Feb. 1, 1949. H. N. WAGAR 2,460,556

COIL ARRANGEMENT FOR ELECTROMAGNETIC DEVICES

Filed Nov. 8, 1947

FIG. 1

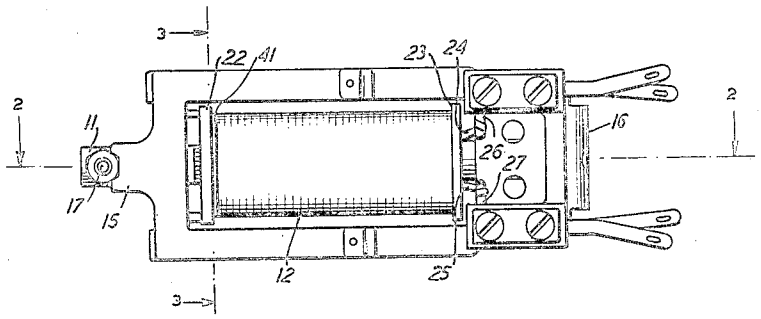


FIG. 2

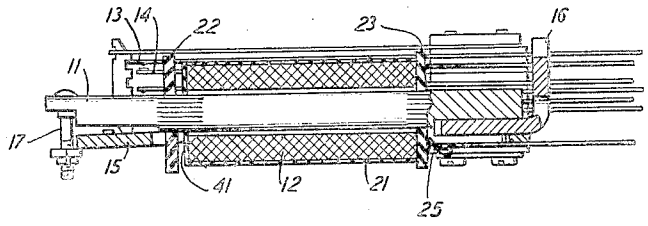


FIG. 3

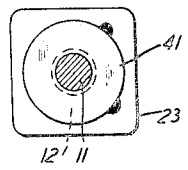
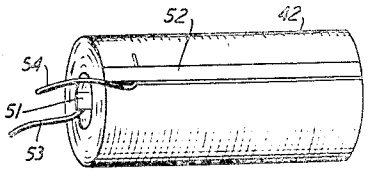


FIG. 4



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COIL ARRANGEMENT FOR ELECTRO-MAGNETIC DEVICES

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4 Claims. (Cl. 175—21)

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This invention relates to an electromagnetic device and more particularly to a coil arrangement for an electromagnetic relay.

An object of the invention is to improve the operation and enhance the reliability and efficiency of electromagnetic devices.

Another object of the invention is to offset certain undesirable effects heretofore found to result from the material shrinkage of electromagnet windings during their ordinary and intended use.

A more specific object of the invention is to substantially reduce the breakage of the lead wires of electromagnetic devices.

The use of electromagnetic relays as switching devices in telephone circuits and the like is, of course, common and is well understood. The electromagnetic relay, long an important element in such circuits, is of even greater importance in present day circuits where the relay is depended upon for a greatly increased number of functions. This has resulted not only in an increased number of relays per circuit but in an increase in the number of operations that each relay is called upon to perform. It is of increasing importance, therefore, that each relay operate reliably and without interruption.

An important factor leading to relay failure has always been the breakage of the lead wires of the electromagnetic winding, i. e., the wires, usually two, which are brought out from the respective ends of the winding to the external terminals provided on the relay structure. A vital factor in increasing the continued reliable operation of relays is obviously, therefore, the prevention of or substantial reduction in the frequency of lead breakage.

It is recognized, in the instance of cellulose acetate filled windings of the type now commonly utilized on electromagnetic relays in view of their many desirable characteristics, that a certain amount of shrinkage of the coil results during the ordinary and intended use of the relay. This shrinkage causes a slight shortening of the coil and results in a withdrawing of the "free" end of the coil from the adjacent spoolhead of the relay. In view of the inevitable shrinkage referred to, it is common practice to "anchor" the coil at the rear or terminal spoolhead only, leaving the other end of the coil free from the front spoolhead.

It is the usual practice, in the use of a coil of the type referred to, to provide a certain definite space, or clearance, between the inner circumference of the coil and the outer surface of the core; this is desirable as it eases manufacturing limits generally and is indeed necessary where,

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as is often the case, the coil must be slipped over portions of the core which are provided with knurled portions.

The ultimate result of the dimensional change referred to is the establishment of a situation favorable to a slight amount of vibration or "play" of the coil with respect to the core; that is, a situation where one end of the coil is firmly attached to the rear spoolhead while having a relatively loose fit over the core and being "free" of the front spoolhead. This motion, which is induced by operation of the relay armature, may be of two general types; either the rear spoolhead itself flexes with respect to the terminals included in the relay spring pile-up or the coil flexes with respect to the terminal eyelets provided on the spoolhead. It has been observed that this motion is a major factor in lead breakage causing, as it does, "working" of the lead wires between the spoolhead eyelet and the relay pile-up terminals and of the lead wires, within the coil, between the ends of the winding and the spool head terminals.

