May 6, 1930. A. M. CURTIS 1,757,703

ELECTRICAL CONTACT DEVICE

Filed July 24, 1926

Fig. 1

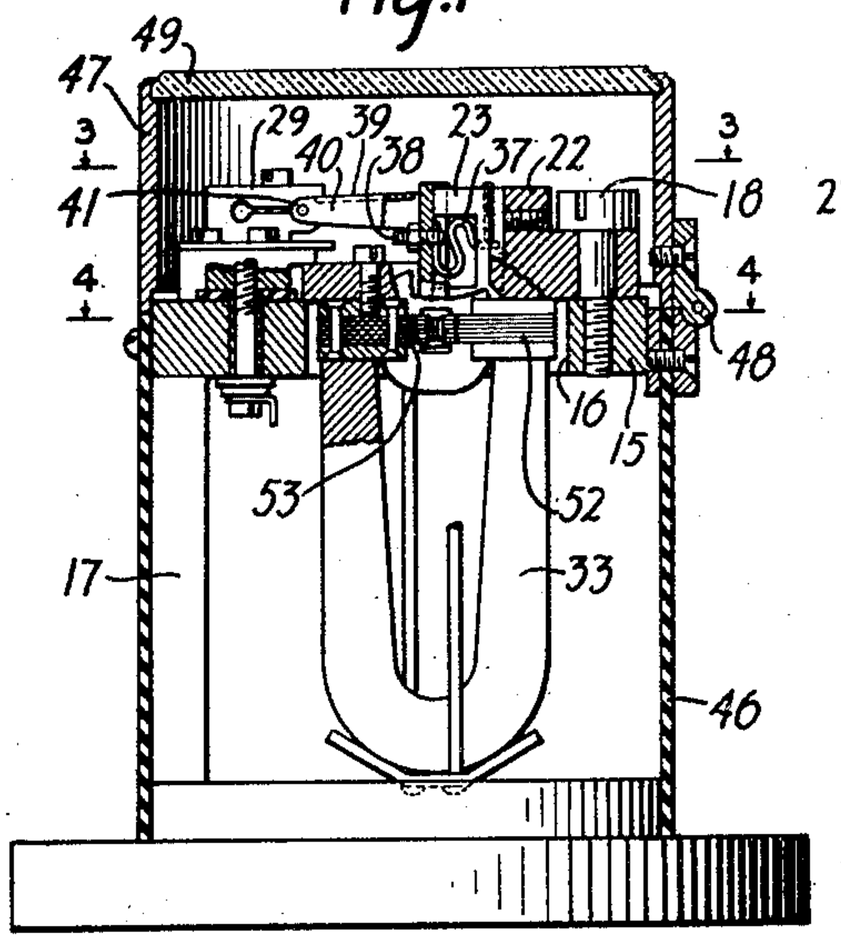


Fig. 2

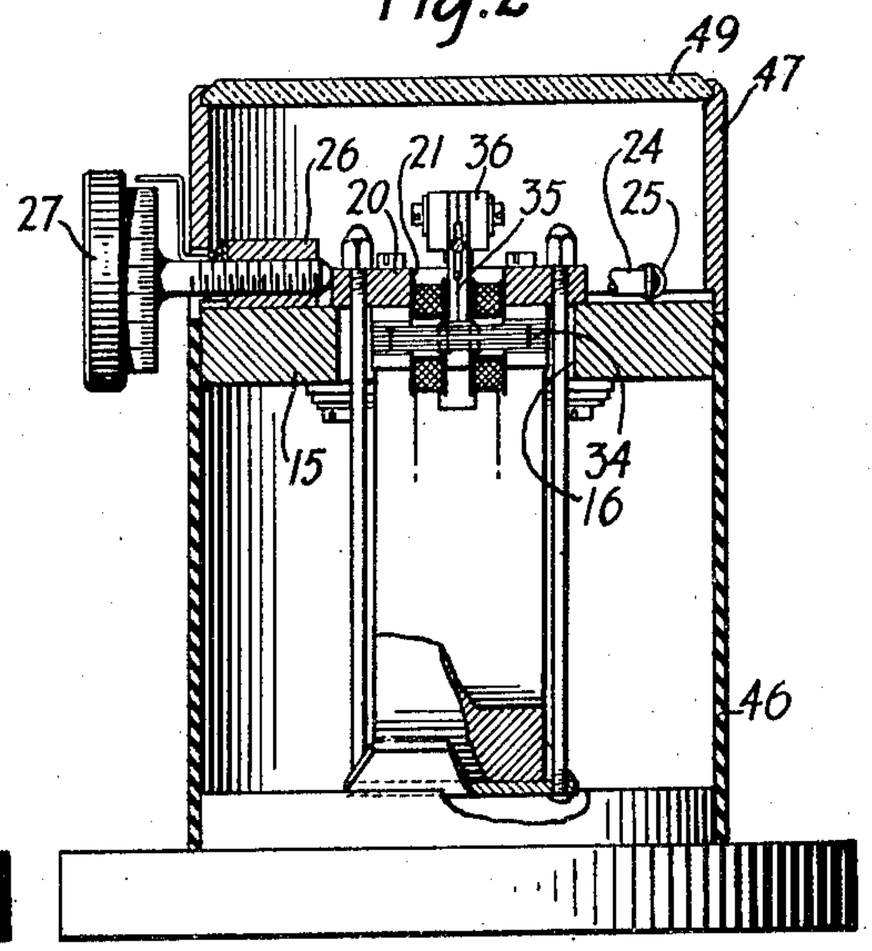


Fig. 3

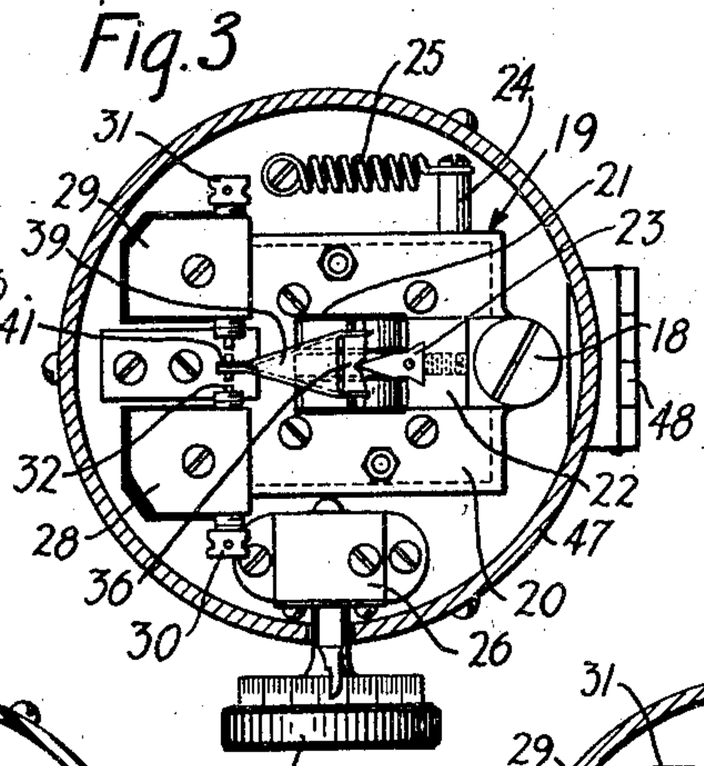


Fig. 6

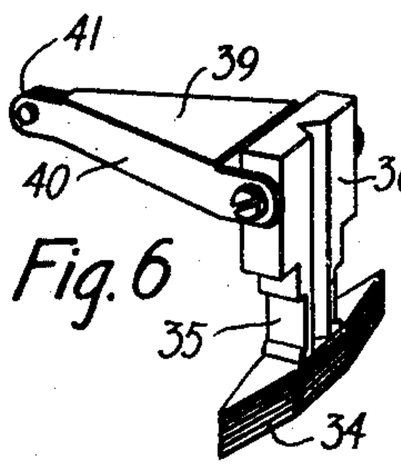


Fig. 7

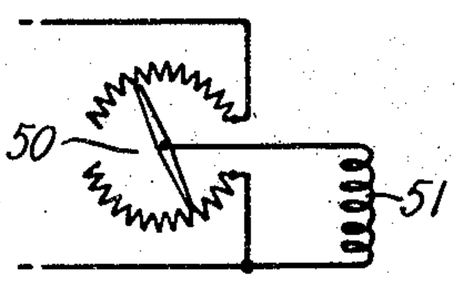


Fig. 4

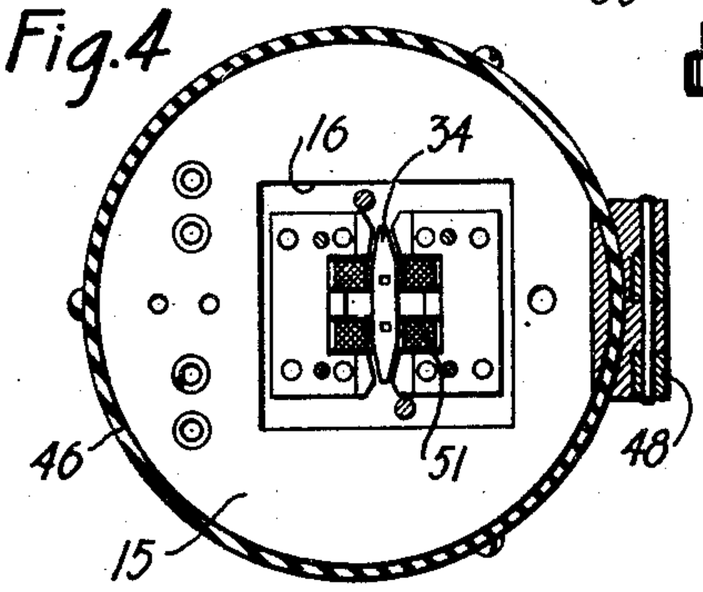
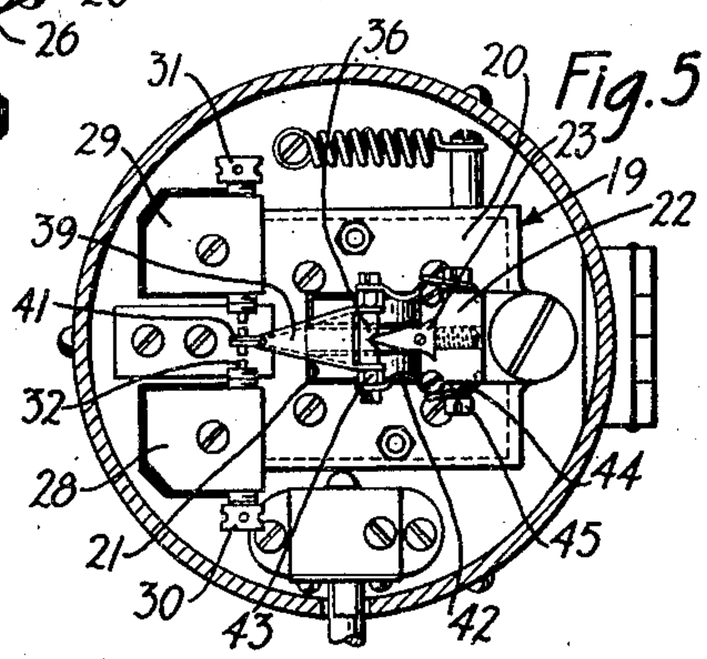


Fig. 5



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by E. E. Briggs Atty.

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UNITED STATES PATENT OFFICE

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ELECTRICAL CONTACT DEVICE

Application filed July 24, 1926. Serial No. 124,595.

This invention relates to electrical contact devices and particularly to relays for use in signaling circuits.

An object of the invention is to obtain an efficient and accurate response to signaling waves—particularly high frequency telegraph waves such as are employed on loaded submarine cable systems.

