No. 665,923. Patented Jan. 15, 1901.

F. R. McBERTY.

TELEPHONIC APPLIANCE.

(Application filed Aug. 12, 1897.)

(No Model.)

Fig.1

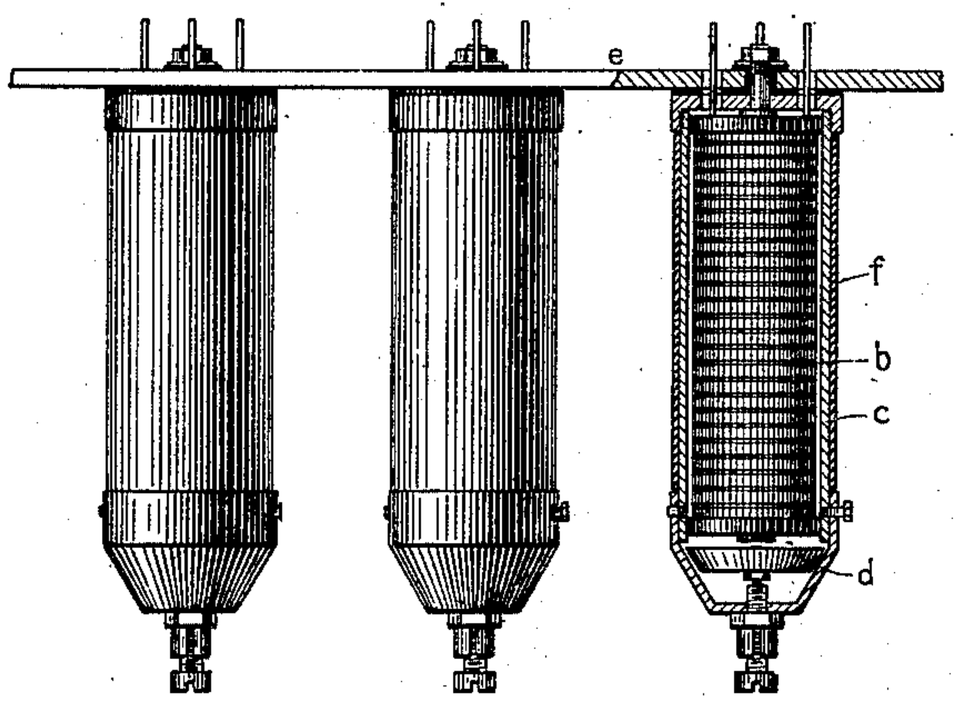


Fig.2

