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Patented May 15, 1900.

W. D. GHARKY.
TELEPHONE EXCHANGE SYSTEM.

(Application filed Apr. 21, 1899.)

(No Model.)

2 Sheets—Sheet 1.

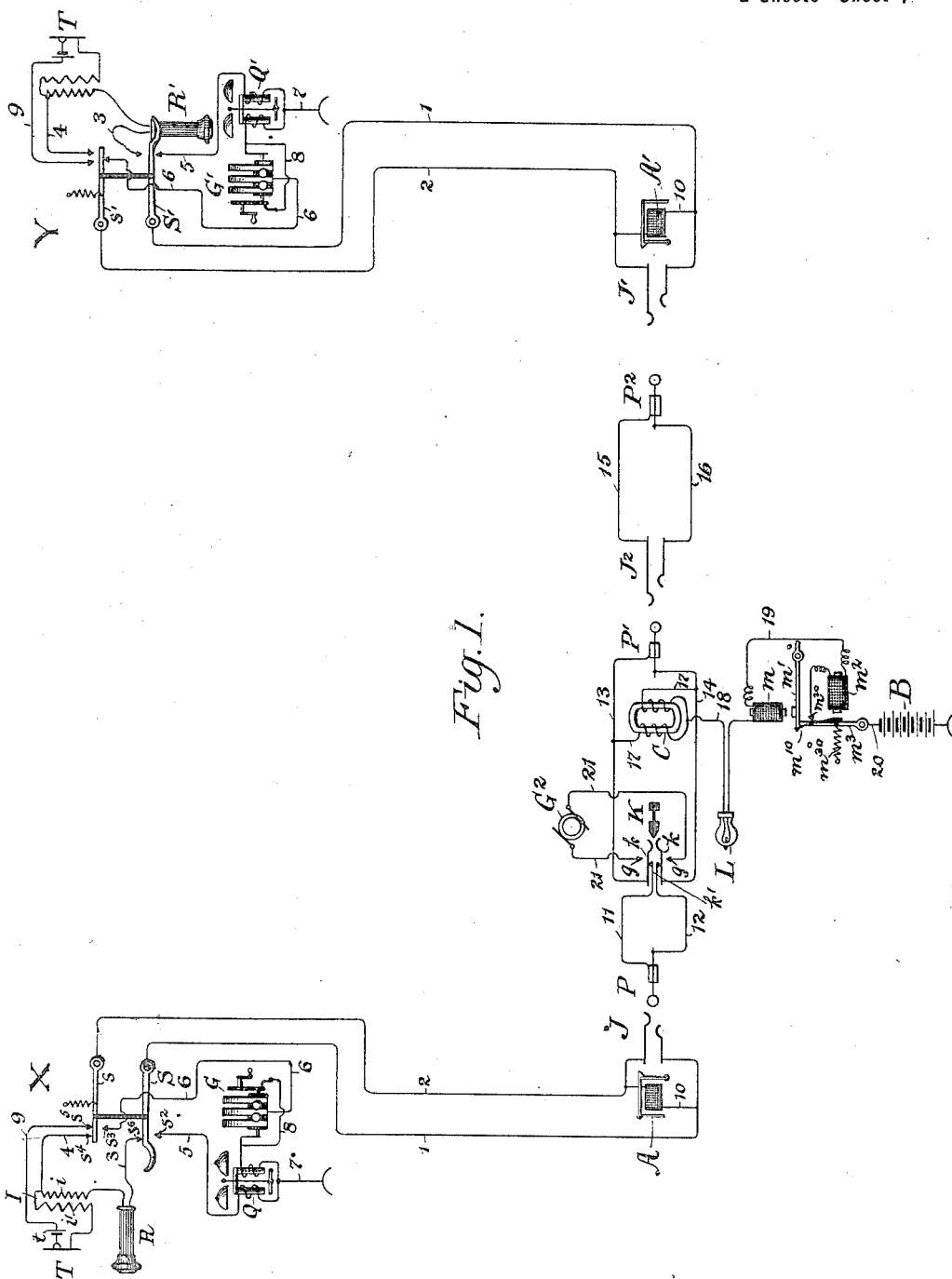


Fig. 1.

Witnesses.