A particular object of the invention is to obtain positive engagement of the contact elements without appreciable chatter, that is, vibration of the contact members.

In accordance with this invention troublesome chatter is greatly reduced by constructing both the moving and fixed contact structures so that their natural periods of vibration are outside the range of signaling frequencies. The movable contact member is made rigid and light not only to prevent chatter but also in order to obtain accurate response to signaling currents of small amplitude.

Contact chatter is further reduced by an arrangement for adjusting the electromagnetic armature and associated elements as a unit with relation to the stationary contact.

A further feature of the invention is the combination of a relay designed to have close coupling between the electrical and mechanical systems and a resistance circuit connected across the windings for dissipating the electrical energy produced therein by the movement of the armature, thus in effect damping the vibration of the armature and associated elements.

The effect of the close coupling is to convert into electrical energy practically all the mechanical energy of the moving armature which is not effective in closing the contacts.

A still further feature of the invention is an armature and pole face structure consisting of laminations of nickel-iron alloy insulated by means of material which will withstand the temperature necessary to heat-treat the structure after assembly.

The relay herein described employs an electromagnetic element of the type described and claimed in the copending applications of H. C. Harrison, Serial No. 678,935, filed December 6, 1923, and Serial No. 66,624, filed May 28, 1925, issued April 16, 1929, as Patent No. 1,709,571. The use of a closely coupled element of this type gives a sensitive response to weak signals and makes it possible to electrically damp the vibration of the moving parts.

