W. W. DEAN.

TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED OCT. 18, 1906.

900,489.

Patented Oct. 6, 1908.

2 SHEETS—SHEET 1.

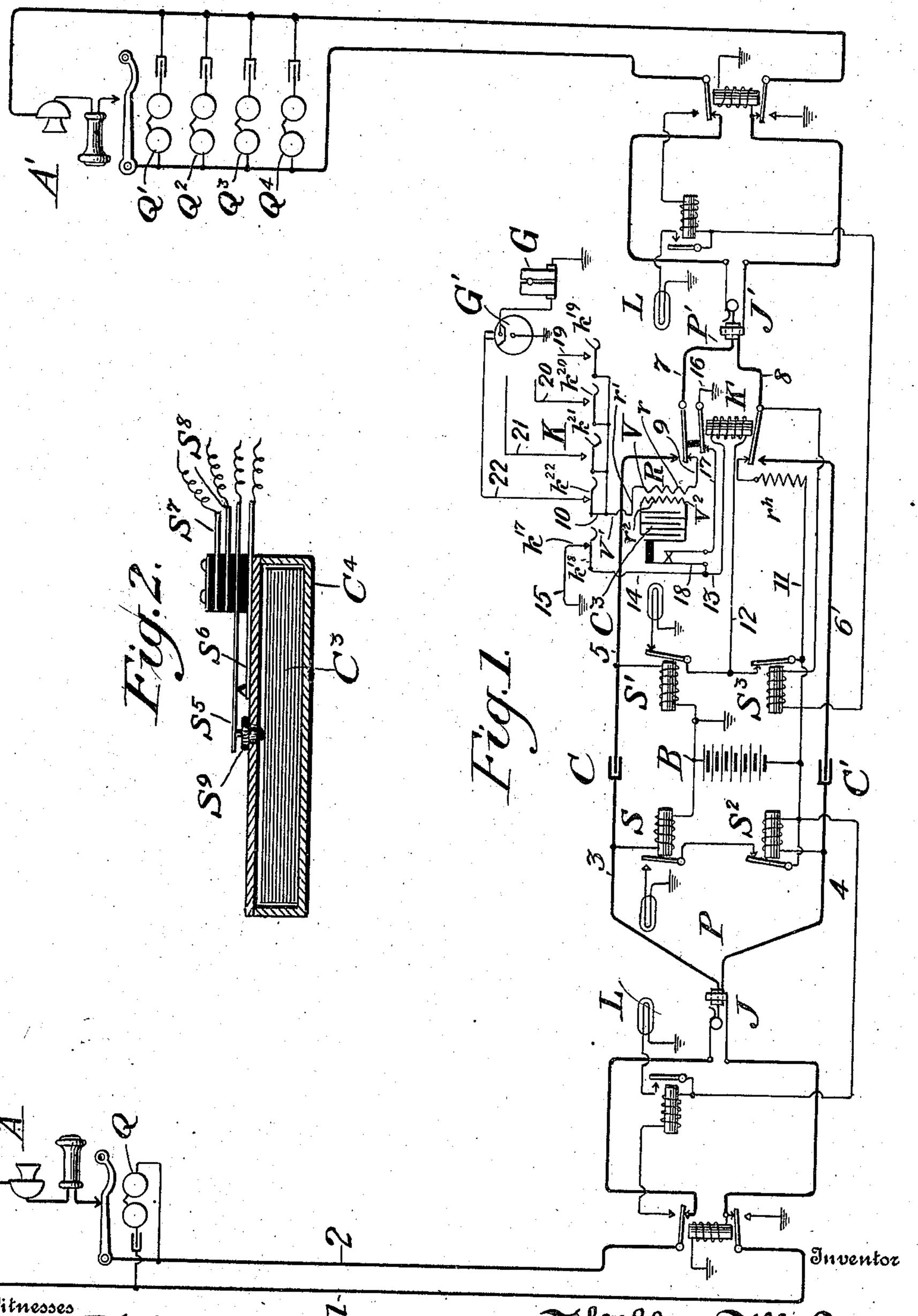

Fig. 1.

