2 Sheets--Sheet 1.

# J. B. STEARNS.

## Duplex Telegraphs.

No. 136,873. Patented March 18, 1873.

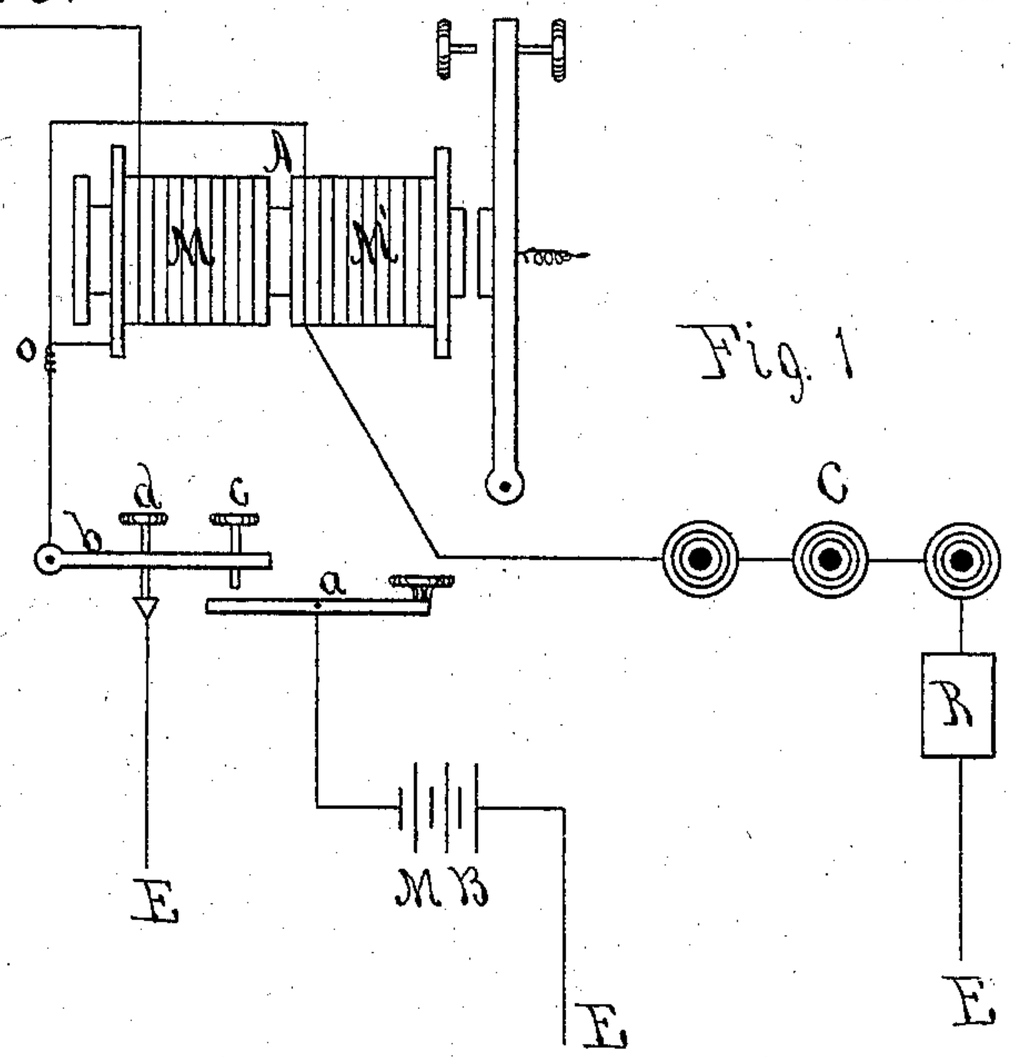