In one form of the invention there is provided a base, upon which is pivotally mounted a plate carrying all parts of the electromagnetic system with the exception of the stationary contacts. This plate is provided with a tensioning device and an adjusting screw by which it may be shifted bodily with relation to the base in order to properly center the contact arm with relation to the stationary contacts which are carried by studs projecting upwardly from the base. Pivotally mounted with relation to the plate, is an armature provided with an axial extension carrying at its upper end, a contact arm of great rigidity, but little mass. The free end of this contact arm is disposed between the stationary contacts above mentioned. The stationary contacts are relatively rigid so as to maintain their natural periods of vibration well out of the frequency range of any signal to be received. The armature, which is composed of a material having high permeability at low magnetizing forces and low hysteresis loss, is pivoted on knife edges which reduce friction losses to a minimum. When it is desired to use the device in three-element signal transmission systems, balancing springs may be connected on opposite sides of the contact arm and adjustably associated with the post to which the armature is pivoted.

In the drawings,

Fig. 1 is a vertical sectional view through a relay embodying the features of this invention.

Fig. 2 is a view similar to Fig. 1 taken at right angles thereto.

Fig. 3 is a horizontal sectional view taken on line 3—3 of Fig. 1.

Fig. 4 is a horizontal sectional view taken on line 4—4 of Fig. 1.

Fig. 5 is a view similar to Fig. 3 showing a modified form of the invention.

Fig. 6 is a perspective view of the moving unit of the relay.

Fig. 7 is a diagrammatic circuit drawing showing the circuit arrangement for electrically damping the vibrations of the contact arm.

Referring to the drawings in detail, a base 15 is formed with a central opening 16. This base is supported by three equally spaced legs 17.

Pivotally secured to the base 15 by means of a screw 18 is a carriage designated in its entirety by numeral 19. This carriage comprises a substantially rectangular plate 20 formed with a central opening 21 for the accommodation of the armature and associated elements which will be more fully set forth hereinafter. Extending upwardly from the plate 20 near the pivot screw 18 is a post 22, the forward face of which aligns with one wall of the opening 21. Secured in the forward face of this post and extending outwardly therefrom is a bearing member 23 which is provided at opposite ends with forwardly extending arms terminating in knife edges. Projecting laterally from the carriage 19 is a stud 24 to the outer end of which is connected a coil spring 25 the opposite end of which is attached to the base 15. Mounted in a bracket 26, secured to the base 15 on the side opposite to that to which coil spring 25 is attached and extending therethrough, is the shank of an adusting screw 27, the inner end of which impinges against the side edge of the plate 20. It will thus be apparent that by turning the screw 27, the position of the carriage with reference to the base 15 may be varied against the tension of the spring 25.

Secured to but insulated from the base 15 diametrically opposite the pivotal connection between the base and the carriage, are relatively massive posts 28 and 29 which are provided with threaded openings for the reception of screws 30 and 31 carrying at their inner ends contact points 32.

Supported on the under side of the plate 20 is a U-shaped permanent magnet 33 the legs of which are disposed in substantially vertical planes and carry at their upper ends laminated pole pieces 52 and 53 of a highly permeable material such as nickel-iron alloy. Between these pole pieces are mounted the energizing coils 51. As illustrated in Fig. 4, the pole pieces are substantially U-shaped and the ends of their arms are disposed in alignment but slightly spaced from each other to avoid contact therebetween and the laminations are preferably insulated from each other by a heat resisting material such as mica.

A laminated armature 34, which is substantially diamond shaped in plan, is disposed between these pole pieces and carries an axial arm 35 which is provided with a substantially V-shaped longitudinal groove. Like the pole pieces above described, the laminations of the armature are preferably composed of a particular nickel-iron alloy commercially known as "Permalloy" and described and claimed in the copending application of G. W. Elmen, filed May 31, 1921, Serial No. 473,877, issued June 1, 1926, as Patent No. 1,586,884. This magnetic circuit is of the type described and claimed in the application of G. W. Elmen Serial No. 492,722, filed August 16, 1921, and has a low retentive force. The laminations are insulated from each other by a heat resisting material such as mica. Such a method of insulation enables the parts to be heat treated after assembly, thus assuring their high permeability at low magnetizing forces.

The upper end of the axial arm 35 terminates in a head 36 to which the contact arm of the device is secured. The axial arm is retained in position on the bearing member 23 by means of a substantially S-shaped tension spring 37, one end of which lies in the V-shaped groove and is retained therein by a securing device such as the stud 38. The other end portion of the spring fits in a hole in the bearing member 23 and is held securely therein by means of a screw, as shown in Fig 1. Spring 37, thus secured, prevents any axial movement of arm 35 relative to bearing member 23 and holds the arm 35 with considerable pressure against the knife edge or bearing member 23.

