

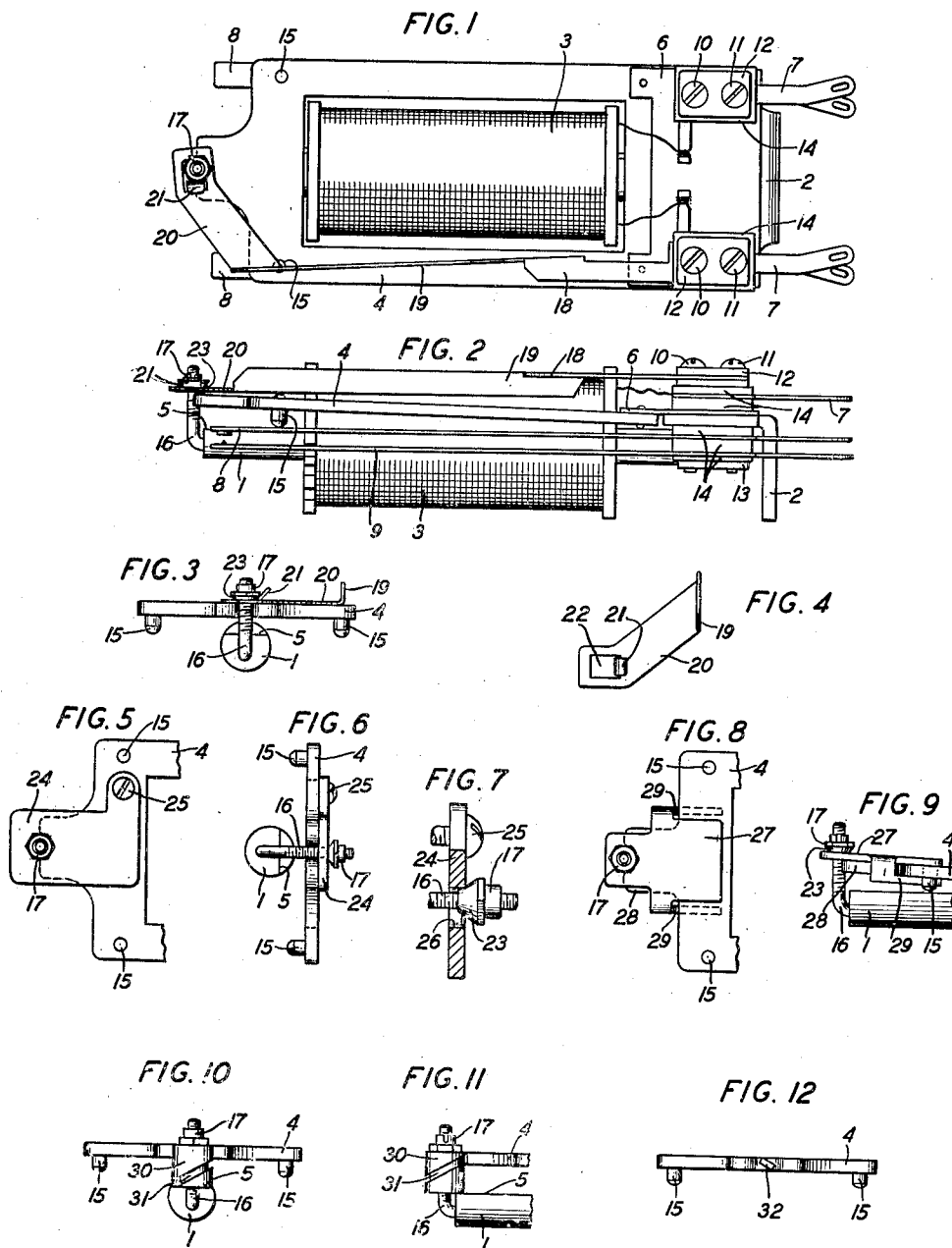
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RELAY

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RELAY

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This invention relates to relays and more particularly to relays for use in telephone systems.

In electric circuits generally and in telephone circuits particularly, electromagnetic relays are extensively employed. In such circuits the functions to be performed are numerous and varied and it is often very essential that relays employed in such circuits shall positively make and break the circuits controlled over their contacts. If the contacts of a relay do not make firmly or break cleanly, or in other words, if the contacts have a tendency to chatter when they make or break, false operation in the circuits controlled thereover will result.

It has been found that one of the factors which contributes to the tendency of relay contacts to chatter upon the release of the armature against the back stop is the rebound of the armature from the back stop due to the kinetic energy stored in the armature during its movement. It has been found from experimentation that if this energy can be dissipated at the moment of impact between the armature and the back stop, the tendency of the armature to bounce or vibrate may be reduced and thereby the transfer of vibration to the contact springs which might result in their chattering will be materially reduced.

