No. 809,186. PATENTED JAN. 2, 1906.

H. A. JUDGE.

TELEPHONE SYSTEM.

APPLICATION FILED SEPT. 9, 1905.

Fig. 1.

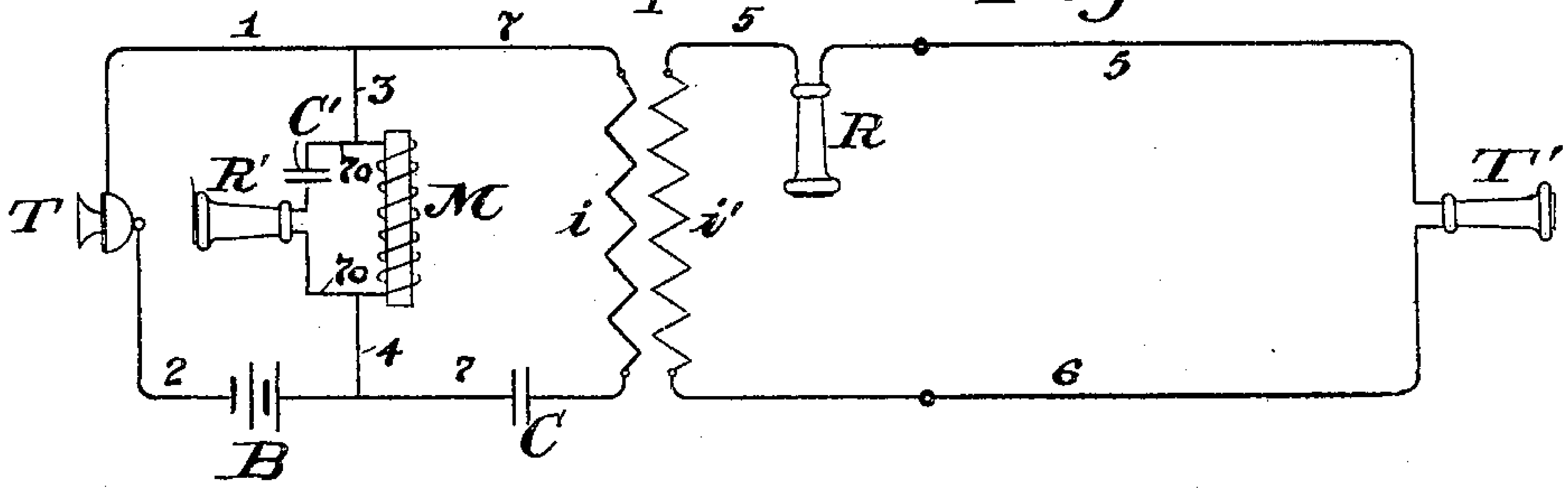


Fig. 2.

