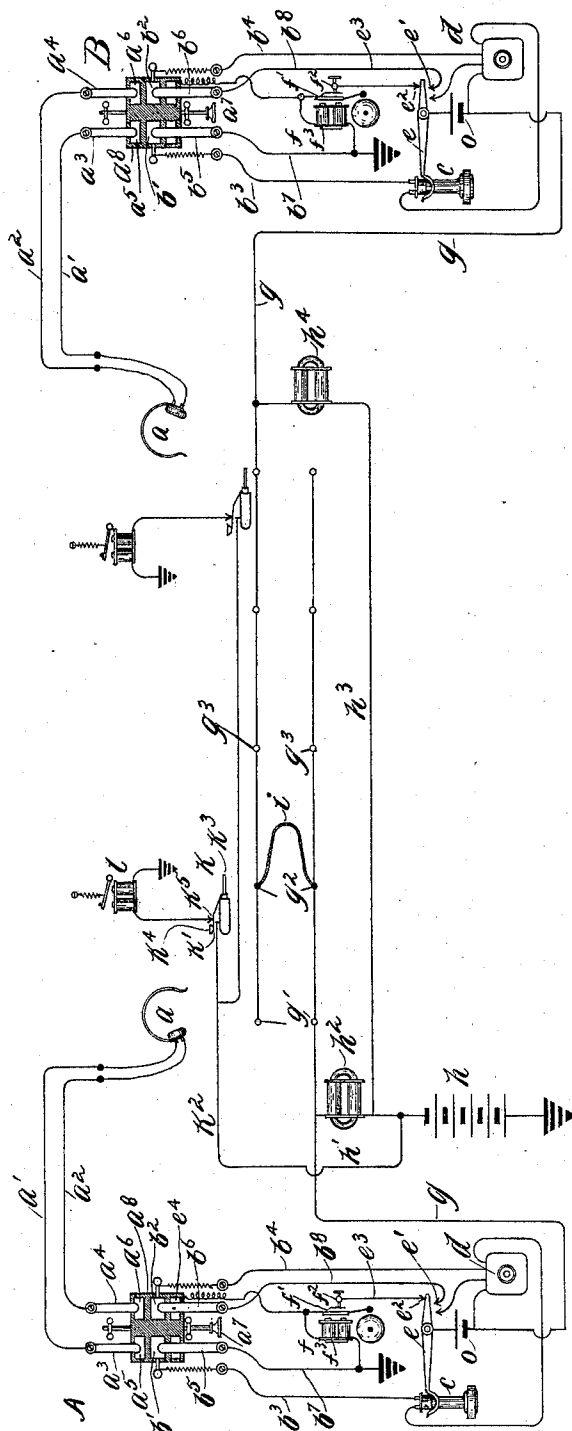


W. W. DEAN.
TELEPHONE SYSTEM.

No. 540,239.

Patented June 4, 1895.

Fig. 1.



Witnesses:
George L. Cragg.
W. Clyde Jones.

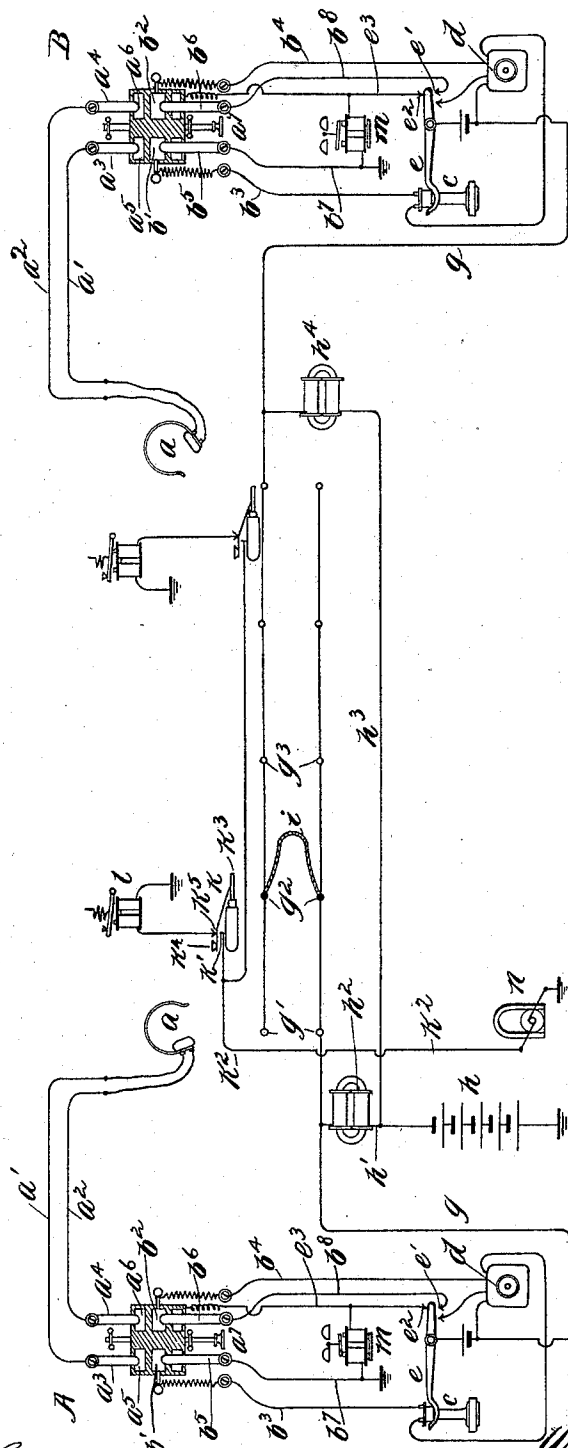
Inventor:
William W. Dean.
By Barton Brown
Attorneys.

