

E. E. CLEMENT.
 SELECTIVE RINGING MEANS FOR TELEPHONE SYSTEMS.
 APPLICATION FILED JAN. 18, 1907.

976,123.

Patented Nov. 15, 1910.

2 SHEETS—SHEET 1.

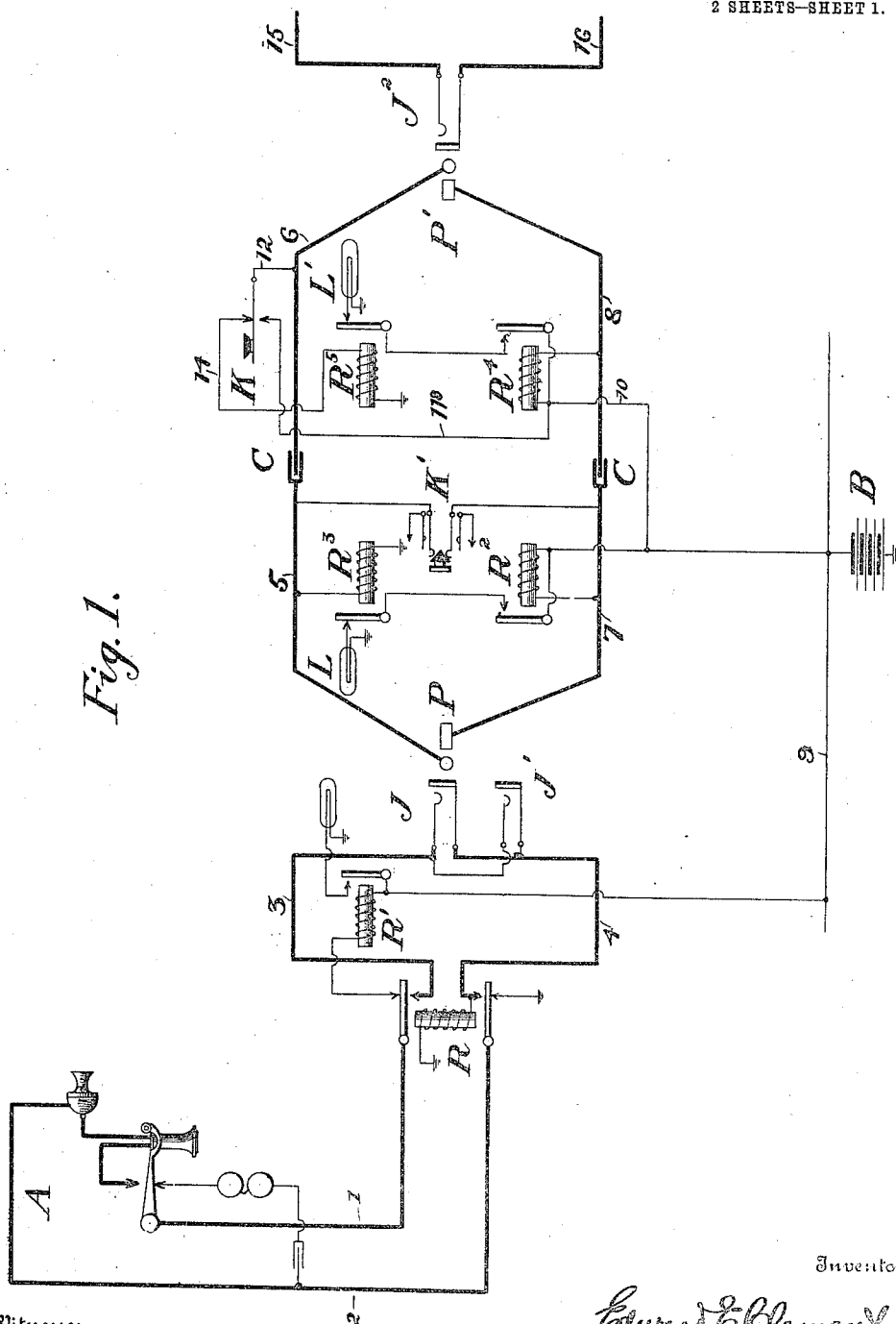


Fig. 1.

