(No Model.)

3 Sheets—Sheet 1.

# S. P. FREIR.

## TELEGRAPH RELAY.

No. 493,620. Patented Mar. 14, 1893.

Fig. 1,

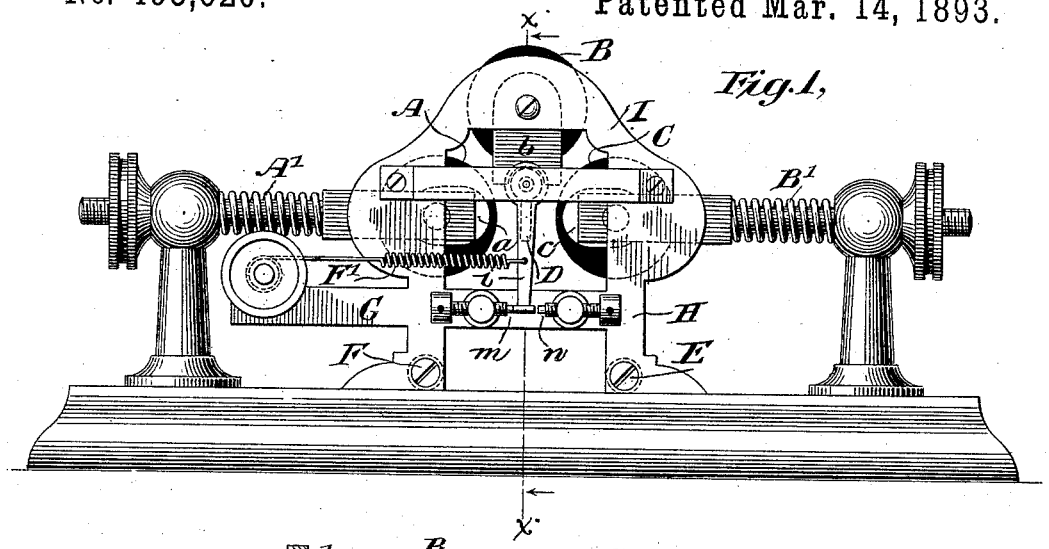



Fig. 2,

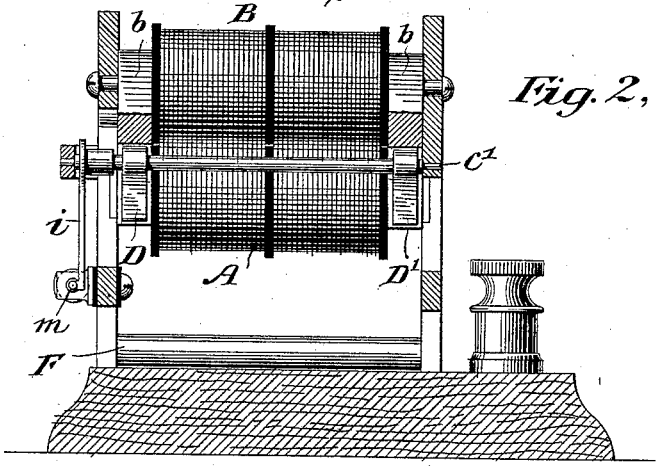
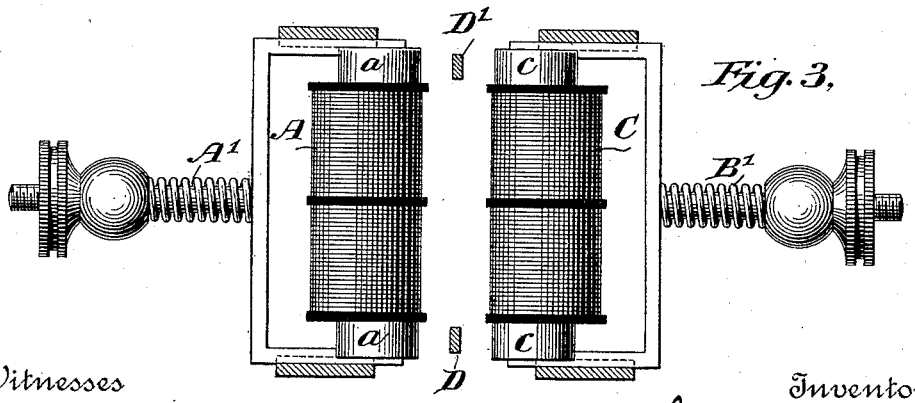



Fig. 3,




Witnesses

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(No Model.) 3 Sheets—Sheet 2.

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## TELEGRAPH RELAY.

No. 493,620. Patented Mar. 14, 1893.

