No. 785,941. PATENTED MAR. 28, 1905.

S. D. FIELD.

COMPOUND RELAY.

APPLICATION FILED JAN. 14, 1905.

Fig: 1

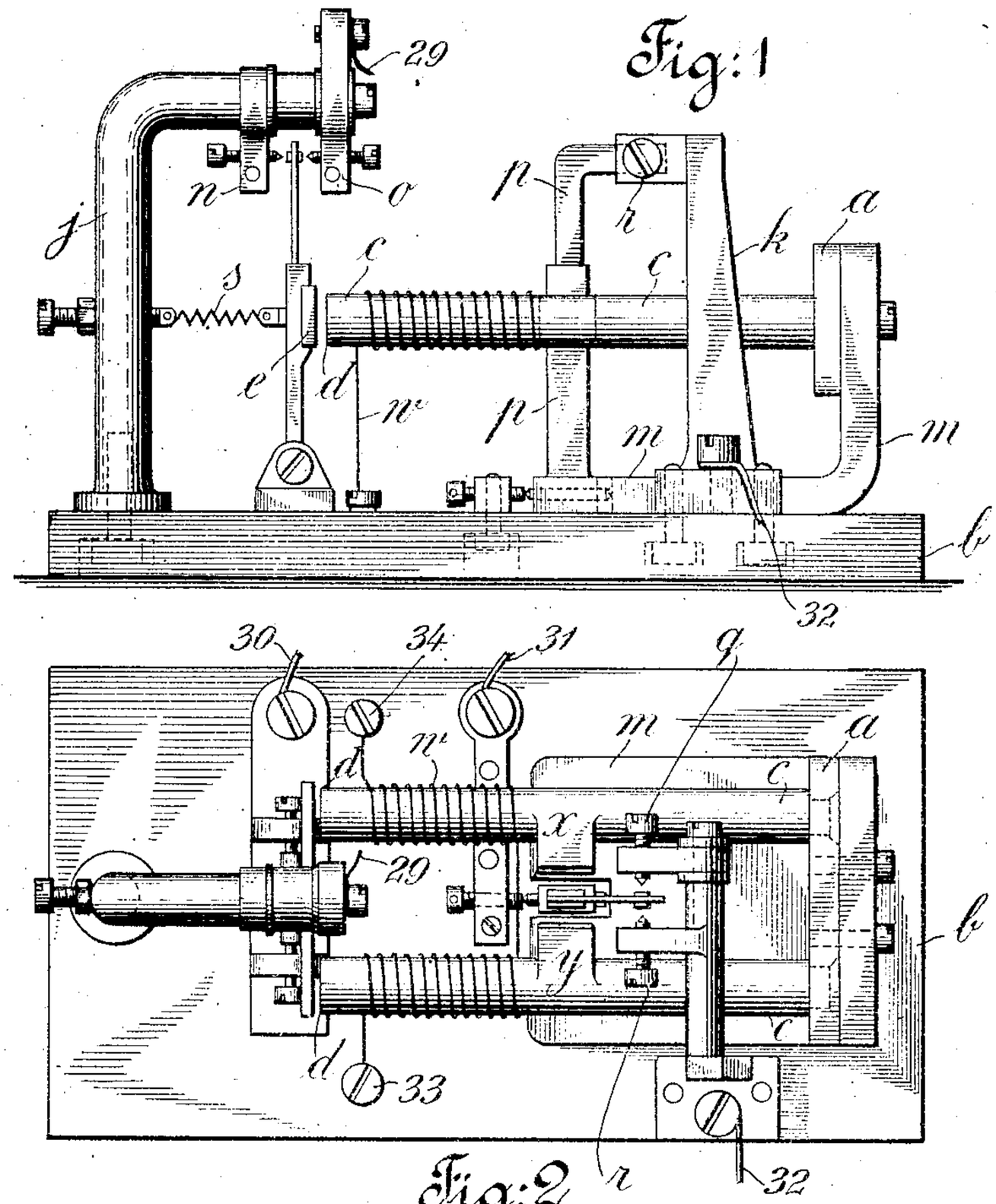



Fig: 2




Fig: 3

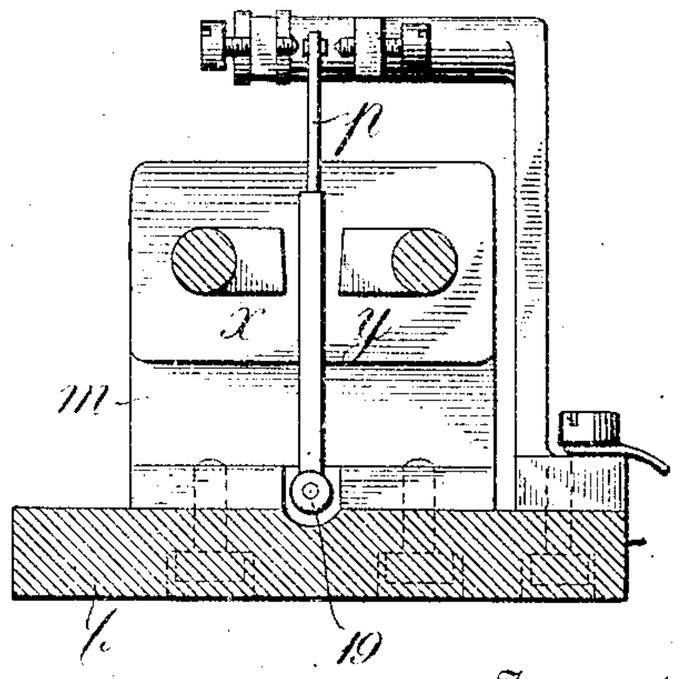
