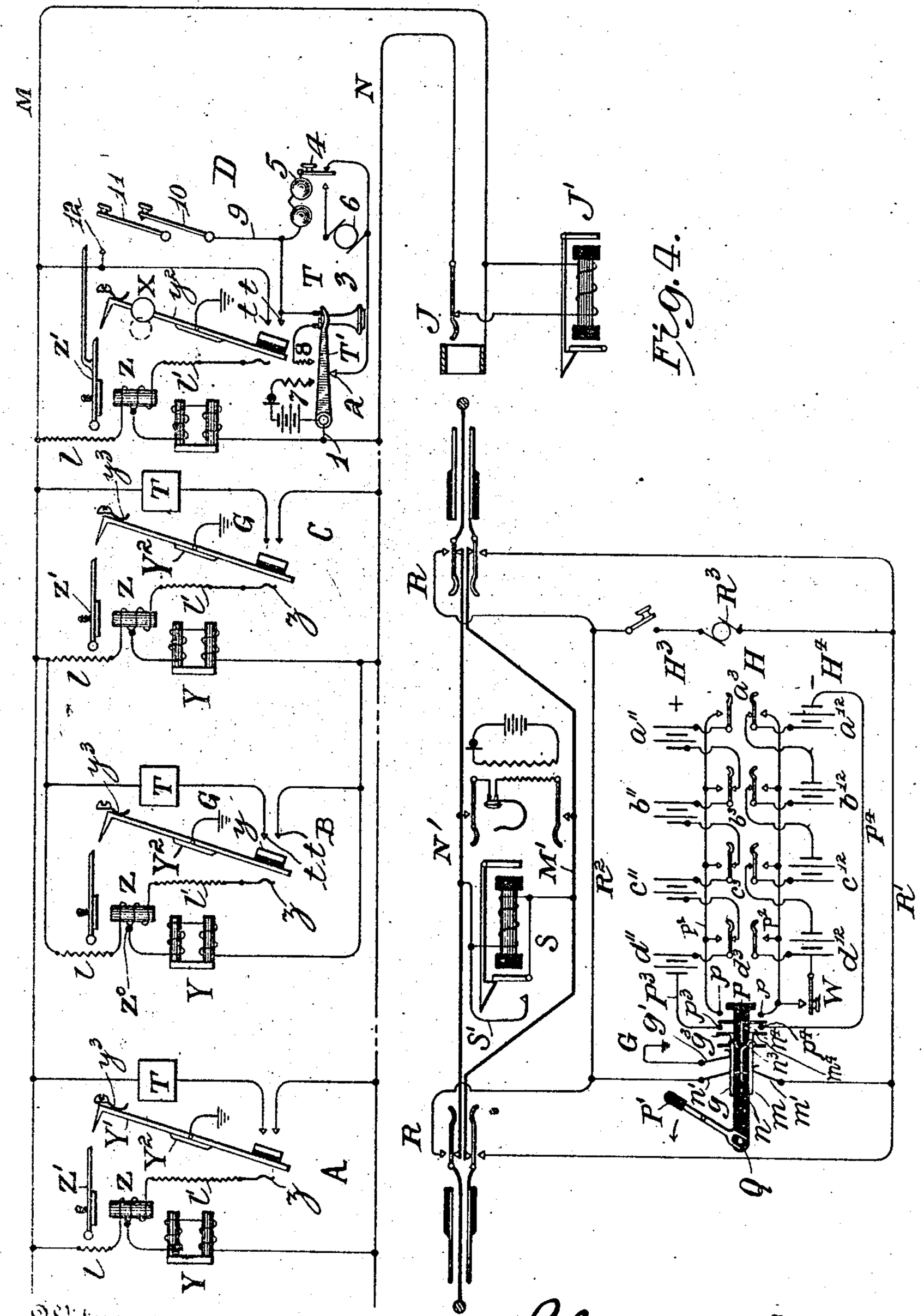

Fig. 4.

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UNITED STATES PATENT OFFICE.

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SELECTIVE SYSTEM.

No. 829,429. Specification of Letters Patent. Patented Aug. 28, 1906.

Application filed March 13, 1903. Serial No. 147,689.

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 specification.

My invention relates to selective systems in which the selection of a particular station or apparatus out of several in the same circuit is determined by the non-actuation of one of several electrically-operated devices associated therewith, and it also concerns various other features and combinations of features hereinafter explained in the specification and pointed out in the appended claims.

