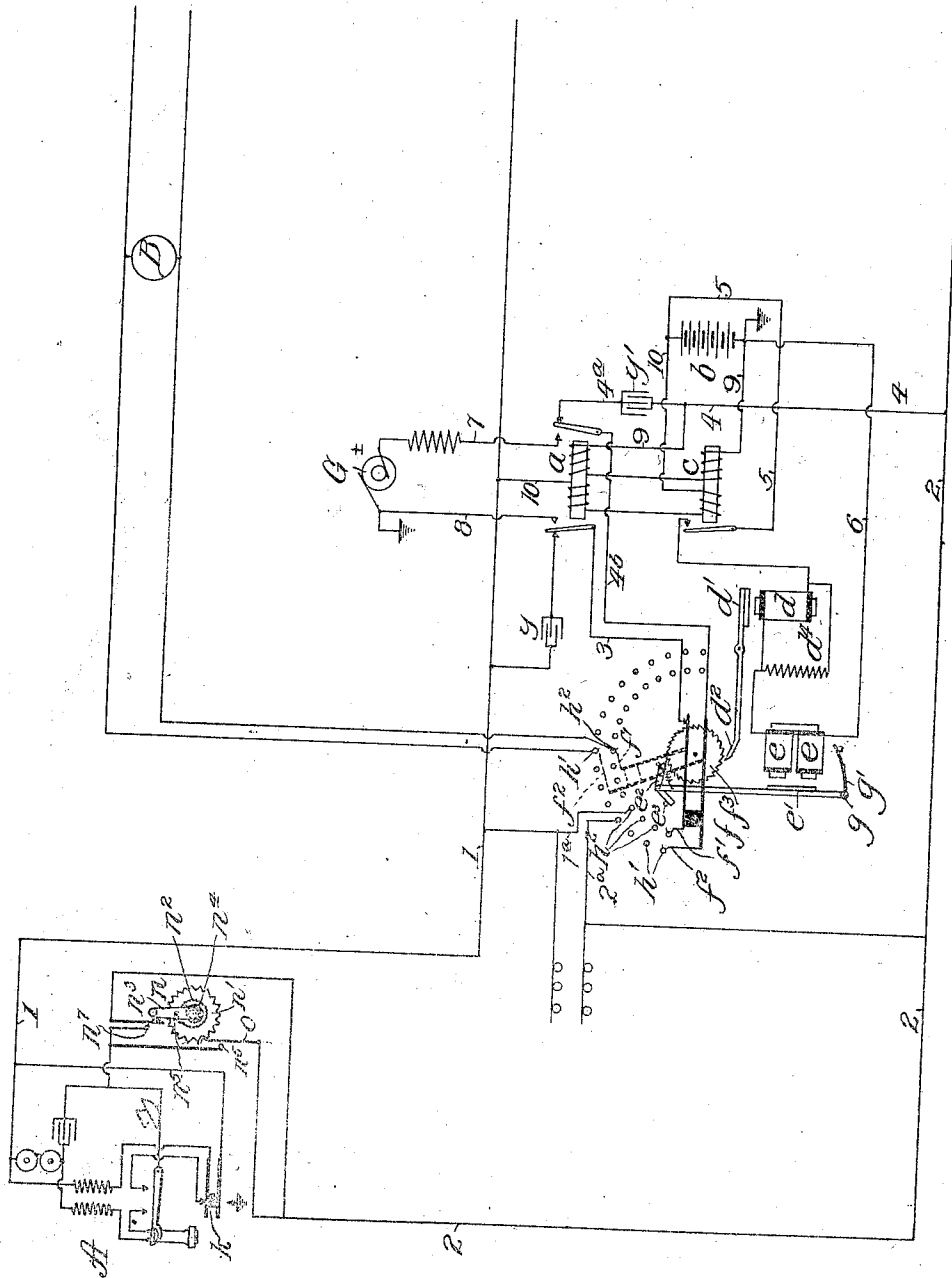


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C. D. ENOCHS.
AUTOMATIC TELEPHONE EXCHANGE.