Witnesses
 H. A. Whiting
 James H. Mann

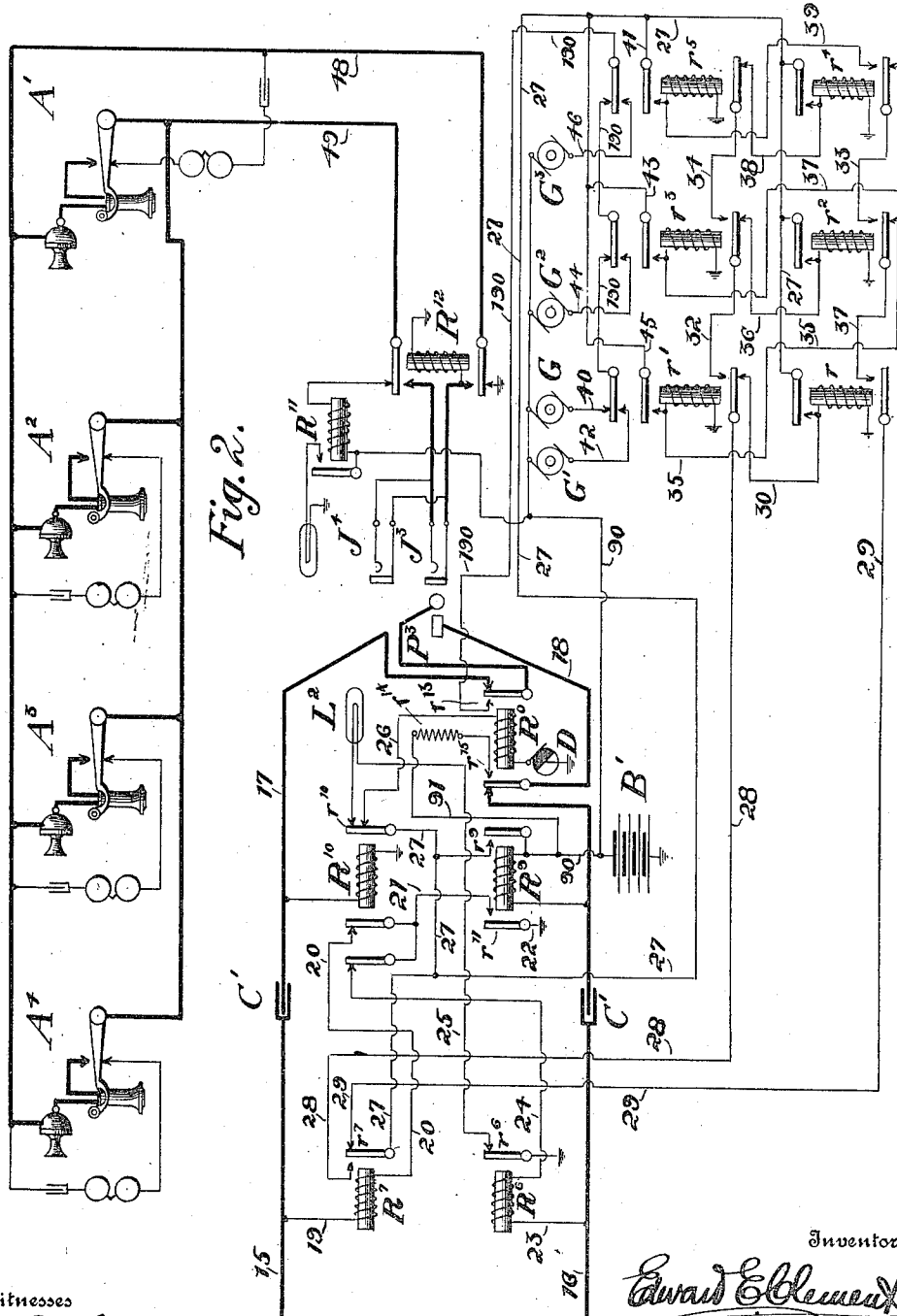
Inventor
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 H. R. Whiting
 James A. Mear

Inventor
 Edward E. Clement

UNITED STATES PATENT OFFICE.

EDWARD E. CLEMENT, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE NORTH ELECTRIC COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

SELECTIVE RINGING MEANS FOR TELEPHONE SYSTEMS.

976,123.

Specification of Letters Patent. Patented Nov. 15, 1910.

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To all whom it may concern:

Be it known that I, EDWARD E. CLEMENT, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Selective Ringing Means for Telephone Systems, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to telephone exchange systems and particularly to circuits and apparatus for selective party-line ringing in such systems.

