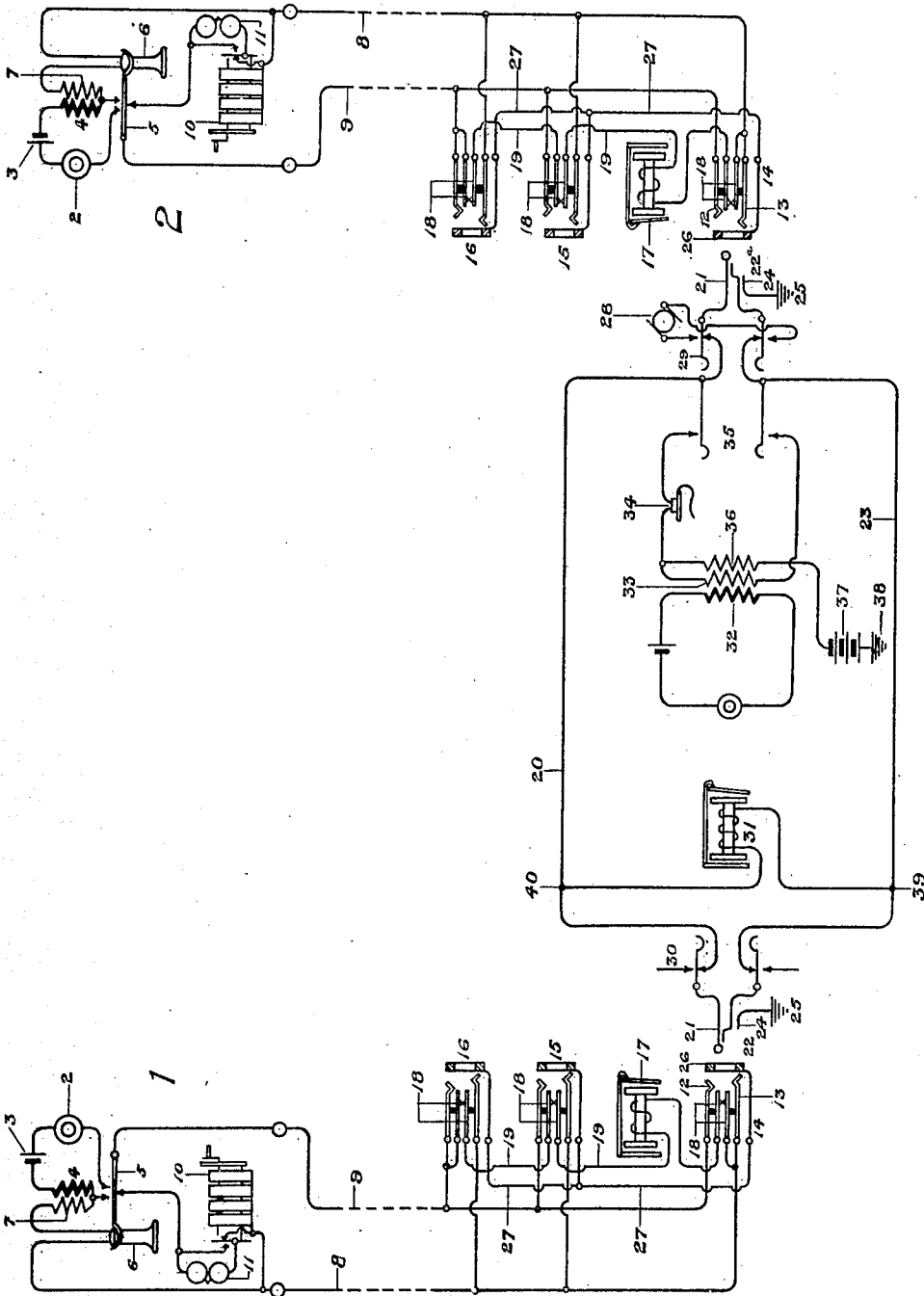


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 TESTING SYSTEM FOR TELEPHONE LINES.  
 APPLICATION FILED MAY 29, 1906.

913,795.

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# UNITED STATES PATENT OFFICE.

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## TESTING SYSTEM FOR TELEPHONE-LINES.

No. 913,795.

Specification of Letters Patent.

Patented March 2, 1909.

Application filed May 29, 1905. Serial No. 262,748.

