(No Model.)

# A. D. MacDONALD.

## TELEGRAPH RELAY.

No. 551,192. Patented Dec. 10, 1895.

*Fig. 1.*

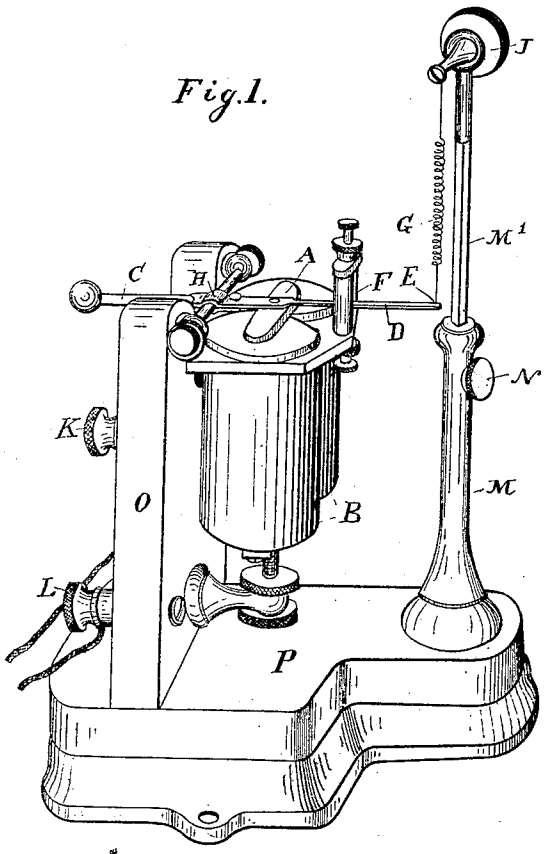



*Fig. 4.*

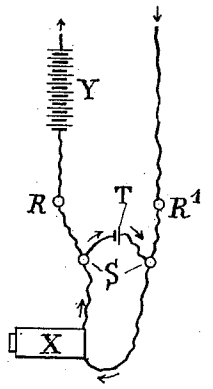



*Fig. 5.*

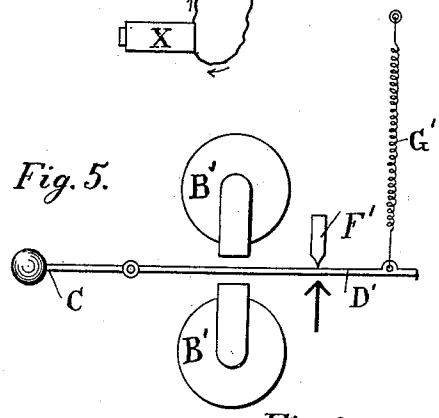
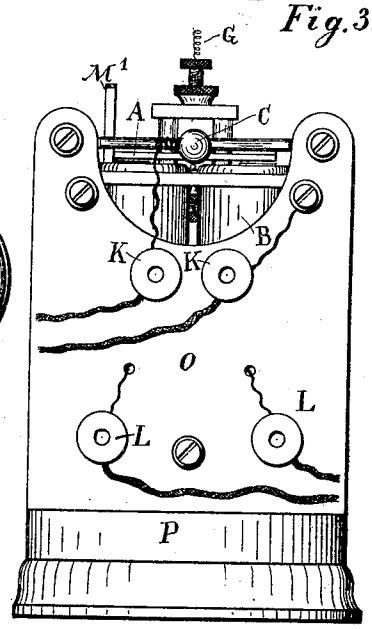



*Fig. 3.*



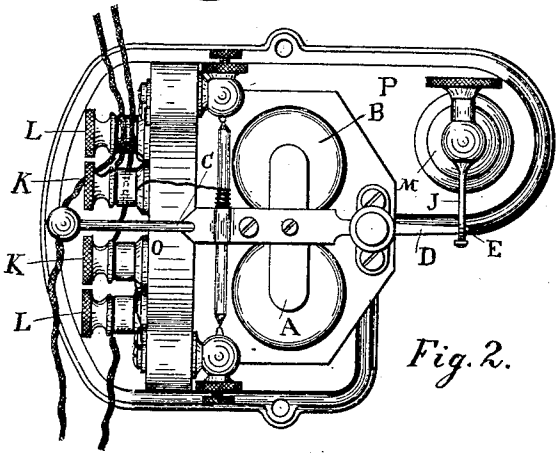




*Fig. 2.*

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ARCHIBALD DAVID MACDONALD, OF MELBOURNE, VICTORIA.

