

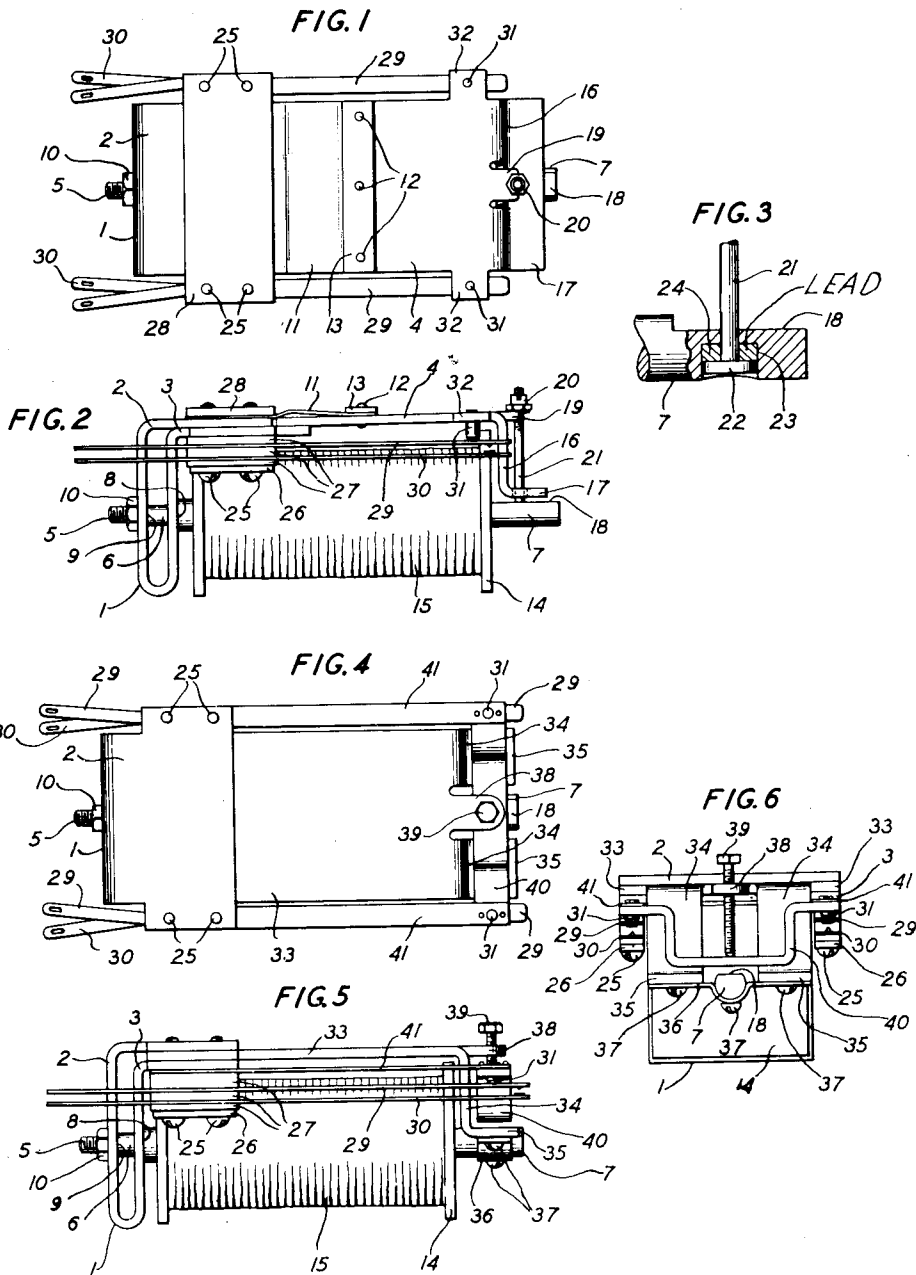
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RELAY

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RELAY

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This invention relates to relays and more particularly to relays for use in the circuits of 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.

