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H. M. STOLLER

2,571,780

DAMPING MEANS

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FIG. 1

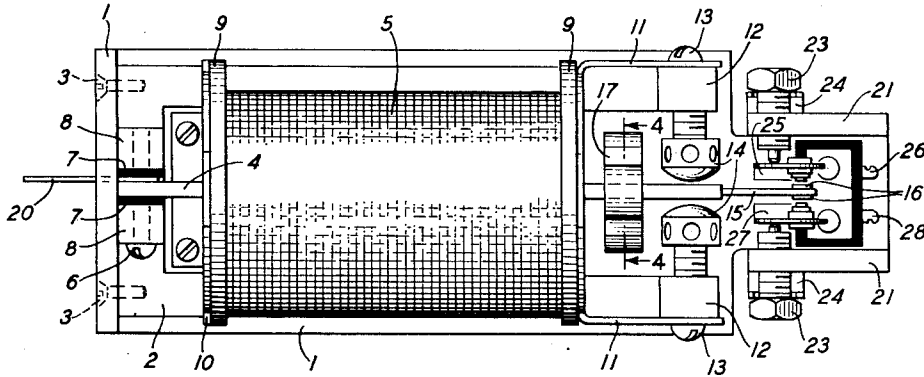


FIG. 2

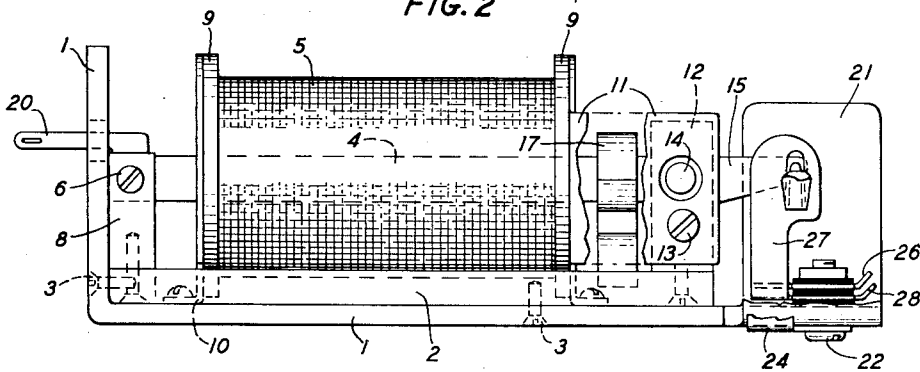


FIG. 3

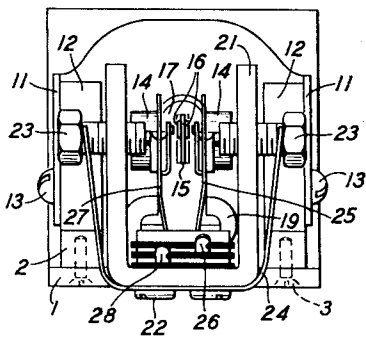


FIG. 4

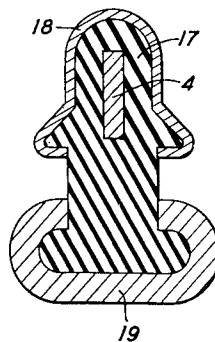
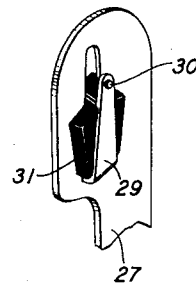


FIG. 5



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DAMPING MEANS

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5 Claims. (Cl. 188—1)

1

This invention relates to electromagnetic relays and more particularly to damping means for polar relays.

During the operation of polar relays, the contacts carried upon the armatures thereof frequently rebound from the fixed contacts with which they cooperate which is undesirable not only because the circuits through the contacts are improperly opened or closed but also because it is deleterious to the contacts.

Such contact "chatter" has been found to be of two independent types: low frequency chatter resulting from the periodic vibration of the armature and high frequency or volumetric chatter resulting from the periodic vibration of the moving contacts against the fixed contacts.

The object of the present invention is to provide a polar relay in which both such types of chatter are effectively suppressed.