Referring to the accompanying drawings, which form a part of this specification, Figure 1 is a diagram of a simple form of circuit involving the selective feature of the present system and illustrating the principle thereof. Fig. 2 shows diagrammatically an alternative form of central switching apparatus for controlling the selection of stations, as hereinafter explained. Fig. 3 is a further modification or development of the selection-controlling apparatus. Fig. 4 illustrates the selective system adapted to a telephone party-line of the bridged magneto type, together with an indication of the usual central-office apparatus and the selection-controlling means connected therewith. Fig. 5 is a modification wherein necessary artificial resistance is made to serve a further useful purpose in the actuation of parts of the apparatus.

In Fig. 1, M and G are conductors joined at one end by a resistance O, upon which at predetermined points along its length are contact-points *a*, *b*, *c*, and *d*. Differential electromagnets or selectors Z are connected, as shown in the figure, between the conductors M and G, and the differential points of said electromagnets are connected with a common or return conductor N, which in this figure leads to one pole of the source of current H, the other pole of which is provided with switching means K for making variable connection with any one of the points *a*, *b*, *c*, or *d*, as desired.

The differential magnets or selectors Z are located in predetermined positions with respect to their resistances from the conductors M and G, so that each is connected with the conductors M and G on either side by proportionally different resistances. Thus the resistance *l* on one side bears a different ratio to the resistance *l'* on the other side for each selector Z.

When contact is made at K with any one of the contact-points *a*, *b*, *c*, or *d*, current from the source H divides at that point into parts of values inversely proportional to the resistances on either side, and the divided currents pass in parallel along the courses M and G into each of the selectors Z and from thence to the common conductor N back to the source of current. The opposing currents which enter the selectors vary in relative values at each selector according to the resistance *l* and *l'* on each side, and their original values may be determined by the variable connection of K with O; but it is obvious that for each pair of resistances *l* and *l'* a point on O can be found at which the current will divide and produce equality of magnetic effect at one selector and an unbalanced effect at all others. The selector Z, which corresponds with the point of the resistance connected with K, will therefore be non-actuated, and if an armature is ordinarily operated by it it will remain in its normal position, while all other selector-armatures will be actuated by the preponderance of current in one of their coils.

The selectors Z may be differential electrochemical indicators or electrically-operated devices of any appropriate type, and the resistances *l* and *l'* may, if preferable, be combined with or wholly constitute the differential windings. In the drawings, however, I have shown said windings as equal and opposite coils connected, respectively, with M and G and with the common return-conductor N, and in Fig. 5 I have indicated a different method of utilizing the resistances *l* and *l'*. It is manifest that I am not limited in the number of selectors which may be connected with the conductors M and G and that an indefinite number of points, such as *a b c*, &c., can be found on the resistance O, such that contact of K with one of them will cause the neutrality of one of said selectors and the simultaneous activity of all of the others.

In the modification shown in Fig. 2 the conductors M and G are respectively connected with like poles of sections H' and H²

of the source of current, and the other poles are connected by the resistance O, upon which the predetermined contact-points *a b c*, &c., may be located, as before. The variable connecting means K is connected directly with the conductor N.

Contact of K with a point, such as *b*, for example, causes current from the sections H′ and H² to travel along the paths or courses M and G in parallel, as before, said currents meeting in the selectors from opposite directions, but with equal effect only at the selector at B and returning through the conductor N, and the proportional parts of the resistance O above and below point *b*, respectively, to their sections of the source of current.

In Fig. 3 I have illustrated an arrangement of selection-controlling means which is adapted for use with the selective systems shown in Fig. 1 and which I prefer, because it obviates the necessity of artificial resistance, such as O. (Indicated in that figure and also in Fig. 2.) Like poles of sections H³ and H⁴ of the source of current H are connected, respectively, with the conductors M and G, and the conductor N is provided with a sliding or other shiftable contact K², whereby it may be connected with predetermined pairs of contact-points a^2, b^2, c^2, or d^2, as shown in the drawings. The pairs of contacts just referred to are so arranged that when N is connected by means of K² with one of them complementary amounts of the sections H³ and H⁴ are connected with the circuit, the remaining parts being temporarily unused. Current from the section H³ above the contact K² traverses the conductor M, and current from the section H⁴ below the contact K² traverses the conductor G, meeting the current, as before, at the differential points of the selectors, whence both currents pass through the conductor N to their respective sections of the source.

The shifting or sliding contact K² is a simple means for determining the amount of each section of battery, which is connected to the conductors M and G, respectively, and these amounts are predetermined for each pair of contacts so that the relative currents in M and G will balance in one of the selectors and produce selective non-actuation, as described in connection with the foregoing figures.