Relay contact chatter is in many cases associated with armature bounce, that is, the rebound of the armature from the back stop structure when it strikes the latter on its release. On the release of the armature the kinetic energy of its motion must in some way be dissipated before the armature and the contact springs controlled thereby can come to rest. This is accomplished through the natural dissipation of the core, the armature, the contact springs and the back stop structure and any relay design which increases the damping of one or more of these elements will therefore increase the dissipation of the kinetic energy of the motion of the relay armature. However, the damping must not be large enough to greatly delay the operation of the relay contacts. The ideal relay design would be such as to reduce the residual vibration to a degree that would leave the relay contacts unaffected thereby, that is, to confine it to such a harmless motion of the armature, or core, or both as would leave the contacts at rest following the impact between the armature and the back stop structure.

Among the several factors which contribute to the tendency of a relay armature to rebound are the energy dissipation in the back stop structure; the mass relationship between the core and the armature; the initial tension in the reed springs which hinge the armature to the core structure and the initial phase relationship between the vibration of the armature and the core.

It has been determined experimentally that the impact of the relay armature upon the back stop structure may be regarded as the impact between two oscillators, the armature and springs controlled thereby being one of the oscillators and the core being the other oscillator. The back stop structure supplies a stiffness which is effective upon the impact between the two oscillators

when the armature is released. As this stiffness is large as compared with that of the core or that of the armature, the armature bounce from the back stop structure may be considered as an example of that type of impact between two oscillators in which the stiffness of the contacting surface between the oscillators is large compared with the stiffness of each of the oscillators involved. The ratio of armature to core amplitude of oscillation after impact may be kept below desired limits if the frequency ratio of the two oscillators is high. This condition may be attained in the design of a relay if the frequency of the core vibration or oscillation is made much higher than that of the armature by making the core as rigid as possible and by making the mass of the core large as compared with that of the armature. The kinetic energy of impact may be further dissipated by a proper design of the back stop structure.

It is therefore the object of this invention to improve the design of an electromagnetic relay through a consideration of these factors in such a manner as to reduce the bounce of the armature and to thereby reduce the tendency of the relay contacts to chatter. This object is attained in accordance with the present invention by the provision of a cushioning means for the screw which carries the usual back stop nut at its point of attachment in the end of the relay core, by the provision of an armature of small mass hinged upon the heel piece by pretensioned reeds of substantial length and by the stiffening of the core structure.

The invention, to disclose these novel features, has been shown in two embodiments, but it is to be understood that these embodiments are merely illustrative and that the applicant's invention is not limited thereto but contemplates such modifications as may fall within the limits of the appended claims.

In both disclosed embodiments of the invention, the mass of the armature is made as small as is commensurate with the magnetic efficiency thereof, in one embodiment, by extending the heel piece well forward toward the front of the relay and hinging the armature to the forward end of the heel piece by a reed spring whereby the armature is materially shortened, and in the other embodiment, by providing a short transverse armature supported by long reed springs extending from the heel piece to the extreme forward end of the relay core. In both embodiments the reed springs which support the armature are of substantial length and are pretensioned to normally

hold the armature firmly against the back stop and the heel piece is made rigid by being bent into a U-shape and having aligned openings in the two arms thereof in which the end of the core is seated, the ends of the arms being bent at right angles overlying each other to afford a support for the armature and spring pile-ups. In one embodiment of the invention the back stop screw, which is threaded upon one of its ends to receive the usual back stop nut with which the relay armature engages upon its release, is engaged at its other end in a recess in the end of the relay core and is cushioned at the point of engagement by a lead washer interposed between the head of the screw and the bottom of the recess.

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

Fig. 1 is a top plan view of a relay disclosing one embodiment of the invention;

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

Fig. 3 is an enlarged detail, partly in cross-section, showing the cushioning means for the back stop screw;

Fig. 4 is a top plan view of a relay disclosing a second embodiment of the invention;

Fig. 5 is a side elevational view of the relay disclosed in Fig. 4; and

Fig. 6 is a front end elevational view of the relay disclosed in Fig. 4.