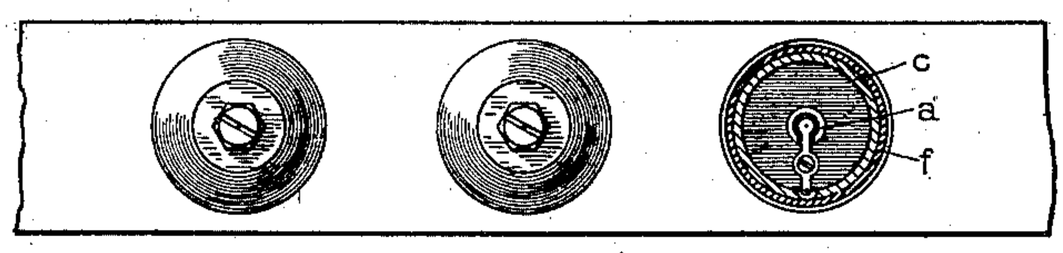


Fig.3

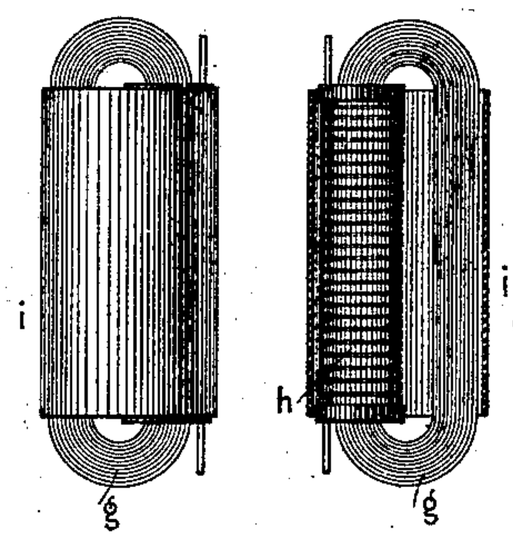


Fig.4

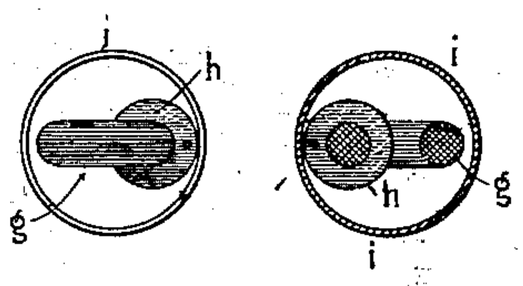
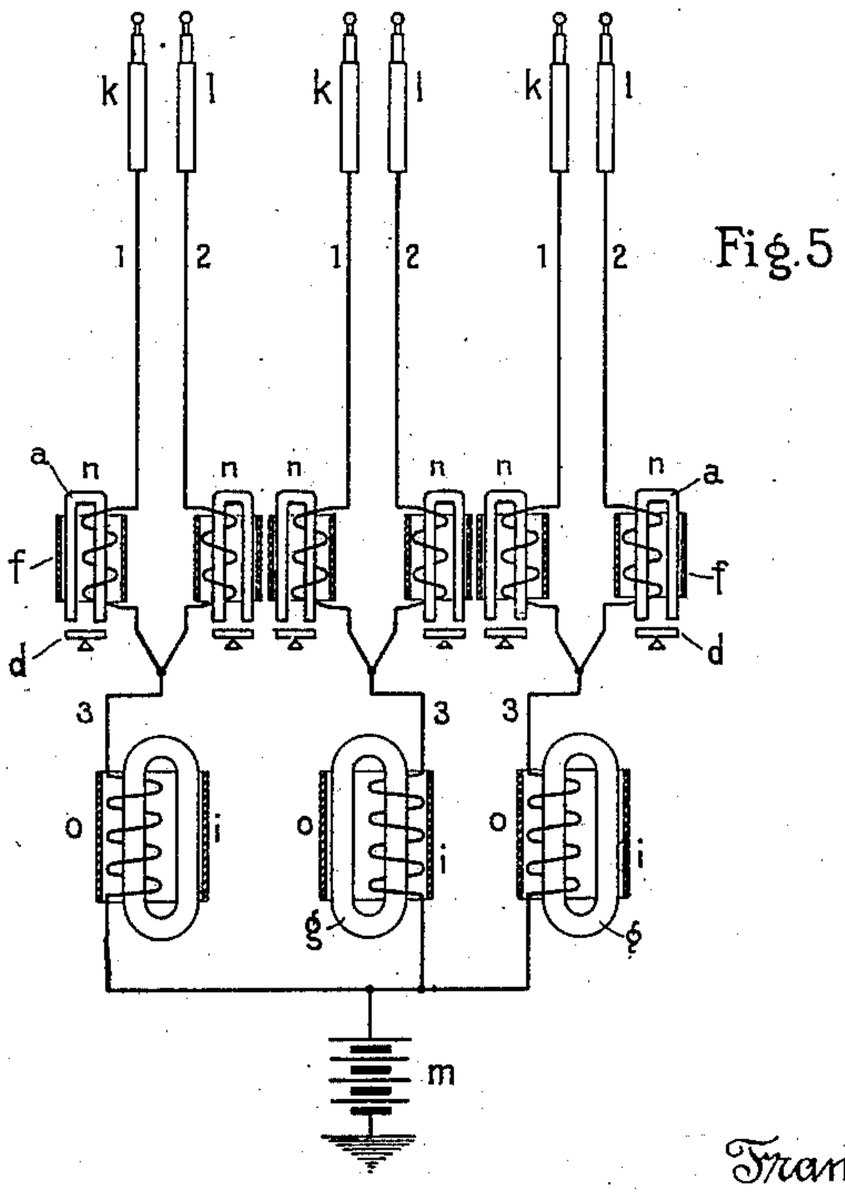