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Fig. 2.



Witnesses:
George L. Bragg.
W. Clyde Jones.

Inventor:
William W. Dean.
By Bacton & Brown
Attorneys.

UNITED STATES PATENT OFFICE.

WILLIAM W. DEAN, OF ST. LOUIS, MISSOURI, ASSIGNOR TO THE BELL
TELEPHONE COMPANY OF MISSOURI, OF SAME PLACE.

TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 540,239, dated June 4, 1895.

Application filed February 21, 1895. Serial No. 539,211. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at St. Louis, in the State of Missouri, have invented
5 a certain new and useful Improvement in Telephone Systems, (Case No. 3,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.
10

My invention relates to telephone systems, and more particularly to a system of that class commonly known as the Law system.

The object of my invention is to provide
15 improved means for testing at one of the multiple boards to determine whether a line is busy and a connection has been made therewith at another of the multiple boards.

A further object of my invention is to replace the primary battery usually employed
20 in the local circuit at the subscriber's station containing the transmitter by a storage battery located in the main telephone line and adapted to be charged by a battery at the
25 central station.

The idea broadly of substituting a storage battery for the primary battery in the local circuit is not new with me, my invention consisting in the circuit connections whereby this
30 feature may be adapted to the Law system. According to the Law system, the substation is connected with a head telephone worn by the operator at the central station by means of a talking circuit and the subscriber by depressing a key connects his telephone in circuit
35 with the operator's telephone and gives the number of his own telephone and that of the called subscriber. The operator then picks up a plug connected with a source of
40 electricity, as a battery, and touches the tip of the plug to the spring jack of the calling subscriber, thus completing circuit through his bell to sound the same and inform him that his call has been received. The subscriber
45 then releases the key and thus cuts his telephone out of circuit with the operator's telephone. To determine whether or not the called subscriber is busy, that is, whether or not his line is connected with another line at
50 some other of the multiple boards, it has been the practice for the operator to touch the tip

of her testing plug, which is connected with a source of current, to the spring jack of the called subscriber. If the subscriber is busy and his telephone is removed from its hook,
55 the circuit through the subscriber's bell will be open and the operator listening at her telephone will hear no sound except the single click caused by the closing of the circuit when the tip of the plug touches the spring jack,
60 and will know that the line is busy. If, on the other hand, his telephone be hanging on its hook, the current from the central station will pass through the subscriber's bell, which is of the direct current, make and break
65 type, thus ringing the bell. The making and breaking of the circuit by means of the bell produce an interrupted current on the line which causes a buzz or rapid clicking sound in the operator's telephone or relay, thus
70 informing the operator that the line called for is not busy. By the act of testing, the bell of the called subscriber is rung and his attention is thus called to the fact that he is wanted at the telephone. This production of
75 an interrupted current on the line in the act of testing is objectionable, as thereby currents are induced on the neighboring lines which cloud or destroy the voice currents thereon, and it is the object of my invention
80 to provide means for testing without the production of such interrupted current.