Fig. 2.

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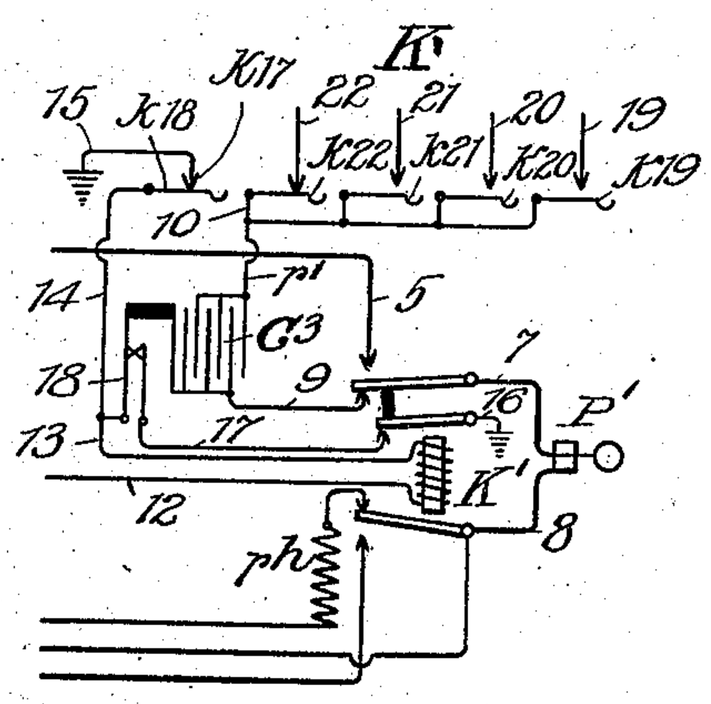
Fig. 3.



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TELEPHONE-EXCHANGE SYSTEM.

No. 900,489. Specification of Letters Patent. Patented Oct. 6, 1908.

Application filed October 18, 1906. Serial No. 339,476.

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to telephone exchange systems and has for its object the improvement of the ringing devices and circuits employed therein.

In the commercial practice of telephony there are a number of conditions to be met in regard to ringing wanted subscribers, which have not heretofore been satisfied. Among these I may mention the necessity for making the operator's work as simple as possible, substituting mechanism in her place wherever practicable, so that said mechanism will perform required operations upon her manual initiation; also the economic condition resulting from raising the standards of exchange construction, and particularly that of the net work of wires and cables in a system, so that the increase in the investment demands the maximum use of the plant at a fixed rate of return, or the maximum rate of return at a fixed use, in order to be profitable, this condition having brought about the general adoption and use of party-lines in cities. Party-line ringing is in many respects a problem by itself, but in my present development of the subject I apply the same principles in its treatment which I employ in ordinary single-party or other ringing, combining therewith the special feature of selection on the part of the operator.

The principal object of my invention is to meet the requirements I have stated, as well as others included in the same category, and in so doing to produce apparatus and circuits for automatic ringing which will be applicable to existing systems as well as new installation, and which for that purpose can be made complete and self-contained in themselves.

A corollary object is the elimination of inductive resistance or other impeding factor in the ringing circuit, and the general improvement of the same in detail.

In attaining my objects I employ as the basis for my scheme of circuits and apparatus, a ringing relay. The operation of this ringing relay is the same whether it be used for single-party lines or for poly-station signaling. It is first energized by the act of the operator, and when energized it performs the important functions of the common ringing key, opening the cord circuit, and connecting the generator circuit across the terminals of the calling plug. In connection with this relay I provide a device responsive to current changes in the subscriber's line, this device maintaining the relay circuit in operative condition, and the relay active, until the subscriber has answered, whereupon the relay is instantly disconnected and the talking circuit thereby restored, clear of all generator connections. This device preferably consists of a loose-leaved condenser associated with an induction coil having a low wound primary. It takes current either from the generator circuit or from the main battery, and the connections are such that it will respond as soon as the subscriber answers, whether the generator is that moment connected, or whether it is during an interval between rings, the battery being then connected. This will be understood when I point out that I preferably employ a commutator in the generator circuit, which puts ringing current on the keys at brief recurring intervals of say two seconds' duration, with intervening intervals of four seconds during which the circuit is grounded, current then coming back over the subscriber's line from the main battery.