Fig. 4,

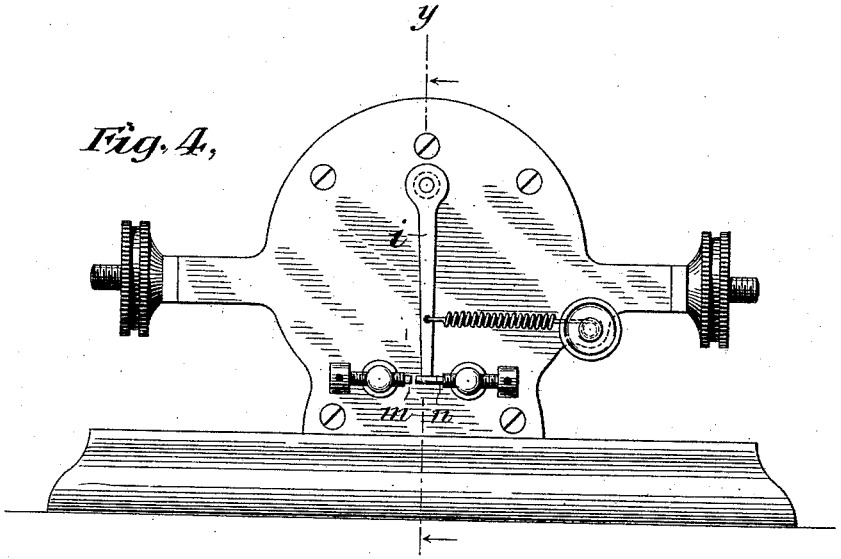



Fig. 5,

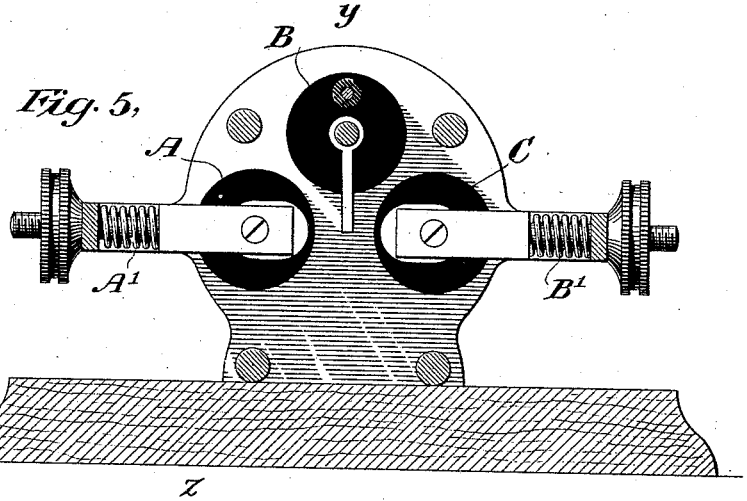
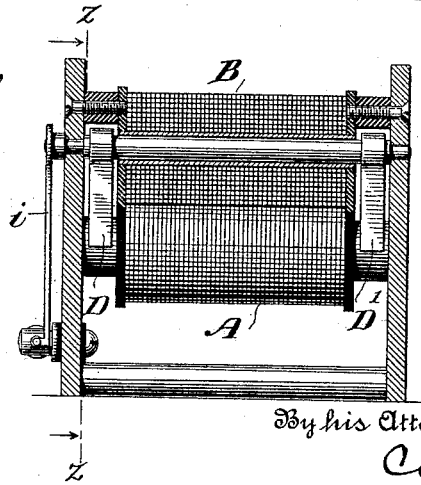