*To all whom it may concern:*

Be it known that I, CHARLES S. WINSTON, a citizen of the United States, residing in Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Testing Systems for Telephone-Lines, of which the following is a specification.

My invention relates to testing system for telephone lines, in which a battery located at each substation is adapted to furnish current to the substation transmitters for conversational purposes, and in which the battery at the central station is adapted to furnish current by means of which the busy or idle condition of a called line may be determined.

One of the objects of my invention is to provide means whereby a busy test may be obtained that will produce a maximum effect upon the operator's receiver by means of current from a battery of minimum strength; that is, means are provided for producing an effect upon the coils of the receiver that increases or renders more pronounced the effect produced thereon by the direct current from said battery, whereby an effective test is obtained with a comparatively weak battery current.

In the accompanying drawing I have illustrated one method of embodying the principle of my invention in a telephone system in which two subscribers' stations are represented as connected in metallic circuit with a central office provided with means for connecting any two subscribers' stations together for conversation. At subscriber's station 1 a transmitter 2 and a battery 3 are adapted to be included in a local circuit with the primary winding 4 of an induction coil, said circuit being closed in the usual manner by the switch hook 5 when the receiver 6 is in use. The telephone circuit extends in two limbs, 8 and 9, to the central office, the receiver 6 being connected in series with the secondary winding 7 of the induction coil in the branch 8, and the switch hook 5 being connected with the branch 9 of said circuit. A ringing generator 10 and the magnet coils of a suitable call bell 11 are adapted to be connected in a normally-closed bridge of the line conductors, said generator being provided with the usual normally-closed shunt when not in use. The subscriber's apparatus at substation 2 is the same as that described with reference to substation 1 and

like figures have been used to designate like parts.

The substation apparatus described is intended to typify any subscriber's local battery outfit and any desired substation apparatus may be substituted therefor.

Each of the subscriber's lines terminates in jack contacts 12 and 13 of the line jack 14, and similar contacts are legged to each of the line conductors from the multiple jacks 15 and 16, one of said multiple jacks peculiar to each substation being located at each section of the switchboard. The line drop or annunciator 17 is connected by means of the conductor 19, in a normally-closed bridge of the line conductors 8 and 9, the circuit of said annunciator being normally closed by the jack springs 18, 18, said conductor 19 preferably connecting the jack springs 18, 18, of the multiple jacks in series. Each of the jacks is provided with a test terminal or ring 26, said test terminals being electrically connected by means of a conductor 27 as shown, said conductor extending throughout the multiple jacks of each line.

The central office apparatus consists of an answering plug 22 and a calling plug 22<sup>a</sup>, the tip contacts 21, 21 of said plugs being connected by the flexible cord strand 20, the sleeve contacts of said plugs being similarly united by the flexible cord strand 23. A third contact 24 is carried by each of said plugs, said contact being normally grounded at 25. A clearing-out drop 31 is connected across the cord strands 20 and 23 and is adapted to be actuated by ringing current from either of the substations, the winding of said drop being of high resistance to prevent shunting the voice currents.

The operator's apparatus consists of a transmitter and battery in a local circuit with the primary winding 32 of an induction coil, the secondary winding 33 of said coil being in series with the head receiver 34, a suitable listening key 35 being adapted to bridge the telephone set across the cord strands 20 and 23. A tertiary winding 36 is provided for the induction coil, said winding being preferably connected between the coils of the receiver 34 and one pole of the test battery 37, the opposite pole of said battery being grounded at 38. A calling generator 28 is adapted to be bridged across the line conductors by any suitable ringing key 29 to send call-

ing current to the substation, a similar calling key being provided upon the answering end of the cord circuit and the connection for the generator being indicated at 30.