This object has been achieved by affixing a flexible extension to the beam armature of a polar relay to introduce a measure of compliance so that the outer end of the extension is free to overtravel somewhat in operation. The low frequency chatter is then effectively eliminated by the placing of a pendulous member of resilient material upon the armature or armature extension. The high frequency chatter is damped by means of a resilient support member for the fixed contacts comprising, in the depicted embodiment of the invention, a flexible metal support for the contacts reinforced with suitable shock-absorbing material.

The invention may be more fully understood from the following detailed description made in reference to the following drawings in which:

Fig. 1 is a top view of a polar relay in which the invention has been embodied;

Fig. 2 is a side view of the relay of Fig. 1 with certain portions broken away;

Fig. 3 is an end view of the relay shown in Fig. 1;

Fig. 4 is a section of the pendulous member used as the low frequency damping means taken through 4—4 of Fig. 1; and

Fig. 5 is a perspective of the contact mounting members by means of which the high frequency vibrations are damped.

It is to be understood that the terms "low frequency" and "high frequency" used herein are

2

used only relative to one another as distinguishing labels. For instance, in a polar relay constructed in accordance with the invention and operating at 60 cycles per second, it was found that the armature and armature extension combination had a natural frequency in the range of 250 to 500 cycles per second while the high frequency chatter of the moving contact against the fixed contact was of the order of 5000 cycles per second.

Referring now to Figs. 1, 2 and 3 of the drawing, a relay is shown which may represent any suitable type of polar relay with which the novel features of the subject invention may be associated. Upon a base member 1 of brass or other non-magnetic material is mounted a permanent magnet 2 by means of screws 3 or by other suitable means. A beam armature 4 extends through an energizing coil 5 and is clamped by means of insulated non-magnetic screws 6 through non-magnetic shims 7 to permanent magnet extensions 8. A terminal 20 is provided to connect the armature in the load circuit. The energizing coil 5 may be mounted between two spool-heads 9 and is held in place at the rear by any suitable supporting means 10 and at the front by means of a non-magnetic bracket 11 affixed to the front spoolhead, apertured to permit the armature 4 to pass therethrough, and extending forwardly to be attached to front permanent magnet extensions 12 by means of screws 13. Engaging tapped holes in front permanent magnet extensions 12 are adjustable pole-pieces 14. Extending forwardly between pole-pieces 14 and firmly fixed to beam armature 4 is the flexible armature extension 15 carrying, at its forwardmost end, movable contacts 16. The detailed parts thus far described are well known in the art, and any suitable polar relay may be used.

A description will now be given of the novel features constituting the improvements to which this application is primarily directed.

The association of the flexible extension 15 with the beam armature 4 provides a measure of compliance through which the contact-carrying end of the extension is free to overtravel. The rebound of the armature and armature extension combination is then damped by the action of a pendulous member which may be located at

the point of maximum displacement of the armature extension, or, as in the depicted embodiment, this low frequency damper 17 may be located on the armature 4 in an area between the front spoolhead 9 and the pole-pieces 14. As may best be seen in Fig. 4 the low frequency damper 17 is suitably shaped to act as a pendulum and comprises a portion of resilient material reinforced by a metal clamp 18 and weighted by an element 19. Any suitable resilient material may be used, with those having a low mechanical phase constant, such as butyl rubber, having been found to be the most satisfactory. As the armature vibrates the low frequency damper 17 swings as a pendulum with the bending of the material surrounding the armature 4 absorbing the kinetic energy of motion thereby minimizing contact bounce. Tests have demonstrated that the best damping is secured by designing a damper with a mass and thickness such that its natural frequency acting as a pendulum is of the order of half the natural frequency of the armature and armature extension combination. In the tested embodiment, the armature extension was designed so that the algebraic sum of the mechanical and magnetic stiffness of the armature-extension combination resulted in a natural frequency of about 400 cycles per second when a moving contact 16 was in contact with its associated stationary contact. Therefore, the low frequency damper 17 was designed to have a natural frequency of approximately 200 cycles per second.

It is to be understood that the term "pendulous member" as used in this specification refers to a body suspended from the armature in such a fashion that it may swing or oscillate relative to the armature.