The object of the invention is to provide means whereby an A operator may select and apply any desired ringing current or ringing combination at a B position, the same as at her own position, without the B operator being required to do anything except put up the desired connection. The A operator also supervises both at her own and the B end of the trunk, and signals the B operator for disconnection when she finally removes her plug from the trunk jack.

Hitherto, so far as I am aware, it has been necessary in trunking calls between exchanges for the B operator to complete the connection, and to select the current or combination of circuits necessary to call a wanted subscriber if he be on a party line. It has been possible for the A operator to control the ringing and to supervise the connection, but no more.

In the present invention, I make use of the principle of impulse transmission employed in automatic exchange systems, placing the selective switching apparatus at the B position and a suitable key or other impulse sender at the A position. The A operator, desiring to ring a particular subscriber on the wanted line, sends a number of impulses designating that subscriber's station over the trunk, thereby working the switching mechanism so that it will connect the appropriate generator or circuits at the B position.

Specifically stated, and referring to a particular system of harmonic selection, I preferably place a set of step by step relays at the B exchange, controlling the circuits of four generators each adapted to furnish current suitable for ringing the bell at a particular station and no other. Any one of

four stations on a line may be called by selecting and connecting the proper generator of this set to that line. At the A position I provide the operator with a key or a set of transmitting keys, by means of which she can send 1, 2, 3 or 4 impulses over the trunk at will. When the connection is complete, she then transmits a proper number of impulses corresponding to the station she wants, whereupon one relay after the other is actuated until the generator is connected which will ring the desired station. The ringing relay then becomes energized and connects the generator so selected through the trunk plug to the line, subject to being cut off either when the wanted subscriber answers or otherwise in any suitable manner.

My invention is not limited to manual systems but may obviously be applied without alteration to automatic and semi-automatic systems. The most frequent application will be to branch exchange work, or what we may call clearing-house systems, wherein a main central office is provided with manually operated switchboard apparatus, and the branch exchanges are equipped with automatic apparatus adapted to be controlled through trunk lines from the main office.

My invention is illustrated in the accompanying drawings in which—

Figure 1 is a diagram of a portion of the apparatus and circuits at a subscriber's or "A" operator's position; Fig. 2 is a similar diagram of a trunk line leading to a "B" position, with a portion of the apparatus at that position.

Referring to the drawings in which the figures are complementary to each other, it will be apparent that the arrangement is based on the assumption of a call from station A for a subscriber A', A², A³ or A⁴, the calling subscriber's line terminating at one switchboard shown in Fig. 1, and the called subscriber's line at another board shown in Fig. 2. Both may be multiple boards or of any other desired type, the showing of the switchboard circuits herein being made for purposes of illustration and not limitation.

Subscriber's line 1—2 in Fig. 1 terminates at the contacts of the cut-off relay R, by which it is normally connected to the line

relay R', battery B and ground. When the cut-off relay is energized the line is connected to its multiple jacks J, J'.

P, P' are the answering and calling plugs of a pair respectively, connected by the cord conductors 5-6 and 7-8. Two pairs of supervisory relays R²-R³ and R⁴-R⁵ control the circuits of the supervisory lamps L, L', in a manner well understood by engineers. Where the connections effected through the cord are between lines terminating on the same switchboard, the cord circuit shown, with the four relays and the lamp, requires no change; but for my present purpose of party line ringing control through the trunks, I provide a key K by which the tip relay R⁵ may be disconnected and the cord conductor 6 put directly on the battery B. This disconnection of the tip supervisory relay prevents its energization when battery is connected, and thus avoids false signals. By tapping the key K, therefore, pulsations of current may be sent over the conductor 6 and thence through the tip of the plug P' and over the tip side 15 of a trunk line 15-16 leading to a "B" board. I make use of these impulses for the purpose of selecting the ringing current to be applied to the called line.

Passing to Fig. 2, the trunk 15-16 is divided by condensers C', and the calling end 17-18 thereof terminates on the plug P³, which is one of a set arranged before the "B" operator for connecting the trunks to the multiple jacks J³-J⁴ of the wanted subscriber's line. The incoming end of each trunk has relays R⁶-R⁷ both of whose circuits are controlled by the tip relay R¹⁰, and the sleeve relay R⁹. The supervisory lamp L² which is intended for clearing out only, is also controlled by the relay R¹⁰. The ringing relay R⁹ is controlled jointly by the relay R¹⁰ and the driven commutator D which may be common to the exchange in which it is located, and may be driven in any suitable manner, as by a pawl and ratchet under control of a magnet fed from the main battery B', or by a motor. If desired, this commutator may be started by the relays of any of the trunks, so as to be running only when it is needed.