5 The operation of the system is as follows:  
 Assuming that a subscriber at station 1 wishes to communicate with a subscriber at station 2, he operates his calling generator 10 which sends calling current through the  
 10 switch hook 5, over the conductors 9 and 19, including the winding of the line drop 17, and the contacts 18, 18, of the jacks, and line conductor 8, back to the generator. This current will energize the coil of the annunciator  
 15 17 of said station and throw the shutter, upon noticing which the operator will insert the plug 22 in the answering jack of said line. The tip 21 of the plug will engage the terminal 12 of the line and the sleeve contact  
 20 will engage the terminal spring 13. The contact anvils of the jack springs 18, 18, will be separated by the tip of the plug to open the circuit of the annunciator 17. The operator will then close her listening key 35 to  
 25 ascertain the number of the station desired. The alternating current induced in the secondary winding 7 by variations in resistance in the substation transmitter will find a path through the operator's telephone set over the  
 30 limbs of the telephone line, jack of springs 12 and 13 and the tip and sleeve contacts of the inserted plug, cord strands 20 and 23, and the contacts of the listening key 35. Upon learning the number of the station desired  
 35 the operator will test the condition of the line wanted by touching the tip of the calling plug to the test terminal 26 of said line. If the line wanted is in use, that is, if a plug is inserted in a multiple jack of said line at an  
 40 other section of the switchboard, all of the test terminals 26 of said line will be connected to ground through conductor 27 and the contact 24 of the plug inserted in a multiple jack of the line. The test terminal 26 of said  
 45 line, located at the switchboard section where the test is being made being grounded as above described, when the tip of the calling plug 21 is touched to said test terminal current will flow from the test battery 37  
 50 through the tertiary winding 36 of the operator's induction coil, receiver 34, listening key 35, plug tip 21, test terminal 26, conductor 27, to the test terminal 26 of the multiple jack in which a plug is inserted, contact 24 of  
 55 said plug, ground 25 and back to battery 37 at its grounded pole 38. The above flow of battery current through the operator's receiver will produce a click in her receiver and notify her that the line desired is busy, providing the battery 37 is of sufficient strength  
 60 to successfully accomplish this result. Current flowing through the tertiary winding 36 as above described, will induce an alternating current in the secondary winding 33, the  
 65 path of said alternating current being traced

from the winding 33 through the lower contact of the listening key 35, cord strand 23, to the point 39, where the current divides, part flowing through the winding of the clearing-out drop 31 to the point 40, the other path 70 from the point 39, including the sleeve of the answering plug, spring 13, line conductor 8, through the substation apparatus, line conductor 9, spring 12 and plug tip 21, to the point 40, cord strand 20, upper contact of the 75 listening key 35, coils of the operator's receiver 34, to the secondary winding 33. The above flow of alternating current will operate to increase the effect produced upon the receiver by the flow of direct current through 80 the coils thereof, above described, to render the same more pronounced and effective. In other words, a double effect is thus produced upon the operator's receiver, both tending to produce a click therein and notifying her 85 that the line is busy. One effect is due to the direct current from battery 37 flowing through the coils of the receiver and through the test terminals 26 to ground; the other effect is due to the induced current flowing 90 over the cord strands and through the clearing-out drop and substation apparatus in multiple, as above described. Thus the direct current test is supplemented and rendered more pronounced by the induced current test which enables a test battery of lower 95 voltage to be used than where the direct current test alone is obtained, a battery of two volts having been found in practice to give a satisfactory test. 100

It is necessary to connect the windings 33 and 36 of the operator's induction coil in such relation that the test current flowing through the coil 36 will produce current in the same direction in the winding 33 as is well known 105 and understood by those skilled in the art.

When the line tested is idle the test terminals will not be connected to ground and no flow of current will result from the battery 37 when the tip of the plug is touched to the 110 test terminal 26 of the line. On finding the line idle the operator will insert the calling plug in the jack of the desired line, depress the ringing key 29 to send ringing current over the line from the generator 28, thus 115 operating the call bell 11 at the substation. When the subscriber at the called station responds and removes his receiver from the hook the subscribers are connected for conversation, the talking circuit of substation 2 120 being the same as that already described with reference to station 1. At the termination of the conversation either subscriber will hang up his receiver and operate his generator 10 to actuate the clearing-out drop 125 31 in the usual manner; the line drops 17 being disconnected from the line by the separation of the jack springs 18, are not operated by the clearing-out signals from the substations. Upon noticing the signal 130

the operator will remove the plugs from the jacks and restore all parts to normal condition.

While I have described my busy testing circuits with reference to particular substation and central station apparatus and with reference to a particular arrangement of circuits, it will be understood that the circuit arrangement and the apparatus associated in the circuits may be varied without departing from the spirit of my invention and that the same is applicable to other systems than that described.

What I claim as new and desire to secure by Letters Patent, is:

1. In a telephone system, the combination with a telephone line, of a plurality of test contacts for said line at the central office, a cord circuit adapted to connect said line with another for conversation, a testing circuit associated with said cord circuit, said testing circuit including a source of current, one winding of an induction coil, and a telephone receiver, a second winding of said induction coil being connected in series with said receiver, whereby the induced current from said second winding is added to the effect of the current in said first winding to cause a distinct click in the receiver, substantially as described.