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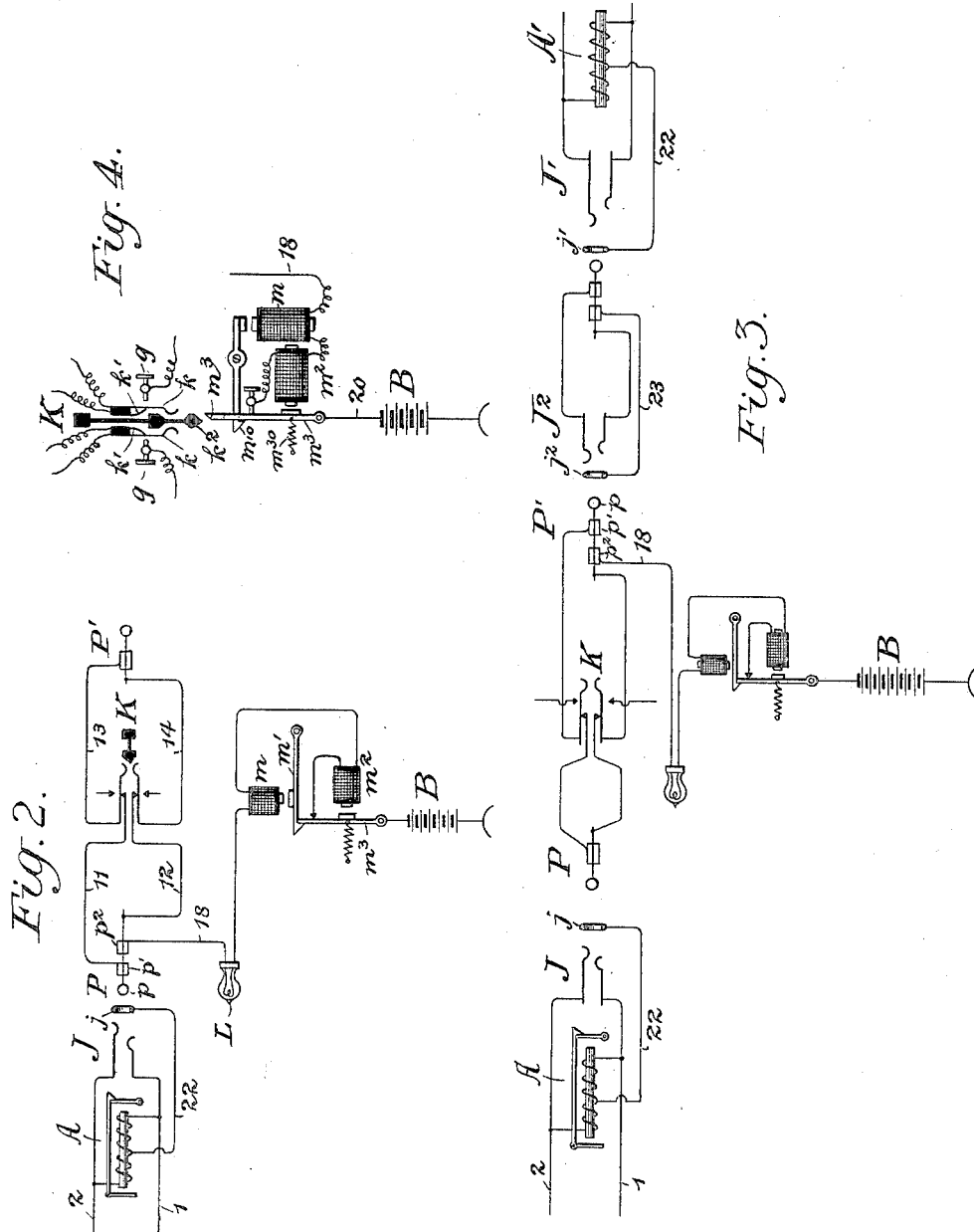
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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 649,868, dated May 15, 1900.

Application filed April 21, 1899. Serial No. 713,880. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM D. GHARKY, a citizen of the United States, residing in the city of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof, in which the same letters and numerals of reference point out the same parts throughout.