The axial arm 35 is elastic to torsional motion so that after the contacts engage, any further motion of the armature will be taken up by the arm. The armature has a tendency to rebound due to the effect of this energy stored in the elasticity of the arm to produce chatter. However, since the magnetic circuit is closely coupled any movement of the armature produces a corresponding electrical current in the windings 51 which must flow through the resistance 50 (shown in the circuit of Fig. 7). The effect of this resistance is therefore to damp the vibration of the armature and thus prevent chatter. In this manner electrical means is utilized to dissipate the unusued mechanical energy of the armature, and the chatterless operation of the device is thus further promoted.

Secured to the head 36 is a contact arm 39 which comprises a substantially triangular plate of a very light but stiff material such as duralumin. This plate is preferably provided along two of its sides with angularly extending reinforcing flanges 40. These flanges project beyond the body of the plate and form a tongue 41 carrying a contact point which is disposed between the contact points 32, previously mentioned. The ends of the flanges 40 opposite those forming the tongue 41 are extended to provide ears by means of which the contact arm is attached to the head 36, above mentioned.

While the device above described is suitable for use in a two-element signal system, it is also desirable that it be adapted for use with a three-element signal system. Such an adaptation is shown in Fig. 5 in which the contact arm is balanced so that when in its normal position its contact point is out of engagement with either of the contacts 32. In order to secure such balancing action, bowed springs 42 are connected to spacers 43 carried on opposite sides of the head 36. These springs extend rearwardly in substantially parallel planes on opposite sides of the post 22 and are adjustably associated therewith by means of clamping plates 44 which are held in adjustable position on said post by screws 45.

The unit as described is contained within a casing 46, provided with a cover 47 which is hinged, as at 48, to the casing and provided with a transparent top 49, so that action of the device may be readily perceived.

In operation, a signaling impulse passing through the magnet coils energizes the armature 34 causing it to move in one or the other direction depending upon the polarity of the signaling impulse and the contact carried by the tongue 41 is thereby moved into engagement with one of the contacts 32. The length of travel of the movable contact is very small and any continued movement of the armature after the contacts are in engagement is stored in the axial arm 35 to be finally dissipated by the shunt previously described.

What is claimed is:

1. A relay including a base, massive stationary contacts secured to but insulated from said base, a carriage pivoted to the base opposite the stationary contacts, a movable contact pivotally associated with the carriage, yieldable means to force the carriage laterally in one direction, and means to move the carriage against the force of the yieldable means whereby the movable contact may be adjusted relative to the stationary contacts.

2. A relay having a base, rigid stationary contacts secured to the base, a massive movable carriage, an electromagnet carried thereby, a magnetically controlled movable contact arm of light mass pivoted to the carriage and a contact carried thereby and disposed between the stationary contacts, the mass of the carriage and magnet combining to produce an adjustable non-vibrating mounting for the movable contact.

3. A relay having a base, massive rigid stationary contacts secured thereto, a massive carriage pivoted to the base, an electromagnet secured to said carriage, a movable contact arm of light mass pivoted to the carriage, a contact carried thereby and disposed between the stationary contacts, the mass of the carriage and magnet combining to provide a non-vibrating mounting for the movable contact arm, and means to adjust the carriage and its assocciated elements relative to the base whereby the movable contact may be adjusted between the stationary contacts without necessitating any change thereof.

4. A relay having a base, massive rigid stationary contacts secured thereto, a massive carriage pivoted to the base, an electromagnet secured to said carriage, a movable contact arm of light mass pivoted to the carriage, a contact carried thereby and disposed between the stationary contacts, the mass of the carriage and magnet combining to provide a non-vibrating mounting for the movable contact, means to yieldably force the carriage in one direction, and adjustable means to move the carriage against the force of the yieldable means.

5. A relay contact arm comprising a thin sheet metal body, said body being triangular in plan, flanges on two sides of said body, said flanges being bent into planes at right angles to the plane of the body, extensions on the flanges at the apex of the body, said extensions being joined to form a rigid tongue, a contact carried by the tongue, and parallel extensions at the opposite ends of the flanges to provide attaching ears by means of which the arm is secured to the armature of a relay.

6. An electromagnetic structure comprising pole tips and an armature composed of laminations of nickel-iron alloy and means capable of withstanding high temperatures for insulating said laminations from one another.

7. An electromagnetic element for a relay comprising pole tips and an armature composed of laminations of nickel-iron alloy and mica insulation therebetween.

In witness whereof, I hereunto subscribe my name this 15th day of July A. D., 1926.

AUSTEN M. CURTIS.