Fig.5



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by Barton & Brown his Attys

UNITED STATES PATENT OFFICE.

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TELEPHONIC APPLIANCE.

SPECIFICATION forming part of Letters Patent No. 665,923, dated January 15, 1901.

Application filed August 12, 1897. Serial No. 647,941. (No model.)

To all whom it may concern:

Be it known that I, FRANK R. McBERTY, a citizen of the United States, residing at Downer's Grove, in the county of Du Page and State of Illinois, have invented a certain new and useful Improvement in Telephonic Appliances, (Case No. 54,) 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.

This invention concerns electromagnets with closed magnetic circuits for use in circuits carrying telephonic or other rapidly alternating or undulating currents, its object being to prevent the inductive propagation of corresponding currents in neighboring circuits or magnets. It is useful particularly in connection with signal magnets or repeating-coils in telephonic circuits, since these are commonly placed close together in large groups and since each circuit must be entirely free from inductive disturbances from other circuits.

When electromagnets interposed directly in telephonic circuits or located in bridges of such circuits are placed near together, it is found that although the magnetic or iron circuit of the magnet may be closed through a mass of iron of large cross-section there is still a considerable amount of magnetic leakage from the extremities of the circuit or stray lines of force. These lines of force seek a return through the magnetic circuits of neighboring magnets, and thus tend to induce disturbing currents in the circuits surrounding the cores of neighboring magnets. This is true not only of electromagnets with movable armatures, but of impedance-coils and induction-coils whether of the open-circuit or closed-circuit type. The present invention aims to prevent the creation of stray lines of force by the undulating or alternating telephonic current, and to this end consists in surrounding the closed magnetic circuit of the electromagnetic appliance with a closed conducting-circuit of low resistance, such as a thick tube of copper or other metal, or in otherwise so disposing in the vicinity of the appliance a mass of conducting material in position to be threaded by the stray lines of force. The function of this mass or tube of conducting material is to prevent the propagation of these lines of force into adjacent magnet cores or circuits by permitting them to expend their energy in inducing currents in the conducting mass. For instance, in the case of a closed-circuit electromagnet surrounded by a copper tube the lines of force which circulate within the closed magnetic circuit are not affected or disturbed by the copper tube, and thus serve with undiminished efficiency to perform any work required; but the stray lines of force emanating from projecting or prominent portions of the magnetic circuit and tending to return through the air or adjacent masses of magnetic material thread the encircling copper tube but once, and therefore induce currents in the copper tube which tend to suppress the rapidly alternating or undulating induction. Thus in the case of two adjacent electromagnets in telephonic circuits which are ordinarily characterized by strong cross-talk rising through their mutual induction the cross-talk may be perfectly suppressed and eliminated by surrounding either, or preferably both, of the closed magnetic circuits with thick tubes of conducting material.

Heretofore in telephonic signal-magnets designed to be used in bridges of telephone-circuits it has been common to construct the magnets in tubular form, the tubular shells of the magnets being continuous cylinders. In such magnets the impedance of the magnet has been greatly diminished by the currents induced in the tubular shell of the magnet; but when an attempt has been made to interrupt the continuity of the electric circuit in the shell, as by slitting the shell longitudinally, the cross-talk produced in the circuits of adjacent magnets has rendered this expedient inoperative. The present invention is based on the discovery of the reason for the freedom of tubular magnets from cross-talk, and its application permits the slitting of the shells to break the induced currents therein, so that the magnet not only possesses the maximum impedance, but is also free from external inductive action.