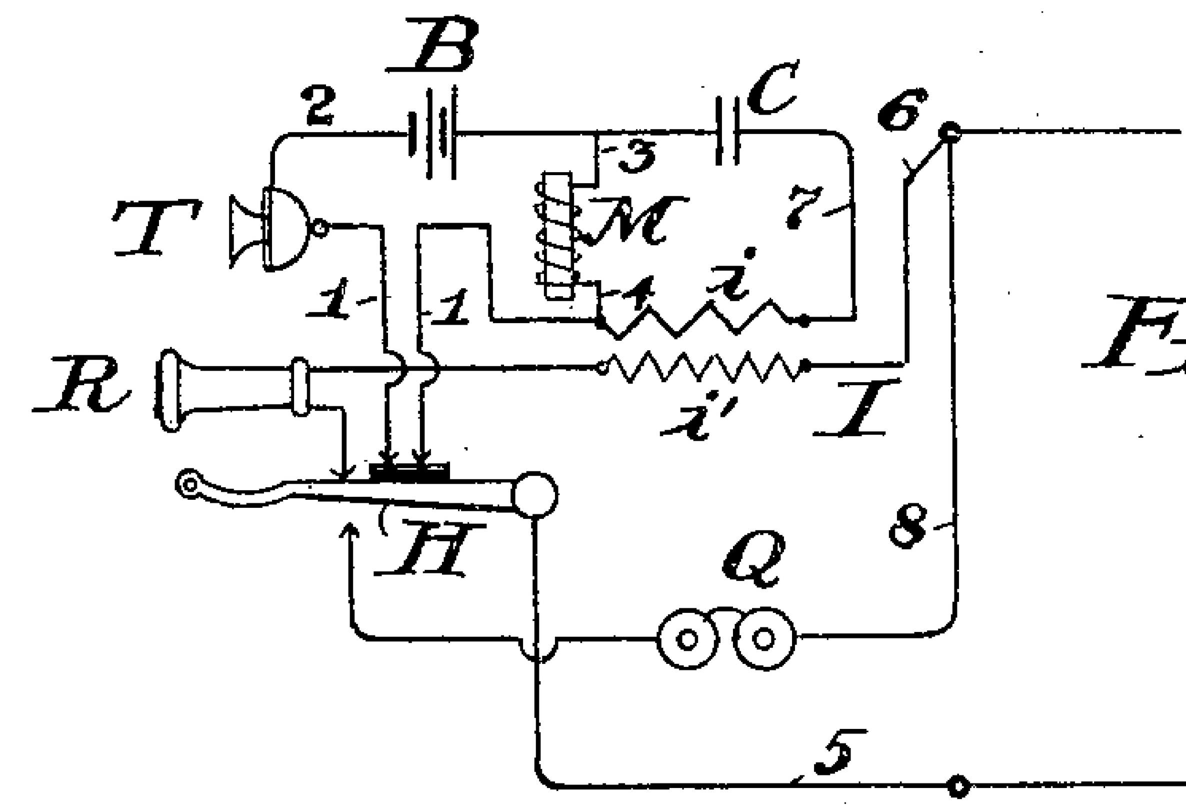


Fig. 3.

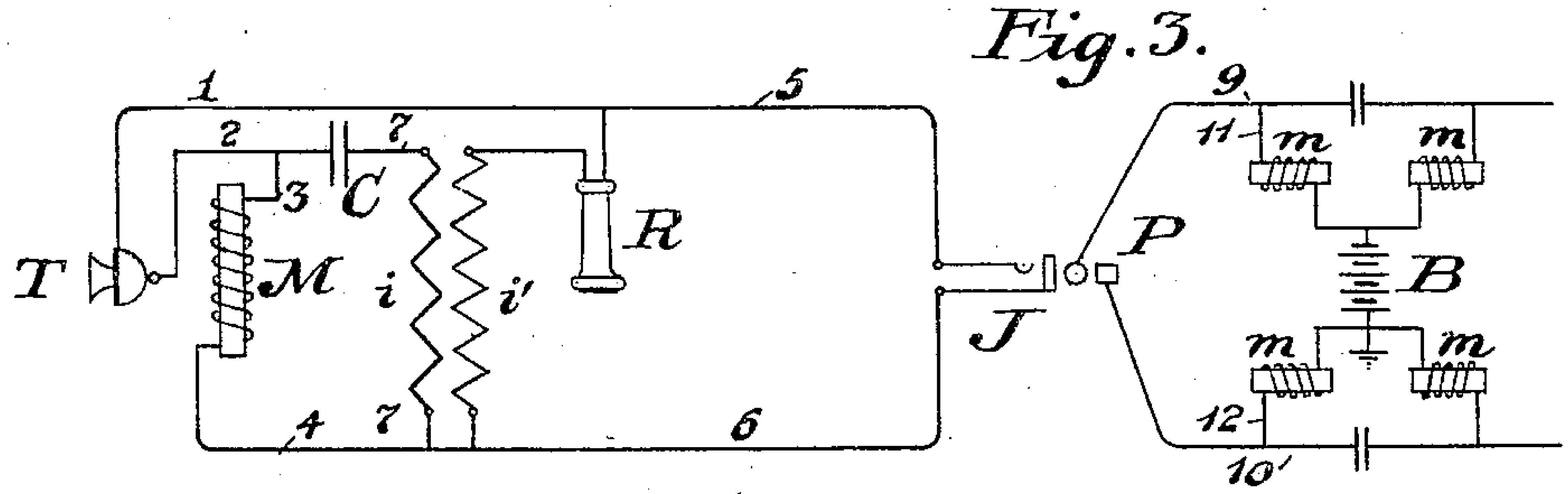


Fig. 4.