Fig. 1

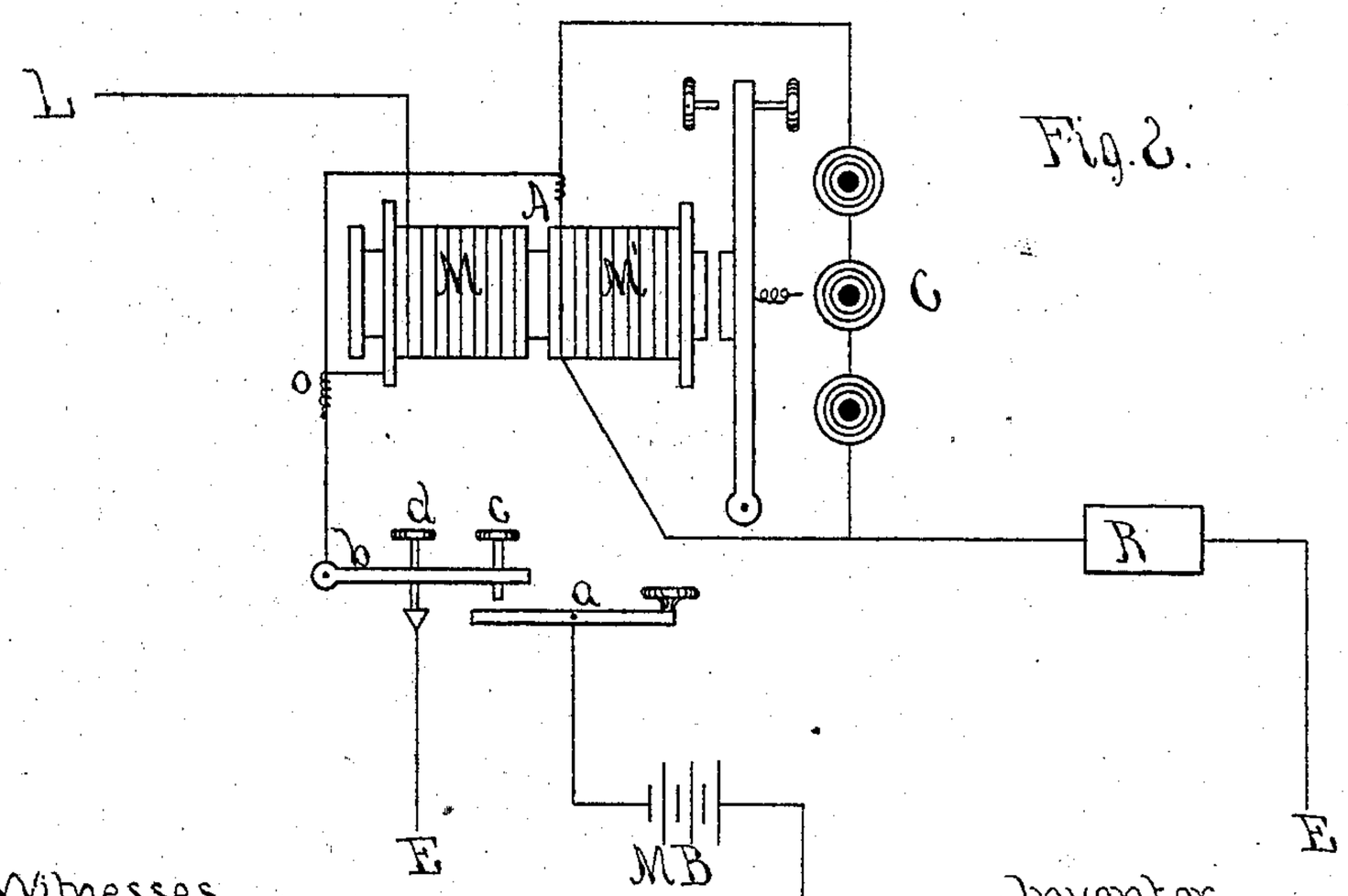


Fig. 2.

Witnesses.

Wm. A. Hayes jr

Jno. Williams

Inventor.