The relay R⁷ controls the selective relays r, r', r², r³, r⁴ and r⁵ through the two wires 28 and 29, each movement back and forth of the armature of this controlling relay setting up an additional one of the relays r', r² and r⁵, and thereby cutting off one generator and cutting on the next one.

The generators G, G', G² and G³ are supposed to be harmonic generators producing current at different frequencies, and the ringers on the party line 48-49 are bridged across in parallel, each being tuned to respond to one of the generators only. Thus by selecting the proper generator, the

desired bell can be rung. It should be clearly understood, however, that I am not limited to this harmonic method of ringing, since there are other methods which can be substituted in the present circuit without difficulty by any one familiar with the art, and in fact, one virtue which I claim for my present system is that it may utilize any known system of ringing. For example, we will assume the normal generator connection at G to be as shown across the wires 90 and 190. Then when the relay r' is energized it may disconnect this generator and connect a generator of positive intermittent current to one side of line; relay r³ may connect the same to the other side of line, and so on. In fact, any desired combination of generators and ringers may be effected through the agency of the selective relays I here describe.

The operation of the system thus described is as follows: Subscriber A calls in by removing his receiver from the hook; relay R' lights the line lamp, and the operator inserts the answering plug P and obtains the number wanted in the usual manner. The listening key employed for this purpose is indicated at K'. Assuming the call to be for a subscriber A³ in another exchange, the A operator depresses an order key and thereby connects her own telephone to the telephone of a B operator at the other exchange, neither the order key and circuit nor the B operator's telephone being shown herein, as they form no direct part of the present invention and are well understood in the art. The B operator upon being given the number of the line wanted, answers back by designating the number of the trunk to be used. The A operator then inserts the plug P' into the designated jack J², and if the line wanted is a party line she proceeds to tap the key K, unless the party wanted is the first party on the line, in which case the arrangement illustrated is normal and he will be automatically rung without any act on the part of the operator. When the plug P' is inserted in the jack J² no current flows from the battery B through the trunk because the branches 20 and 24 are both open at the front contact of the armature r¹¹ of the relay R⁹. The B operator, however, immediately inserts the plug P³ into the jack J³ of the wanted line, after testing the same in the usual way. The moment this is done, the following circuit is completed for the relay R⁹: B', 90, R⁹, 18, P³, J³, R¹², and ground back to battery. This pulls up both the relays R⁹ and R¹², the latter being the cut-off relay of the line 48-49, and acting upon its energization to connect the line wires to the jack J³ and at the same time to disconnect the line relay R¹² and ground. The energization of relay R⁹ pulls up its armatures, closing the fol-

following circuits: 22, r^{11} , 21, 20, R^7 , 19, 15, J^2 , P^7 , 6, 12, 14, R^5 , and ground. (No effect is produced by this closing as both ends are grounded). 22, r^{11} , 21, 24, R^5 , 23, 16, J^2 , P^7 , 8, R^4 , 10, and battery B. Current in this latter circuit energizes the relays R^5 and R^4 , both of which pull up their armatures, the former thereby breaking the connection from ground through its armature r^6 to the lamp wire 25; and the latter connecting the battery wire 10 to the armature of the relay R^5 , and thence to the supervisory lamp L^1 . Thus the lamp L^1 will glow indicating to the A operator that connection is completed but the called subscriber has not yet answered, and this lamp will remain glowing until he does answer. The lamp L^2 , on the other hand, does not glow, since the B operator is not intended to supervise, and this lamp is needed only for a clearing out signal.