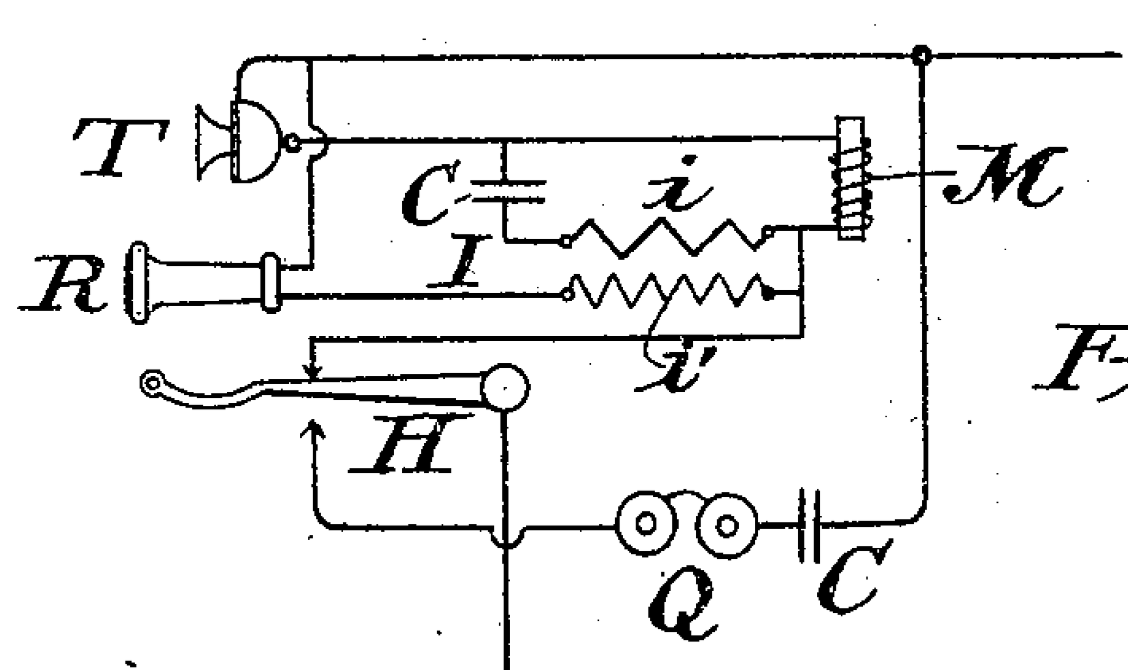
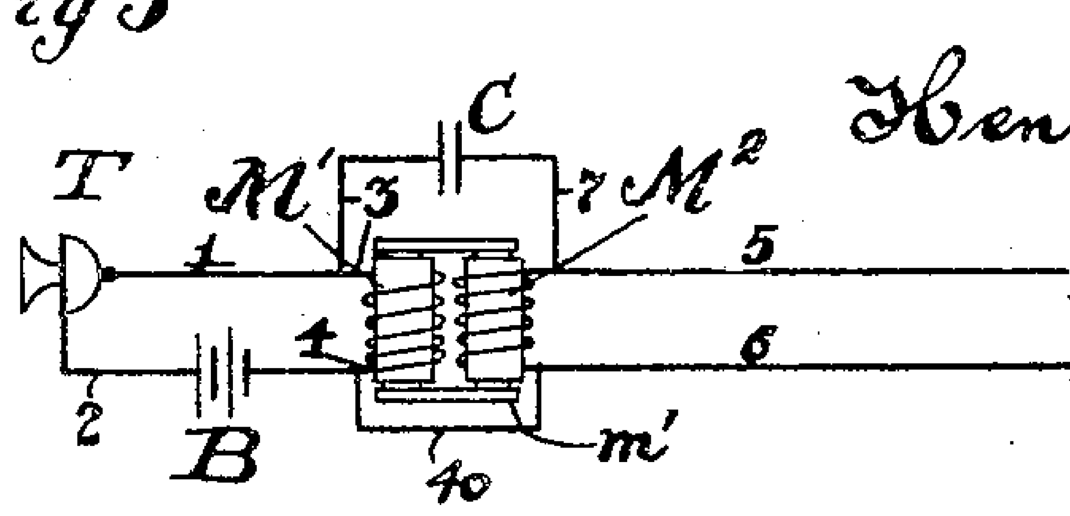


Fig 5



Witnesses

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TELEPHONE SYSTEM.

No. 809,186. Specification of Letters Patent. Patented Jan. 2, 1906.

Application filed September 9, 1905. Serial No. 277,700.

To all whom it may concern:

Be it known that I, Henry A. Judge, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to electric-transmission systems wherein signal-indications are intended to be produced at a distant place by means of current changes at the sending-station.

My invention is particularly adapted for use in telephone systems, and I have described it as applied thereto; but it is also useful in many other connections—as, for instance, in space telegraphy and the like—all of which will sufficiently appear upon reading the detailed description hereinafter given.