Fig. 6,

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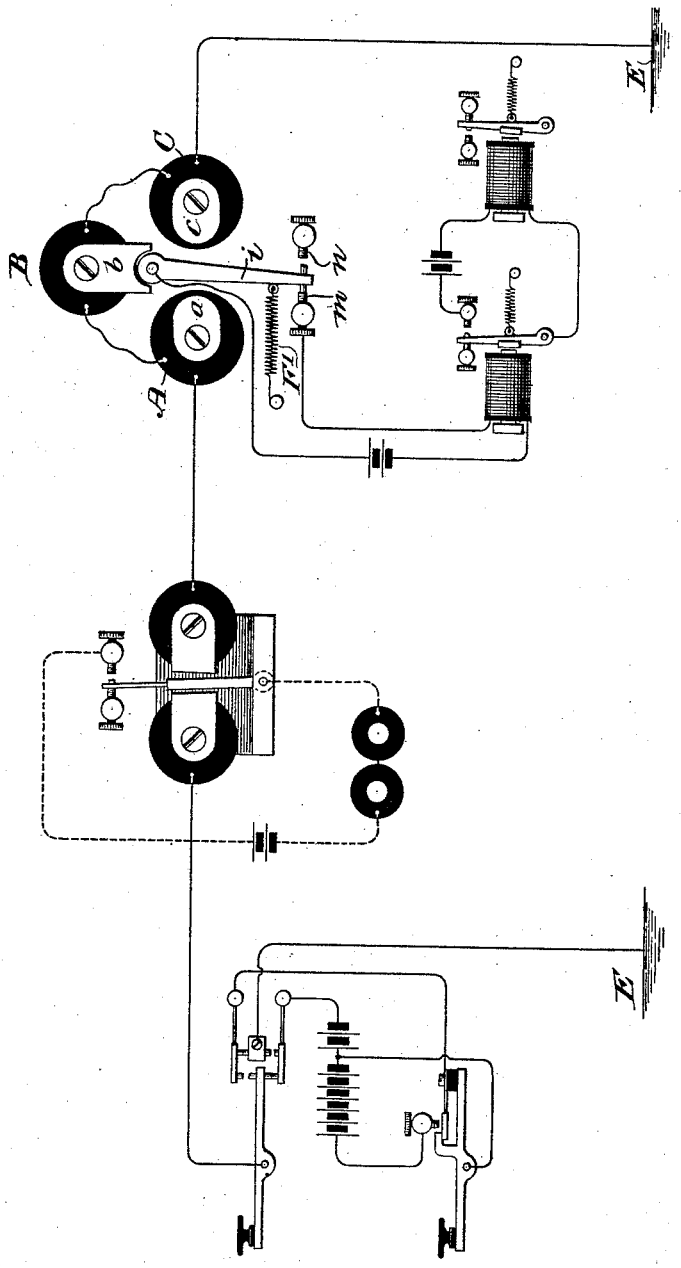
3 Sheets—Sheet 3.

# S. P. FREIR.

## TELEGRAPH RELAY.

No. 493,620. Patented Mar. 14, 1893.

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# UNITED STATES PATENT OFFICE.

SAMUEL P. FREIR, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK.

## TELEGRAPH-RELAY.

SPECIFICATION forming part of Letters Patent No. 493,620, dated March 14, 1893.

Application filed December 15, 1891. Serial No. 415,088. (No model.)

*To all whom it may concern:*

Be it known that I, SAMUEL P. FREIR, a citizen of the United States of America, residing at East Orange, county of Essex, and State of New Jersey, have made a new and useful Improvement in Telegraph-Relays, of which the following is a specification.

In quadruplex telegraphy, where two messages are simultaneously sent in the same direction, one by reversals and the other by changes in current strength, a difficulty is encountered in accurately recording signals of the latter class, which is due to a period of no current through what is termed the neutral relay at the moment of current reversal. Thus the neutral relay, which should alone respond to changes in current strength, is made responsive, in a measure, to signals passing over the line which should be received by the polarized relay only; and in this manner signals which should be received upon the neutral relay only are confused by those of the other class. In other words, there is a mutilation of signals upon the neutral relay which occurs in each instance at the moment of reversal, there being a cessation of current flowing through the neutral relay, and thus it is that its armature, which was previously attacted, will be momentarily released and will make a movement toward the back or working contact which, if completed, would cause a false signal.

It is the object of my invention to produce a neutral telegraph relay which shall be exceedingly sensitive under the action of signaling impulses due to changes in current strength, and as well a relay which shall, as far as possible, avoid the false movement of its armature occurring during the cessation of current at the moment of reversal; and to this end I employ the principle of mutual attractions and repulsions between the moving and fixed parts of the relay, at the same time avoiding the use of permanent magnets or polarized tongues.

In the accompanying drawings, Figure 1 represents the frame upon which the relay coils are mounted. There are two end plates or supports, but only the front one, indicated by G, H, I, is shown. The second plate, however, is substantially the same in construction and the two are connected rigidly together by parallel rods or plates E, F, and by the iron core of coil B. The two fixed coils, however, are mounted upon frames the ends of which slide within grooves formed in said end pieces in such manner that they may be moved forward and backward by set screws A′, B′, thus enabling pole pieces *a*, *c*, to be adjusted to and fixed in any desired position in respect to the vibrating armature D. Fig. 2 is a side view of the more important parts shown in end view in Fig. 1, and particularly of coil B, which is employed to polarize its stationary armatures which in turn polarize movable armatures for actuating the relay tongue. Fig. 3 is a plan view of the two horizontal coils of the relay, with lateral adjusting devices, for mutually attracting and repelling the relay armatures D, D′, from side to side. Fig. 4 represents a front view of a modified form of my relay, in which is particularly shown the relay tongue *i*, and its stops *m*, *n*. Fig. 5 is a front view of coils and pole pieces employed in this modification. In this instance coil B and its core vibrate together, while armatures D, D′ are rigidly affixed to said core. Fig. 6 is a side view partly in section, showing the same form of relay in which the relay armatures are rigidly attached to the rotating core of the polarizing coil. Fig. 7 represents a diplex system, or that half of the quadruplex by which two messages are simultaneously transmitted in the same direction, one by current reversals, and the other by changes in the current strength; and it particularly illustrates two transmitting keys, the one for effecting current reversals, and the other to cause changes in current strength; and as well two receiving instruments—the one at the left—a polarized instrument, responsive to current reversals, and the other for recording messages by changes in current strength.