Fig. 4 represents the above-described system of selective control applied to a polystation line in which M and N are line conductors terminating in line-jack J and line-signal J′ at the central station. At each of the substations A, B, C, and D a subscriber's telephone apparatus T is disposed in normally open bridge connection with the conductors M and N. The selectors Z are differential electromagnets connected on one side with the conductor M through a resistance *l* and on the other side with the contact-point *z* through resistance *l′*, the resistances *l* and *l′* bearing a different ratio to each other at each station. The differential points Z⁰ of said electromagnets are connected through polarized relays Y with the conductor N, which is thus the common return-conductor for the selectors Z as well as one side of the telephone-line proper.

The armatures Y² of the relays Y may be constructed and arranged in any suitable manner—as, for example, as shown in my prior patent, No. 688,118, December 3, 1901. They are polarized and have a normal bias due to their polarization toward the nearest pole of the relay, which bias causes them to persist in the last position in which the current has placed them; but this bias may of course be secured by mechanical means, if desired. The armatures Y² are adapted to connect the contact-points *z* with the ground when moved in one direction and to close the gap across contacts *t t* of the normally open telephone-bridge when moved in the other direction, an insulated contact-plate *y* being provided on the front face of the armature for this purpose, as shown in the drawings. As the armature moves in the direction to engage contact-point *z* an extension y^2 encounters the spring or yielding stop y^3, which has sufficient strength only to resist the force of the bias of the armature and hold it out of contact with *z* when it is not positively moved into contact with it by the proper energization of Y.

The selectors Z are also provided with armatures Z′, normally held in an undeflected position by means of springs or gravity and so disposed with respect to the relays that when deflected they obstruct the paths of the extensions y^2 and block their movement to close the telephone-bridges. The blocking of the extensions, however, takes place after they have passed the middle points of their strokes, so that their normal bias will hold them interlocked with the extensions y^2 until the latter are returned to their original positions by means of the relays Y. It will be observed that the extensions y^2 are provided with pointed projections or spurs at their extremities, extending to a position just in front of the ends of the deflecting members Z′ when the relay-armatures are in their normal or intermediate position, the purpose of this arrangement being to bring the relay-armature virtually as close as possible to the blocking member and still to permit it to move beyond its middle point when Z′ has been deflected.

At the station D, I have shown the telephone apparatus T in detail for the purpose of more clearly illustrating the operation of the system, which will be hereinafter described; but it is of course to be understood that the subscriber's telephone apparatus

may be connected with the system in various different ways which will be obvious to those skilled in the art.

When the switch-hook T′ is depressed by the weight of the receiver thereon and the relay-armature Y^2 has connected the contacts *t t*, current from the line conductor N may pass through conductor 1, switch-hook T, lower contact-point 2, conductor 3, switch 4, ringer 5, contact-points *t t* to the conductor M. The subscriber's magneto-generator 6 is adapted to be inserted in the circuit by means of the switch-key 4, or of course an automatic switch-generator may be used without the switch 4. When the receiver-hook is raised, the local transmitter-circuit 7 is closed, and the current from the secondary 8 of the transformer may find its way to the line N through conductor 1 on one side and through the receiver and contact-points *t t* on the other to line M.

Another means of connecting the telephone apparatus with the line conductors M and N is provided, by which the subscribers may connect with the line to initiate a call at any time when the line is not busy, as will be later described. This connection is effected by means of the conductor 9, leading to a key 10 of conducting material, which is adapted to engage a key or bolt 11, which in turn may engage a contact-point 12, connected with line conductor M. The armature Z′ is adapted to block the circuit-closing movement of the bolt 11 in the same manner as it does the relay-armatures Y^2, so that when an armature Z′ is deflected neither the armature Y^2 nor the bolt 11 can be operated to connect the telephone with the line. For the purpose of simplification in the drawings I have indicated the bolt 11 as blocked by an extension of the selector-armature; but in actual practice the selective apparatus is inclosed in a casing and the armature Y^2 and the bolt 11 are compactly disposed side by side, engaging the single end of the armature Z′.

If desired, a target X may be secured to one of the moving parts—such, for example, as y^2—to be visible through a window in the casing when the armature is in its blocked position, such condition indicating to the subscriber that the line is busy.

