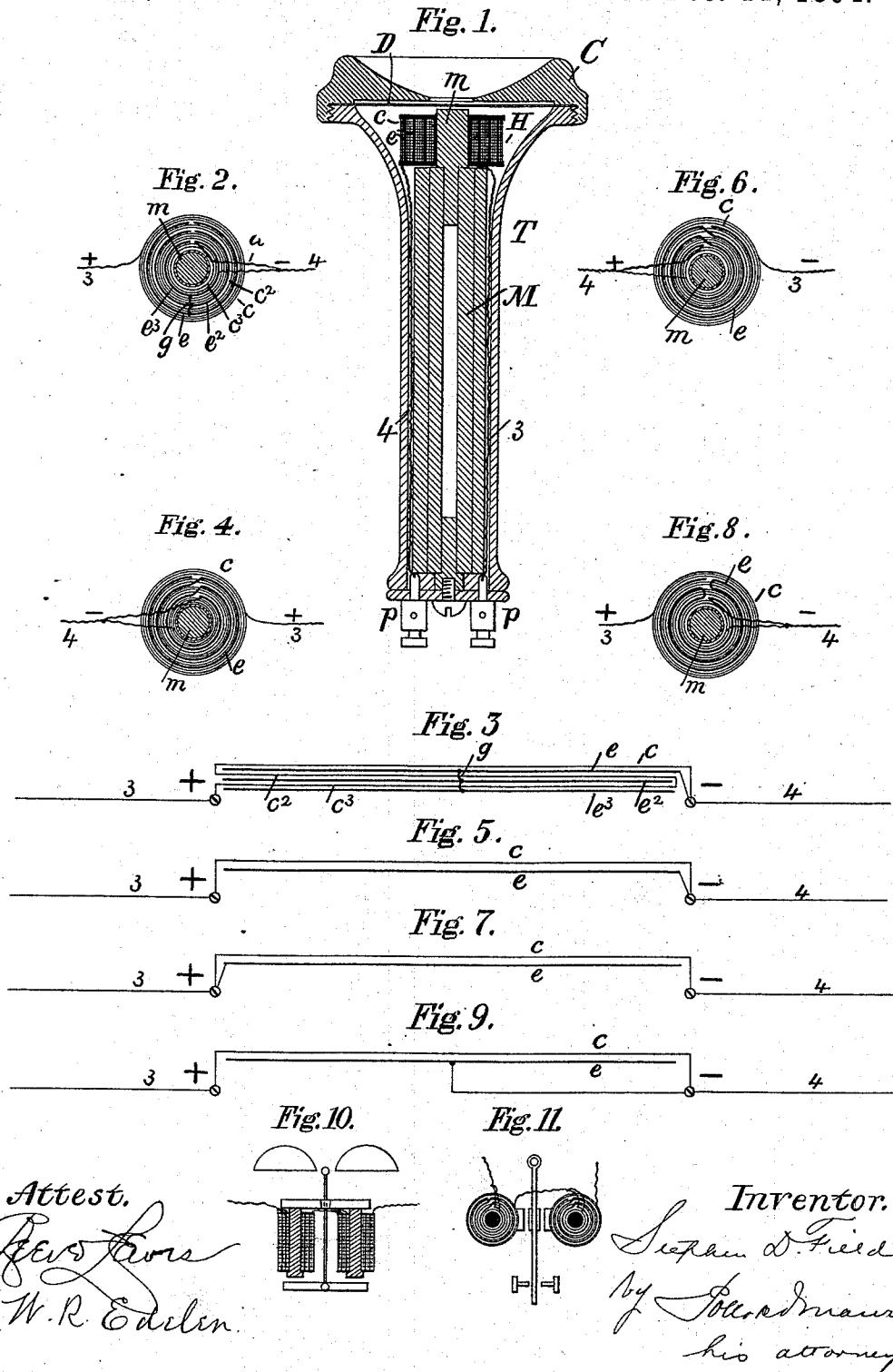


(No Model.)

S. D. FIELD.
SUPPRESSION OF SELF INDUCTIVE OBSTRUCTION IN ELECTROMAGNETIC
APPARATUS.

No. 530,516.

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UNITED STATES PATENT OFFICE.

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SUPPRESSION OF SELF-INDUCTIVE OBSTRUCTION IN ELECTROMAGNETIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 530,516, dated December 11, 1894.