Joseph B. Stearns

by his Attorney

W. L. Hayes.

2 Sheets--Sheet 2.

# J. B. STEARNS.

## Duplex Telegraphs.

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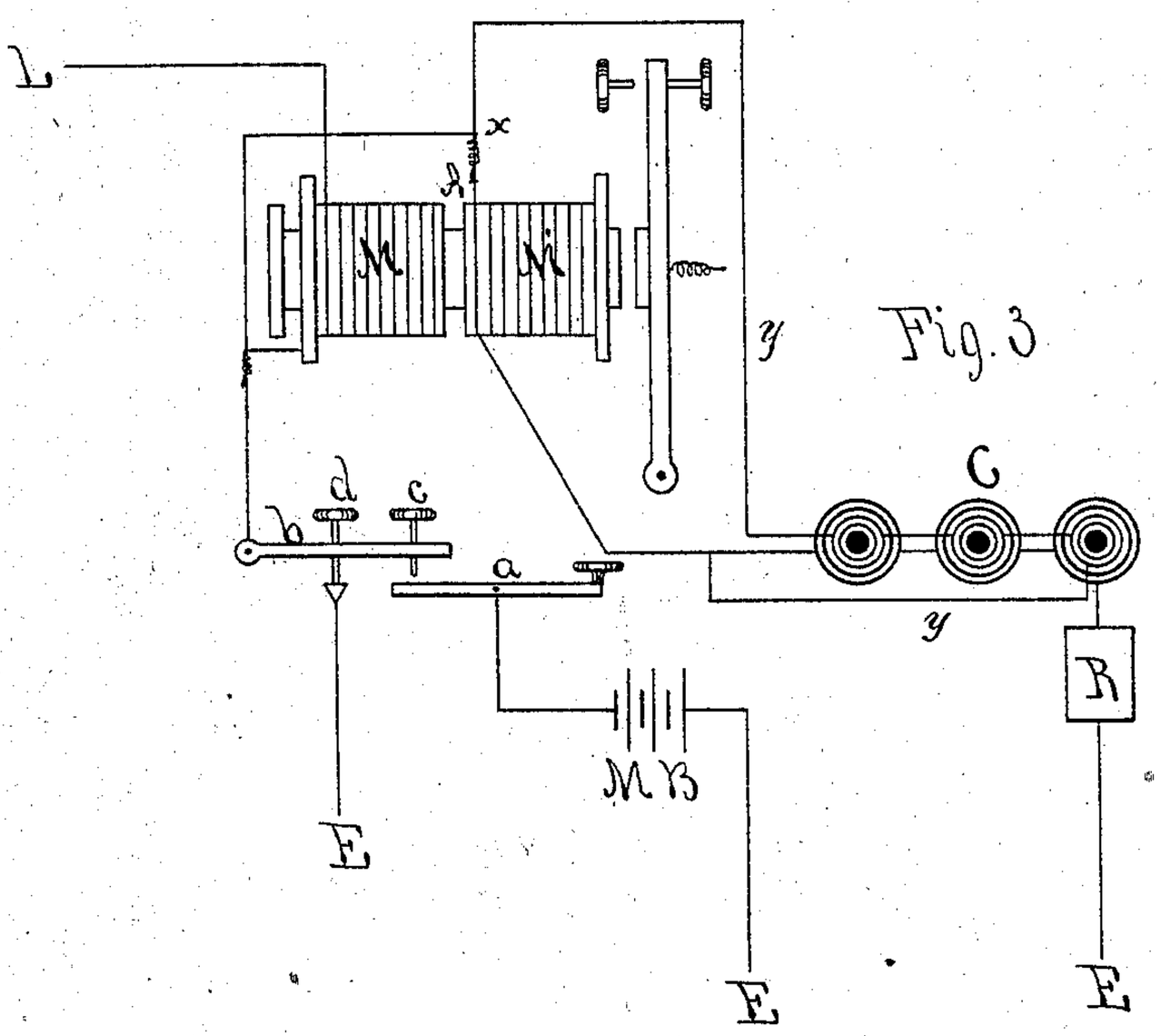


Fig. 3

Witnesses
C. L. Hayes
Wm A Hayes jr

Inventor.
Joseph B. Stearns
by his attorney
A. L. Hayes

# UNITED STATES PATENT OFFICE.

JOSEPH B. STEARNS, OF BOSTON, MASSACHUSETTS.

## IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **136,873,** dated March 18, 1873.

*To all whom it may concern:*

Be it known that I, JOSEPH B. STEARNS, of Boston, in the county of Suffolk, State of Massachusetts, have invented a new and useful Improvement in Telegraph Apparatus, of which the following is a specification:

This invention relates to apparatus for the simultaneous transmission of two signals from opposite ends of the same line-wire; and consists in the combination, with said apparatus, of a series of helices of wire so arranged and connected that they prevent the effects on the relay or other receiving instrument at the sending station due to the "static induction" or "charge" of the line, both when the line is connected with the battery and when the battery is disconnected and the line put to earth.

The accompanying drawing forming part of this specification represents my invention, in which drawing Figures 1, 2, and 3 show plans for connecting and arranging the helices.

In these figures, A is the relay; *m m'*, its coils; K, the key, composed of two levers, *a* and *b*, the latter having on it the contact-stops *c* and *d;* C, the series of coils; R, a rheostat or resistance-coil; M B, the main battery; and L, the line.

For the purpose of more clearly explaining my invention, I will first proceed to describe a form of double-transmitting apparatus, selecting for that purpose that patented by me June 2, 1868, and numbered 78,547. This apparatus is shown in the drawing.

The conditions necessary for success in the double transmission of signals are, first, having each relay at either station always in the circuit on the line; second, preventing the transmission of currents from either station from affecting the relay at that station; and, third, maintaining the resistance of the line always the same.