The central office comprises the usual plug and cord circuit, together with an operator's listening-in set, a disconnected signal S, bridged across the strands M′ and N′, and the usual switch-keys, which need not be here described. It is also provided with a selection-controlling apparatus capable of being applied to the line to supply opposing currents in predetermined proportions to the conductors M and the ground G in the manner described in connection with Fig. 3, said opposing currents returning through the common return-conductor N.

Upon the operation of the key R, while the plug is inserted in the jack J, the leads R′ and R^2 are connected, respectively, with the conductors M and N, and the selection-controlling apparatus associated with said leads is in condition for operation.

Instead of a sliding contact, as shown in Fig. 3, this switching apparatus is provided for convenience and accuracy in manipulation with a series of switch-keys a^3, b^3, c^3 and d^3, such as are common in telephone construction, one for each station on the party-line. The source of current (represented generally by H) is divided into sections H^3 and H^4, conveniently shown on either side of the row of switch-keys. The positive poles of predetermined elements or groups of elements of each section of the source of current H are connected with the movable spring members of the switch-keys, and the negative poles of the intermediate elements of section H^3 are connected with the inside fixed contact-points of the switch-keys on one side, as shown in the drawings, and the negative poles of the elements of section H^4 are connected with the inside fixed contact-points of the switch-keys on the other side in the same manner, except that with the section H^3 the negative poles are progressively connected with the next adjacent switch on the left-hand side, while those of section H^4 are progressively connected with the next adjacent switch-key on the right-hand side. The outside fixed contacts of the switch-keys are connected with a conductor or a pair of conductors P^2, which terminate in a pair of contact-terminals *p p*, and conductors P^3 and P^4 lead, respectively, from the negative pole of sections H^3 and H^4 to contact-terminals p^3 and p^4. The contacts p^3 p^4 constitute the fixed terminals of the two sections of the battery, and their common terminal is the pair of contacts *p p*. These terminals are adapted to be connected with the line-circuit in either direction by means of the pole-changer P, which I now proceed to describe.

A longitudinally-movable shaft Q of insulating material carries upon it a pair of oppositely-extending spring-fingers n^3 and n^4, both of which are connected with the sliding contact-plate *n* and are adapted to engage, respectively, with the contacts p^3 p^4 and the pair of contacts *p p*. The shaft also carries insulated spring-fingers g^3 and m^4, respectively, connected with sliding contact-plates *g* and *m*, and they are adapted to engage, respectively, with contact-terminals p^3 p^4 in one position and with *p p* in another. The sliding contact-plates *m*, *n*, and *g* are in permanent contact with brushes *m′*, *n′*, and *g′*, and a handle P′ is connected with the shaft Q to give it the proper movement, so that the connections of the battery may be conveniently made, reversed, and broken at the option of the operator.

The switch-keys a^3, &c., are normally in

contact with their inside contact-points, and when not operated the elements or groups of elements of each section of the battery are consecutively connected by them in series with one another with the negative poles of each section connected with the contact-terminals p^3 p^4, as already described. A special key W is also provided which serves to connect the positive pole of one of the sections to one of the contacts p p, and thereby apply the current of an entire section to one of the divided or parallel courses, for the purpose of unbalancing or operating all selectors. Instead of the battery elements a^{11} b^{11}, &c., and a^{12} b^{12}, &c., I may use a series of direct-current generators or a single generator with its winding progressively tapped.

The operator's magneto-generator R^3 is connected between the leads R' R^2, so that it may be utilized either by the manual operation of a key, as shown, or by means of an automatic switch in the well-known manner; but in any case this generator and that at the subscriber's station should be of the pulsating type and of respective polarities which will not disturb the appropriate positions of the polarized armatures of the relays Y.

In describing the operation of the system I will assume that the telephone operator wishes to select the subscriber at station D. After plugging into the jack J and depressing the key R, she depresses the switch-key d^3, which corresponds with station D, whereby the elements a^{12}, b^{12}, c^{12}, and d^{12} of section H^4 and element d^{11} of section H^3 are connected with the common contact-terminals p p. She then moves P' in the direction of the arrow to its primary position and current is applied to the line, including the relays Y with the appropriate polarity to move all the armatures Y^2 against the tensions of springs y^3 into engagement with their contacts z. Both differential coils of the selectors are thereby connected in the circuit between M and G, from which they receive opposing currents of predetermined proportions in the following manner:

Current from the connected elements from section H^4 may pass from contact-terminal p^4 through the sliding contact and brush m', lead R' and plug to the line M and from thence through the different resistances l to the selectors. Current from element d^{11} may pass from terminal p^3, through finger g^3 and brush g' to the ground G, and from thence through resistances l' to the selectors, where it joins with the other current and passes through relays Y and conductor N to brush n', contact-plate n, fingers n^4, and contact-terminal p p to the outside fixed contact-points of the switch-key d^3 back to the respective sections of the source of current. The circuit is the same for the other selection-controlling keys, except that more or less of the elements of each section are respectively connected to the line when they are operated. In the case assumed the opposing current from the sections of H arrive at the differential electromagnet at station D with equal effects in its core, and Z' is therefore not deflected; but at all other stations owing to the different relative values of l and l' one current is in preponderance, and the armatures Z' are deflected into blocking positions. This condition continues until by a further movement of the pole-changer in the direction of the arrow the spring-fingers g^3 and m^4 are snapped suddenly into contact with terminals p p and spring-fingers n^3 into contact with terminal p^3 and p^4, whereby the current in the circuit is reversed, but the relative proportions of the current supplied, respectively, to the conductors M and G preserved unchanged. The relay-armatures respond to this reversal by a rapid movement toward contacts t t, which is necessarily accelerated by the tension of springs y^3, and the ground connections of selectors Z are at the same time interrupted at z.

The contacts z are preferably following contacts adapted to maintain the ground connection of selectors Z until the spurs on extensions y^2 reach or pass the ends of armatures Z', so that the selector at station D is maintained in neutralized or non-actuated condition even after the reversal of current. When the contact z is subsequently disconnected from the ground, the selector of course becomes unbalanced; but before its armature Z' can deflect into blocking position the spur on extension y^2 will have passed beyond it, and the contacts t t at the station D will be closed. At station D only has the telephone-bridge been closed, and the other stations are effectively locked out of the line by means of their deflected selectors, which latter also prevent the manual operation of the bolts 11. Furthermore, the targets X at each non-selected station are moved into view and indicate the condition of the line. The operator may then release key R and disconnect the source of current H, which is no longer needed, as the bias of the relay-armatures will preserve the selected and locked-out condition of the line. She may then converse with the subscriber at D through the cord-circuit or connect the line with other lines of the exchange in the usual manner. When the conversation is finished, the operator manipulates the key R and pole-changer P to reverse the position of the relay-armatures and open the telephone-bridge at station D, which also releases or unblocks the selective apparatus at the other station and puts the line in condition for further use.

When a subscriber, such as D, wishes to communicate with the central office, he first ascertains that the line is free by noticing the busy-signal and depresses key 10, which

moves the bolt 11 into contact with 12, which closes his normally open telephone-bridge to the line, and while holding key 10 depressed he operates his magneto-generator 6,(and the key 4,) which delivers a pulsating current through the switch-hook T′, connection 1, line conductor N, line-signal J′, releasing the drop, conductor M, contact 12, bolt 11, key 10, connection 9, ringer 5, key 4, back to 6. Upon receiving the call the central operator connects the selection-controlling apparatus with the line and moves the pole-changer to its primary position—that is to say, with the spring-fingers n^4 in contact with terminals p p and g^3 and m^4 in connection, respectively, with p^3 and p^4, and she depresses key W at the same time, which causes the current from the whole section H^4 of the battery to pass through the lead R′, conductor M, through the upper coils of the selectors Z, relays Y, and conductor N, causing the relay-armatures Y^2 to move in the direction of contact-points z and connect the selectors with the ground. As none of the elements of the section H^3, however, are connected in the circuit by this operation, the opposing or lower coils of the selectors receive no current, and the selectors are consequently unbalanced and their armatures deflected into the blocking position at all of the stations on the line, except at station D, at which the deflecting member Z′ is held undeflected by means of the bolt or key 11, which the subscriber is holding depressed. The operator may then reverse the current in the line by a further manipulation of the pole-changer, and the relay-armatures move in the direction to close the telephone-bridge, as before; but the bridge at station D is the only one that is closed, and the other substations are obviously locked out in the manner heretofore described. The operator may then release the key R and ascertain the wants of the subscriber, who thus has the exclusive use of the line.

Should the subscriber at D wish to connect with another subscriber on the same party-line—such, for example, as C—he holds his key 11 depressed while the operator again reverses the current in the circuit by means of her pole-changer, thus restoring the relays to their normal or elevated positions, and presses switch-key e^3, whereupon current from the elements c^{11} and d^{11} of one section and from elements a^{12}, b^{12}, and c^{12} of the other passes into the line through the paths heretofore traced, the relative values of these currents being predetermined to cause the action of all selectors except that at station C. Upon the succeeding reversal of the current, as before, the relay-armatures move to close the telephone-bridges and will be blocked therefrom at all stations except C and D, the one because of the selective non-blocking and the other because of the manual blocking by the bolt 11. The telephone operator then sends a ringing-current into the line conductors M and N, which passes in parallel through the ringers at both C and D and indicates to the one subscriber that he is wanted and to the other that he has secured his connection, and upon the removal of the receivers from their respective hooks the two subscribers on the same line may converse to the exclusion of all others on the line.