In party-line ringing, as in single station line work, the operator simply depresses the proper key, which closes the circuit of the ringing relay, which in turn closes its own locking circuit through the normally closed contact of the static relay, whose primary is included between the generator circuit and the line. Generator current then goes to line at successive intervals, as already stated, until the subscriber answers, when the static relay breaks the locking circuit, the ringing relay lets go, all generator connections are cut off, and the talking circuit is restored.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a diagram showing two subscribers' lines, one having four subscribers' stations connected thereto, and a central office equipment for interconnecting the lines, including my improved ringer devices. Fig. 2 is a longitudinal section showing the way in

which the condenser which I preferably employ operates the contact springs. Fig. 3 shows a modified arrangement without an induction coil.

Referring now to Fig. 1, I have shown therein two subscribers' stations, A, A′, each connected to the central office by line-wires 1 and 2, terminating in the contacts of a cut-off relay, and connected when its relay is energized to the respective jacks, J, J′. Each line has a lamp signal, L, governed by the relay in the usual way, and both lines are supplied with current for all purposes from the common main battery B. To interconnect these lines I show a cord-circuit 3, 4, 5, 6, 7, 8, separated by condensers, C, C′, and provided with the usual supervisory signals controlled by relays, S, S′, S^2, S^3. These relays are bridged across the respective ends of the cord circuit in pairs, with the battery B between them. The conductors 3—4 terminate in the answering plug P, while the conductors 5—7 and 6—8 terminate in the calling plug P′. The combination key K and the ringing relay K′ are associated with this plug P′. Also associated with the plug is a static relay or circuit controller R.

One form of static relay which I may use as shown in Fig. 2, comprises a loose-leaf condenser C^3, inclosed within a suitable casing or box C^4, upon which the contact springs S^6 and S^6, and terminals S^7 and S^8 are mounted, somewhat after the fashion of those on an ordinary magnetic relay. The lower contact springs S^5 and S^6 are normally together, the spring S^5 being longer than the other and having its end overlying the upper end of a shouldered stud S^9 which rests upon the lid of the box with its shank extending down through and held therein to engage the condenser. It is well known that when alternating charges are imparted to the leaves of a condenser, the mutual attractive and repulsive forces which are set up, cause the leaves to flutter unless they are suitably confined. In those condensers used merely for transmission of alternating currents, it is customary to use heavy pressure so as to bring the leaves into intimate relation, which is maintained by fitting the structure into a tight and rigid receptacle. In the present case I may secure the leaves of my condenser at the ends or at any other suitable point or points which will enable their relative lateral positions to be maintained, and prevent the displacing of the interposed insulating sheets, which may be of paraffined paper or any other suitable material. The alternative sheets throughout are connected, one set of sheets being joined to the terminal S^7 and the other to the terminal S^8 as indicated in the diagram of Fig. 1. When the alternating current is sent across these terminals through the condenser, these leaves being unconfined, will swell and subside with considerable aggregate amplitude of movement. This movement lifts the stud S^9 and so lifts the upper spring S^5, and breaks the circuit therethrough. It will be understood that this description of a suitable static relay for my purpose is merely tentative as numerous other types might be substituted without any change in the invention, which relates more particularly to the system rather than to the structure of the condenser, although I shall claim the latter as novel.

It will, of course, be understood that it is not necessary to employ the induction coil shown in Fig. 1, since the condenser might be included directly in the ringing circuit in place of the primary of the induction coil, as shown in Fig. 3. In this figure the circuit connections shown in Fig. 1 are reproduced except that the condenser terminals are connected directly with wire r^1 and wire 9, all of the other circuit connections remaining the same. Only a portion of the complete circuit shown in Fig. 1 is shown in Fig. 3, it being understood that the circuit connections not indicated are identical with those shown in Fig. 1. It is better, however, to have an induction coil, because potentials of the alternating current can then be stepped up, the higher pressure thus obtained being more suitable for working the condenser than the relatively low potential of the ringing current. Another advantage of the induction coil or transformer is that the primary can be made low-wound with comparatively few turns, so that it will offer very little resistance to the current passing through it. A condenser connected directly in any circuit always offers a certain amount of retardation and in order to avoid this, a low-wound primary is preferably used.