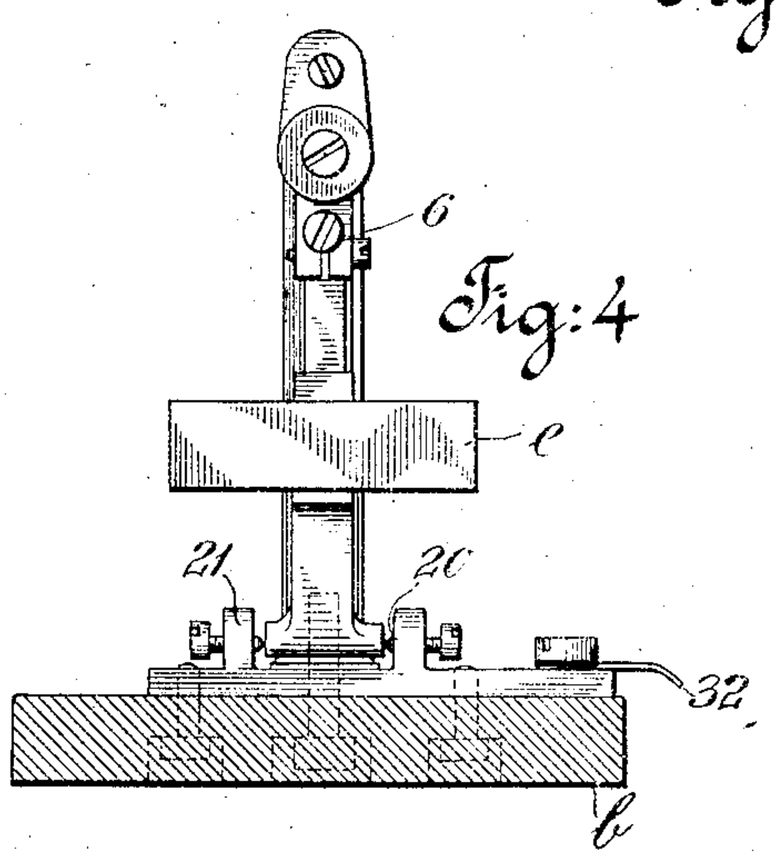



Fig: 4

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No. 785,941. Patented March 28, 1905.

# UNITED STATES PATENT OFFICE.

STEPHEN D. FIELD, OF STOCKBRIDGE, MASSACHUSETTS.