My invention relates to telephone-exchange systems, and particularly to systems wherein each subscriber has but a single line-terminal and connection between subscribers' lines whose terminals are not upon the same board-section is effected through the agency of trunk or transfer lines. I have found it expedient in such cases to localize the responsibility for the through connection as much as possible, and for that purpose the answering operator is required to perform all of the work incident to a complete connection except the actual connection and a disconnection of the trunk or transfer plug. Such localization of responsibility requires that the answering operator shall have a means of supervising as well as controlling each step of the connection. It is the direct object of this invention to furnish such a supervisory means of improved arrangement and design.

In attaching signals to telephone-circuits it is frequently found convenient to employ ground-taps, and part of this invention depends upon the use of such ground-taps; but as grounds upon telephone-lines are always objectionable and are liable to cause trouble during conversation according to this invention all grounds are removed from the lines during conversation.

Referring to the accompanying drawings, Figure 1 is a diagrammatic representation of two telephone-stations connected with central station, together with the apparatus for interconnecting the lines. Figs. 2, 3, and 4 are similar representations of certain modified circuits and apparatus.

In Fig. 1, X and Y are two subscribers' stations connected, respectively, at the central

station to spring-jacks J and J'. In proximity to the spring-jacks annunciators A and A' are connected each in a bridge 10 across its pair of line-wires. The apparatus at the two subscribers' stations is exactly the same in every respect, and the parts are lettered the same, with the exception of exponents, so that the following description of station X will suffice for both.

The line-wires 1 and 2 terminate at the subscriber's station in two movable members of a switch-hook S s. These two members are mechanically connected by a piece of insulating material or by an insulated piece of any sort, so as to move together. The member S carries the usual bifurcated support for a telephone-receiver R, the weight of which is adapted to move the entire switch in one direction, while a suitable spring is arranged to move it in the other direction when the receiver is removed. When the receiver is upon the hook, the latter rests upon a contact s², its other member s resting upon a contact s³, the contacts s² s³ forming terminals of a circuit 5 6, containing a hand-generator G and a ringer Q. The generator is provided with the usual shunt connection 8.

When the hook-switch rises, the line-wires are disconnected from the circuit 5 6 and through contacts s⁴ and s⁶ are brought into connection with circuit 3 4, containing the receiver R and the secondary winding i of the induction-coil I. At the same time the switch member s, making contact with the terminal s⁵, closes the local circuit 4 9, containing the transmitter T, the local battery t, and the primary winding i' of the induction-coil.

The middle point of the windings of each ringer Q Q' is connected by wire 7 to ground. It should be noted, however, that when the receivers are off the hooks and conversation is going on these grounds are not in any way connected with the line.

At the central station connection between subscribers' lines whose terminals are upon the same board is directly effected by means of a pair of plugs P and P', forming the terminals of a cord-circuit 11 12 13 14. This circuit is normally completed through anvils k' and springs k of a ringing-key K, the depres-

sion of whose button, however, is adapted to separate the springs from the anvils and cause them to impinge upon terminals *g* of the circuit 21 21 of a calling-generator *G*².

5 It will be observed that by such operation the answering-plug and the calling-line receive no current, but that the calling-plug is connected to the generator.

Bridged across the conductors 13 14 is a 10 wire 17, forming the terminals of equal windings on an impedance-coil *C*. The middle point of these windings is connected by a wire 18 to a lamp *L* and thence to a magnet *m* by wire 19, to a magnet *m*², to and through the 15 contact *m*²⁰ and armature *m*³, and by wire 20 to battery *B* and to ground. The armature *m*³ is normally held up against the contact *m*²⁰ by a hook *m*¹⁰ on the end of an armature *m*¹, which is under the control of the magnet 20 *m* and is pivoted at its opposite end, so that it is retracted from the magnet by gravity alone. The armature *m*³, on the other hand, is adapted to be retracted from the magnet *m*² by a spring *m*³⁰, and in order to make the 25 action of the armature quick and sensitive the spring is given some tension and is located so as to produce a pull directly opposite to that of the magnet.

The apparatus thus far described is sufficient for interconnection of lines on the same 30 board; but for lines located upon different boards trunk-lines are employed, each having a jack *J*² at the answering-board and a plug *P*² at the calling-board, connected with each 35 other by conductors 15 16.

The description of the operation will be confined to a trunk or transfer connection, as connection upon one board is the same, omitting the trunking.