The relay disclosed in Figs. 1 to 3, inclusive, is provided with a heel piece 1 of magnetic strap iron bent into a substantially U-shape with the ends of its arms 2 and 3 bent at right angles and extending forwardly toward the front of the relay structure and spot welded together thus affording a rigid heel piece structure. The lower arm 3 extends beyond the upper arm 2 to provide a ledge for supporting the rear end of the armature 4. The arms of the heel piece are provided with aligned openings of different diameter in which the reduced portions 5 and 6 of the core 7 are tightly seated with the shoulders 8 and 9 thereof abutting against the inside faces of the arms 2 and 3 of the heel piece 1. The end of the core is clamped to the heel piece by the nut 10 threaded upon the end of the reduced portion 5 of the core 7. The heel piece thus affords a rigid support for the core 7. The entire relay may be supported on a mounting rack or frame by extending the reduced portion 5 through a hole in the rack before applying the nut 10 and employing the nut 10 for the dual purpose of clamping the relay heel piece to the rack and of clamping the core 7 to the heel piece.

The armature 4 rests at its rearward end upon the ledge formed by the forwardly extending arm 3 of the heel piece and is held in a hinging position thereon by the pretensioned reed spring 11, one end of which is clamped to the heel piece in a manner to be later described and the other end of which is secured to the armature by rivets 12 extending through the armature and through the clamping strip 13. The forward end of the armature extends beyond the forward spoolhead 14 of the energizing coil 15 mounted on and surrounding the core 7 and is bent downwardly as indicated at 16 and outwardly as indicated at 17 with the outwardly extending portion 17 overlying the pole face 18 on the forward end of the core 7. The armature 4 is also provided with a forwardly extending ear 19 for engagement be-

neath the nut 20 carried by the back stop screw 21.

The back stop screw 21 carrying the back stop nut 20 on its threaded end, serves as a means for limiting the releasing movement of the armature 4 in response to the energy stored in the pretensioned reed spring 11 upon the deenergization of the relay coil 15 and also serves as a means for adjusting the air-gap between the face of the armature extension 17 and the pole face 18 of the core 7. The headed end 22 of the back stop screw 21 is seated in a recess 23 in the end of core 7 and is cushioned therein by a washer 24 of lead or other shock absorbing material whereby the energy of impact incident to the ear 19 of armature 4 striking against the back stop nut 20 will be absorbed and the tendency of the armature to rebound will be materially reduced. Furthermore, the armature being of relatively small mass and being firmly held after its release against the back stop nut 20 by the reed spring 11, the tendency of rebound is still further reduced.

A spring pile-up is positioned on each side of the relay coil 15 and is secured to the heel piece 1 by screws 25 which pass through a clamping plate 26, insulating strips 27, the contact springs, the arms 2 and 3 of the heel piece, the reed spring 11 and into threaded holes in the clamping plate 28. Each spring pile-up may comprise any desired combination of contact springs, but has for convenience of illustration been disclosed as comprising a single pair of springs 29 and 30. The armature springs 29 are operable into engagement with their mate springs 30 when the armature is attracted toward the pole face 18 of the core 7 upon the energization of the relay coil 15, by studs 31 of insulating material secured in lateral ears 32 of the armature 4.

The embodiment of the invention disclosed in Figs. 4 to 6, inclusive, comprises a similar U-shaped heel piece 1 having arms 2 and 3 bent at right angles and extending forwardly toward the front of the relay structure. The ends of the arms are slightly separated and embrace the rear end of the yoke 33 which may be secured thereto by spot welding or in any other desired manner. The arms of the heel piece are provided with aligned openings of different diameter in which the reduced portions 5 and 6 of the core 7 are tightly seated with the shoulders 8 and 9 thereof abutting against the inside faces of the arms 2 and 3 of the heel piece. The end of the core is clamped to the heel piece and the heel piece is clamped to a suitable mounting rack by the nut 10 threaded upon the reduced portion 5 of the core 7. The heel piece thus affords a rigid support for the core 7.

The forward end of the yoke 33 extends beyond the front spoolhead 14 of the energizing coil 15 mounted on and surrounding the core 7 and is bifurcated to form two pole-pieces which are bent downwardly as indicated at 34 and outwardly as indicated at 35 with the top faces of the portions 35 thereof lying in the plane of the pole face 18 of the end of core 7. For the purpose of adding rigidity to the forward end of the core 7, the core is connected to the portions 35 of the yoke 33 by a strap 36 of non-magnetic material which is secured to the portions 35 and to the core 7 by the screws 37. The yoke 33 is also provided with a forwardly extending ear 38 through which the back stop screw 39 is threaded.

