Oct. 26, 1948. L. J. STACY 2,452,079

RELAY

Filed June 22, 1944

FIG. 2

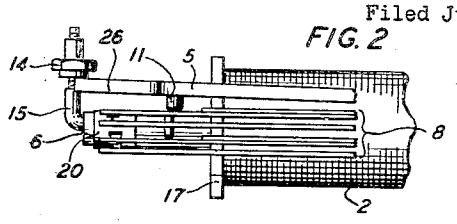


FIG. 3

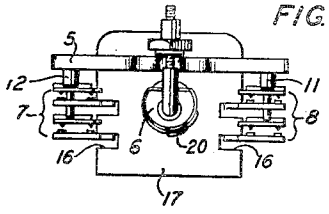


FIG. 1

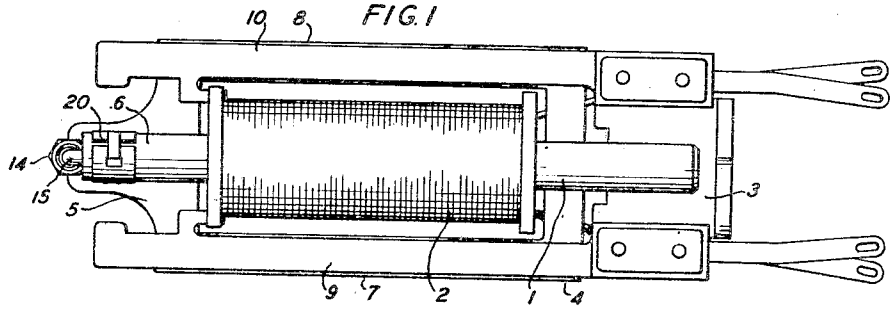


FIG. 4

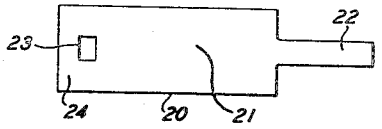


FIG. 5

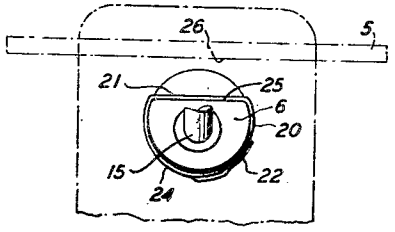


FIG. 6

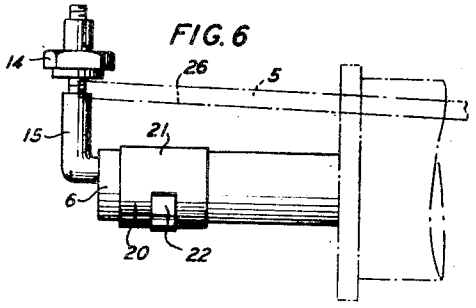
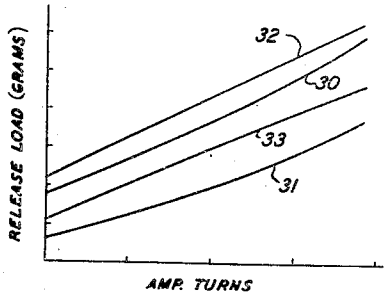


FIG. 7



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RELAY

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Application June 22, 1944, Serial No. 541,636

1 Claim. (Cl. 175—336)

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This invention relates to electromagnetic switching devices and particularly to relays used in telephone systems.

An object is to improve the accuracy of the release characteristics of the armatre of a relay when the energizing current is discontinued.

Heretofore relays have been provided in which the release characteristics have been controlled by various means such as spring tensioned devices applied to the armatures, choice of magnetic material for the armature and core, dimensional relationship of the parts, non-magnetic coatings and current adjustments to regulate the flux density produced by the energizing winding in the core and armature. Actual air-gaps or non-magnetic spacers have also been used between the core and armature but merely for the purpose of preventing the armature from sticking. With these prior means it has not been possible to adjust the release characteristics within as close limits as was often desired. Such lack of control is particularly noted in relays manufactured in large numbers where the manufacturing variations cannot be very closely adjusted. These irregularities become more objectionable and more difficult to eliminate in relays of the slow-to-release type where means are provided such as copper slugs or additional windings to effect slow-to-release characteristics and where the requirements for the release characteristics are more exacting than in ordinary relays.

It has been observed by the applicant that due to such irregularities residual magnetism, remaining in the core and armature after the operating current was discontinued had a disturbing influence on the stable performance of such relays. To remedy this difficulty it was thought that in addition to the usual adjustments an air-gap could be provided by inserting a non-magnetic shim or spacer between the core and armature to control the residual magnetism to effect the desired release characteristics. However, in such relays when the release time must be more accurately gauged the air-gap would have to be exceedingly small which made it impracticable to use non-magnetic shims of a corresponding thinness as such shims are difficult to handle and easily destroyed and generally unstable. The applicant then conceived of the use of a magnetic shim between the core of the armature to control the residual magnetism and discovered that such a shim could be of a greater thickness than a non-magnetic shim and yet have the same effect. In fact he found that the magnetic shim may be several times as thick as a non-magnetic shim to

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produce an effect equal to that provided by an actual air-gap or by a non-magnetic shim of such smaller dimensions. The reason why the magnetic shim is preferable is that the reluctance introduced in the magnetic circuit thereby is more readily controllable to reduce the residual magnetism to the required value. In other words, by the applicant's invention a shim possessing the necessary physical strength is provided that controls the release characteristics of a relay within closer limits than can be obtained by any other known practical means.