Referring to Fig. 1, A and C are parallel stationary electro-magnets which are provided with soft iron cores having at each end pole pieces *a*, *c*, extending therefrom at right angles; while above coils A and C is a third coil, B, whose soft iron core is parallel with those of A, C, from the ends of which likewise extend pole pieces *b*. Beneath pole

pieces *b* is placed a shaft, and opposite each pole piece *b* is rigidly attached to said shaft an armature D or D′, and at one end a tongue *i*, which plays between contacts *m*, *n*, said tongue being normally held against the former by a retractile spring F′. The three electro-magnets A, B, C, are preferably connected together in series; their coils, however, are so wound that a current passing over the circuit produces a south pole in *a*, a south pole in *b*, and a north in *c*. At the same time the south polarity in *b*, by induction, produces a north pole in the upper end of the armature D and a south in its lower portion, and thus it is that the pole piece of *a*, under this direction of current, tends to repel the south polarity in the lower end of armature D, while an attractive influence is at the same time exercised by the north polarity in *c*; and if the current be made sufficiently strong, the relay tongue *i* will be forced away from *m* against *n* and will there remain during the continuance of this condition of current, and will only return to contact *m* when the strong flow of current ceases. At the time of current reversal, when signals are being sent for reception upon the polarized relay, there will be a momentary cessation of current through coils A, B, C, but with this arrangement of electro-magnets, the absence of current is not sufficient to permit the relay armature to be so far relinquished that the tongue *i* can return to the back stop *m*. If the armature D, under the influence of the battery with the negative pole to line as shown in Fig. 7, were repelled by pole piece *a* and attracted by *c*, the same would be true if the current were reversed; but in the latter case, *c* would become a south pole, *a* a north, and the lower end of D a north. Thus, although the magnetism of the several pole pieces is reversed, their respective attractions and repulsions remain unchanged.

In Fig. 3, A, C conspicuously represent the two adjustable electro-magnets by which the relay armature is attracted from side to side; while B in Fig. 2 is the electro-magnet by which the armatures D, D′ are polarized, the latter being mounted upon a pivotal shaft *c*′.

Instead of employing a fixed coil as shown in Figs. 1 and 2, with pole pieces rigidly attached to its stationary core to inductively polarize a movable armature of the relay, I have shown in Figs. 5 and 6 an arrangement in which coil B and its iron core are rigidly fixed together, but are rotatable within the limits of movement required for tongue *i*, Fig. 4, to vibrate between.

What I claim, and desire to secure by Letters Patent, is—

1. In a diplex or quadruplex telegraph system, a relay which is responsive to changes in current strength, consisting of three coils, all included in a single circuit, one for polarizing the armature of said relay, and the other two, under the influence of the same current, serving to mutually attract or repel said armature or armatures.

2. In a diplex or quadruplex telegraph system, in which two messages are simultaneously transmitted, one by changes in current strength and the other by reversals, a neutral relay employing electro-magnets having soft iron cores and pole pieces, all of whose coils are included in a single circuit and so arranged that one shall polarize the armature or armatures of said relay, and the others mutually attract and repel said armature or armatures, as set forth.

3. In a telegraph relay, the combination of coils A, B, C, end plates G, H, I, connecting bolts E, F, sliding frames for carrying coils A, C, and set screws A′, B′.

4. In a telegraph relay, the combination of three electro-magnets, all of whose coils, A, B, C, are included in the main-line circuit, each being provided with a stationary iron core and pole piece, and a soft iron vibrating armature, D, whose pivoted end is in close proximity to and is intermittently polarized by the core of one of said electro-magnets, while its free end is mutually attracted and repelled by the cores of the two other electro-magnets, substantially as described.

5. In a diplex or quadruplex telegraph system in which two messages are simultaneously transmitted, one by changes in current strength and the other by reversals, a relay having a soft-iron vibrating armature whose pivoted end is intermittingly polarized by an electro-magnet in the main circuit and an additional magnet placed in said circuit which serves to intermittingly attract or repel the free end of said armature according to the latter's direction of movement to make a signal and the position of said magnet, whether on one side or the other of said armature.

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