## COMPOUND RELAY.

SPECIFICATION forming part of Letters Patent No. 785,941, dated March 28, 1905.

Application filed January 14, 1905. Serial No. 240,996.

*To all whom it may concern:*

Be it known that I, STEPHEN D. FIELD, a citizen of the United States, residing in Stockbridge, Berkshire county, Massachusetts, have invented certain new and useful Improvements in Compound Relays, of which the following is a specification.

My invention consists of a receiving instrument or relay having two independently-movable armatures, one of which responds to changes in polarity without regard to current strength, while the other responds to changes in current strength without regard to polarity. Each armature controls a separate and independent local circuit.

The object of my invention is to provide an improved relay for use in diplex or quadruplex telegraphy, where two separate and independent messages are sent in the same direction at the same time, which relay shall perform the functions of the two relays commonly employed in a more perfect and more successful manner and shall avoid the resistance due to the greater number of coils in circuit when two relays are employed.

My improvement consists, first, in a single relay having two armatures which coöperate beneficially in their influence upon the core or cores as distinguished from the distributing reaction incident to the use of similar apparatus heretofore known or used; second, in a polarized relay having two magnetic circuits and two armatures employed in connection with a single main-line coil, whereby the coil resistance is reduced or minimized.

My improved relay is a modification of the so-called "D'Arlincourt" relay. Said relay consists of a permanent magnet bent in the form of a right angle. Two soft-iron cores are fixed to one terminal, and half-way between the terminals of the cores between the cores is a pair of pole-pieces. The line-coil is located on the core between these core-pieces and the free end of the cores. An armature, polarized by the opposite pole of the permanent magnet, vibrates between these intermediate pole-pieces. The magnetism generated has two magnetic circuits of widely different resistance, one including the intermediate pole-pieces and short air-gap and the other including the free core-terminals and wider air-gap. A current in the coil magnetizes the cores, and the magnetic flux or flow, overcoming the influence of the permanent magnet, includes the intermediate pole-pieces and short air-gap and the base or bar joining the cores at their base. When the line-current ceases, the permanent magnet reëstablishes a magnetic flux in the opposite direction through these intermediate pole-pieces, and this occurs before the effect of a reversal in the line-current can be effective. This unfits the D'Arlincourt relay for use in diplex or quadruplex telegraphy, because the polarized armature will respond to a cessation of current as well as to a reversal.

I have found that the addition of a neutral armature to the free polar ends of the D'Arlincourt relay at once brings the magnetic circuits to nearly equal value and furnishes an apparatus wherein the outer or neutral armature may be used to record variations in current strength, while the polar armature is more sensitive to reversals and less sensitive to minor variations. In my arrangement the polarization automatically adjusts itself to the current, giving a high degree of sensitiveness to the apparatus when employed to record reversals of varying strengths of current. The addition of a neutral armature brings the two magnetic circuits nearly into equilibrium, for the reason that when the neutral armature is nearer the poles and a strong current in the line-coil the lines of force acting on the polar armature are reduced. When a weak current is on the line, the neutral armature being withdrawn, the lines of forec acting on the polar armature are increased. It is sometimes desirable to give a bias to the polar armature to obviate the effect of "foreign currents" or "vagrant currents," such as those due to leakage and other causes, and the magnetic value of the two polar projections presented to the neutral armature is thereby altered—that is, one pole will become weaker, the other stronger—

by reason of the upsetting of magnetic balance due to the bias of the polar armature. This disturbance of magnetic balance largely affects the value of the vagrant currents as a disturbing factor on the neutral armature. When the neutral armature is withdrawn, the D'Arlincourt effect becomes apparent, and the weak reversals have nearly as much effect as the stronger ones. For this reason in my arrangement the reactions on the core, inseparably due to the use of two armatures, is changed from a disturbing cause to a beneficial coöperation.

The accompanying drawings illustrate my invention.

Figure 1 is a side elevation of my improved relay. Fig. 2 is a plan view. Fig. 3 is a sectional elevation taken on a line just in front of the polarized armature, and Fig. 4 is a sectional elevation on a line just in front of the neutral armature.