The invention has been illustrated in the accompanying drawings in which Fig. 1 shows a bottom view of a relay structure to which the applicant's invention has been applied;

Fig. 2 shows a fragmentary side view;

Fig. 3 shows a front view of this relay shown in Fig. 1;

Fig. 4 shows a typical form of the applicant's shim or spacer;

Figs. 5 and 6 show a method of applying the shim to the core of the relay shown in the preceding figures; and

Fig. 7 indicates the performance characteristic of the relay under various release load and ampere turn conditions.

Referring now to the drawings, Fig. 1 shows a typical relay structure to which the applicant's spacer may be applied. This relay may consist of a round core member 1 on which a winding 2 is wound. The rear end of this core extends out from the winding and attached thereto is a mounting member 3. This member carries a hinged U-shaped armature 4. This armature crosses at 5 the front core portion 6 for the attraction of the armature toward the core when the winding is energized. Below the side members 7 and 8 of this U-shaped armature are mounted separate spring pile-ups 9 and 10 actuated by studs such as 11 and 12 to open and close the connections between the springs in various combinations when the armature is attracted by the core. The springs are so tensioned as to normally keep the armature in released condition. The backstroke of the armature is regulated by a nut 14 on a screw 15 attached to the free end of the core portion 6. The spacing of the various springs are as shown in Fig. 3 controlled by slots such as 16 in the insulated front spoolhead 17 for the winding 2.

On this end portion 6 of the core is wrapped the applicant's magnetic shim or spacer 20 which may be shaped as shown in Fig. 4 with a central flat portion 21, a right-hand narrow band portion

22, and provided with a slot 23 in the opposite left-hand end portion 24 of the shim. The shim may be made of nickel or other suitable magnetic material. This shim 20 may be applied to the core with its central portion 21 lying flat on a corresponding flat surface 25 on the core portion 6 and the opposing ends of the shim may be wrapped around the core with the band portion 22 inserted in the slot 23 and folded back over itself to hold the shim tightly in place. The flat central portion 21 of the shim forms a definite and fixed spacing between the flat surface 25 on the core portion 6 and the surface 26 on the cross member 5 of the armature. It has been found that when the release performance of a relay of this general type was not as accurate and stable as was expected and desired, due, for example, to various irregularities in construction and material used for the core and armature or when relays of this type lose some of their sensitivity due to wear from long usage or for other reasons, such irregularities caused excessive residual magnetism to remain in the core of the armature after the winding was deenergized. This residual magnetism may have the effect of preventing the armature from releasing at the proper time and may even prevent the armature from releasing at all. To attempt to remedy these defects it was, of course, undesirable to increase the spring tension beyond certain limits as this would seriously affect the operating time of the armature, while on the other hand if attempts were made to regulate the ampere turns of the winding, this would seriously affect both the operate and release time of the relay. It should be borne in mind that to secure an extremely accurate adjustment of the release time, an air-gap could be provided between the core and armature to control the residual magnetism, but this air-gap would under all circumstances have to be made exceedingly small. Attempts were made to provide such an air-gap by inserting a non-magnetic shim between the operating surfaces of the core and the armature. However, such a shim would have to be of such small thickness (of the order of 0.001 inch, for example) that it would be difficult to handle and apply and would be in general undesirable from the standpoint of manufacture and wear. Thus the problem of controlling the desirable minute air-gap must be approached from an entirely different angle. The applicant then conceived of the use of a magnetic shim for insertion between the core and the armature. It was found that this shim could be made of considerably thicker material than could a non-magnetic shim and could therefore be easily applied and be rugged enough for handling as well as of greater durability. He discovered that such a magnetic shim of considerably thicker material has the same result as an actual air-gap or a non-magnetic shim of the smaller dimension even though the actual distance from the core and armature was considerably increased. The reason why such a shim can be used to obtain the desired delicate adjustment is that it has a magnetic saturation characteristic which provides a reluctance equal to that produced by an actual air-gap which might be provided by a thin unmanageable non-magnetic shim or by some other means. In other words the magnetic shim controls the residual magnetism in the core and armature and adjusts by its reluctance the release characteristics within closer limits than could be obtainable by any other known practical means. In such relays which require this close adjustment of the release characteristics the applicant has found that compared with a non-magnetic shim, this magnetic shim may be approximately two to three times thicker and entirely satisfactory and reliable. The applicant's invention is particularly suitable for the adjustment of the release time in relays of the slow-to-release type where copper plugs or auxiliary windings are provided for that purpose.

Fig. 7 shows in graphic form test results obtained by the use of the applicant's invention a relay having undesirable release characteristics. Various release loads are indicated on the axis of ordinates and ampere turns are indicated on the axis of abscissas. The curve 30 indicates maximum design limits allowable for the release characteristics of a relay under different loads and ampere turns. The curve 31 indicates minimum design limits allowable for release characteristics of the relay under such different loads and ampere turns. On the other hand the curve 32 indicates the release characteristics obtained by a relay without the applicant's shim applied between the core and the armature, while the curve 33 indicates the release characteristics obtained by this relay when the applicant's shim is used. Thus it is clearly shown that the release of the armature with the applicant's shim applied will take place well within the upper and lower design limits on a great variety of values of load and ampere turn conditions. This therefore clearly indicates the improvements in release performance that may be obtained by the use of the applicant's invention.

What is claimed is:

In combination in an electromagnetic relay, a fixed core and an armature movable toward said core, a coil around said core for producing magnetic flux to attract said armature toward said core when said coil is energized, and a separable spacer inserted between said core and armature to limit the residual magnetism in said core and armature to control the release characteristics of said armature when said coil is deenergized, said spacer comprising a band of thin magnetic material wrapped around the pole-piece end of said core and having a tongue portion on one end thereof extended through a slot in the other end thereof and then bent back on itself to firmly clamp said spacer around the core.

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