A feature of the present invention resides in means associated with the front or "free" end of the coil which, while not interfering with the inevitable dimensional changes in the coil, is effective to prevent the vibratory motion of the coil with respect to the core referred to above.

According to specific embodiment of the invention a washer of a diameter commensurate with that of the coil and of suitable material, for example of phenol fibre faced on one side with cellulose acetate, is adhesively attached to the front, free end of the coil; the washer is not attached to the front spoolhead however, the coil therefore being free with respect to this spoolhead as before. The central aperture of the washer, which is of a shape commensurate with the shape of the core, provides a sliding fit on the core; this size relationship does not change as the washer is substantially immune to shrinkage. The sliding fit of the washer on the core permits the inevitable shortening of the coil on the core as shrinkage occurs but is effective to maintain firm anchorage of the front end of the coil on the core so far as the vibratory motion referred to above is concerned. The washer is thin enough to slide readily on the core but sufficiently rigid to resist lateral forces. The use of this type of washer has been found effective in the prevention of vibratory motion of the coil on the core and a very substantial reduction of lead breakage has resulted from the invention.

Complete understanding of the above and other

embodiments of the invention and appreciation of the several desirable features thereof will be gained from consideration of the following detailed description and the annexed drawings in which:

Fig. 1 is a top plan view of an electromagnetic relay embodying features of the present invention;

Fig. 2 is a cross-sectional side elevation of the relay of Fig. 1 showing the condition existing after a certain amount of shrinkage of the coil has occurred;

Fig. 3 is an end view taken on line 3—3 of Fig. 1 and showing particularly the arrangement of the restraining washer on the core certain portions of the rear spring pile-up being omitted from the view for purposes of clarity; and

Fig. 4 is a side elevation of the coil with outer cover removed to show the lead wire anchoring means.

Referring now to the drawings, the relay illustrated is of the well-known flat type and includes the usual essential parts including core 11, of generally cylindrical cross-section, energizing coil spring 12 mounted thereon, contact spring assembly including contact springs 13 and 14, U-shaped armature 15, mounting bracket 16 and armature back-stop adjusting means 17. Core 11 is attached suitably to mounting bracket 16, for example by welding. The front end of core 11 terminates in a flattened pole-piece for cooperative action with armature 15. Front spoolhead 22 and rear, or terminal end, spoolhead 23 are rigidly positioned on core 11 as illustrated; the core is provided with knurled portions as illustrated to provide firm anchorage for the spoolheads.

As is well understood, armature 15 is attracted to the end pole-piece section of core 11 when coil 12 is energized to cause operation of the contact springs. The basic features of this general type of relay and its method of operation are well understood and are fully described in many prior patents and will therefore not be recited herein.

Energizing winding, or coil, 12 which is provided with a cover 21 of suitable material may be of the so-called cellulose acetate filled type as described, for example, in F. E. Henderson Patent 2,118,924 of May 31, 1938. While this type of coil has many desirable features which have resulted in its wide use, it is recognized that a certain amount of shrinkage, with resultant dimensional changes, does occur during ordinary usage. At the time of manufacture of the relay, coil 12 fits snugly between front spoolhead 22 and rear spoolhead 23 (as shown in Fig. 1) and may, under certain manufacturing conditions, fit snugly upon core 11, although usually a small space will be provided by original design between the inner circumference of the coil and the core as set forth above. The rear end of the coil is anchored to rear spoolhead 23 by suitable means but, in view of the expected shrinkage, the opposite end of the coil is not anchored to its associated spoolhead 22 but is left free therefrom.

After a short period of time it will usually be found that, due to shrinkage of coil 12, we have a condition such as that illustrated in Fig. 2. This shrinkage will result both from the acetone treatment at the time of manufacture, which causes immediate shrinkage lengthwise of as much as $\frac{1}{32}$", and from atmospheric aging conditions. As shown, a substantial space now exists between the inner torus of coil 12 and the outer circumference of core 11 while the shortening of the

coil has resulted in a "backing away" from front spoolhead 22 leaving an appreciable gap between the front end of the coil and the spoolhead. It will be remembered that coil 12 is anchored to rear spoolhead 23 but is free of front spoolhead 22.

As pointed out in the opening portions of the specification, we now have, or would have if it were not for the novel means contemplated by the present invention which will be described shortly, a situation favorable to vibration of coil 12 on core 11, induced for example by the shock resulting when armature 15 is operated and released. As set forth above, this vibration has been found to be a major factor in causing breakage of the lead wires, causing, as it does, flexing of lead wires 24 and 25 between the spoolhead terminals and pile-up terminals 26 and 27 and/or flexing of the lead wires within the coil between the winding ends and the spoolhead terminals.