Assuming that the medium to be used for transmission is a wire circuit, such as a telephone-circuit, and that the mode of transmission is to be by producing certain electrical changes or waves in said circuit, my invention contemplates increasing both the sharpness and the amplitude of the changes, so that with the expenditure of no more energy than is at present consumed better effects at the distant end will be produced. Heretofore, perhaps, the most efficient means of transmission has been by producing changes in the resistance of a local circuit containing a source of current and the primary of an induction-coil whose secondary was connected to line.

While my invention does not depend upon the employment of an induction-coil or of a circuit without resistance, I preferably employ a local circuit and cause it to discharge itself into a path which for currents thus produced has very little resistance.

Briefly stated, I connect a transmitting device and a source of current to line and then across the transmitting end I connect an agency for storing up and discharging energy so as to magnify the changes produced in the transmitting device itself. Thus for telephonic purposes I make a local circuit composed of a battery, a transmitter, and the windings of an electromagnetic coil having a high coefficient of self-induction. The discharge-circuit is connected to the terminals of this coil, so as to constitute a shunt about it. The result is that when changes are produced by the transmitter the coil which is preferably of low resistance, discharges into the discharge-circuit or "kicks" synchronously with said changes, greatly accentuating the same and apparently acting somewhat like a check-valve in the supply-pipe of a force-pump—*i. e.*, the ohmic resistance being low the normal supply to the transmitter is all that the instrument will take and the energy expended in the latter produces current changes in the discharge-circuit proportional in their amplitude to the actual changes in resistance in the transmitter. In practice I usually employ an induction-coil connecting its primary in the shunt about the discharge-coil or the latter in a shunt about the primary. The receiver may be either in the line-circuit or in a second shunt about the coil, and I include a condenser in the receiver branch in such case, as well as in the branch containing the primary. The secondary of the coil will of course go to line. I have obtained very satisfactory increased effects by using several discharge-coils in successive branches, and I have also connected up a pair of coils with a common magnetic circuit after the fashion of a repeating-coil with excellent results.

My invention is illustrated as to its telephonic embodiment in the accompanying drawings, wherein—

Figure 1 is a diagram showing the theoretical connections of a local-battery transmitting-station. Fig. 2 is a diagram of the actual connections thereof in practice. Fig. 3 is a similar diagram of the theoretical connections of a common battery-station. Fig. 4 is a diagram of the actual connections thereof, and Fig. 5 is a modification.

Referring to Fig. 1, T represents a transmitter of such initial resistance and with such amplitude of change as may be required by the voltage of the battery employed. With the ordinary local battery the transmitter-resistance should be low, and the changes in any case should of course be great relatively to the initial resistance of the entire local or primary circuit. R is the receiver connected with the secondary winding i' of the induction-coil I to the line-wires 5 and 6, which pass to a distant station and there are connected to the receiver T'. B is the battery, and C is a condenser of suitable capacity—say two microfarads—both connected in the circuit 1 2 7, which also includes the primary winding i of the induction-coil I and the transmitter T. Across the circuit thus completed is a bridge 3 4, containing the electromagnet M, wound so as to have a very high coefficient of self-induction, but low ohmic resistance for continuous current. Fig. 2 shows the actual connections of this circuit in practice. A switch-hook H and a ringer Q are added, the hook serving to sever the talking-circuit when down and cut in the ringer, but to complete the talking-circuit and cut out the ringer when up. I have shown in Fig. 1 a receiver R′, connected across the wire 7 by means of wires 3 and 4, which of course amounts to putting it in a second shunt about the coil M. The condenser C′ is included in its branch 70. It will be understood that this is an alternative arrangement for that shown for the receiver R, also that I may include the receiver in divers other ways. I do not wish to limit myself as to this, since I have found that several different arrangements may be used with perfect satisfaction. The operation of this circuit is as follows: Continuous current from the battery B flows through the circuit 1 2 3 4, the transmitter and the coil presenting practically the only resistance external to the battery and the latter being negligible. When the transmitter responds to sounds by altering its resistance, the waves or surgings thus produced are thrown with perfect directness and great sharpness into the shunt 7 around the coil M. It is unnecessary to go into a detailed statement of the reasons for this. The discharges from the coil are produced by and are synchronous with the changes in the transmitter, and I have found in practice that with a heavy sparking coil used in this manner the effect in the primary circuit 1 2 7 itself is as great and as sharp as usually in the secondary without the coil, while volume is greater.