The A operator now taps the key K, as already stated. We are assuming the party wanted is the third party on the line, whose bell is tuned to respond to current from the generator G^2 . The A operator presses down the key K twice. Each time she does this, the battery B is connected through the trunk wire 15 to the relay R^7 , by the following path: B, 10, 11, 12, 6, P^7 , J^2 , 15, 19, R^7 , 20, 21, r^{11} , 22, and ground back to battery. The relay R^7 , which may be wound to a suitable resistance so that it will respond properly over any desired length of trunk and with any desired voltage, responds to each impulse by pulling up its armature r^7 , and then releasing it again. Upon pulling it up for the first time, it closes the following circuit: B', 90, 27, r^7 , 28, 30, r , and ground back to battery. The first relay r of the selective set thereupon pulls up, and by so doing connects the wire 27 directly to its own windings so as to lock itself up, and also connects the wire 29 to the wire 37, which leads through the armature of the relay r^2 and its back contact to wire 35, and thence to the relay r^1 . The wire 29, however, is open at this instant, since it terminates at the back contact of the armature r^7 , but it receives current as soon as that armature has fallen back after the first impulse from the operator's key, over the following path: B', 90, 27, r^7 , 29, 37, 35, r^1 , and ground back to battery. The relay r^1 immediately pulls up, locks itself through the wire 45 on to the wire 27, and also disconnects the wire 28 from the wire 30 and connects it to the wire 32, leading to the second of what I call the guard relays, marked r^2 . A third circuit change produced by this relay r^1 is the disconnection of the ringing wire 190 from the wire 40 leading to generator G, and its transfer to the wire 42 leading to the generator G^1 .

As the armature r^7 responds to the second

pulsation of current from the A operator's key, the foregoing operations are repeated, except that instead of relay r , it is the relay r^2 which responds to current through the wire 28, and which locks itself up on wire 27 and at the same time transfers the wire 37 from the wire 35 to the wire 33, thereby connecting the relay r^3 to the wire 29, so that it will obtain current through that wire when the armature r^7 falls back again. As that occurs, the relay r^3 is energized, locking itself on the wire 27, cutting the wire 190 off the generator G^1 , and connecting it to the generator G^2 . There being no further impulses over the trunk, the relay R^7 remains quiescent, and the generator G^2 remains connected to the ringing relay contacts through the following path: r^{13} , 190, armatures of relays r^5 and r^3 , wire 44, generator G^2 , wire 90, wire 91, and to the contact r^{15} through the resistance r^{14} , which is included because it is necessary to keep the main battery B' connected while ringing, in order to hold up the cut-off relay R^{12} . A similarly grounded resistance r^{140} is simultaneously included in circuit with the relay R^9 , in order that it may also be held up.

The generator connections having now been prepared, the actual ringing is done in the following manner: The commutator D is constantly rotating, and as it rotates it grounds the relay R^9 , which is connected on the other side through the wires 26 and 27 to the front contact of armature r^9 of the relay R^9 , and thence through wire 90 to battery B'. The commutator D may be formed in any suitable manner, but I have shown it as half metal and half insulation, so as to produce equal intervals of silence and ring. When it completes the circuit of the relay R^9 , the latter pulls in its armatures, severing the cord conductors 17 and 18, and connecting the plug P^3 through the forward fragments of the cord to the contacts r^{13} and r^{15} , which are already connected to the generator G^2 . Current from this generator therefore passes out over the line wires 48—49 and rings the bell at the desired station. As the commutator rotates further, it cuts off the relay R^9 , and for an interval the cord conductors are restored and then the subscriber A^3 may reach and control the supervisory relay R^{10} . If he answers during this interval, or during any subsequent interval, the relay R^{10} will pull up on current passing over the following circuit: B', 90, R^9 , 18, P^3 , J^3 , 48, A^3 , 49, 17, R^{10} , and ground back to battery. The pulling up of relay R^{10} breaks the circuit of the ringing relay by separating the wires 26 and 27, disconnects the lamp L^2 from the battery wire 27, and disconnects the wires 20 and 24 from the wire 21 which as we have already seen is at this time grounded. The effects are these: First, the ringing relay is not again

energized, although the commutator may continue to rotate. The relays R^4 , (Fig. 1) and R^5 , (Fig. 2) both lose current, and the supervisory lamp L' in Fig. 1 goes out because its circuit is broken at the armature of relay R^4 . The A operator is thus advised that the called subscriber has answered. At the same time, the circuit of the lamp L^2 is completed to the armature r^6 only, being broken at armature r^{10} . Hence this lamp remains dark.