At the central station I provide a battery which is connected with each of the lines of the exchange or with each of a group of lines
85 by branches, the branches connecting the battery with the several lines being in multiple with one another, and a resistance coil being placed in each branch to cut down the current flowing over the line and through the
90 subscriber's bell to such an extent that the passage of the current through the bell will not ring the same. All the spring jacks in the exchange are thus connected with a source of current and the operator is provided with a
95 testing plug connected through a sounding relay whereby she may connect her relay in circuit with the battery, by touching her testing plug to the spring jack of the called subscriber. If the line be not busy current will
100 flow from the battery through the branch circuit connecting the battery with the line and

through the sounding relay, but the current will be of insufficient strength to sound the relay; and the operator hearing no sound, will know that the line is not busy. Should the line be connected with another subscriber, current from battery will flow through two of the branch circuits to the testing plug and sounding relay, and as the current is thus of greater strength, having two parallel paths through the branches containing the resistance, the sounding relay will be actuated, thus informing the operator that the line called for is busy. I am enabled to utilize the battery thus provided for testing purposes at the central station for charging the secondary batteries placed in the subscribers' local circuits, resistances placed in the branches connecting the battery with the lines serving to cut down the current so that a small volume of current flows from the battery over the line and through the subscriber's bell. The storage battery of the subscriber is placed in the main line circuit, and is thus charged while not in use.

I will describe my invention with reference to the accompanying drawings, in which—

Figure 1 illustrates two subscribers' lines connected together for conversation in accordance with my invention, the sub-stations being provided with direct-current make-and-break bells. Fig. 2 is a similar view showing the sub-stations provided with alternating-current or magneto bells.

Like letters refer to like parts throughout both the figures.

The operator's head telephone *a* is connected by lines *a'* *a''* with springs *a³* *a⁴* which rest upon contacts *a⁵* *a⁶* provided upon a plate adapted to be moved by key *a⁷*. Upon the plate *a⁸* are also provided contacts *b'* *b²*, between which are connected by conductors *b³* *b⁴* the subscriber's receiver *c* and the secondary of his transmitter *d*. Upon the contacts *b'* *b²* rest springs *b⁵* *b⁶*, the spring *b⁵* being connected to ground by a conductor *b⁷* and the spring *b⁶* being connected by a conductor *b⁸* with a contact *e'* against which the switch lever *e* is adapted to rest when the telephone is removed from the hook. The switch lever *e* normally makes connection with contact *e²* connected through the make and break contacts *f'* *f²* of a vibratory bell *f*, the end of the conductor *e³* being connected with a contact *e⁴* provided upon the sliding plate *a⁸*. Between the conductors *e³* and *b⁷*, the electromagnet *f³* of the bell is connected. The switch hook *e* is connected with the central station by a line *g* connected with spring jacks *g'* *g²* *g³*, &c., upon the several switchboards at the exchange.

The line *g* is connected with the pole of the grounded battery *h* by means of a branch wire *h'* containing a resistance coil *h²*. The apparatus of subscriber B, shown at the right, is the same as that provided in connection with subscriber A, and the parts have been

indicated by similar reference letters. The line *g* of subscriber B is connected with the pole of battery *h* by means of a branch *h³* containing a resistance coil *h⁴*. The operator is provided with a number of connecting cords *i*, provided with plugs upon the ends adapted to be inserted into the spring jacks of two lines to connect the same together. Each operator is provided with a testing plug *k* carrying an insulated contact point *k'* which is connected by means of conductor *k²* with the pole of battery *h*. The tip *k³* of the plug is connected with a key *k⁴* normally resting against a contact *k⁵* connected to ground through a sounding relay *l*. When the key *k⁴* is depressed, connection with contact *k⁵* is broken and key *k⁴* closes against contact *k'*, thus connecting the tip *k³* of the plug with conductor *k²*.