The switch-hook T′ may obviously be mechanically connected to operate and depress the bolt 11 when it is raised to its elevated position, and thereby reduce the number of acts required of the subscriber.

When the subscribers have replaced their receivers and have given the usual disconnect-signal, which operates the drop S, the telephone operator may cause the relay-armatures to move away from the contacts t t, which movement unlocks the blocked selectors and also disconnects subscribers C and D. Upon withdrawing the plug the relay-armatures assume their normal intermediate positions resting against the springs y^3 and the line is ready for another call. The disconnect-signal S is provided with a short circuit S′ for the purpose of short-circuiting immediately after the drop falls any alternating clearing-out current, which if allowed to enter the selective line would tend to operate the polarized armatures Y^2.

It may sometimes be desirable to complicate the construction of relays Y by including in their windings the proportional resistances l and l' on either side of the selectors. Such a construction is illustrated in Fig. 5, in which the location of the resistances will be readily discerned without special explanation. Care must be taken, however, that these added windings be of the proper direction with respect to the circuit, so that they will not neutralize.

I claim—

1. In a selective system a source of current and a plurality of line conductors constituting parallel courses for the current, electrically-operated devices connected between said conductors and adapted to receive opposing currents from said courses, in combination with means for varying the strengths of current respectively to said courses.

2. In a selective system, a source of current and two line conductors constituting parallel courses for the current, electromotor devices connected between said conductors at different resistance distances from a point on one of them and adapted to receive opposing currents from said courses, in combination with means for varying the supply of current respectively to said courses.

3. In a selective system, a source of current and two line conductors constituting parallel courses for the current, in combina-

tion with differential selectors, connected between said conductors and connections from the differential points of said selectors to the source of current; means for varying the supply of current respectively to said courses, whereby the effects of said selectors may be selectively rendered neutral.

4. In a selective system, a source of current and two line conductors constituting parallel courses for the current, in combination with differential electromagnets connected between said conductors, connections from the differential points of said electromagnets to the source of current, the said differential points being located at proportionally-different resistance distances from each of the said two conductors, and means for varying the supply of current respectively to the said two courses.

5. In a selective system, a source of current and two conductors constituting parallel courses for the current, in combination with a coil at each substation connected to one of said conductors and a corresponding coil connected to the other conductor, a common connection from each pair of coils to the source of current, and means for varying the supply of current respectively, to the said two courses, whereby the magnetic effects of the members of any pair of coils may be selectively balanced.

6. In a polystation telephone system, a source of current and a circuit comprising parallel courses for the current, selectors adapted to receive opposing currents from said courses, telephone apparatus at the substations and means controlled by said selectors for connecting the telephone apparatus with the circuit, and means for varying the relative strengths of the currents supplied respectively to the parallel courses.

7. In a polystation telephone system, two line conductors constituting parallel courses for current, selectors adapted to receive opposing currents therefrom, telephone apparatus in normally open bridges of the circuit, and means controlled by the selectors for closing said bridges, in combination with a source of current and a switching apparatus adapted to vary the relative strengths of the currents respectively supplied to the two line conductors.

8. In a polystation telephone system, a source of current, two line conductors and a common return therefor, selectors connected between said line conductors at proportionally-different resistance distances from each of them, a telephone apparatus at a substation and means controlled by the selector of that substation for connecting the telephone in the circuit, and a switching apparatus at an operating station for varying the proportions of current supplied respectively to said two line conductors.

9. In a polystation telephone system, two conductors and selectors connected thereto at proportionally-different resistance distances from each of them, a common return from said selectors, a telephone apparatus at a substation in a normally open bridge from one of said conductors to the common return and means controlled by a selector at the substation for closing said bridge, in combination with a source of current at an operating station and a variable connection of the same with the circuit.

10. In a polystation telephone system, two line conductors and a common return conductor therefor, a line-jack, differential selectors connected with all of said conductors and adapted to receive opposing currents, normally open telephone-bridges across two of said line conductors, and means controlled by said selectors for closing said open bridges in combination with a central-station apparatus comprising a plug and cord circuit and connections to a source of current for controlling the relative porportions of said opposing currents.