*b* is a base of insulating material to which the parts are fixed.

*m* is a permanent magnet.

*c c* are soft iron cores fixed to a soft-iron base *a* and to one polar extremity of the permanent magnet *m*. The free polar terminals of the cores *c* are shown at *d*. Intermediate the ends of the cores *c* are two polar projections *x* and *y*.

*w* is a coil of insulated wire wound upon the cores *c* at a point between the pole-pieces *x* and *y* and the poles *d*. The terminals of *w* are shown at 33 and 34.

The structure so far described is common to the D'Arlincourt relay and to my improvement. In the former the magnetic flux due to the current in *w* is through *c x y c* and the air-space separating the poles *d* and also through *c a c* and the air-space separating the poles *d*. When circuit is broken in *w*, the magnetic flux in *c x y c* disappears first and a flux due to the permanent magnet *m* is established in the circuit *x y c a c* in the reversed direction. This renders the D'Arlincourt relay useless in quadruplex work.

*p* is a polarized armature pivoted at 19 in inductive proximity to the pole of permanent magnet *m* opposite to that bearing the cores *c*. This armature and a suitable contact-point carried by it vibrates between the stops *q* and *r*, the latter being supported on the bracket *k* to make and break a local circuit, the terminals of which are shown at 31 and 32. In inductive proximity to the free pole *d* I have pivoted a neutral armature *e*. It may have the usual trunnion-bearings (shown at 20 and 21) and a retracting-spring *s*. It carries a contact-point which vibrates between the stops *n* and *o*, supported on the bracket *j*, to make and break a local circuit, the terminals of which are shown at 29 and 30. The presence of this armature *e* tends to equalize the resistance to the magnetic flux in the two circuits above described, and the flux due to magnet *m* immediately following cessation of current in *w* instead of flowing through *c x y c a* flows through *c e c a* and is harmless. In quadruplex operation, where two strengths of current are used, when the greater strength of current is to line and a reversal occurs the greater magnetic flux due to the greater current is largely taken up in the magnetic circuit *x c d e d c y*. In other words, the neutral armature *e* brings the two magnetic circuits nearly into equilibrium. When armature *e* is well up to the poles and the stronger current is on the line, fewer lines of force proportionally act on the polar armature. When a weaker current is on the line, armature *e* being withdrawn causes more lines of force to concentrate on the polar armature.

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

1. In an electromagnetic receiving instrument the combination of a soft-iron core having two pairs of free poles at separated points, means for permanently polarizing said cores, a polarized armature for one pair of pole-pieces, a suitable magnetizing-coil, and a neutral armature for the second pair of pole-pieces.

2. In a relay a suitable core of magnetic metal, means for permanently polarizing said core applied at one terminal, means for intermittently varying the magnetism at the other terminal, a pair of free poles at said second terminal, a pair of free poles intermediate said magnetizing devices, a neutral armature at the terminal poles and a polarized armature at the intermediate poles.

3. In a relay a suitable core having two pairs of pole-pieces affording two magnetic paths or circuits, means for permanently polarizing said core located at or near one terminal of said core, means for intermittently varying the polarity of said core located at or near the other terminal of said core, a neutral armature at the free polar terminals and a polarized armature at the intermediate polar terminals.

4. In a relay a suitable core having two pairs of pole-pieces providing two magnetic paths or circuits, means for permanently polarizing said core located at or near one terminal of said core,means for intermittently varying the polarity of said core located at or near the other terminal of said core, a neutral armature pivoted at the free polar terminals, a polarized armature pivoted at the intermediate poles and pairs of circuit-closing points, one for each armature.

5. In a relay a suitable core having two pairs of pole-pieces providing two magnetic paths or circuits, a permanent magnet fixed

to one terminal of said core, a suitable coil of insulated wire located on the core at or near the other terminal thereof, a neutral, suitably-retracted, pivoted armature at the free core-terminals, a pivoted armature polarized by said permanent magnet pivoted at or near said intermediate poles, a pair of circuit-closing points for the neutral armature and a pair of circuit-closing points for the polarized armature.

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