To eliminate high frequency or volumetric chatter at the contacts, the "stationary" contacts are resiliently mounted. Referring again to Figs. 1, 2 and 3 a U-shaped bracket 21 is affixed to a forwardly extending portion of base member 1 by means of screws 22. A pair of stationary-contact adjusting screws 23 are threaded in bracket 21 and may be restrained from vibrating out of adjustment by U-shaped spring member 24 which is bifurcated at each end to accept the screws 23. A spring pile-up assembly is mounted on U-shaped bracket 21 by means of screws 22 and comprises a series of insulating strips separating and clamping contact support 25 and its terminal 26 and contact support 27 and its terminal 28. The contact supports 25 and 27 extend upwardly on each side of armature extension 15. As may best be seen in Fig. 5, a tongue 29 is punched from each of the contact supports 25 and 27 so as to extend parallel to and spaced from the support from which it is formed. A contact 30 is mounted at the upper end of each tongue 29. The supporting of the fixed contacts in such a fashion provides a flexible mounting which can vibrate during operation of the relay as a result of the moving contacts 16 striking the contacts 30. To efficiently damp the high frequency chatter, a suitable shock-absorbing material 31 is placed between each tongue 29 and its associated contact support 25 or 27. A material having a low mechanical phase constant is desirable and butyl rubber has been found to be satisfactory. In the depicted embodiment, the resilient member 31 is placed between the pieces of metal so that a portion thereof extends through the aperture in contact support 25 or 27 created by the punching out of tongue 29. If butyl rubber is used, heating

for a few hours at a temperature in the vicinity of 200° F. will cause the rubber to "cold flow," thus causing it to seal itself in place, artificially age, and relieve internal strains. This rubber and metal combination firmly supports the contact and yet permits sufficient movement thereof to eliminate the high frequency chatter. The utilization of damping means designed in accordance with this invention not only provides effectively chatterless operation over a wide range of applied current values, but also has been found to actually increase the efficiency of operation of the relay. This results from the fact that by damping the armature bounce a lower value of ampere turns can be applied with chatter-free operation still being obtained.

It is to be understood that the designations of frequency in the particular configuration of the described embodiment are but representative and illustrative, that the invention may be associated with any suitable relay, and that many changes may be made in the above embodiment within the scope of the invention.

What is claimed is:

1. In a relay, a horizontal member pivoted about an axis extending perpendicularly to the longitudinal axis of said member and a massive pendulous damping member of resilient material depending downwardly therefrom and oscillatable about an axis of suspension comprising the longitudinal axis of said horizontal member, said damping member being deformable upon oscillation to absorb a portion of the kinetic energy of motion of said horizontal member.

2. In a relay a horizontal member pivoted about an axis extending perpendicularly to the longitudinal axis of said member and a pendulous damping member depending downwardly therefrom and oscillatable about an axis of suspension comprising the longitudinal axis of said horizontal member, said pendulous member comprising a mass of resilient material in intimate contact with two sides of said horizontal member, said damping member being deformable upon oscillation to absorb a portion of the kinetic energy of motion of said horizontal member.

3. In a relay, a horizontal member pivoted about an axis extending perpendicularly to the longitudinal axis of said member and a pendulous damping member depending downwardly therefrom and oscillatable about an axis of suspension comprising the longitudinal axis of said horizontal member, said pendulous member comprising a mass of resilient material in intimate contact with and surrounding a portion of said horizontal member, said damping member being deformable upon oscillation to absorb a portion of the kinetic energy of motion of said horizontal member.

4. In a relay, a horizontal member pivoted about an axis extending perpendicularly to the longitudinal axis of said member and damping means depending downwardly therefrom and oscillatable about an axis of suspension comprising the longitudinal axis of said horizontal member, said damping means comprising a mass of resilient material encompassing a longitudinal portion of said horizontal member, the center of gravity of said means being offset from the longitudinal axis of said horizontal member, said damping means being deformable upon oscillation to absorb a portion of the kinetic energy of motion of said horizontal member.

5. In a relay, a pivoted horizontal member and damping means depending downwardly therefrom, said damping means comprising a mass of

5

resilient material in intimate engagement with and surrounding a longitudinal portion of said pivoted member and a weight affixed to said mass, said means being oscillatable about the longitudinal axis of said pivoted member upon movement of said pivoted member, said mass being deformable upon the oscillation of said means to absorb a portion of the kinetic energy of motion of said pivoted member.

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Executrix of the Estate of Hugh M. Stoller, Deceased.

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