In Fig. 3 I have shown the coil M connected in the same sort of a bridge of the line 5 6 with the transmitter, the line-wires in this case being shown as terminating in a spring-jack J, taking a plug P with cord-conductors 9 10, a bridge 11 12, containing the battery B, and choke-coils m m. This arrangement at the central office forms no part in itself of my invention, any convenient arrangement to furnish battery from the central office over the metallic circuit being possible of use. At the substation the coil M is shunted, as before, by the branch 7, containing the primary i and the condenser C. The secondary i' and the receiver R are in a shunt-path across the line. In Fig. 4 the same arrangement is shown commercially arranged with the exception that two condensers are shown for convenience when in practice only one would be used, the contacts on the hook H being then correspondingly arranged. The operation of this modification is as follows: Current from battery B at the central office flows over the following circuit: 5,1,T,2,3,M,4, 6. When the transmitter commenses to act, the waves are thrown into the following circuit: 5,1,T,2,7,i,6. The branch i'—R is of high resistance, so it does not take the battery-current in any quantity. The waves due to the transmitter are thrown to line through the wires 5 6 and so through the cord conductors 9 10 and condensers therein to the distant station direct. This, however, is only incidental. The greater part of the energy is utilized in the propagation of higher potential alternating waves in the secondary, which of course go to the distant station through the same path.

It will be understood that I consider the arrangement of Figs. 1 and 2 the better of those I have illustrated; but by using such a voltage in Fig. 3 that the line resistance becomes a minor factor the same large effects can be had as in the other arrangement approximately.

In Fig. 5 I have shown a modified arrangement which I have found to work quite satisfactorily. This comprises the coils M′ and M^2, wound upon a continuous core or a pair of connected cores m', and therefore reacting upon each other by producing changes in the flux through said core. The branch 7 from the local wire 1 to the line-wire 5 shunts both coils and contains condenser C. The wire 2 goes to battery and is connected by branch 4 to the first coil M′, which on the other side is connected through wire 3 to wire 1. The two coils M′ and M^2 are joined on one side by wire 40, connecting wires 4 and 6, the coil M^2 being, in fact, bridged across the line-wires if no induction-coil is used. The operation of this arrangement is somewhat more complicated than that of the others and can only be explained by carefully considering the magnetic changes that take place in response to the current changes in the circuit 1, 2, 3, and 4. The effect in the line is very marked.

Many other arrangements will probably suggest themselves to those skilled in the art, and I wish it to be understood that all variations in arrangement which do not change the essential feature of employment of a discharge-coil substantially in the manner I have described are within the scope and purview of my invention.

Upon casual inspection it may not be entirely clear why, with the arrangement shown in Fig. 1, voice-currents are not injuriously shunted, also why discharges from the coil M are not partly shunted. I have found by experiment that, whether or not there is leakage through a shunt-path, by making the resistance of this path greater than that through the primary of the induction-coil or the coil M the loss is negligible and is entirely overbalanced by the elimination of the receiver resistance from the line. The circuits shown have proved entirely satisfactory in actual practice.

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

1. In a telephone system, a talking-circuit comprising a direct path of negligible resistance for continuous current, a magnetic discharge-coil a transmitter and a source of current therein, and a shunt-path around the said coil only, said shunt opaque to continuous current but passing high-frequency currents directly, substantially as described.

2. In a telephone system, a transmitter and a source of current-supply, a condenser, and the primary winding of an induction-coil, all in series with each other, together with a bridge across the circuit in shunt of the condenser and primary, said bridge containing an electromagnet having windings of low ohmic resistance but high self-induction, substantially as described.

3. In a telephone system, a circuit containing a transmitter, a source of current-supply and the primary of an induction-coil, with a bridge across said circuit containing an electromagnet, substantially as described.

4. In a telephone system, a talking-circuit containing a transmitter, a battery and an electromagnet, with a shunt around said electromagnet only, said shunt containing a condenser and connected to line, substantially as described.

5. In a telephone system, a transmitter, a battery, and an electromagnet of relatively low ohmic resistance in series with the battery and transmitter, and a shunt around said magnet only, said shunt so arranged as to be practically opaque to continuous currents but transparent to periodic currents, substantially as described.

6. In a telephone system, a transmitter, a battery, and an electromagnet of relatively low ohmic resistance in series with the battery and transmitter, a receiving device and a shunt around said magnet opaque to direct current and including the line-circuit and the receiving device, substantially as described.

7. In a telephone system, a circuit containing a transmitter, a source of current-supply and the primary of an induction-coil, a secondary connected to line, and a bridge across said circuit containing a receiver and a condenser only, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

HENRY A. JUDGE.

Witnesses:
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