40 Supposing that subscriber *X* desires to converse with subscriber *Y*, he first operates his generator *G* and then removes his telephone from the hook and awaits a response. The current from the generator rings his own 45 bell and also throws down the drop of the annunciator *A* at central. The answering operator, perceiving the signal, restores the drop and inserts plug *P* in jack *J*, at the same time asking the number wanted. I have not shown 50 the operator's circuit nor the instruction-circuit between operators, as these are of any suitable and well-known type and if shown would unnecessarily complicate the drawings. Having ascertained the number re- 55 quired to be *Y*, the operator inserts the plug *P*¹ into the jack *J*² of a trunk-line leading to *Y*'s board. At the same time if the armature *m*³ of the magnet *m*² is not in the position shown in Fig. 1 the operator places it 60 so. The number is communicated by the answering operator to the trunk operator at the other board through the usual instruction-circuit, whereupon the trunk operator inserts the plug *P*² into the jack *J*¹ of the wanted 65 line. As soon as this connection is made a circuit is completed for the main battery *B* as follows: By wire 20 to armature *m*³, contact

*m*²⁰, magnet *m*², wire 19, magnet *m*, wire 18, lamp *L*, and wire 18 to and through the windings in parallel of the impedance-coil *C*, by 70 wire 17 to conductors 13 14, and thence through the two sides of the trunk-line in parallel and through the line-wires 1 2 of the wanted line in parallel to switch members *S*¹ *s*¹, wires 5 6, shunt 8, windings in parallel 75 of [the ringer *Q*¹, and wire 7 to ground and back to battery. It must be observed that the ground being on a subscriber's line only when his hook-switch is depressed the calling subscriber having his telephone off the 80 hook affords no path for this current. The flow of current in this circuit from battery *B* causes the lamp *L* to glow and both magnets *m* and *m*² to attract their armatures. The answering operator perceiving the lamp 85 *L* to glow knows that the line is connected clear through and proceeds to depress the button of the ringing-key *K* to throw calling-current thereupon. This current passing 90 over the metallic circuit actuates the ringer *Q*¹. Subscriber *Y*, answering the call, removes the receiver *R*¹ from his hook, whereupon the latter rises, closes his line and local talking circuits, and simultaneously throws off the ground. This breaks the circuit that pre- 95 viously existed for current from battery *B*, and both magnets *m* and *m*² are therefore de-energized at the same instant and the lamp *L* is extinguished. The armatures of the two magnets start to retract together; but the armature *m*³ moves more quickly by reason of 100 its spring, (the other armature being influenced solely by gravity,) and therefore gets outside of the hook *m*¹⁰ before the latter has descended far enough to restrain it. The circuit from ground through the battery *B* to 105 line is thus interrupted between armature *m*³ and contact *m*²⁰ and so remains until the subscribers have finished their conversation and rung off, which they accomplish by hanging 110 up their receivers and again energizing the magnets of the annunciators *A* and *A*¹.

Figs. 2, 3, and 4 illustrate modifications of the system thus described, whereby the impedance-coil *C* is done away with, and instead of the wire 18 being connected thereto 115 it is adapted to be prolonged to the middle point of the windings of one of the line-annunciators.

In Fig. 2 each annunciator *A* has a wire 22 120 taken off from the middle point of its winding and connected to a third contact in the jack, shown as a thimble *j*. The answering-plug is here provided with three contacts *p*, *p*¹, and *p*². The first two make contact with 125 the ordinary jack-springs and the last co-operates with the contact-thimble *j* and is the terminal for the wire 18. The operation in this case is precisely the same as before, the annunciator *A* constituting an impedance- 130 coil and its location being a matter of indifference as long as it is bridged across some portion of the through-circuit. There is one difficulty, however, to be overcome, which is

that with the apparatus shown in Fig. 2 when the trunk-plug has been inserted and the magnets m and m^2 have attracted their armatures the operation of the ringing-key will break the ground-circuit, and thereby cause the armatures to retract and a false signal to be given. To overcome this, the construction shown in Fig. 4 has been designed. Here the spindle of the ringing-key is provided with a projection k^2 , which when the ringing-key is depressed passes behind the upper end of the armature m^3 and holds the same up until the hook m^{10} again engages it. Another way of overcoming this difficulty is shown in Fig. 3, where the wire 18 is connected to the third contact p^2 on the plug P' and is prolonged through a thimble j^2 in the trunk-jack J^2 and a third conductor 23 in the trunk-circuit to a similar contact on the trunk-plug. All of the lines are provided with thimbles j, j' , connected by wires 22 to the middle point of the line-annunciator windings. It will be observed that by this method of connection the wire 18 is put to line between the called subscriber and the ringing-key, and hence can never be cut off by the latter from the former.