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AUTOMATIC TELEPHONE-EXCHANGE.

No. 828,101.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, CLAUDE D. ENOCHS, a citizen of the United States, residing at La Crosse, in the county of La Crosse and State of Wisconsin, have invented a certain new and useful Improvement in Automatic Telephone-Exchanges, of which the following is a full, clear, concise, and exact description.

My invention relates to a telephone system; and its object is to provide an arrangement of apparatus and circuits by which two magnets included in said circuit may be actuated simultaneously, or one of the magnets may be actuated independently of the other.

My invention when used in connection with an automatic telephone system provides a circuit in which only non-polarized magnets are used and in which few contacts are employed, thus providing a cheap and simple system by which the selective switching of any two subscribers' instruments into connection with each other may be readily accomplished.

In my invention, when employed in connection with an automatic exchange, I employ the usual apparatus at a subscriber's station, including an interrupter and the usual selector at the central office.

In the circuit of my invention two double-wound non-polarized relays are employed, one for controlling the selecting mechanism and one for controlling the ringing-generator, the relays being so connected in the circuit that one winding of each is between the battery and the line. When the calling subscriber after removing his receiver from the hook operates his interrupter, the metallic circuit through the relays is interrupted, with the result that the ringing-relay, being differentially wound, is not operated, while the selecting-relay, being cumulatively wound, is actuated. The selecting-relay responds to the interruptions and through the medium of a local circuit, including a stepping and a retaining magnet, operates the selector. When the calling party operates his ringing-key, the metallic circuit is opened and one side of this telephone-line is grounded, a circuit being thus completed over said line through the central battery to ground. This circuit includes only one winding of the differentially-wound ringing-relay, and hence this relay is

energized and operates to connect the selector-brushes to the ringing-generator or other source of ringing-current.

I will describe my invention more particularly by reference to the accompanying drawing, which is a circuit-diagram of two telephone-lines extending from their respective subscribers' stations to a central office, where each line is equipped with apparatus for performing the various switching operations required in making connection with any other line of the exchange, it being understood that each line of the exchange has an equipment similar to that illustrated in the drawing.

The system shown is arranged on the central-battery plan both for signaling and talking. Each line has, as usual, two main conductors or line-wires 1 2, and the central battery *b* is connected in a bridge of the circuit, one pole of the battery being grounded in accordance with the usual practice. Two double-wound non-polarized relays are connected in the bridge, the one, *a*, for ringing, and the other, *c*, for selecting, the relays being so connected in circuit that one winding of each is between the battery and the line. The line-wires 1 and 2 terminate in the contact-brushes *f'* *f*², respectively carried by a selector-arm *f*. Each line has a pair of terminals *h'* *h*² on each selector, with which the movable contacts of the selector-arm may make connection.

The rotating arm *f* is arranged to be advanced by a stepping-magnet *e* and to be held in its advanced position by a retaining-magnet *d*, said magnets being connected in a local circuit 5 6, which is controlled by the selecting-relay *c*, said relay in turn being controlled by the switching mechanism at the subscriber's station.

The contact-brushes *f'* *f*² of the selector-arm *f* are arranged to trail over the pairs of stationary line-terminals *h'* *h*², arranged in a circle about its axis. The contact-brush *f'* of the selector-arm is arranged to be connected by a conductor 3 with the line conductor 1, of which it forms an extension, said conductor 3 being conductively divided by a condenser *y* and normally closed at contacts of relay *a*. Similarly, the contact-brush *f*² of the selector-arm is arranged to be connected with line conductor 2 by extensions 4^b, 4^a, and 4 of said conductor, said extension 4^a

also being normally closed at contacts of relay *a* and conductively divided by a condenser *y'*.