As shown in Fig. 1, the circuit controller R comprises an induction coil whose primary r is connected directly in the ringing circuit by the wire r' and the secondary r^2 of the induction coil has its terminals connected to the respective sets of sheets of the condenser C^3. The secondary r^2 is electrically disconnected from everything else except the condenser C^3, but the primary r forms a part of the common generator circuit 9—10 passing to the key K, and having branches to all the springs k^{19}, k^{20}, k^{21}, k^{22}. The relay K′ is included in a circuit, 11, 12, 13, 14, 15, passing through the springs, k^{17}, k^{18}. This circuit is closed, from the main battery to ground, when any one of the plungers is pressed all the way down so as to close together the springs, k^{17}, k^{18}. As soon as the relay attracts its armatures, owing to this closure, it locks itself through the supplemental circuit, 16, 17, 18, which passes through normally closed contacts of the static relay R. I have shown the station A equipped with a ringer Q, and the station A′ with a ringer Q′. Ringers Q^2, Q^3, Q^4 symbolize three other s...

tions connected across the same circuit, 1—2, as the station A′. Any one of the ringers Q′, Q², Q³, Q⁴ may be operated by sending out to line a current of the proper frequency; since all the ringers are wound in a manner well understood in the art. In order to furnish proper currents for this selection, I provide four generators or other sources of current, connected to the four wires 19, 20, 21 and 22, leading to the four plunger springs in the key K. I have shown but one of these sources of current, marked G, and connected from ground to the wire 22 through the constantly driven commutator G′, which has a segment insulated for the generator and the rest of its periphery grounded. The proportions of the grounded and generator segments may be varied at will, but they are preferably such and the speed of revolution is so adjusted, that the source of current, G, will be connected to the wire 22 for two seconds, and the wire will be grounded for four seconds, in each revolution. The four generators G may be and preferably are common to the whole exchange, the wires 19, 20, 21 and 22 being taken off from the different commutators to the various keys at the different operators' positions.

The operation of the system thus described is as follows: Assuming subscriber A to have called, and the call to have been answered in the usual way, also that the calling plug P′ has been inserted in the jack J′ of the wanted line, if the wanted line is a single-party line, the operator closes the springs k^{17}, k^{18}, by depressing a plunger, whereupon the relay K′ becomes energized by current from the main battery B, and draws in its armatures, as shown in Fig. 1, thereby opening the cord conductors 5—7 and 6—8, and connecting the portions 7 and 8 to the wires 9, 11, respectively. The wire 9 thus leads from the tip of the plug through the wire r^3 to wire 10, to key K, to generator, and ground; on the other side the wire 8 goes to main battery through the resistance r^h. The locking circuit for the relay K′ is as follows; B, 11, 12, K′, 13, 18, r', 17, 16, ground. As long as the static relay remains in normal condition the relay K′ would therefore remain energized, maintaining the generator connected to the wanted line. It will be observed that so far as single party ringing is concerned all of the springs k, 19, k^{20}, k^{21}, k^{22} could be done away with, a single pair of springs being substituted therefor, to connect a single generator to the wire 10. When the called subscriber answers, his telephone T, becomes bridged across the line 1- -2 in place of his ringer Q′ thus substituting a low resistance for a relatively high one and thereby permitting a very large increase in the generator current flowing in the line. The static relay R is so proportioned and adjusted that the amount of current required to actuate a subscriber's ringer, as limited by the resistance thereof, is insufficient to expand the condenser C³ enough to break the contact springs S⁵ and S⁶. When the subscriber has bridged his telephone, the consequent increase in current through the primary r throws a high potential current through the condenser C³ from the secondary r^2, so that it expands and causes the plug S⁹ to press the spring S⁵ away from the spring S⁶, thereby opening the normally closed contacts and breaking the circuit 16, 17, 18. As soon as this is broken, the relay K′ releases its armature and cuts off the generator, at the same time restoring the continuity of the cord conductors. It will, of course, be understood that the operation of a single party line will be substantially identical with the one just described with the exception that the ringing key K would only have one set of contact springs.

