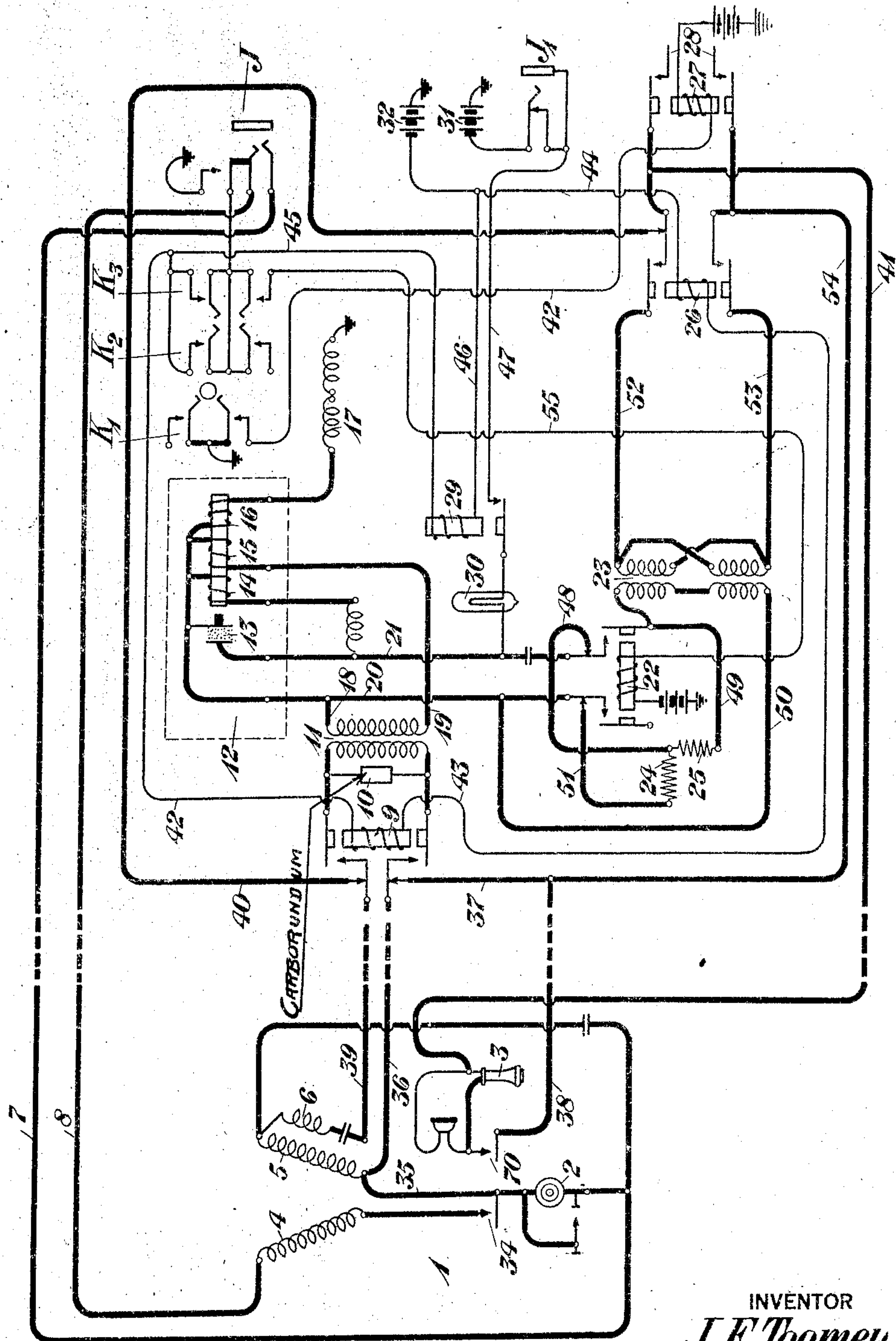


J. F. TOOMEY.
 TELEPHONE APPARATUS.
 APPLICATION FILED MAY 16, 1919.

1,407,046.

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TELEPHONE APPARATUS.

1,407,046.

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To all whom it may concern:

Be it known that I, JOHN F. TOOMEY, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Telephone Apparatus, of which the following is a specification.

This invention relates to telephone circuits and particularly to equipment adapted for use with substations associated with such circuits.

The general purpose of the invention is to provide arrangements which will improve the receiving on telephone circuits and the arrangements are intended particularly to be used at substations where the subscribers are unable to hear properly with the usual substation apparatus or where other circumstances make it especially desirable to improve receiving.