The ringing-relay *a* is differentially wound and the selecting-relay *c* cumulatively wound, so that when the metallic circuit is closed the relay *a* is not operated, while the relay *c* is actuated to close the local circuit 5 6, including the battery *b*, the stepping-magnet *e*, and the retaining-magnet *d*.

Of course it is understood that the stepping-arm *f* may be mounted radially upon a ratchet-wheel *f*³, which is suitably mounted to rotate. The stepping-magnet *e* is provided with an armature *e'*, which carries a pawl *e*², pivoted on its end and adapted to engage the teeth of the ratchet-wheel *f*³. The armature is pivoted at *g* and is normally held away from the magnet by the spring *g'*. When the armature is attracted, the pawl *e*² is released from the post *e*³ and is drawn by a spring into engagement with the toothed wheel *f*³. This advances the ratchet-wheel, and the selector-arm is carried thereby one step. The ratchet-wheel *f*³ is arranged to be held at any point to which it may be advanced by a retaining-pawl *d*², forming an extension of the armature *d'* of the retaining-magnet *d*. When the armature *d'* is in its normal unattracted position, the retaining-pawl *d*² is out of engagement with the ratchet-wheel; but when said armature is attracted the retaining-pawl is held against the ratchet-wheel. The coöperation of both the stepping-magnet and the retaining-magnet is necessary to bring about the rotation of the selector-arm.

The retaining-magnet *d* is arranged to act sluggishly in releasing by means of a non-inductive shunt *d*⁴, while the stepping-magnet is adapted to respond quickly to a cessation of current. Since these two magnets *d* and *e* are in series in the local circuit 5 6, when an intermittent or pulsating current is passed through the circuit the armature *d'* will be continuously attracted, while armature *e'* will be vibrated. The result is a step-by-step advance of the ratchet-wheel and the selector-arm carried thereby, the number of steps of advance being determined by the number of impulses of current applied to the magnets. The means for actuating the relay *c* to cause the production of these intermittent currents is an interrupter *n* at the subscriber's station, the operation of which is hereinafter described.

The ringing-generator *G* is included in a circuit 7 8, normally open at the contacts of relay *a* and adapted to be closed by the operation of said relay, as hereinafter described.

As before stated, the advance of the selector-arm *f* at the central station is dependent upon the intermittent closing of the local circuit 5 6, which is controlled at a normally open contact of the selecting-relay *c*. To pro-

duce an intermittent excitation of this relay *c*, the subscriber's station equipment includes, in addition to the usual telephone apparatus, an interrupter which, when operated, will intermittently open and close the metallic circuit, and hence the relay *c* will be intermittently excited. Any form of interrupter for making and breaking the circuit may be used. That which I have chosen to illustrate comprises a toothed wheel *n'*, arranged to actuate a movable spring *o* as the teeth of the wheel pass in succession under said spring. A ratchet-wheel *n*² is mounted to rotate with the toothed wheel *n'*. A controller-arm *n*³, which may be moved forward loosely upon the axis of the wheel against the tension of a coiled spring *n*⁴, carries a pawl *n*⁵, which, as the controller-arm is returned by the spring after its advance, engages the ratchet-wheel to carry the same and the toothed wheel *n'* around with it, whereby the spring *o* is actuated to close and open the circuit at contact *n*⁶. The number of times the contact *n*⁶ is closed and opened depends upon the distance to which the controller-arm is advanced, which distance is regulated by the calling subscriber to correspond with the terminal on the selector to which the called subscriber is connected.