The armature 40 extends transversely of the pole-piece extensions 35 and core 7 and is of substantially U-shape as disclosed most clearly in

Fig. 6. The upper ends of the vertical arms of the armature are bent outwardly at right angles and are riveted to the forward ends of two pre-tensioned reed springs 41, the rear ends of which are clamped to the heel piece in a manner to be described. In its normal or released position, the armature is held firmly against the lower end of the back stop screw 39 by the reed springs 41, the back stop screw serving to limit the releasing movement of the armature and to adjust the air-gap between the lower face of the armature and the pole faces of the core 7 and return pole-pieces 35.

A spring pile-up is positioned on each side of the relay coil 15 and is secured to the heel piece 1 by screws 25 which pass through a clamping plate 26, insulating strips 27, the contact springs, the reed springs 41 and into threaded holes in the arms 2 and 3 of the heel piece and the yoke 33. Each spring pile-up may comprise any desired combination of contact springs, but has for convenience of illustration been disclosed as comprising a single pair of springs 29 and 30. The armature springs 29 are operable into contact with their mate springs 30 when the armature is attracted upon the energization of relay coil 15, by studs 31 of insulating material secured to the outwardly extending ends of the armature 40.

By the provision of a rigid support for the core 7 of the relay, as disclosed in both embodiments of the invention and particularly as disclosed in Figs. 4 to 6, inclusive, in which the core is supported at both of its ends, the vibration of the core which would be imparted through the heel piece to the relay armature is materially reduced and the tendency of the armature to bounce upon its impact either with the back stop or with the core is consequently reduced. A further reduction in armature bounce is attained in accordance with both modifications of the invention by the provision of an armature of small mass compared with the mass of the core structure. A still further reduction in armature bounce is attained in the embodiment of the invention disclosed in Figs. 1 to 3, inclusive, by cushioning the back stop screw to absorb the energy of impact when the armature strikes the back stop nut. Since the armature acts directly upon the moving springs of the spring pile-ups, the reduction of the armature bounce as attained by the invention thus reduces the tendency of the contact springs to chatter.

What is claimed is:

1. In an electromagnetic structure, a U-shaped heel piece having the two arms thereof spaced apart and provided with aligned openings therethrough, the ends of said arms being bent at right angles and overlying each other, and a core seated in said openings and extending parallel to the angular extensions of said arms.

2. In an electromagnetic structure, a U-shaped heel piece having the two arms thereof spaced apart and provided with aligned openings of different diameters therethrough, the ends of said arms being bent at right angles and overlying each other, a core having shouldered portions seated in said openings and extending parallel to the angular extensions of said arms, and a nut threaded upon the end of said core for firmly clamping said core to said heel piece.

3. In an electromagnetic structure, a U-shaped heel piece provided with aligned openings of different diameters in the two arms thereof, the ends of said arms being bent at right angles, overlying each other and spot welded together,

a core having shouldered portions seated in said openings and extending parallel to the angular extensions of said arms, and a nut threaded upon the end of said core for firmly clamping said core to said heel piece.

4. In an electromagnetic structure, a U-shaped heel piece provided with aligned openings of different diameters in the two arms thereof, the ends of said arms being bent at right angles and overlying each other, one of said arms extending beyond the other to form a ledge, an armature pivoted on said ledge, a spring for holding said armature in engagement with said ledge, a core having shouldered portions seated in the openings of said heel piece and extending parallel to the angular extensions of said arms, and a nut threaded upon the end of said core for firmly clamping said core to said heel piece.

5. In an electromagnetic structure, a U-shaped heel piece provided with aligned openings of different diameter in the two arms thereof, the ends of said arms being bent at right angles and overlying each other, one of said arms extending beyond the other to form a ledge, an armature pivoted on said ledge, a pre-tensioned spring for holding said armature in engagement with said ledge, a core having shouldered portions seated in the openings of said heel piece and extending parallel to the angular extensions of said arms, and a nut threaded upon the end of said core for firmly clamping said core to said heel piece.