In general an improvement in receiving may be effected by connecting a telephone repeater amplifier in the receiving circuit at the substation, so arranged that it will amplify the voice currents in the receiving circuit. Where an arrangement of this kind is employed with ordinary types of telephone substations, the amplified currents in the receiver are of sufficient magnitude under certain conditions to affect the diaphragm of the transmitter, thereby creating a condition known as "singing." This feature, in addition to being objectionable to the subscriber, practically makes the arrangement inoperative if any appreciable amplification is required. Furthermore with such an arrangement the currents in the receiver are of such magnitude that the subscriber could not speak directly into the transmitter mouthpiece without making the receiver currents objectionably loud. Accordingly to prevent such difficulties the substation embodied in the arrangements of this invention includes a side tone reduction coil of the type illustrated in the U. S. Patent No. 1,254,471 granted to G. A. Campbell reference being had to Fig. 13 of said patent. Due to the amplification of the receiver current some means is desirable in this arrangement to prevent objectionable and possibly dangerous clicks in the receiver due to static discharges on the line or an accidental connection of ringing current to the circuit while the subscriber has the receiver to his ear. In the arrangements of this invention

this is accomplished by including therein a bridge or shunt across the input circuit of the repeater amplifier, the bridge including an element such as carborundum which has the property of decreasing in resistance when subjected to a sudden increase in voltage on the line. Accordingly a sudden increase of voltage on the telephone circuit would cause the bridge to operate as a shunt for the current. The invention furthermore includes means whereby the repeater amplifier may be switched in and out of the receiving circuit and its efficiency regulated by the operator. Supervisory apparatus may also be associated with the arrangements of the invention. Other and further features of the invention will be more clear from the detailed description of the operation of the invention.

In the drawing is illustrated a circuit diagram of a preferred form of the invention. While the arrangements of the invention have been specifically illustrated as associated with a private branch exchange, it is understood that it is capable of embodiment in many other forms of circuits. A substation 1 is illustrated which includes a transmitter 2, a receiver 3, and the windings 4, 5 and 6 so arranged as to substantially reduce and prevent side tone disturbances, similar arrangements being illustrated in the U. S. Patent No. 1,254,116 to G. A. Campbell. The substation 1 is connected to the jack J at the switchboard of the private branch exchange operator. A jack J₁ is also provided for testing the current flow over the circuit. For this purpose a plug (not shown) would be provided which might be connected to an ammeter and by this means the amount of current flowing through the repeater circuit might be determined for testing purposes. Associated with the receiver circuit is the repeater amplifier 12, which is of the type illustrated in the U. S. patents No. 1,156,636, and No. 1,159,603 to H. E. Shreeve. In repeater 12 the repeater button is illustrated as 13, the magnetizing winding is 16 and is connected to the retardation coil 17, the compensating winding is 14, and 15 is the receiving winding. Located at the switchboard of the private branch exchange are the keys K₁, K₂ and K₃. When the key K₁ is operated the operators' supervisory apparatus associated with conductors 28 may be connected to the receiver

circuit. When the keys K_2 or K_3 are operated the repeater 12 is connected to the receiver circuit and rendered operative. The key K_3 furthermore controls the relay 22 and means for regulating the gain of the repeater. Bridged across the input path of the repeater is the shunt 10 including carbon element which will decrease in resistance when subjected to an increase in voltage. Any sudden increase of voltage on the telephone circuit accordingly will reduce the resistance of the shunt path 10 and the increased currents transmitted to the receiver circuit will be shunted through the path 10. By this means objectionable and possibly dangerous clicks in the receiver due to static discharges on the line or other sudden increase of current thereover are prevented.

The invention may now be more fully understood from the following description of its operation.