Application filed July 24, 1894. Serial No. 518,479. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN D. FIELD, residing at Stockbridge, in the county of Berkshire and State of Massachusetts, have invented certain Improvements in the Suppression of Self-Inductive Obstruction in Electromagnetic Apparatus, of which the following is a specification.

This invention relates to the suppression or neutralization of the obstructive effects occurring in coiled conductors by reason of the passage through such conductors of changing currents of electricity, and opposing such passage.

The object of the invention is to provide means whereby an electro-magnet may be so constructed as to be practically neutral to the reactance or obstructive action due to the self-induction of conductors when closely coiled about a magnetic core as in ordinary electromagnets, without at all impairing their efficiency. This self inductive obstruction opposes the passage of all changing currents, and is a very serious obstacle to the transmission of rapidly varying currents such as voice currents, or those employed in vibratory telegraphy; whether as developed in the transmitting and receiving or translating instruments themselves, or as developed in instruments located intermediately in the circuit as at way stations, and its neutralization therefore is a matter of considerable importance.

It is a well known fact that the self induction and electro-static capacity of an electric circuit may be reciprocally utilized each to counteract the adverse influence of the other; and in suppressing the injurious action of self induction it is a familiar practice to associate condensers with the circuit in order that their effects,—which considered alone would act adversely,—may be available to oppose and neutralize the equally but different effects of magnetic reactance.

In Letters Patent No. 491,163, granted to me February 7, 1893, is disclosed one mode of accomplishing the desired result, viz:—by means of condensers attached at intermediate points in a helix or series of helices.

In my present invention I attain a like result by causing the insulated conducting wire

of an electromagnetic helix to serve as one plate of a condenser, of which a strip or ribbon of tinfoil or other similar conductor interposed between the layers of the said winding, forms the remaining plate; this ribbon being thereby brought into a position where it will have reciprocal inductive relations with the associated convolutions of wire.

My invention further consists in an electro-magnet having an associated incomplete electro-static shunt composed of a conductor extending between the layers of the magnet winding; in an electro-magnet which is also a condenser, the winding thereof forming one condenser plate, and a separate conductor interposed between the layers of said winding constituting the other condenser plate; and in a magneto telephone which combines its ordinary elements with the incomplete electrostatic shunt circuit, whose conductors are interposed between the layers of the telephone coil winding.

Many modifications may of course be arranged without any departure from the spirit of the invention, as is indeed indicated in the drawings which accompany and illustrate the specification.

In adapting my invention to a translating or other instrument such as a speaking telephone, a bell magnet or a relay, I sometimes employ a series of conducting plates, or strips, connected in parallel, and placed between the several layers of the coil or helix conductor; or alternatively, I employ a number of such plates connected in sequence in such a way that the charges and discharges which may be regarded as an induced current, will circulate in them around the magnet core in the same direction as that circulating in the coils of the magnet helix; or, if desired, the conducting plates or strips may be connected in series, but in such a manner that the induced current will circulate in a direction opposite to that of the line current.

In the drawings, Figure 1 shows a cross section of a telephone with which the present invention is associated. Figs. 2, 4, 6 and 8 represent cross sections in plan, of electromagnetic coils fitted with the electrostatic attachment in accordance with my invention; and Figs. 3, 5, 7, and 9, are theoretical diagrams

representing the electrical arrangement of the said cross-sections respectively. Fig. 10 indicates an application of my invention to an ordinary polarized bell, and Fig. 11 to a relay.

5 In Fig. 1, T is a magneto telephone with the usual magnet M, with core *m*, helix H, diaphragm D, and cap C, and its coil terminals 3 and 4 extend within the case to the binding screws *p* and *p*².

10 In the coil or helix H, *c* represents the winding of wire and *e* the several interposed portions of the inductive circuit strip.

Figs. 2 and 3 are different expressions of the same organism. They show an arrangement wherein the inductive circuit plates *e*, *e*², *e*³, &c., are all connected in multiple with the inside terminal of the helix, the point of union being shown at *g*, and the plates being interposed between the several layers *c* *c*² and *c*³, of the continuous conductor extending from 3 to 4, through the helix. An exceedingly minute vibration is required to traverse but a very few turns of wire before finding an inductive passage to the nearest interposed inductive circuit plate; while a more prolonged impulse will find its circuit either through all of the wire of the helix to the other terminal, or through a greater or lesser portion of the wire to two or more of the interposed plates.

