F. H. BEST.

TESTING APPARATUS.

APPLICATION FILED MAY 14, 1920.

1,414,397. Patented May 2, 1922.

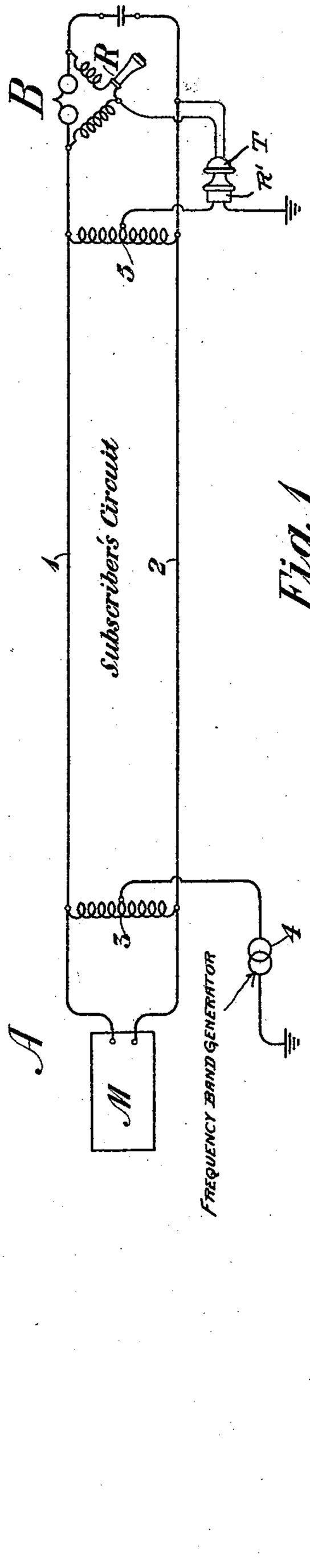

Fig. 1

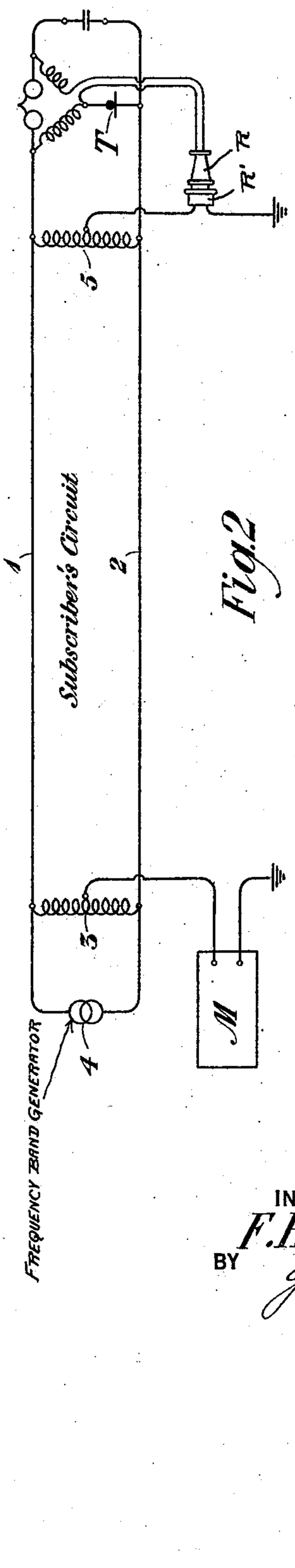

Fig. 2

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TESTING APPARATUS.

1,414,397. Specification of Letters Patent. Patented May 2, 1922.

Application filed May 14, 1920. Serial No. 381,462.

To all whom it may concern:

Be it known that I, FRED H. BEST, residing at Westfield, in the county of Union and State of New Jersey, have invented certain Improvements in Testing Apparatus, of which the following is a specification.

This invention relates to testing apparatus, and is concerned particularly with methods of and means for determining the combined transmission efficiency of a telephone instrument and the line circuit thereof. It is particularly applicable to subscribers' circuits in service, and is described herein with special reference thereto, but it is to be understood that the invention is not limited to this particular application thereof.

In its preferred form of embodiment, the invention proposes to employ the wires of the subscriber's circuit in a so-called simplex circuit, consisting of the wires of the subscriber's circuit in parallel with each other and connected at both ends to ground, for sending testing energy from the central office to the subscriber's station; converting this energy into sound energy by means of a receiver or other telephonic translating device of known characteristics; reconverting the sound energy into electrical energy in the subscriber's circuit by placing the aforementioned receiver against a transmitter or receiver of the subscriber's set; and determining the amount of electrical energy which reaches the central office.