When the telephone is removed from its hook, the hook engages contact *e⁴*, thus closing the circuit of battery *o* through the primary of induction coil *d*, the battery *o* being a storage battery, and placed in the main telephone line so that normally current from battery *h* passes through the branch *h'* over telephone line *g* through battery *o* and to ground through the subscriber's bell. The resistance coil *h²* placed in the branch *h'* is of such magnitude that the current traversing the bell will be insufficient to ring the bell but will gradually charge the battery *o*. Supposing subscriber A is desirous of talking with subscriber B, he depresses key *a⁷*, thus bringing the contact plates *b'* *b²* into engagement with springs *a³* *a⁴*, the subscriber's receiver *c* and transmitter *d* being thus connected in circuit with the head telephone *a* of the operator. The subscriber then repeats his own number and that of the called subscriber. To notify the calling subscriber that the order has been received, the operator takes up the plug *k*, depresses key *k⁴* and touches the tip of the plug to the spring jack of the calling subscriber. Circuit is thus closed from battery *h* over conductor *k²* to the tip of the plug, and thence through the spring-jack over line *g* of subscriber A to his telephone hook *e*, contact point *e'*, conductor *b⁸* to spring *b⁶*, thence to contact plate *e⁴* (the key *a⁷* being depressed) thence by conductor *e³* through the electromagnet *f³* of the bell to ground. The hammer of the bell thus makes a single stroke to notify the calling subscriber that his order has been received. He then releases key *a⁷*, which is returned by means of a spring to the position illustrated. The operator then touches the testing plug *k* to the spring jack of the called subscriber, that is, the line of subscriber B. If subscriber B be not busy, current will flow from battery *h* through branch *h³* and resistance coil *h⁴*, thence through the spring jack, testing plug and sounding relay *e*. The current thus flowing being of insufficient strength to operate the relay, the operator knows that the line is

not busy, and connects the two lines by the cord set *i*, one of the plugs being inserted in a spring jack of each subscriber.

If the line of subscriber B were connected at another board, current would flow through two of the branch circuits to the test plug. Thus if two lines be connected as illustrated, and the test plug be touched to spring jack *g*³, current will flow from battery *h* to spring-jack *g*³ by two paths, one path through branch *h*¹ and resistance coil *h*², and the other path through branch *h*³ and resistance coil *h*⁴. Sufficient current is thus directed through the sounding relay to actuate the same, and the operator is thus informed that the line is busy. The testing plug being inserted in the spring-jack of the called subscriber, and it being determined that the line is not busy, the operator depresses the key *k*⁴, thus sending current from battery *h* over conductor *k*² through the testing plug and spring jack, and line *g* of subscriber B, thence through his telephone hook *e*, to contact *e*² and to ground through his bell, the bell being thus rung to call the attention of the subscriber.

In Fig. 2 I have illustrated a modification of the subscriber's station apparatus and also of the ringing apparatus at the central station, the vibratory bell being replaced by a magneto or alternating current bell *m* connected between the conductors *e*³ and *b*¹, the make and break contacts *f*¹ *f*² interposed in the conductor *e*³ being thus dispensed with. At the central station a generator *n* is provided for ringing purposes, being connected with the insulated contact *k*¹ upon the testing plug by conductor *k*².

The resistance coils *h*² *h*⁴ should possess sufficient retardation effect to prevent the shunting of the voice currents passing over the line. When an alternating current generator is provided at the central station for calling purposes, and a bell at the subscriber's station adapted to respond to the alternating current, the coils *h*² and *h*⁴ may be adjusted for retardation only, and the voltage of the battery may be such as to give the necessary

current for the charging of the storage batteries at the subscribers' stations.

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

1. In a telephone system, the combination with telephone lines extending to spring jacks upon multiple switchboards at the central station, of a battery at the central station, a branch conductor extending from the pole of said battery to each of said telephone lines, whereby all of the spring jacks are included in circuit with said battery, a testing plug adapted to be connected with any spring jack, and a responsive device in circuit with said plug and adjusted to respond to the battery current when the same flows to the plug through two of said branch conductors, but adapted to remain quiescent when current flows to the plug through only one of said branch conductors; whereby a test may be made to determine whether a line is busy.

2. The combination with a number of telephone lines extending to the central station, of a battery at the central station connected with all of said telephone lines, a retardation coil included in circuit between each of said telephone lines and said battery, a storage battery included in the line circuit at each of the sub-stations and adapted to be traversed by current from said battery, and switch contacts controlled by the removal of the telephone from its hook for closing said storage battery in a local circuit with the microphone and the primary of the induction coil; whereby the storage batteries at the sub-stations are charged by the central station battery, the interposition of said retardation coils preventing the diverting of the voice currents; substantially as described.

In witness whereof I hereunto subscribe my name this 16th day of February, A. D. 1895.

WILLIAM W. DEAN.

Witnesses:

GEORGE P. BARTON,
GEORGE L. CRAGG.