Heretofore it has been proposed to dissipate the energy of the armature at the moment of impact thereof with the back stop by absorbing the energy of impact within the back stop structure. In accordance with the present invention it is proposed to absorb or dissipate the energy by an inertia element associated with the armature and brought into action through the engagement thereof with the back stop. The kinetic energy of the armature is dissipated in moving the inertia element to a new position in a small space of time. If there is no rebounding of the armature at the moment of impact thereof with the back stop the energy will therefore be dissipated by the work required to overcome the inertia of the inertia element or weight. This may be expressed by the following equations:

(1) Kinetic energy of the armature=

$$\frac{Iw^2}{2}$$

(2) Work done in moving inertia element=

$$\int f dx$$

When these forces are equal there will be no rebound of the armature and therefore

$$(3) \quad \frac{Iw^2}{2} = \int f dx$$

But if the mass of the inertia element is m and the time during which force is applied to

move it is t then the force required to move the inertia element may be expressed

$$(4) \quad f = m \cdot \frac{d^2x}{dt^2}$$

And by substituting Equation 4 in Equation 3 the following equation is obtained which expresses the condition requisite for overcoming the rebound of the armature

$$(5) \quad \frac{Iw^2}{2} = \int m \cdot \frac{d^2x}{dt^2} \cdot dx$$

The inertia element for attaining this desired condition may be mounted on the armature, mounted independent of the armature, but engaged between the armature and the back stop at the moment of impact between the armature and the back stop, or mounted on the back stop structure and frictionally engaged by the armature in its movement.

In accordance with one embodiment of the invention a spring member supported on the mounting bracket of the relay extends forwardly over the top of the armature and is provided with a cam portion normally engaged beneath a conical surface formed on the lower portion of the usual back stop nut. With this construction when the armature is released toward the back stop nut, it first engages the end of the spring member and thereby presses it against the conical surface of the back stop nut whereby the end of the spring member is cammed laterally. Due to the force exerted by the spring member because of its spring action and inertia in opposition to the camming action the spring member dissipates the energy of impact between the armature and the back stop nut. In accordance with further embodiments of the invention, the inertia member which is cammed laterally upon engagement with the conical surface of the back stop nut may be pivotally or slidably supported on the armature rather than mounted independently thereof. In accordance with a still further embodiment of the invention, the inertia element may be in the form of a roller rotatably supported on the back stop screw and having a spiral cam groove therein with which an extension of the forward end of the armature is engaged. With this latter construction the movement of the armature causes the rotation of the roller and due to the inertia of the roller opposing the rotary motion imparted thereto by the engagement of the armature extension therewith, the energy stored in the armature is largely dissipated at the time the armature has moved either to its fully released position or to its fully operated position.

The invention will be more readily understood from the following detail description taken in connection with the accompanying drawing in which:

Fig. 1 is a top plan view of a well-known type of relay in which the invention is embodied;

Fig. 2 is a side elevational view of the relay disclosed in Fig. 1;

Fig. 3 is a partial end elevational view of the relay of Fig. 1 showing the relationship between the spring inertia member, back stop nut and armature;

Fig. 4 is an enlarged detail of the forward end of the spring member;

Figs. 5, 6 and 7 show a modified form of inertia member pivoted on the armature, Fig. 5 being a plan view of the forward end of the armature, inertia member and back stop nut, Fig. 6 being an end view thereof, and Fig. 7 being an enlarged end view of the inertia member partly in cross-section and the back stop nut;

Figs. 8 and 9 show a further modified form of inertia member slidably positioned on the armature, Fig. 8 being a plan view of the forward end of the armature, inertia member and back stop nut, and Fig. 9 being a side elevational view thereof; and

Figs. 10, 11 and 12 show a further modified form of the invention, Fig. 10 showing an end view of the armature and back stop structure, Fig. 11 showing a side elevational view thereof, and Fig. 12 showing the forward end of the armature with the cam extension thereof.

The relay shown in Figs. 1 to 4, inclusive, of the drawing is of a well-known type consisting of a core 1 secured at its rear end to a heel-piece or supporting bracket 2, an energizing coil 3 surrounding the core 1, an armature 4 having rear and forward cross members and side arms uniting said cross members, the forward cross member of which cooperates with the pole face 5 of the core 1 and the rear cross member of which is riveted to a reed hinge 6, coil terminal lugs 7 and a spring pile-up on each side of the relay coil 3, each comprising two or more contact springs such as 8 and 9. The reed hinge 6, coil terminal lugs 7 and springs 8 and 9 are suitably clamped to the mounting bracket 2 by screws 10 and 11 which pass therethrough and through the clamping plates 12 and 13. For insulating the terminal lugs and contact springs from each other, from the bracket 2 and from the clamping plates 12 and 13, strips 14 of insulating material are interposed. For engaging the contacts of springs 8 and 9 of each spring pile-up upon the attraction of the armature 4 toward the core 1, the armature is provided near its forward end with operating studs 15 of insulating material.