The battery supply for the line 48—49 is derived through the relays R^9 and R^{10} from the battery B' , over the line circuit already traced. The subscribers A and A³ have control of the respective lamps L and L' in the A operator's cord circuit, just the same as if they were in the same exchange. When subscriber A hangs up his receiver, his relay R^3 becomes deenergized and the lamp L glows. Similarly, when the subscriber A³ hangs up his receiver his relay R^{10} lets go its armature, and completes the circuits of the relays R^4 and R^5 , whereupon the lamp L' in Fig. 1 again receives current and glows. The glowing of both the lamps L and L' advertises to the A operator the desire of the subscribers for disconnection. The plugs P and P' are thereupon taken down from the jacks. The effect of this at the B end is that the lamp L^2 immediately glows, receiving current through the following circuit: battery B' , 90, r^9 , 27, r^{10} , L^2 , 25, r^6 , and ground. This advertises to the B operator the fact that the trunk is idle, and should be disconnected, whereupon she takes down the plug P³, and as the relay R^9 immediately lets go its armature the lamp L^2 goes out. At the same time, since current is removed from the wire 27 by the retraction of the armature r^6 , all the relays r^7 , r^3 , r^5 , r^7 , r^2 and r^4 let go their armatures because they have lost their locking current, hence all of the generator connections are immediately restored to their normal condition ready for renewed operation.

The ringing of subscribers by the A operator in her own exchange may be done with an ordinary ringing key, or in any other desired manner. This forms no part of the present invention, except that I may provide the same equipment for the cord circuit in Fig. 1 that is shown for the cord circuit in Fig. 2, the relays r , r' , etc., having their wires 28 and 29 passing then direct to the key K, instead of to the contacts of the relay R^7 . The key K in such case would not be connected to the cord conductor 6, but to the battery wire 10 direct, so that its operation would be precisely the same as that of the armature r^7 in Fig. 2, the only difference being that it is moved by hand instead of by a magnet. The arrangement of the supervisory relay R^5 in connection with the ringing relay R^9 and the commutator D in

such case would be precisely the same as the arrangement of relays R^{10} and R^9 and commutator D in Fig. 2, so that I have not considered it necessary to illustrate this specific variety of the invention. It goes without saying that such selection would not be as useful or necessary for direct key ringing at an A position as it is at the B positions, because at the A positions we can run the generator wires 40, 42, 44 and 46 direct to the keys, without the intermediation of relays. However, there are cases in which it is desirable to have uniformity of apparatus and methods, and in such case I may apply this arrangement as stated.

For the sake of simplicity, I have shown a single key K which the operator presses down a number of times in order to select the desired generator. This key may be replaced in practice if desired by means for automatically sending any number of impulses. Such means are too well known to need detailed description. For example, a plurality of keys may be employed, each one pressed down against the tension of a spring, and directly making and breaking the contacts between the wires 11, 12 and 14, by means of teeth on its shank, or indirectly by means of a toothed wheel to which it is geared. This device may also be in the form of a dial transmitter, having a lever corresponding to the key K, moved by teeth on a spring drum, which is moved forward as many teeth as will correspond to the number desired to be transmitted. Still another form might have the same toothed wheel, and a setting arm fixed to it whereby it could be turned, and when released returned by its spring, moving the contacts a number of times equal to the number of teeth turned around in setting. For further examples I may refer to the entire class of variable signal dial transmitters, under fire telegraphy.

I am aware that sundry changes may be made in the system I have thus described, without departing from the spirit of my invention, and I take this occasion to state that I contemplate all such changes as within the scope of my claims, believing this invention to be broadly novel and original with me.

Having thus described my invention what I claim and desire to secure by Letters Patent is:

1. A trunk ringing system for telephone exchanges comprising means controlled by an A operator for connecting a calling subscriber with a trunk line, means at a B or trunking station for connecting the trunk with the wanted subscriber's line, said line serving more than one subscriber's station, a selective signaling device at each station, a plurality of generating devices associated with the B switching position, and auto-

matic means controlled through the trunk line by the A operator for selecting and connecting the proper generator to ring the bell at the desired station, substantially as described.

2. In a telephone exchange system, subscribers' lines terminating in different switchboards, a trunk line interconnecting said switchboards, an A operator's connective apparatus for connecting a calling line through the trunk with a called line terminating on the other or B switchboard, selective ringing apparatus at the B board, and selective actuating devices at the A board controlling the same through the trunk line, substantially as described.

3. In a telephone exchange system, a plurality of subscribers' lines terminating at different central offices, and trunk lines interconnecting the central offices, means controlled by A operators for connecting said trunk lines with calling subscribers' lines, means controlled by B operators for connecting the trunk lines with wanted subscribers' lines, switching means for selectively ringing the bells at any one of several stations on the same line, with separate setting means for selectively controlling the same through a trunk line when connected, substantially as described.