11. In a selective system, a circuit including two line conductors and differential selectors adapted to receive opposing currents respectively therefrom and adapted to be operated by a preponderance of one of said currents, a line-jack for said circuit and a plug-circuit adapted for connection therewith, a source of current in the plug-circuit and switching apparatus for varying the relative strengths of the opposing currents.

12. In a selective system, a circuit comprising two line conductors and a return conductor therefor, differential selectors in the circuit and a line-jack connected with one of said line conductors and the return conductor, in combination with a plug and circuit connection therefrom to a source of current, and a variable connecting means associated with said source for controlling the proportion of current respectively supplied to said line conductors.

13. In a selective system, a source of current and a circuit including electromagnets and armatures therefor adapted to be blocked, in combination with electromoter devices receiving opposing currents from the circuit, adapted to normally block said armatures but to be non-blocking when said currents are equal in effect, and a switching apparatus for controlling the proportions of current supplied to the circuit whereby the electromotor devices may be selectively rendered non-blocking.

14. In a selective system, a source of current and circuit including electromagnets and armatures adapted to be blocked in combination with differential electromotor devices adapted to receive opposing currents from the circuit and to be operated by a preponderance of one of said currents to block said armatures, and a switching apparatus for va-

rying the relative strengths of said opposing currents.

15. In a selective system, a source of current and circuit therefor comprising parallel courses for current, electromagnets at the substations in multiple relation to the circuit and provided with armatures adapted to be blocked in combination with electromotor blocking means adapted to receive opposing currents from said courses, and to be operated by a preponderance of one of said currents, and means at an operating station for proportioning the current respectively supplied to said parallel courses so that the blocking means will be actuated only at the non-selected stations.

16. In a selective system, two line conductors and a common return conductor therefor, electromagnets at the substations in multiple relation to the circuit having armatures adapted to be blocked, in combination with differential selectors connected with said line conductors at proportionally-different resistance distances from each of them, and to said common return, a source of current and a variable connection between said source and the circuit for varying the current supplied respectively to said two line conductors.

17. In a selective system, a source of current and circuit comprising divided paths for the current, differential selective devices adapted to be connected with said paths to receive opposing currents therefrom, relays in the circuit for connecting said devices to the said paths, and switching apparatus for operating said relays and for varying the current supplied respectively to said paths.

18. In a selective system, a source of current and circuit comprising divided paths for the current, selective devices adapted to be connected with said paths to receive opposing currents therefrom, relays in multiple relation to the circuit for connecting said devices to the said paths, means for operating said relays, and a variable connection for varying the proportions of current supplied respectively to said paths.

19. In a selective system, a source of current and circuit comprising two line conductors, the same constituting parallel courses for the current, selective devices adapted to receive opposing currents from said courses, relays for connecting said devices with the said two line conductors at proportionally-different resistance distances from each of them, means for operating said relays, and a variable connection for varying the proportions of current supplied respectively to said parallel courses.

20. In a selective system, a source of current, a circuit comprising two line conductors constituting parallel courses for the current, electromagnets in multiple with the circuit having armatures adapted to be blocked, in combination with normally non-blocking electromotor devices for blocking said armatures connected between the said two line conductors at proportionally-different resistance distances from each of them, and a switching apparatus for supplying current to the circuit and varying the current supplied respectively to said two courses.

21. In a polystation telephone system two line conductors constituting parallel courses for the current, and a return conductor, telephone apparatus at the stations, and relays for connecting the telephone apparatus to the circuit, and means for operating said relays, differential electromagnets connected to the line conductors and the return conductor having armatures adapted, when deflected, to block the relays, in combination with a source of current and switching apparatus at an operating station for varying the current supplied respectively to the said parallel courses, whereby said armatures may be deflected at the non-selected stations.

22. In a polystation selective system, a circuit comprising two line conductors constituting parallel courses for the current and differential electromagnets, relays in the circuit adapted to connect said differential electromagnets with the said two line conductors at proportionally-different resistance distances from each of them, and a return-conductor in combination with a source of current for operating said relays, and switching apparatus for varying the supply of said current respectively to the said parallel courses.

23. In a polystation telephone system, two line conductors, differential electromagnets adapted to be connected at the substations between one of said conductors and the ground, relays connected between the differential points of said electromagnets and the other conductor, armatures for the differential electromagnets and armatures for the relays adapted to be blocked by said first-named armatures, in combination with means at an operating station for selectively controlling the blocking action of said first-named armatures.