If a connection is desired with the substation 1, the operator at the private branch exchange will insert the plug of her cord circuit or of the calling line into the jack J. The connection will then be completed to the receiver of the substation as follows: from the tip contact of jack J, conductor 8, winding 4, contact 34, conductors 35, 36, 37 and 38, contact 70, to the receiver 3, and also from the ring contact of jack J over conductor 7, winding 6, conductors 39, 40 and 41 to the receiver 3. If the operator desires to monitor or supervise such a connection, the key K_1 will be operated and the following circuit closed: from ground, contact of key K_1 , conductor 42, winding of relay 27, to battery. The closing of this circuit will operate relay 27 and connect the conductors 28 leading to the operator's telephone set to the conductors 40 and 41 of the above traced circuit. If it is desired to include in the connection the repeater apparatus 12 either the key K_2 or the key K_3 may be thrown. If the key K_2 is thrown, the following circuit will be closed: from ground, contact of jack J, upper contact of key K_2 , conductor 42, winding of relay 9, conductor 43, winding of relay 26, conductor 44, to battery 32, and ground. At the same time a circuit will be closed from ground, contact of jack J, upper contact of key K_2 , conductor 45, winding of relay 29, conductor 46, to battery 32, and ground. The closing of these two circuits will operate the relays 9, 26 and 29. The operation of relay 29 will apply battery to the repeater apparatus 12 over the following circuit: from ground, battery 31, contact of jack J, conductor 47, contact and armature of relay 29, filament of ballast lamp 30, over conductor 21, to the repeater apparatus. The closing of this circuit will render the repeater apparatus 12 in a condition for op-

eration. The operation of relay 9 will connect the input circuit of repeater 12 to the induction coil of substation 1 and the operation of relay 26 will connect the output circuit of repeater 12 to the receiver of substation 1. Accordingly, the current coming in over conductors 7 and 8 to the substation will now be transmitted over conductors 36 and 39 and over contacts and armatures of relay 9 through the left hand winding of transformer 11. This current will then be transmitted over conductors 18 and 19 to the repeater 12 and will be transmitted in amplified form therefrom over conductors 20 and 21. This current will be transmitted from conductor 21 through the left hand winding of transformer 23 as follows: from conductor 21, right hand normal contact of relay 22, conductor 48, series resistance 25, conductor 49, left hand windings of transformer 23, conductor 50, to conductor 20. Bridged across this circuit is the shunt resistance 24. The shunt resistance 24 and the series resistance 25 are so proportioned as to regulate the gain of the repeater to a desired degree. The amplified current will then be transmitted through the transformer 23 and over conductors 52 and 53, armatures and contacts of relay 26, and over conductors 54 and 41, to the receiver 3. If the operator upon supervising on a connection completed as described ascertains that the repeater is not giving the desired degree of amplification, the repeater may be adjusted so as to give a greater gain. This is accomplished by throwing the key K_3 . The throwing of key K_3 closes the following circuit: from ground, contact of jack J, lower contact of key K_3 , conductor 55, winding relay 22, to battery and ground. The closing of this circuit will operate the relay 22. At the same time ground will be applied from the upper contact of key K_3 to conductor 42 and the previously traced circuit through relays 9 and 26 will be held closed. The operation of relay 22 will disconnect the shunt resistance 24 and the series resistance 25 from the output circuit of repeater 12 and the output circuit of repeater 12 will now be completed as follows: from conductor 21, right hand make contact and armature of relay 22, left hand windings of transformer 23, conductor 50, to conductor 20. The removal of these resistance elements from the output circuit of the repeater will increase the volume of sound in the receiver 3. It is pointed out that the repeater apparatus cannot be conditioned for operation or connected to the substation by the operation of either the key K_2 or the key K_3 , until a plug such as the plug of the operator's cord circuit or of the calling line has been inserted in the jack J and ground applied to the upper contact thereof. This arrange-

ment serves as a safeguard to prevent the arrangements from functioning until a connection has been made with the substation.

While the invention has been disclosed as embodied in certain specific arrangements which have been deemed desirable, it is understood that it is capable of embodiment in many and widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. In a telephone system, a substation including a side tone reduction coil and a receiver circuit, an amplifier associated with said substation, a plurality of switching means, means controlled by each of said switching means for including said amplifier in said receiver circuit, means controlled by each of said switching means for rendering said amplifier operative, and means controlled by one of said switching means for increasing the gain of said amplifier.

2. In a telephone system, a substation including a side tone reduction coil and a receiver circuit, an amplifier associated with said receiver circuit, and a shunt across the input path of said amplifier, said shunt including an element the resistance of which will decrease when subjected to a sudden increase in voltage.

3. In a telephone system, a substation including a side tone reduction coil and a receiver circuit, means to establish a connection with said substation, an amplifier, switching means whereby said amplifier may be rendered operative and included in said receiver circuit, and means whereby the operation of said switching means will be rendered a nullity until a connection has been established with said substation.

In testimony whereof, I have signed my name to this specification this 15th day of May 1919.

JOHN F. TOOMEY.