These conditions are fulfilled as follows in the apparatus to be described: The relay or receiving magnet A is composed of two coils, *m m'*, wound in opposite directions upon the same core, so that when currents of equal duration and strength pass through both coils at the same time the magnetic effect of one is neutralized by that of the other, and the armature of the relay is not attracted. When the circuit is closed at the key in the transmission of signals, the current passes from the main battery M B through the lever *a* and stop *c* to the point *o*, where it divides, one portion passing through one coil, *m*, to the line, the other portion passing through the other coil, *m'*, in the other direction to the earth through a rheostat or resistance-coil, R, having the same or nearly the same resistance as the line. As each coil is traversed at the same time by a current of the same strength, but of opposite direction, the magnetic effects of each are neutralized, the one by the other, and consequently the armature of the relay is not attracted and no signal is given; but when a current is transmitted from the distant station it passes through only the coil *m* of the relay, and not through the coil *m'*, on account of the resistance between that coil and the earth, the balance between the magnetic forces of the two coils is disturbed, and the armature of the relay is attracted and a signal given. It is thus seen that the relay at one station is affected only by the currents transmitted from the other station, and not by the currents transmitted from the station where it is situated; and consequently both stations are enabled to send simultaneously, the respective relays at each station, though always in the circuit, responding only to the current from the other station.

I will now proceed to explain my invention: It is a well-known phenomenon in the operation of the electric telegraph that a submarine, subterranean, or long land line of telegraph acquires by induction, when connected with a battery, a charge of electricity, known as the "static charge." This charge has been found in telegraphing an impediment to the proper transmission of signals, for the reason that when the line is connected with the battery a portion of the current is absorbed in charging the line, and therefore said current does not have sufficient strength to make a signal until the charge has been given, causing a retardation of the signals, and when the battery is disconnected and the line put to earth the discharge of the static charge causes a return current in an opposite direction to the current from the battery.

In the duplex system these effects of the static charge are serious obtacles to successful working, for the reason that the retardation referred to, when the line is connected with the

battery, prevents the current through the coil connected with the line from acquiring its maximum strength as soon as the current through the resistance, the equilibrium between the magnetic forces of the coils is destroyed, the relay-armature is attracted, and a "false signal" is given; and when the battery is disconnected and the line put to earth, the return current from the static charge traverses the coil connected with the line, the equilibrium between the magnetic forces of the coil is also disturbed, and a false signal made.

In making short contacts to form "dots" the line does not usually have time to acquire its full charge, and the difficulties referred to are not as serious as when longer contacts to form "dashes" are made.

In Letters Patent No. 126,847, granted to me May 14, 1872, I have described a method of preventing these effects of the static charge by connecting the branch or compensating circuit with a condenser. My present invention is another method of preventing the effects referred to; and to that end consists in connecting that branch of the circuit which passes through the relay to the resistance with a series of helices wound with one or more wires, which, when the relay is connected with the battery, absorb, in rendering the coils magnetic, the same or nearly the same amount of electricity as is absorbed by the line, and therefore prevent the current through that coil of the relay which is connected with these helices from acquiring its maximum strength before the current through the coil of the relay connected with the line has acquired its maximum strength, so that the balance between the magnetic forces of the two coils is not disturbed and a false signal is prevented; and which helices, when the relay is disconnected from the battery and the line put to earth, give, in becoming demagnetized, a return current of the same or nearly the same strength as the return current from the line, neutralizing its effect, and again preventing the disturbance of the balance and the consequent false signal. These helices may be provided with cores of soft iron for the purpose of increasing their power. They are connected with the relay in various ways.

In Fig. 1 they are shown as placed between the relay and the resistance, and as wound with a single wire. In Fig. 2 they are shown as placed across the poles of the coil $m'$ in a branch circuit. In this case they become magnetic from that portion of the current deflected from the main current through the coil $m'$, and the resistance R must be lessened to allow for the deflected current in order that the magnetism of the coils $m$ $m'$ may be equal. In Fig. 3 the coils are shown as wound with two wires, one being connected directly with the resistance-coil and other forming the branch circuit across the poles of the coil $m'$. In this case, when the current reaches the point $x$ it divides, one portion passing through the coil $m'$ and one of the wires of the helices; thence through the resistance to the earth, the other portion passing, by the wire $y$, through the inner wire of the helices in the same direction, and again through the outer wire to the earth.

I have shown the use of the helices with one form of double-transmitting apparatus. There are other forms with which they may be used with the same effect and for the same purpose—as, for instance, in the bridge system patented November 12, 1872, No. 132,932.

*Claim.*

What I claim as my invention, and desire to secure by Letters Patent of the United States, is—

In an apparatus for double transmission, the combination of a helix or series of helices with a branch or compensating circuit, whereby the effect of static induction upon the receiving relay or instrument is counteracted, substantially as and for the purpose herein specified.

JOSEPH B. STEARNS.

Witnesses:

W. A. HAYES, Jr.,

A. L. HAYES.