I am aware that many changes may be made in the apparatus and some changes in the circuits, which I have herein set forth, without altering the characteristic essential features of my invention, and all such changes are contemplated by me and are to be taken as within the scope of my claims.

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

1. In a telephone exchange system, an operator's cord circuit and calling plug, a ringing relay adapted to connect the generator to line, and a static relay controlling the ringing relay.

2. An automatic ringing device for telephone systems, comprising a ringing relay having line and generator connections, an operator's key adapted to momentarily close the relay circuit, short circuit contacts controlled by the relay so that when energized it will lock itself, and statically operated means controlled by the wanted subscriber to break the relay locking circuit.

3. In a telephone system, a cord circuit automatic ringing device comprising a ringing relay, an operator's key adapted to temporarily close the circuit of said relay, a locking circuit closed through itself by the relay when energized, and statically operated means then becoming associated with the wanted subscriber's line circuit, adapted to break said locking circuit when the subscriber removes his telephone.

4. In a telephone system, a cord circuit automatic ringing device comprising a ringing relay, a generator circuit adapted to be connected to line, a locking circuit closed by the relay through itself when energized, statically operated means for breaking the locking circuit, and means included in the generator circuit adapted to control said statically operated means.

5. In a telephone system, a cord circuit

automatic ringing device comprising a ringing relay, a generator circuit adapted to be connected thereby to line, a locking circuit closed by the relay through itself when energized, means for breaking the locking circuit, and an induction coil responsive to an act of the called subscriber for operating the locking-circuit-breaking means.

6. In a telephone system, a cord circuit automatic ringing device comprising a ringing relay, a generator circuit adapted to be connected thereby to line, a locking circuit for said relay closed by itself when energized, means responsive to an act of the called subscriber, static means associated with said responsive means for breaking the locking circuit, and a manual key under the control of the operator for initially closing the circuit of the ringing relay.

7. In a telephone exchange system, an operator's cord circuit and calling plug, a ringing relay associated with said cord plug and adapted to connect generator circuit thereto, an operator's ringing key for connecting a generator to said generator circuit, means controlled in the use of said ringing key for energizing the relay, and a current responsive static device thereafter included in the ringing generator circuit and controlling said relay.

8. In a telephone exchange system, an operator's cord circuit and calling plug, a ringing relay associated with said cord plug and adapted to connect generator circuit thereto, an operator's ringing key for connecting a generator to said generator circuit, means controlled in the use of said ringing key for energizing the relay, a locking circuit for the relay, a static condenser for breaking the locking circuit, and a current responsive device thereafter included in the ringing generator circuit and controlling said static condenser.

9. In a telephone exchange system, an operator's cord circuit and calling plug, a generator, a ringing relay associated with said cord plug and adapted to connect generator circuit thereto, an operator's ringing key for connecting a generator to said generator circuit, means controlled in the use of said ringing key for energizing the relay, a locking circuit for the relay, a static condenser for breaking the locking circuit, and an induction coil thereafter included in the ringing generator circuit and responsive to an act on the part of the called subscriber for operating said static condenser.

10. In a telephone system, automatic ringing means comprising a ringing relay, a generator adapted to be connected thereby to line, a locking circuit closed by the relay through itself when energized, contacts for breaking the locking circuit, and static means responsive only to current of large volume in the line as determined by the act of the called subscriber, for opening said contacts.

11. In a telephone system, connective means, and associated automatic ringing means comprising a ringing relay, a generator adapted to be connected thereby to line, a locking circiut closed by the relay through itself when energized, normally closed contacts in the locking circuit, a loose leaf condenser adapted when highly charged to expand and open said contacts, means included in the generator circuit for producing a large potential difference across said condenser, and means controlled by the subscriber in answering to augment the amount of current in the circuit, without lowering the potential.

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

WILLIAM W. DEAN.

Witnesses:
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