To limit the movement of the armature 4 away from the core 1 upon the deenergization of the coil 3 and to afford means for adjusting the normal air-gap between the front cross member of the armature 4 and the pole face 5 of the core 1, the back stop screw 16 carrying the back stop nut 17 is provided. The back stop screw is L-shaped having its horizontal arm seated in the end of the core 1 and its vertical arm threaded to receive the back stop nut 17.

Clamped to the bracket 2 by the screws 10 and 11 is a forwardly extending spring 18 having a laterally flexible intermediate portion 19 and an end portion 20 extending inwardly, as shown in Fig. 1, overlying the outer surface of the outer end of the armature and engaged beneath the back stop nut 17. The end of the inwardly extending portion 20 of the spring 18 is provided with a cam surface 21 struck up therefrom in such a manner as to provide an opening 22 through which the back stop screw 16 extends.

The lower surface of the back stop nut 17 is provided with a conical surface 23 with which the cam surface 21 of the spring 18 normally engages.

With the relay constructed in this manner, when the coil 3 is deenergized and the armature 4 is moved toward the back stop nut 17 under the influence of the springs 8, it first engages the portion 20 of the spring member 18 forcing it toward the back stop nut 17. As the spring member moves, its cam surface 21 rides over the conical surface 23 of the back stop nut whereupon the end portion 20 of the spring is deflected laterally until the armature 4 engages the inner end of the back stop nut at which time the releasing movement of the armature is arrested. Due to the opposition force exerted by the spring member because of its spring action and inertia and also due to the frictional resistance introduced by the sliding movement of the cam surface 21 of the spring member on the conical cam surface 23 of the back stop nut and the lateral sliding movement of the section 20 of the spring member on the outer surface of the armature the energy of impact between the armature and the back stop nut is absorbed and thereby the tendency of the armature to rebound from the back stop nut and impart such vibration to the contact springs as to cause them to chatter is materially reduced.

As an alternative construction, an energy absorbing inertia member may be mounted on the armature itself as illustrated in Figs. 5 to 7, inclusive. In this embodiment of the invention, the inertia member is a rectangular plate 24 freely pivoted to the armature by the screw 25 and having an opening 26 therein through which the back stop screw 16 extends. The outer edge of the opening 26 is beveled to afford a cam surface which cooperates with the conical surface 23 of the back stop nut. To reduce wear due to the camming movement of the member 24 as the beveled edge of the opening 26 thereof rides upon the conical surface 23 of the back stop nut, the contacting surfaces of the member and nut may be plated with a wear resisting material such as chromium. The relay is mounted on the mounting rack with the armature lying in a vertical plane and in its attracted position the member 24 will, due to its weight, occupy a position with the upper end of its opening 26 resting upon the back stop screw.

When now the operating coil is deenergized and the armature moves in its releasing movement, the beveled edge of the opening 26 in the inertia member 24 will engage with the conical surface 23 of the back stop nut and thereby the member will be swung about the pivot screw 25 until, when the armature reaches its extreme released position, the armature will engage the inner end of the back stop nut. Due to the opposition force introduced in overcoming the inertia of the inertia member 24 and also in some part to the frictional engagement between the inner surface of the member 24 and the outer surface of the armature, the energy stored in the armature is absorbed and rebound of the armature from the back stop nut is thereby reduced.

A further modification of the invention in which the friction member is mounted on the armature is disclosed in Figs. 8 and 9. According to this modification, the inertia member 27 is formed as a plate retained on the extension 28 of the forward end of the armature 4 by lugs 29 bent at right angles to the surface of the mem-

ber 27 and underlying the inner surface of the armature. The member 27 is provided with an opening similar to that disclosed in Fig. 7 through which the back stop screw extends and which opening has a beveled edge which cooperates with the conical surface 23 of the back stop nut. To reduce wear the beveled edge of the opening in the member 27 and the conical surface 23 of the back stop nut may be plated as previously described. The relay constructed in accordance with this modification functions in the manner described in connection with the embodiment of Figs. 5 to 7, inclusive.