24. In a polystation telephone system, line conductors and subscribers' telephone apparatus in normally open bridges thereacross, a differential electromagnet for each bridge controlling the closure thereof and means for varying the degrees of potential in the said line conductors whereby any one differential electromagnet may be selectively rendered inactive to permit the closure of its bridge simultaneously with the actuation of the other differential electromagnets.

25. In a polystation telephone system, two line conductors and subscribers' telephone apparatus in open bridges thereacross, a relay in parallel with said open bridge and adapted to be operated to close said bridge, a

differential electromagnet for each such relay adapted to block its operation and means for selectively causing any differential electromagnet to permit the operation of its relay.

26. In a polystation telephone system, two line conductors, subscribers' telephone apparatus in open bridges thereacross, a polarized relay in parallel with said bridges, the armature of which is adapted to close either the telephone-bridge or another connection, a spring yieldingly holding said armature in an intermediate position, and a pole-changer for reversing the current in said relays, in combination with a differential electromagnet for blocking said relay, connected in the circuit by said relay, and means for selectively causing any differential magnet to be non-blocking.

27. In a selective system, a source of current, and a circuit comprising divided paths for the current and a return conductor, polarized relays in said circuit, and differential selectors adapted to be connected in said circuit by said relays, in combination with a pole-changer and switching apparatus for varying the proportions of current respectively supplied to said divided paths.

28. In a selective system, a source of current divided into sections two line conductors supplied with current of the same polarity from said sections and a common return from said conductors, including a variable connection with said sections and the common return, whereby the proportions of the currents supplied to each of said conductors may be varied.

29. In a selective system, a source of current divided into sections, two line conductors supplied with current of the same polarity from said sections, and a common return from said conductors, including a variable connection with said sections and the common return, whereby the proportions of the current supplied to each of said conductors may be varied and means for reversing the current in the circuit without changing said proportions.

30. A selective switching apparatus comprising two sections of a source of current, and terminals connected respectively with like poles of said sections, a third terminal and means for connecting it with complementary parts of each of said sections.

31. A selective switching apparatus comprising two sections of a source of current and terminals connected to like poles of said sections, a third terminal and switch mechanisms for connecting the same with predetermined parts of said two sections, said parts when so connected being complementary to each other with respect to a section of the source of current.

32. A selective switching apparatus, comprising two sections of a current source, two terminal contacts connected respectively with like poles of said sections, a pair of terminal contacts adapted to be connected with complementary parts of each of said sections, a movable member comprising contact-fingers adapted to alternately engage said two terminal contacts and said pair of contacts and connections from said movable fingers to a line-circuit.

33. In a polystation telephone system, two conductors constituting parallel courses for current, selectors adapted to receive opposing currents therefrom and a common return from said selectors, an operating station comprising a current source in two sections, each section being adapted to be connected with one of said conductors, and a variable connection between the common return and said sections whereby complementary parts of each section may be connected in the circuit to supply current to the parallel courses in predetermined proportions.

34. A polystation telephone system, comprising two line conductors and differential electromagnets connected therebetween, a third conductor connected with the differential points of said electromagnets, in combination with a source of current divided into sections having like poles respectively connected to the two first-named conductors and switching apparatus adapted to connect said third conductor with complementary parts of said sections.

35. In a selective system, two line conductors and differential electromagnets connected thereto and a common return, relays included in the circuit, the windings of said relays comprising artificial electrical resistance on either side of said differential electromagnets, and means for operating said relays and differential electromagnets.

36. In a selective system, a relay-armature adapted to be blocked and a movable member for blocking the same, a coil for actuating said blocking member adapted to be connected to the circuit by the said armature, in combination with a following contact between the coil and the armature, whereby a blocked or a non-blocked condition may be assumed before the coil is disconnected from the circuit.

37. In a selective system, a selector one of whose terminals is connected to a following contact, a member for connecting said following contact to the circuit when moved in one direction, and an armature for the selector adapted to deflect, when said connection is broken, into the path of the movement of said member in the other direction.

38. In a selective system, a selector one of whose terminals is connected to a following contact, a movable member for connecting said following contact to the circuit, and an

armature for the selector adapted to deflect into the path of movement of said movable member, in combination with a projection on said movable member extended to a position adjacent the end of said deflecting member, whereby the movable member may pass beyond the middle point of its traverse when the deflecting member is deflected.

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

SYLVANUS ALBERT REED.

Witnesses:
OSCAR W. JEFFERY,
H. G. KIMBALL.