30 In Figs. 4 and 5, the interposed plates *e* are serially connected and their connection is such that the currents inductively developed in them flow around the core *m*, in the same direction as the line current flowing in the continuous conductors *c*.

In Figs. 6 and 7 the connection of the inductive circuit strip is made at the outer terminal of the continuous conductor, and the two conductors are relatively arranged in such a manner that the plates *e* of the said strip are in sequence, while the induced currents will in their effect oppose that of the line currents circulating in the helix conductor *c*.

45 The arrangement shown in Figs. 8 and 9 shows the several concentric plates or strips *e* connected in series as in the two previous plans, but each concentric layer is so connected that the induced current flows in it around the core in a direction opposite to that flowing in its associate strip on either side.

Experiment proves that the reactance of the electro-magnetic coil is much reduced by the neutralizing operation of any of these plans of constructing the associated inductive circuit.

55 In telephone circuits which have intermediate or way stations the impedance of the bell magnets at such way stations has been so high, that voice currents have found much difficulty in passing them, but if such bell magnets are provided with the means indicated herein, as shown in Fig. 10, the difficulty is much reduced, and the said voice currents or other rapidly vibrating currents, may then find ready passage through the said electro-magnets.

The same is true with respect to telegraph

lines; and currents varying at high frequencies, can be transmitted easily and without distortion through relay magnets to which as in Fig. 11 this invention has been applied. 70 Any of the circuit arrangements shown in Figs. 2, 4, 6 or 8 may be employed in connection with the bell and relay of Figs. 10 and 11 or with any electro-magnet. Thus by the application of my invention to electro-magnets, and the consequent neutralization of the self induction, and virtual transformation of such magnets into condensers, vibratory currents, or currents of frequent variation or change, are enabled to pass through their coils with great facility, while the working efficiency of the coils or helices themselves, or the facility with which they can act upon, or be acted upon by their magnetic cores, remains 85 practically unimpaired.

I am aware that it is not new to attempt the elimination of the effects of self induction of coiled wires by means of cylinders of metal interposed between the layers of such coiled wire, but in all such cases, of which I have knowledge each cylinder so interposed, forms a closed circuit around the core of the magnet; and such closed circuit affords a path for currents induced by line currents passing through the wire of the surrounding helix; but these currents at all times necessarily delay magnetic changes, since when the main current is rising, the direction of the induced current is in opposition thereto, tending to weaken or make sluggish the effect thereof; while when the main current is falling the induced current is of like direction and tends to perpetuate the effect of the said main current. This delay renders such devices inefficient, when used in connection with apparatus intended to manifest currents of high frequency of vibration—that is to say, in such devices, self-induction is eliminated at the expense of the working efficiency of the magnet in which the device is incorporated; being accomplished by dynamic or magneto electric induction, in contradistinction of static induction which is employed in the device described in this specification. 115

Having now fully described my invention, I claim—

1. In an electro magnet, the combination with the helices or convolutions thereof, of a conductor in reciprocal inductive relation with the wires composing said coils or helices, for the purpose of suppressing the reactance or self induction of the magnet, substantially as described. 120

2. The combination with an electro-magnet, of an associated incomplete electro-static shunt or inductive circuit, connected with one of its terminals, and having branches or extensions interposed between the several layers of its convolutions, substantially as described. 125

3. A combined electro magnet and condenser the condenser having for one of its plates the winding of the electro-magnet, and 130

for the other a strip or ribbon of tinfoil or like conductor interposed between the several layers of the said winding in inductive relation thereto.

5 4. The combination in a magneto telephone, with the magnetic core, and its surrounding helix, of an associated incomplete inductive circuit interposed continuously between the several layers of the said helix, substantially
10 as described.

5 5. A magneto telephone having conducting strips, ribbons or plates branching or extending from one of the terminals of its helix, and interposed between the several layers of
15 the winding of said helix, whereby the electro-static capacity of said helix is increased.

6. An electro magnet comprising the following elements in combination; a core capable of being magnetized; a winding or helix of two or more layers surrounding the same; and
20 one or more incomplete inductive circuits placed in inductive relation to the said helices, substantially as specified.

In testimony whereof I have signed my name to this specification, in the presence of
25 two subscribing witnesses, this 17th day of July, 1894.

STEPHEN D. FIELD.

Witnesses:

THOMAS D. LOCKWOOD,
CHAS. E. EVANS.