The invention is illustrated in different forms in the attached drawings, whereof—

Figure 1 is a side elevation of a group of

tubular relays, one of the relays being in partial section. Fig. 2 is an end elevation of the same, one of the relays being seen in transverse section. Fig. 3 is a side elevation of two impedance-coils constructed in accordance with this invention. Fig. 4 is an end elevation of the same. Fig. 5 is a diagram representing the usual switchboard-circuits, including signal-controlling relays and impedance-coils.

The signal-controlling relay comprises a core *a* with wire *b* wound thereon, which is arranged centrally in a tubular shell *c* of iron, one end of the shell being closed with a cap of magnetic material. This shell is constructed from sheet metal folded in tubular form, the edges, however, being separated by a slight distance. The object of this mode of constructing the shell is in the present instance merely for the sake of economy, inasmuch as shells folded from sheet metal are very much cheaper and simpler to manufacture than continuous tubes; but in the case of similar relays adapted for use in bridges of telephone-circuits wherein the impedance of the electromagnet is of importance the tubular slit shell forms a suitable return-circuit for the magnetic lines of force, while being itself a broken electric circuit to electromotive forces created in it by induction.

Opposite the exposed or polar extremity of the core and shell is placed an armature-disk *d*, ordinarily retained in vertical position and resting on its edge, so as to rock toward the magnet in response to the attraction of the core and shell exerted upon it. Suitable insulated contact-pieces are provided for the armature to be closed when the armature is attracted. Several of these relays are mounted on a common base *e*, and a large number of relays are ordinarily grouped as compactly as possible.

Following the present invention, a copper tube *f* is placed over the tubular shell of each magnet.

The impedance-coil represented in Figs. 3 and 4 comprises merely a closed or ring circuit of iron wire *g*, of which a portion is surrounded by one or more windings *h* of wire, adapted for inclusion in electric circuits. In fitting this device with the present invention a copper tube or ring *i* is placed over the closed magnetic circuit, embracing the complete circuit.

When either of the before-described appliances—the magnet or the impedance-coil—is included in the telephone-circuit, the lines of force produced by current circulating in the magnet-windings do not wholly traverse the iron circuit provided for them. A few tend to stray or emanate from prominent or projecting portions of the iron circuit and to find return-circuits through neighboring magnets or electrical circuits. When, however, these lines of force are of rapidly fluctuating or alternating character, they expend their energy in inducing current in the copper shells *f* and *i*, respectively, and are almost wholly suppressed thereby.

In the case of the impedance-coil or of the magnet designed to present great impedance to telephonic current through its winding the lines of force useful as impedance circulate wholly in the iron of the magnetic circuit, and thus since they are wholly contained within the copper tube, or thread it twice in opposite directions, they induce no currents therein.

Fig. 5 represents plug-circuits adapted for use in telephone-switchboards, each comprising a pair of connecting-plugs *k* and *l*, united by conductors 1 2, from the point of junction of which a ground branch 3 is led to battery *m*. In each conductor 1 and 2 a signal-controlling magnet *n* is interposed, while in each ground branch 3 an impedance-coil *o* is located. When a pair of plugs is in use, current flows through the impedance-coil *o* to the plug-circuit and thence to the telephones at the united stations. The telephonic undulations in this current produced by the substation transmitting-telephones are not propagated to any appreciable extent through the impedance-coil *o* on account of the impedance thereof. The copper tube *i* about the impedance-coil prevents the induction of like undulations in adjacent impedance-coils. The telephonic currents traverse the windings of the signal-controlling magnets *n*, however, the windings of these magnets being of low resistance, and produce correspondingly undulating magnetization therein. The magnetic circuits of these magnets are complete with the encircling copper tubes, so that the magnets serve efficiently to do whatever work is required of them, while in this case also the copper tubes prevent induction between adjacent magnets.