The operation of the system may now be understood. When a subscriber at station A, for example, desires to call the subscriber at station B, he takes his telephone-receiver from its hook, whereby a metallic circuit is completed, which may be traced as follows: from the positive terminal of the battery *b* through the conductor 9, including a winding of relays *c* and *a*, conductor 4, line 2, the subscriber's telephone set, line 1, conductor 10, including the other windings of relays *a* and *c* to the negative terminal of battery *b*. The ringing-relay *a* being differentially wound is not operated, while the selecting-relay *c* being cumulatively wound is actuated and closes the local circuit 5 6, causing the magnets *d* and *e* to advance the selector-arm one step. This movement is merely incidental and effects no change in the talking-circuits. The subscriber now operates his interrupter *n* to make and break the circuit at contact *n*⁶, whereby an intermittent current is caused to flow from the central battery *b* through the above-described metallic circuit. The selecting-relay *c* responds to the interruptions, and thus causes corresponding intermittent impulses to be transmitted over the local circuit 5 6. The stepping-magnet *e* is thus caused to intermittently attract its armature and so to advance the selector-arm step by step. The selector-arm is held in its advanced position by the retaining-magnet *d*, which being made sluggish does not follow the pulsations of the current, but keeps its armature steadily attracted. When the operation of the

interrupter n ceases, the metallic circuit is closed at the contact n^7 , so that while the subscriber's receiver is off of its hook the relay c is actuated, the local circuit 5 6 closed, and the retaining-pawl d^2 in engagement with the teeth of the wheel f^2 . The subscriber at A having operated his interrupter n , so that the selector-arm f , carrying the extensions of his line, is in engagement with the terminals $h' h^2$, to which the subscriber's line at station B is connected, the telephone-line of the subscriber at A is placed in connection with the line of subscriber at station B. The next step is to ring up the subscriber at station B. To do this, the subscriber at station A operates his ringing-key k , thereby first grounding the line 1 and then opening the metallic circuit. It is necessary to ground one line before opening the circuit in order that the contact of selecting-relay c may be held closed during the switching operation and further actuation of the selector-arm thereby prevented. A circuit is then closed from ground at station A through line 1, conductor 10, including a winding of relays a and c , battery b , to ground at the central station. Since this circuit includes only one winding of the differential relay a , said relay, as well as relay c , is energized. The relay a operates to close its front contacts, and thus to connect the selector-brushes $f' f^2$ to the ringing-generator G or other source of ringing-current through lines 7 and 8, respectively. Current then passes to contacts $h' h^2$ of the called subscriber's line out to the called station through the bridge containing the signal-bell. As soon as the subscriber at A ceases to operate his ringing-key his line is again closed at the back contacts of the relay a , and when the called subscriber answers, a talking-circuit between the two stations is established. A subscriber on a party-line can also signal and converse with any other subscriber on the same line. The operation of selecting and ringing is exactly the same as that above described, since the calling-line is also connected by conductors 1^a and 2^a with terminals on the selector. In calling another substation on the same line the calling subscriber rings in accordance with the code-number signal of the station wanted.

I claim—

1. In an automatic telephone-exchange, the combination with a telephone-line extending from a substation to a central-office battery, one pole of which is grounded, of a selecting-relay connected in said circuit, selecting mechanism controlled by said relay, a differentially-wound ringing-relay having its windings also included in said circuit with one winding on either side of said battery, ringing mechanism controlled by said ringing-relay, and switching mechanism at the substation for closing the circuit of the line and

for grounding one side of the line, whereby said selecting-relay may be independently actuated or both relays simultaneously actuated, substantially as described.

2. In an automatic telephone-exchange, the combination with a telephone-line, of a bridge of the line at the central office including a battery one pole of which is grounded, two double-wound relays having their windings included in said bridge, each relay having one winding on either side of said battery and one magnet being cumulatively wound, and the other differentially wound, selecting mechanism controlled by said cumulatively-wound relay, a ringing-generator controlled by said differentially-wound relay, switching mechanism at the subscriber's station whereby the metallic circuit of the line may be closed and the cumulatively-wound relay independently actuated to operate the selecting mechanism, and additional switching means whereby one line may be grounded and the relays simultaneously actuated, the differentially-wound relay to actuate the ringing mechanism, while the other relay controls the selecting mechanism, substantially as described.