In a modification of the invention, the testing current may be sent to the subscriber's station over the metallic circuit and returned to the central office over the simplex circuit, but the former method is preferable to the latter for the reason that the comparatively weak current which flows back to the central office is not subject to such disturbances as ground potentials or other noises caused by the ground connections of the simplex circuit.

A good understanding of the invention may now be had from the following description thereof, having reference to the accompanying drawing, in which Figure 1 is a diagrammatic view showing the preferred form and arrangement of apparatus embodying the invention, and Fig. 2 a similar view showing the modification thereof.

Similar characters of reference designate similar parts in each of the views.

In Fig. 1, reference numerals 1 and 2 designate the line conductors of a subscriber's circuit extending between a central office A, and a subscriber's station B. At the central office the circuit terminates in the usual jacks which, however, have been omitted in the drawing for the sake of simplicity and at the subscriber's station the circuit is completed by a telephone instrument, comprising the usual transmitter T, and receiver R. The particular type of circuit arrangement, by means of which the transmitter and receiver are associated with each other and with the line circuit, is immaterial to the present invention, it being understood that any of the usual circuit arrangements may be employed.

To make a test of the transmission efficiency of the subscriber's circuit and instrument combined, the test man at the central office bridges a retardation coil 3 across the line wires and connects a source of testing current 4 between the midpoint of this coil and ground. The test man at the substation B bridges a coil 5 across the line wires and connects a receiver R′ between the midpoint of this coil and ground. These connections complete a simplex circuit between the central office and the substation, which circuit comprises the testing source for the coil 3, the wires 1 and 2 in parallel with each other, the coil 5 and receiver R′ to ground return. The current from the testing source causes response of the receiver R′, and the sound energy thus generated is impressed on the transmitter T of the subscriber's instrument by placing the receiver R′ at a predetermined distance from the transmitter, as, for example, against the mouthpiece. The sound energy causes transmitter T to generate electrical energy in proportion to its efficiency, which energy flows over the metallic circuit, formed by conductors 1 and 2 in series, to the central office, where it enters a measuring apparatus indicated at M. This apparatus is preferably a transmission measuring set of any suitable type, such, for example, as is described in the patent to O. B. Blackwell, No. 1,261,096, dated April 2, 1918. The amount of current which returns to the central office is an indication of the combined efficiency of transmission of the subscriber's circuit and the transmitter of his telephone instrument.

To determine the efficiency of the subscriber's receiver in combination with the line circuit, the test man at the substation

places the receiver R′ against the receiver R, thus causing the same to generate a current which is transmitted by the subscriber's circuit to the central office, where it may be measured by the measuring set M.

In order to approach as nearly as possible to the conditions which obtain during the actual use of the subscriber's circuit and instrument, it is desirable that the frequencies of current for which the above tests are made should be of about the same range as that of the natural voice. The source 4 is therefore preferably a frequency band generator, the frequency of which varies rapidly over the voice range, or part thereof, and which gives results which closely approximate the conditions obtaining for actual voice currents. The receiver R′ should, moreover, be one of known characteristics so that allowances may be made for the efficiency of conversion thereof. This is particularly necessary where it is desired to compare tests made by means of different testing receivers.

In the modification illustrated in Fig. 2, the testing current source is connected in series with wires 1 and 2 so that this current flows over the subscriber's metallic circuit and causes response of the receiver R of the subscriber's instrument. This receiver is placed against the testing receiver R′, and causes the same to send current over the simplex circuit back to the central office, where it is measured by means of the device M, connected between the midpoint of the coil 3 and ground. This method is applicable to the transmitter only if the same is of the electromagnetic type, the ordinary carbon button transmitter being non-reversible in its operation. This method is not as reliable as the first, for the reason that the comparatively weak currents returning to the central office are more liable to noise interference when flowing through the simplex circuit than when flowing in the metallic circuit.

In either form of embodiment the invention avoids the necessity of carrying a large amount of testing equipment from substation to substation, and necessitates merely the use of a portable retardation coil and receiver by the test man at the substation.

Instead of the retardation coils 3 and 5 any other impedances, such as resistances, may be used to set up the simplex circuit as will be readily understood. Many other changes and modifications may be made in the apparatus embodying the invention, and the method for practising the same, the scope of the invention being limited only as defined by the appended claims.