2. In a telephone system, the combination with a telephone line having a local battery substation thereon, of a plurality of test contacts for said line at the central office, a cord circuit adapted to connect said line with another for conversation, a testing circuit associated with said cord circuit, an induction coil, a source of current and a receiver in series in said testing circuit, a winding of said induction coil being in series with said receiver but not with said source of current, whereby the induced current from said second winding is added to the effect of the current in said first winding to cause a distinct click in the receiver, substantially as described.

3. In a telephone system, the combination with a telephone line having a local battery substation thereon, of a plurality of test contacts for said line at the central office, a cord circuit adapted to connect said line with another for conversation, a testing circuit associated with said cord circuit, said testing circuit including a source of current, one winding of an induction coil, and a telephone receiver in series, a second winding of said induction coil also connected in series with said receiver, whereby the current through the receiver is increased when a busy line is tested, substantially as described.

4. In a telephone system, the combination with a telephone line having a local battery substation thereon, of a plurality of test contacts for said line at the central office, a cord circuit adapted to connect said line with

another for conversation, a testing circuit associated with said cord circuit and containing a receiver, the primary of an induction coil and a source of current in series, the secondary of said induction coil being also in series with said receiver, whereby both primary and secondary currents pass through the receiver giving the maximum effect from said source, substantially as described.

5. In a telephone system, the combination with a telephone line, of a plurality of test contacts for said line at the central office, a cord circuit adapted to connect said line with another for conversation, an operator's listening key adapted by its actuation to place a receiver and one winding of an induction coil in series between the talking conductors of said cord circuit, a second winding of said induction coil and a source of current adapted to be placed in series with the receiver of the operator's listening set when the tip of said cord circuit is touched to the test contact of a busy line, the current in said latter path being adapted to induce an additional current through the receiver, whereby a minimum voltage source may be employed for the test, substantially as described.

6. In a telephone system, the combination with a telephone line, of a plurality of test contacts for said line at the central office, a cord circuit adapted to connect said line with another for conversation, a listening key adapted by its actuation to place one of said test contacts, the tip of the cord circuit, a telephone receiver and the winding of an induction coil in series with a source of current when said tip contact is touched to the test contact of a busy line, a second winding of said induction coil being connected in series with said receiver, whereby the current in said testing circuit induces an additional current through the receiver such that the primary and secondary currents of said induction coil are added to produce the maximum effect in the receiver, substantially as described.

7. The combination with a telephone line having testing contacts at the central office, of a cord circuit having a testing contact to register with the contacts of the line, a testing conductor for the cord circuit, an operator's induction coil, a source of current, a winding of said induction coil and a receiver in said testing conductor, and a second winding of the induction coil in series with said receiver during testing, substantially as described.

8. The combination with a telephone line having testing contacts at the central office, of a cord circuit having a testing conductor, an operator's induction coil, a listening key adapted when actuated to connect a winding of said induction coil in a bridge of the cord circuit, a receiver in said bridge and in said testing conductor, a second winding of the

operator's induction coil and a source of current also in said testing conductor, substantially as described.

9. In a telephone system, the combination  
 5 with a telephone line having testing contacts at the central office, of a cord circuit having a pair of talking strands, an impedance connected between said talking strands, an operator's induction coil, a receiver adapted to  
 10 be connected in series with a winding of said coil and in a bridge of the talking circuit, a testing conductor containing a source of current, a winding of said induction coil and said receiver, current in said testing conductor  
 15 being adapted to induce current in the first coil of said induction coil through the receiver and through said impedance coil, whereby a distinct click is caused in the receiver, substantially as described.

20 10. In a telephone system, the combination with a telephone line having test con-

tacts at the central office, of a cord circuit having a testing contact to register therewith, a testing conductor connecting there-  
 25 with, an operator's induction coil, a winding of said coil and a receiver being connected in said test conductor and included in the path of current flow when a test is made with a busy line, a second winding of said induction coil and said receiver connected in a local  
 30 circuit closed during testing, whereby the current through said first winding and the receiver will induce an additional current through the receiver and thereby cause a distinct click, substantially as described.

35 Signed by me at Chicago, county of Cook, and State of Illinois, in the presence of two witnesses.

CHARLES S. WINSTON.

Witnesses:

C. B. CAMP,  
 E. F. GRIER.