## TELEGRAPH-RELAY.

SPECIFICATION forming part of Letters Patent No. 551,192, dated December 10, 1895.

Application filed November 2, 1894. Serial No. 527,751. (No model.)

*To all whom it may concern:*

Be it known that I, ARCHIBALD DAVID MACDONALD, a subject of the Queen of Great Britain and Ireland, and a resident of the Sun Building, Queen Street, Melbourne, in the Colony of Victoria, Australia, have invented certain new and useful Improvements in Methods of and Mechanism for Operating Armatures of Telegraphic Relays, of which the following is a specification.

In the ordinary forms of telegraphic relay the principal drawback is the necessity for frequent readjustment of the instrument as the strength of the current varies from time to time, owing to meteorological or other influences. Further, it is found that the current in practice often weakens to such an extent that even when adjusted to its limit the relay will not work so as to produce intelligible signals. Relays in most general use have the cores, armatures and armature-lever, and regulating-spring arranged in a manner which necessitates unnecessarily strong currents (whether obtained from galvanic cells or other sources) to work such relays. Such currents are as a general rule supplied by means of galvanic cells, which are especially costly to maintain in considerable numbers, so that the reduction of the expenses for current has become a desideratum.

My improvements relating to the construction of relays are designed to obviate the necessity for frequent readjustments, and to render the employment feasible of much weaker currents than are ordinarily employed, in this way effecting a distinct economy. In consequence of the mechanism I use being adapted to continue the working whether the current be strong or weak, my instruments will give signals when ordinary ones would fail to do so. When weak currents are used, as I prefer, the induction troubles now common will practically disappear. Among the economies which may be effected by my said improvements are the abolition of repeating-stations on many long lines.

The method of regulating my mechanism is by increasing or decreasing the tension of a specially-arranged spring operating a specially-constructed armature-lever, but I further have invented a method of causing relays when they are found non-responsive to very weak currents to become sensitive to the same, and so enable working to be carried on. This latter improvement in the method of causing relays to act is applicable to relays generally, but it will require to be brought into use only occasionally—*i. e.*, when the current has become abnormally weak.

My improvements in mechanism may be applied to relays of various kinds; but for the purpose of making their nature apparent I will now describe them as applied to a simple non-polarized instrument, as shown in the drawings, in which—

Figure 1 shows, in perspective, a relay containing my improvements. Fig. 2 represents a plan view of the same instrument from above, and Fig. 3 shows an elevation of it from the rear. Fig. 4 is a diagram showing the apparatus as in application of my said method of working relays, and Fig. 5 is a plan view showing contacts.

As will be seen the improvements are in the mechanism for operating the armature A. In this construction the core and coils B stand upright and the armature-lever is extended on both sides of its axis or fulcrum H and so arranged that its arms C and D lie horizontally when at rest. To secure this result I make the weight of the extension C almost but not quite sufficient to act (when the instrument is free from electrical or magnetic influence) as a counterpoise to the end D, carrying the armature A. The arm D is extended to E—*i. e.*, considerably beyond the contact-points F—and at or near its extremity it is connected to the lower end of a spiral vertical spring G, the upper end of which is connected by a thread or the like to a micrometer or regulating-screw J to enable the spring-tension to be adjusted. The spring is unlike those ordinarily used, as it is so arranged that its weight is not a factor in the pull it gives upon the armature, and it is so delicate that a pull of less than one grain may be exerted by it on the end of the armature-lever. A pull of about two grains, when there is no current, should cause such spring to raise the end E until the contact-point at F is up against the back-stop. This is how the instrument should be set—*i. e.*, with the said two-grain pull lifting E when starting to work it. It is necessary to see

that the armature-lever is horizontal, and when up against the back-stop barely opening the local circuit, so that when the local circuit is closed the armature shall be as close to the cores as practicable without touching them.