The inertia element may, if desired, be mounted on the back stop screw, as illustrated in Figs. 10 and 11. In accordance with this embodiment of the invention, a roller 30 is rotatably supported on the back stop screw with its lower end abutting the pole face 5 of the core 1 and its upper end abutting the inner face of the back stop nut 17. The roller is provided with a spiral cam groove 31 in its cylindrical surface in which a cam extension 32 on the end of the armature 4 is engaged. During either the attractive or releasing movement of the armature, the cam extension 32 rides in the groove 31 of the roller thereby causing the roller to rotate and due to the inertia of the roller in opposition to the force applied to it to cause its rotation the armature is prevented from striking the back stop nut at the end of the releasing movement or from striking the pole face 5 at the end of its attractive movement with force sufficient to cause it to rebound.

What is claimed is:

1. In an electromagnetic device having a core and an armature, a back stop structure for adjusting the air gap between said core and said armature comprising a screw secured in the end of said core and an adjustable back stop nut thereon, and an inertia member interposed between said armature and said nut and movable by said armature in its movement toward said nut, said member in its movement slidably and frictionally engaging said armature and said nut.

2. In an electromagnetic device having a core and an armature, a back stop structure for adjusting the air gap between said core and said armature comprising a screw secured in the end of said core and an adjustable back stop nut thereon, said back stop nut having a conical cam surface, and an inertia member interposed between said armature and said nut having a cam portion cooperative with the cam surface of said nut upon the movement of said armature toward said nut whereby said member is caused to slide on the surface of said armature.

3. In an electromagnetic device having a core and an armature, a back stop structure for adjusting the air gap between said core and said armature comprising a screw secured in the end of said core and an adjustable back stop nut thereon, said back stop nut having a conical cam surface, an inertia member supported on said armature interposed between said armature and said nut and having a cam portion cooperative with the cam surface of said nut upon the movement of said armature toward said nut whereby said member is caused to slide on the surface of said armature.

4. In an electromagnetic device having a core and an armature, a back stop structure for said armature comprising a screw secured to said core and having a back stop nut thereon, said

back stop nut having a conical cam surface, an inertia member supported on said armature interposed between said armature and said nut and having a bevel edged opening therein through which said back stop screw extends and cooperative with the cam surface of said nut upon the movement of said armature toward said nut whereby said member is caused to slide on the surface of said armature.

5. In an electromagnetic device having a core and an armature, a back stop structure for said armature comprising a screw and a back stop nut thereon, said back stop nut having a conical cam surface, an inertia member pivoted on said armature interposed between said armature and said nut and having a cam portion cooperative with the cam surface of said nut upon the movement of said armature toward said nut whereby said member is caused to slide on the surface of said armature.

6. In an electromagnetic device having a core and an armature, a back stop structure for adjusting the air gap between said core and said armature comprising a screw secured in the end of said core and an adjustable back stop nut thereon, said back stop nut having a conical cam surface covered with a wear resisting material, an inertia member supported on said armature interposed between said armature and said nut and having a cam portion covered with a wear resisting material cooperative with the cam surface of said nut upon the movement of said armature toward said nut whereby said member is caused to slide on the surface of said armature.

7. In an electromagnetic device having a core and an armature, a back stop structure for said armature comprising a screw secured to the end of said core and a back stop nut thereon, said back stop nut having a conical cam surface plated with a wear resisting metal, an inertia member supported on said armature interposed between said armature and said nut and having a bevel edged opening therein through which said back stop screw extends, the beveled edge of said opening being plated with a wear resisting metal and cooperative with the cam surface of said nut upon the movement of said armature toward said nut whereby said member is caused to slide on the surface of said armature.

8. In an electromagnetic device having a heel-piece, a core secured thereto, an armature hinged to said heel-piece, a back stop structure for adjusting the air gap between said core and said armature comprising a screw secured in the end of said core and an adjustable back stop nut thereon, said back stop nut having a conical cam surface, and a spring member having one end rigidly secured to said heel-piece and having its free end interposed between said armature and said back stop nut, the free end of said spring member having a cam portion engageable with the cam surface of said nut upon the movement of said armature toward said nut whereby said spring member is caused to slide laterally on the surface of said armature.

9. In an electromagnetic device having a core and an armature, a back stop structure for said armature comprising a screw secured to the end of said core and a back stop nut thereon, a roller rotatable on said screw and having a spiral cam groove in its cylindrical surface, and a cam extension on the free end of said armature engaged in said groove whereby upon the movement of said armature said roller is rotated.

10. In an electromagnetic device having a core and an armature, a back stop structure for said armature comprising a screw secured to said core and extending at right angles to the pole face of said core and a back stop nut on said screw, a roller rotatable on said screw and positioned between said back stop nut and the pole

face of said core, said roller having a spiral cam groove in its cylindrical surface, and a cam extension on the free end of said armature engaged in said groove whereby upon the movement of said armature said roller is rotated.

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