6. In an electromagnetic structure, a heel piece, a core attached thereto having a pole-face on its forward end, a coil on said core, a yoke attached to said heel piece and extending forwardly over the top of said coil parallel to said core, the forward end of said yoke being bifurcated and bent downwardly at the front end of said coil and then bent outwardly to form two return pole-pieces, the pole-faces of which lie in the plane of the pole-face of said core, an armature extending transversely of and overlying the pole-faces of said pole-pieces and the pole-face of said core, and reed springs for supporting said armature each secured at one end to said heel piece and at the other end to said armature.

7. In an electromagnetic structure, a heel piece, a core attached thereto having a pole-face on its forward end, a coil on said core, a yoke attached to said heel piece and extending forwardly over the top of said coil parallel to said core, the forward end of said yoke being bifurcated and bent downwardly at the front end of said coil and then bent outwardly to form two return pole-pieces positioned respectively on the opposite sides of the forward end of said core with the pole-faces thereof lying in the plane of the pole-face of said core, a strap of non-magnetic material attached to said pole-pieces and to said core for rigidly supporting the forward end of said core, an armature extending transversely of and overlying the pole-faces of said pole-pieces and the pole-face of said core, and reed springs for supporting said armature each secured at one end to said heel piece and at the other end to said armature.

8. In an electromagnetic structure, a U-shaped heel piece having the ends of its arms bent at right angles and overlying each other, a core secured to said heel piece extending parallel to the angular extensions of said arms and having a pole-face on its forward end, a yoke the rear end of which is embraced between and secured to

the angular extensions of said arms, the forward end of which is bifurcated to form two return pole-pieces positioned respectively on the opposite sides of the forward end of said core with the pole-faces thereof lying in the plane of the pole-face of said core, a strap of non-magnetic material attached to said pole-pieces and to said core for rigidly supporting the forward end of said core, an armature extending transversely of and overlying the pole-faces of said pole-pieces and the pole-face of said core, and reed springs for supporting said armature each secured at one end to said heel piece and at the other end to said armature.

9. In an electromagnetic structure, a heel piece, a core attached thereto and having a pole-face on its forward end, a yoke attached to said heel piece and extending forwardly parallel to said core, the forward end of said yoke being bifurcated to form two return pole-pieces, the pole-faces of which lie in the plane of the pole-face of said core, an armature extending transversely of and overlying the pole-faces of said pole-pieces and the pole-face of said core, reed springs for supporting said armature each secured at one end to said heel piece and at the other end to said armature, an ear on said yoke overlying said armature, and a back stop screw threaded through said ear for engagement by said armature.

10. In an electromagnetic structure, a U-shaped heel piece having the two arms thereof spaced apart and provided with aligned openings there-through, the ends of said arms being bent at right angles and overlying each other, a core seated in said openings and extending forwardly parallel to the angular extensions of said arms, an armature supported from said extensions and

cooperating with the forward end of said core, and a back stop screw for adjusting the normal air-gap between said armature and said core.

11. In an electromagnetic structure, a U-shaped heel piece having the two arms thereof spaced apart and provided with aligned openings there-through, the ends of said arms being bent at right angles and overlying each other, a core seated in said openings and extending forwardly parallel to the angular extensions of said arms, an armature supported from said extensions and cooperating with the forward end of said core, and a back stop for adjusting the air-gap between said core and said armature comprising a headed screw extending through the end of said core with its head seated in a recess in said core, a lead washer interposed between the head of said screw and the walls of said recess for cushioning said screw at its point of attachment to said core and a back stop nut on said screw for engagement by said armature when said armature is released to its normal position.

12. In an electromagnetic structure, a U-shaped heel piece having the two arms thereof spaced apart and provided with aligned openings there-through, the ends of said arms being bent at right angles and overlying each other, one of said arms extending beyond the other to form a ledge, a core having shouldered portions seated in the openings of said heel piece and extending parallel to the angular extensions of said arms, a coil on said core and an armature pivoted on said ledge and extending forwardly over the top of said coil and downwardly at the front of said coil into cooperative relation with the forward end of said core.

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