What I claim is:

1. The method of determining the efficiency of transmission of a subscriber's telephone instrument and circuit thereof, which consists in sending testing current from the central office to the substation over the subscriber's line wires in parallel with each other, converting this energy at the substation into sound energy, reconverting the sound energy into electrical energy by means of a translating device of the subscriber's instrument, causing this energy to flow back to the central office through the line wires in series with each other, and ascertaining the amount of energy which is thus transmitted to the central office.

2. The method of determining the transmission efficiency of a telephone instrument and the line circuit associating the said instrument with a central office, which consists in causing a flow of testing current over said line wires from the said central office to said substation, converting said energy into sound energy at the substation, reconverting the same into electrical energy by means of a translating device of the subscriber's instrument, causing said electrical energy to flow over said line wires to the central office, and determining the amount of said energy reaching the office.

3. The method of determining the efficiency of a telephone instrument and its line circuit, which consists in causing the flow of testing current from one end of the circuit to the other through the line wires in series with each other, converting the electrical energy reaching said other end into sound energy by means of a translating device of the subscriber's instrument, reconverting the sound energy thus created into electrical energy by means of an auxiliary telephonic translating device, transmitting the reconverted energy over said line wires in parallel to the first end of the circuit, and determining the amount of energy received at the said first end.

4. The method of determining the transmission efficiency of a subscriber's circuit and telephone instrument, which consists in causing the flow of current approximating in frequency characteristic that of the natural voice from the central office to the substation over the line wires in parallel with each other, causing the said current to actuate a translating device for converting electrical energy into sound, operatively associating said translating device with the transmitter and receiver of the subscriber's instrument one after the other, and measuring the electrical energy which is caused to enter the central office by the said transmitter and receiver respectively.

5. In an apparatus for determining the transmission efficiency of a telephone instrument and the line circuit thereof, means for associating the wires of said line circuit in simplex circuit, a source of testing current associated with one end of said line, means

for connecting said source in one of said circuits for transmitting testing energy to the subscriber's station, means thereat for converting the testing energy into sound energy, and reconverting the same into electrical energy, said means comprising a translating device of the subscriber's instrument, means for causing return flow of said reconverted electrical energy over the other circuit to said first end of the line, and means for determining the amount of energy reaching the said end.

6. The apparatus of claim 5 in which the circuit for transmitting the testing energy to the subscriber's station is the simplex circuit and the circuit for the return flow is the line circuit.

7. The combination with a telephone instrument and circuit therefor extending between a central office and the said instrument, of conducting elements bridged on said circuit adjacent its ends, a source of current of frequency characteristic approximating voice current associated with the said conducting element at the central office, a telephone translating device associated with said other conducting element so as to respond to current flowing from said source over said conductors in parallel, said device being arranged to cause the response of a translating device of the said instrument, and means at the central office for ascertaining the current entering said office due to the response of the last mentioned translating device.

8. The method of determining the efficiency of transmission of a subscriber's circuit, which consists in sending testing current from the central office to the substation over the subscriber's line wires in parallel with each other, translating the energy thereof at the substation and applying it to the circuit consisting of said line wires in series with each other, and ascertaining the amount of energy which is thus transmitted to the central office.

9. The method of determining the efficiency of transmission of a line, which consists in sending testing current from one end of the line to the other over its two wires in parallel, translating this energy and applying it to send current over the circuit comprising the said two wires in series, and ascertaining the amount of energy which is thus transmitted to the initial sending end of the line.

10. The method of determining the efficiency of transmission of a line consisting of two parallel conductors, which consists in sending energy one way over the line, translating this energy at the receiving end of the line and sending it back the opposite way over the line, and determining the amount of energy received at the initial sending end of the line, the transmission in one of the two ways being over the two conductors of the line in parallel and the other of the two ways being over the same two conductors in series.

11. The method of determining the efficiency of transmission of a subscriber's telephone circuit, which consists in sending testing current from the central office to the substation over the subscriber's line wires, translating this energy at the substation and applying it to generate current in the circuit comprising said line wires, and ascertaining the amount of energy which is thus transmitted to the central office, the transmission one way, as aforesaid, being over the subscriber's line wires in parallel, and the transmission the other way, as aforesaid, being over the said line wires in series.

In testimony whereof, I have signed my name to this specification this 13th day of May, 1920.

FRED H. BEST.