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

1. In a telephone-exchange system, a subscriber's station and a central station, and a line connecting the two, a connective circuit at the central station, a signal-circuit, a switch normally maintaining the same in connection with the connective circuit, a magnet included in said signal-circuit and controlling the switch, and a generator connected thereto, together with a branch from the other side of said generator to the subscriber's station where it is normally, while the apparatus is in disuse, maintained in connection with the subscriber's line, and means controlled by the subscriber for disconnecting the generator branch from his line, substantially as described.

2. In a telephone-exchange system, a central station, subscribers' stations, and circuits connecting each subscriber's station with the central station, connective circuits at the central station, a signal-circuit for each connective circuit normally connecting the latter through a generator to ground, a supervisory signal therein, a switch for the signal-circuit, a magnet controlling the switch and included in said circuit, and a ground-tap at each subscriber's station normally in connection with his line-circuit, and adapted to complete said signal-circuit on the completion of a connection, but adapted to be disconnected therefrom when the line is switched for conversation, substantially as described.

3. In a telephone-exchange system, a central station, and subscribers' stations connected therewith by lines terminating in spring-jacks thereat, connective cord-circuits terminating in plugs to interconnect said jacks, a signal-circuit for each cord-circuit,

with a switch for holding the same normally connected thereto, a detent for said switch to hold it closed, the switch being adjusted to retract quickly when released, and the detent being adjusted to move sluggishly, a pair of magnets included in the signal-circuit and controlling the switch and detent respectively, a grounded generator connected to the signal-circuits, and a ground-tap at each subscriber's station normally connected to his line-circuit, but adapted to be disconnected therefrom when the line is switched for conversation, substantially as described.

4. In a telephone-exchange system, a central station, subscribers' stations, and lines connecting the latter with the former, connective circuits and a signal-circuit for each connective circuit with a switch normally completing a connection between the two, and a detent for keeping said switch closed, a pair of magnets in each signal-circuit, both acting simultaneously, one to remove the detent from the path of the switch and the other to hold the switch as long as the signal-circuit remains intact at other points, and means at each subscriber's station for breaking the signal-circuit when its connective circuit is attached to his line, substantially as described.

5. A switch for supervisory signal-circuits consisting of a movable member forming a part of the circuit, relatively-fixed members, a detent for maintaining the movable members in closed relation with said fixed members, a pair of magnets in series with the switch-contacts, one magnet controlling the movable member and the other controlling the detent, substantially as described.

6. In a telephone-exchange system, a central station, subscribers' stations and circuits connecting the former with the latter, connective circuits at the central station, a signal-circuit normally joined to each connective circuit, having a branch entering each subscriber's station and there normally completed through his line, but interrupted at the central-station terminal thereof, means controlled by the operator in effecting connection with a line to complete the entire signaling-circuit and means under the control of the subscriber for thereafter breaking the same, substantially as described.

7. In a telephone-exchange system, a central station, subscribers' stations, and line-circuits connecting the latter with the former, connective circuits at the central station, a signal-circuit connected from each connective circuit to a generator and ground, a normally-closed switch included in said signal-circuit and a magnet also in said circuit adapted to hold the switch closed as long as the circuit remains intact at other points, and a ground-tap at each subscriber's station normally connected to the subscriber's line-circuit, but adapted to be disconnected therefrom by the act of switching a line for conversation, whereby when an operator makes connection

with a line the signal-circuit will be closed, and when the subscriber responds by switching the line for conversation the signal-circuit will be broken, and thereafter the line
5 will remain free from grounds, substantially as described.

In testimony whereof I have hereunto set

my hand, in the presence of two witnesses,
this 18th day of April, A. D. 1899.

WM. D. GHARKY.

Witnesses:

ANDREW V. GROUPE,
EDWARD E. CLEMENT.