3. In an automatic telephone-exchange, the combination with a telephone-line, of a selector having a selector-arm carrying a pair of contact-brushes constituting terminals of said line, and stationary contact-terminals of other lines, a local circuit including a magnet for operating mechanism by which said contact-brushes are trailed across said terminals, a circuit including a ringing-generator, two double-wound relays in bridge of the telephone-lines, the one for controlling the selecting-circuit being cumulatively wound, and the one for controlling the ringing-circuit differentially wound, said relays being connected in circuit with one winding of each between the battery and the line, and means at the subscriber's station for controlling the operation of said relays.

4. In an automatic telephone-exchange, the combination with a telephone-line, of a selector individual to the line having a pair of movable contact-brushes and stationary contact-terminals, a normally open local circuit including a stepping-magnet and a retaining-magnet for operating mechanism by which said contact-brushes are trailed across said terminals, a normally open circuit including a ringing-generator, two double-wound relays, one for controlling the selecting-circuit and the other the ringing-circuit, said relays being connected in bridge of the telephone-circuit with one winding of each between the battery and the line, and means at the subscriber's station for controlling the operation of said relays.

5. In an automatic telephone-exchange, the combination with a selector having a movable contact-brush adapted to form the ter-

5 minal of a calling-line, stationary contacts of
 other lines with which said movable brush is
 adapted to be engaged, a local selecting-cir-
 10 cuit including a magnet for operating mech-
 anism by which said contact-brush is trailed
 across said terminals, a ringing-circuit in-
 cluding a ringing-generator, a selecting-relay
 and a ringing-relay connected in series with
 15 the central battery in bridge of the telephone-
 lines for controlling the selecting-circuit and
 the ringing-circuit respectively, said relays
 each having double windings, said selecting-
 relay being cumulatively wound and said
 20 ringing-relay differentially wound with one
 winding of each relay between the battery
 and the line, an interrupter at the subscriber's
 station for making and breaking the metallic
 circuit through said relays by which the se-
 25 lecting-relay is energized to move the selec-
 tor-brush to the terminals of the called sub-
 scriber, and a ringing-key at the subscriber's
 station by means of which a grounded return-
 circuit is closed including only one winding of
 the differentially-wound ringing-relay, where-
 30 by said relay is energized to connect the ring-
 ing-generator to the circuit of the called sub-
 scriber, substantially as described.

35 6. In an automatic telephone-exchange,
 the combination with a selector having a pair
 of movable contact-brushes adapted to form
 terminals of a calling-line, stationary con-
 tacts of other lines with which said movable
 brushes are adapted to be engaged, a local
 selecting-circuit including a stepping-magnet
 and a retaining-magnet for operating mech-

anism by which said contact-brush is trailed
 across said terminals, a ringing-generator; a
 selecting-relay and a ringing-relay connected
 in series with the battery one pole of which is
 40 grounded, in bridge of the telephone-lines for
 controlling the selecting-circuit and the ring-
 ing-generator respectively, said relays each
 having double windings, the selecting-relay
 being cumulatively wound and the ringing-
 45 relay differentially wound with one winding
 of each relay between the battery and each
 line, an interrupter at the subscriber's sta-
 tion for making and breaking the metallic
 circuit through said relays by which the se-
 50 lecting-relay is intermittently energized,
 thereby opening and closing the selecting-
 circuit so that the magnets in said circuit ad-
 vance the selector-brushes to the terminals of
 the called subscriber, and a ringing-key at the
 55 subscriber's station by means of which the
 metallic circuit is opened and a grounded cir-
 cuit is closed including only one winding of
 each of said relays, whereby the ringing-re-
 lay is energized to connect the ringing-gener-
 60 ator to the circuit of the called subscriber
 and the selecting-relay is energized to close
 the selecting-circuit, whereby the retaining-
 magnet holds the selector-arm in its advance
 position, substantially as described.

In witness whereof I hereunto subscribe 65
 my name this 26th day of July, A. D. 1905.

CLAUDE D. ENOCHS.

Witnesses:

RUTH WARREN,
 OLGA JENSEN.