In accordance with the features of the present invention a washer 41, which may be of phenol fibre, is attached to the front, free end of coil 12 by suitable adhesive or otherwise. The outer diameter of washer 41 is commensurate with that of coil 12 and it is provided with a central aperture of such size and shape as to provide a sliding fit on core 11. Washer 41, while firmly attached to the end of coil 12, is not attached to spoolhead 22 and is of such material that it is substantially immune to shrinkage whereby the sliding fit on the core is preserved irrespective of the dimensional changes in coil 12.

It will be obvious from inspection of Fig. 2 that the addition of washer 41 does not conflict with the inevitable shortening-up of coil 12 and the backing away from spoolhead 22; the washer merely slides along on core 11 as this dimensional change in the coil progresses. It will be also obvious, however, that the presence of washer 41 is effective to maintain firm anchorage of the coil 12 on core 11 so far as the objectionable vibration of the shrunken coil on the core, which was heretofore encountered, is concerned. It will be noted that the knurled section provided on core 11 is of sufficient length to permit considerable sliding movement of washer 41 while remaining on the knurled area.

Provision of the washer contemplated by the invention has been shown by actual use to be effective in materially reducing lead breakage in relays. Addition of the washer does not necessitate any change in the major design of the relay and does not result in any material increase in the cost of the relay.

Referring now to Fig. 4 there is illustrated means for anchoring the lead wires of a coil such as that utilized on the relay of Fig. 1. Coil 42 may be similar to coil 12 but is shown with the outer covering sheet removed. Coils of this type may be individually wound or may be machine wound in the form of a long "stick" which is then sawed up into individual coils. In accordance with the present plan, after the first few turns have been wound, a first strip 51 of "Scotch-tape" with a fabric backing is laid along the finished turns with the adhesive side facing outward. The winding process is then resumed and, upon completion, a second strip 52 of Scotch-tape with fabric backing is laid along the completed winding with the adhesive side facing inward. Now as the "inner" and "outer" ends of the winding are "fished out" of the completed coil, they will pull free only until they contact an edge of the respective strips 51 and 52 at which points of en-

gagement they are firmly anchored. Thus lead wire **53** is anchored at the point of its engagement with the edge of strip **51** and lead wire **54** is anchored at the point of its engagement with the edge of strip **52**.

Provision of strips such as **51** and **52** in the manner described is effective to anchor the lead wires and prevent unravelling thereof and, further, the angular position of the strips may be fixed in accordance with the exact points at which the lead wires are to be brought out of the coil for example, in the structure of Fig. 1, the lead wires may be so anchored as to be brought out near to the respective spoolhead terminals.

While certain specific embodiments of the invention have been selected for detailed description, the invention is not of course limited in its application to such embodiments. For example, while features of the invention have been illustrated as applied to a flat type relay, it will be obvious that the invention is applicable as well in connection with other types of electromagnetic devices and, in fact, in connection with electromagnetic devices other than relays. Again, while the motion limiting washer has been shown applied to a cylindrical core, it will be obvious that the arrangement is applicable as well in connection with cores of other shape, for example those with square or rectangular cross-sections; in such event, of course, the central aperture of the washer would be of corresponding shape. The embodiments described should be taken as illustrative of the invention and not as restrictive thereof.

What is claimed is:

1. An electromagnetic device comprising a core, an energizing coil positioned on said core, said coil being of a type subject to shrinkage in use, and separate means attached to each end of said coil acting cooperatively to prevent motion of said coil on said core in a direction at right angles to the longer axis thereof, the first of said means being anchored in position on said core and the second of said means being slidably mounted on said core.

2. An electromagnetic device comprising a core, a coil mounted on said core, said coil being of a

type subject to shrinkage during use, a spoolhead mounted on said core relatively near to one end thereof, means for attaching one end of said coil to said spoolhead, a washer positioned on said core and providing a sliding fit thereon, and means for attaching said washer to the other end of said coil, said washer being of a material substantially immune to shrinkage during use.

3. An electromagnetic device comprising a core, an energizing coil positioned on said core, said coil being of a type subject to shrinkage in use, a spoolhead mounted on said core relatively near to one end thereof, means for attaching one end of said coil to said spoolhead, a washer positioned on said core having a centrally located aperture therein of size and shape comparable to the cross-sectional area and shape respectively of said core whereby to provide a sliding fit thereon, and means for attaching said washer to the other end of said coil, said washer being of a material substantially immune to shrinkage during use.

4. An electromagnetic device comprising a core, a first spoolhead fixedly mounted on said core relatively near to one end thereof, a second spoolhead fixedly mounted on said core relatively near to the opposite end thereof, an energizing coil mounted on said core between said two spoolheads, said coil being of a type subject to progressive dimensional changes during use due to shrinkage, means for attaching one end of said coil to one of said spoolheads, and a washer positioned on said core between the other end of said coil and the other of said spoolheads, said washer providing a sliding fit on said core, being attached to said other end of said coil but free of said other spoolhead and being substantially immune to shrinkage.

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REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
2,162,356	Peek, Jr.	June 13, 1939