I claim as my invention—

1. The combination with a core of magnetic material and a magnetizing winding therefor, of a mass of magnetic material forming a return-circuit for the lines of force emanating from said core, whereby a complete magnetic circuit is formed, and an electrically-conducting circuit encircling the core and the return-circuit, substantially as described.

2. The combination with a mass of magnetic material formed to constitute a substantially closed complete magnetic circuit, of a magnetizing winding surrounding a portion of said magnetic material to produce induction in the circuit, the remainder of said magnetic material forming a return-circuit for the lines of force emanating from the portion surrounded by said winding, and a closed circuit of electrically-conducting material inclosing substantially the entire magnetic circuit, whereby the lines of force are confined to the aforesaid closed magnetic circuit provided for them, substantially as set forth.

3. The combination with a telephone-circuit, of an electromagnet having a substantially closed magnetic circuit and a winding

on one limb only of said magnetic circuit in the telephone-circuit, and a closed electrical circuit of low resistance associated with the electromagnet in position to be threaded by lines of force straying from the portions of the magnetic circuit not covered by the winding, substantially as described.

4. The combination with telephone-circuits and magnet-windings therein located near one another, of masses of magnetic material arranged in substantially closed complete magnetic circuits, the said magnet-windings surrounding portions of said magnetic circuits to produce induction therein, the portions not so surrounded forming return-paths for the lines of force, and closed circuits of electrically-conducting material having low resistance, interposed between said magnets and adapted to be cut by lines of force between one magnet and another, to shield each magnet from the lines of force of other magnets, substantially as described.

5. The combination with an electromagnet comprising a mass of magnetic material arranged in a substantially closed complete magnetic circuit, and a magnetizing-winding surrounding a portion of such circuit, the portion not so surrounded forming a return-path for the lines of force, of a tube or ring of copper inclosing substantially the entire magnetic circuit, as described.

6. The combination with telephone-circuits and electromagnetic appliances therein, each such appliance comprising a practically-closed magnetic circuit and an exciting-winding in the telephone-circuit encircling a limb of said magnetic circuit, said appliances being contiguous to one another, of a tube of copper surrounding both limbs of the closed magnetic circuit of each appliance, whereby cross-talk between the appliances is prevented.

7. The combination with a tubular magnet comprising a magnetic core, a magnetizing-winding surrounding the same, and a tubular shell of magnetic material inclosing the core and its winding, said shell being united with the core and forming a return-path for the lines of force emanating from said core, of a copper tube inclosing the tubular shell of said magnet, substantially as and for the purpose set forth.

8. The combination with a tubular magnet having a shell longitudinally slit to prevent eddy-currents, and the armature thereof, of a tube of copper surrounding the shell, as described.

9. The combination with a telephone-circuit and a closed bridge thereof, and a tubular magnet having its winding in the said bridge and provided with a shell longitudinally slit to prevent eddy-currents, of a tube of copper surrounding the said shell; whereby the impedance of the magnet in the bridge is increased, while cross-talk from the magnet is prevented, as described.

10. The combination with a magnet comprising a core and the winding thereon, an armature for the core and magnetic material forming a return-circuit for the lines of force between the core and the armature, of a copper tube encircling the said core and return-circuit, as described.

11. The combination with a telephone-circuit and a closed bridge thereof, an electromagnet having a substantially closed magnetic circuit in the said bridge, the magnetic circuit of the electromagnet being formed to prevent the formation of eddy-currents by changes of current in the magnet-winding, of a shell of good conducting material surrounding the closed magnetic circuit, as described.

In witness whereof I hereunto subscribe my name this 18th day of May, A. D. 1897.

FRANK R. McBERTY.

Witnesses:

ELLA EDLER,

GENEVA STEVENS.