As work proceeds there is little residual magnetism, so long as the current remains weak; but when the current strengthens the residual magnetism increases and necessitates a tightening of the vertical spring, (the height of J being regulated by means of the screw N in a hollow post M, in which the bar M′ is adapted to slide,) until the pull is as great as may be required.

In polarized relays I place the coils B′ with their length running horizontally and one core above the other, so as to allow the armature-lever D″ to oscillate vertically between said cores. The armature or lever for such relay may be constructed and arranged, in respect to pivoting and counterpoising, as above described for ordinary relays, with the agate or back-stop F′ uppermost, and be furnished with a special spring G′, also arranged as above set forth. Hitherto such relays have had no spring and no counterpoise device as applied by me. My said apparatus thus avoids mechanical impediments to working with weak currents and makes the receiving-instruments extremely sensitive, so that the speed of signaling is increased.

In the drawings it will be observed that various known parts of relays are shown, and the use of these will be well understood by persons versed in the art of telegraphy without further reference thereto.

K K are binding-screws for local circuit, and L L binding-screws for connection of main-line wire, and O an upright or supporting frame for parts as shown.

I will now describe in detail my aforesaid method applicable to relays generally.

When a main-line current is too weak to work a relay at any time in the process of working or before working has been established, the sensitiveness of the relay is increased greatly by the following means, viz: I cut off the weak main-line current and momentarily short-circuit the electromagnet of the relay with, say, one Leclanché cell, with the same polarity as the main-line current. This is illustrated in Fig. 4, which is not to scale, and in which R R′ shows main line entirely disconnected from the relay, and S shows a wire connecting one cell T to the relay X, the latter connection or circuit being made only after the main line R R′ has been disconnected. An important point is that the currents from lines S and R through the relay shall both have the same polarity. This is shown in the diagram by the arrows and the arrangement of cells T and Y, the former being near and the latter being remote from X. The current thus passed through the coils is of about six millampères, four to six being adequate. The telegraph-operator should then work his key and set the adjustment low, and then take off the short-circuit cell T and reconnect main line at R R′, when it will be found easy to adjust for and work with weak currents as was required to be done. A much less desirable modification of this method would be to introduce a number of cells, as T, in the short circuit without disconnecting the main-line current, but this course is not so simple. It might require many cells to be used, and if the ordinary proper number of cells be employed it might still not be attended with such favorable results as the one-current method above set forth. In some cases, however, this double-current method answers, such current being made to pass through the relay with a combined strength of about four to six millampères.

When relays are worked after having been at rest sufficiently to enable their residual magnetism to be discharged, I find that my above process is greatly superior in its effectiveness to what it would be if it were applied to a relay which had not had such rest and which contained residual magnetism.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a relay the combination with an electro-magnet of a lever fulcrumed at one side of said magnet, and having on one side of its fulcrum in successive order an armature, contact points, and a tension spring the latter vertically set above the end of said lever, and on the other side of said fulcrum an arm or extension of such weight as to act as a counterpoise to the first named side of the lever and allow the latter to rise against the back stop when the said spring is regulated to exert an upward pull substantially as and for the purposes set forth.

2. In a polarized relay when at a state of rest a horizontally arranged pivoted armature lever adapted to oscillate vertically between cores placed one above another as set forth said lever being fulcrumed on one side of said cores and having on the other side of said cores, contact points, and a tension spring the latter vertically set above the end of said lever, and on the other side of said fulcrum an arm or extension of such weight as to act as a counterpoise to the first named side of the lever and allow the latter to rise up against the back stop when the said spring is regulated to exert an upward pull substantially as and for the purposes set forth.

In witness whereof I have hereunto set my hand in presence of two witnesses.

ARCHIBALD DAVID MACDONALD.

Witnesses:

GEO. G. TURIS,

E. F. NICHOLLS.