4. In a telephone exchange system, subscribers' lines terminating on jacks in two different exchanges, a trunk line interconnecting the exchanges, means associated with the trunk line for supplying selective ringing current thereto for use in calling over party lines, impulse actuated switching means coöperating therewith for selective purposes, and a selective impulse transmitter associated with each answering or A operator's apparatus, adapted to be connected through a trunk when in use to the said switching means, substantially as described.

5. In a telephone exchange system, a plurality of subscribers' lines terminating on jacks at different central offices, a trunk line extending between said offices and terminating at one end in a jack and at the other in a plug, A operator's cord circuits for connecting calling subscribers' jacks with the trunk jack, an impulse transmitter associated with one or more of said cord circuits, means for generating current for selective ringing over party lines, and selective switching devices associated with the plug terminal of the trunk for determining the ringing current to be applied thereto, said switching devices adapted to be controlled over the trunk by said impulse transmitter, substantially as described.

6. In a telephone exchange system, a trunk line between exchanges for interconnecting subscribers' lines terminating at the different exchanges, a selective transmitter associated with the originating end of said

trunk, and selective ringing devices at the calling end of the trunk responsive to said transmitter, substantially as described.

7. In a telephone exchange system, means for trunk ringing over party lines comprising a plurality of harmonic generating devices at the calling end of a trunk, an automatic switching device for applying the same selectively to a called line when the trunk is connected thereto, a relay associated with the trunk and controlling said switching device and an A operator's impulse transmitter for controlling said relay through the trunk, substantially as described.

8. In a telephone exchange system, subscribers' lines terminating on jacks in different central offices, a trunk line extending between the offices, an A operator's cord circuit and terminal plugs for connecting a calling line jack with the trunk, an impulse transmitter connected with said cord circuit, a relay responsive thereto connected to the B end of the trunk, selective generating means also at the B end of the trunk, automatic switching devices therefor responsive to said relay, and automatic means for applying a selected ringing current to the called line when the selection has been made, substantially as described.

9. In a telephone exchange system, subscribers' lines terminating in different central offices, a trunk line interconnecting the central offices, a ringing selector at the B end of the trunk, an operator's cord circuit and supervisory signal at the A end of the trunk, an operator's transmitter device for controlling the ringing selector, associated with said cord circuit, and means for disabling the supervisory signal while said transmitting device is being operated, substantially as described.

10. In a telephone exchange system, subscribers' lines terminating at different offices and a trunk line interconnecting the offices, A operator's connective apparatus for connecting a calling subscriber with the trunk, supervisory signals associated therewith, means for connecting the B end of the trunk with a wanted subscriber's line, a ringing selector associated with said means, a clearing out signal also associated with said means, an actuating device for said ringing selector, associated with the A operator's connective apparatus, and relays associated with said connective apparatus and with the trunk responsive to the act of the called subscriber and adapted to control the ringing, substantially as described.

11. In a telephone exchange system, subscribers' lines terminating at different offices and a trunk line interconnecting the offices, A operator's connective apparatus for connecting a calling subscriber with the trunk, supervisory signals associated therewith,

means for connecting the B end of the trunk with a wanted subscriber's line, a ringing selector associated with said means, a clearing out signal also associated with said means, an actuating device for said ringing selector, associated with the A operator's connective apparatus, and relays associated with said connective apparatus and with the trunk responsive to the act of the called subscriber and adapted to control the A operator's supervisory signal and the ringing, whereby ringing current will be removed from the called line and the A operator apprised thereof when the subscriber answers, substantially as described.

12. In a telephone exchange system, trunk ringing means comprising an operator's selective transmitter, a ringing selector responsive thereto at the B end of each trunk, and relays associated with the B end of the trunk for connecting the ringing generator, and responsive to the act of the called sub-

scriber for disconnecting said ringing generator, substantially as described.

13. In a telephone exchange system, trunk ringing means comprising the following instrumentalities: an A operator's cord circuit and an impulse transmitter connected thereto, a plurality of selective ringing generators at the B end of the trunk with automatic switching means responsive to the A operator's transmitter to select any one of said generators, a ringing relay and a commutator controlling the same for connecting the selected generator to the called line, and a trunk relay responsive to the act of the called subscriber to control said ringing relay, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

EDWARD E. CLEMENT.

Witnesses:

E. EDMONSTON, Jr.,
JAMES H. MARR.