United States Patent

Bosch et al.

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[54] **ELECTROMAGNET ASSEMBLY FOR RELAYS**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**.....**H01f 7/13**

[58] **Field of Search**.....335/274, 276, 279, 275

[56] **References Cited**

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[57] **ABSTRACT**

An electromagnet assembly has a U-shaped armature mounted on an electromagnet yoke by means of leaf springs forming extensions of the armature arms and serving to hold the armature normally spaced from the magnetizable yoke, the armature arms and springs being related and connected in an especially advantageous manner.

14 Claims, 4 Drawing Figures

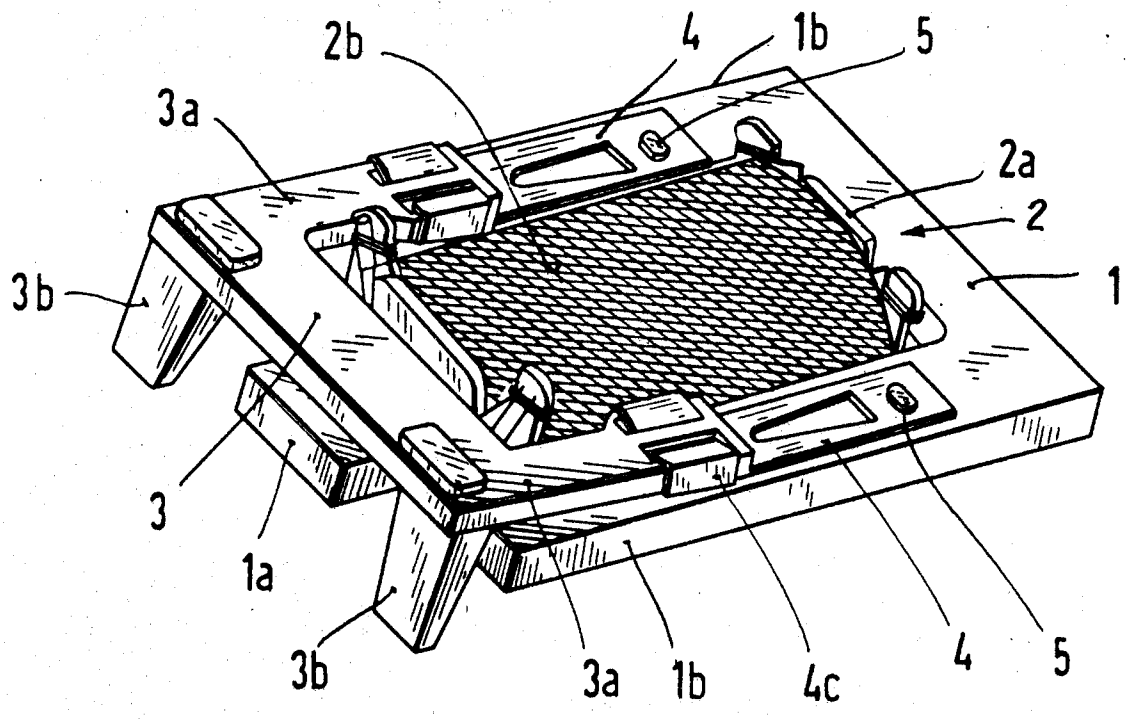


Fig. 1

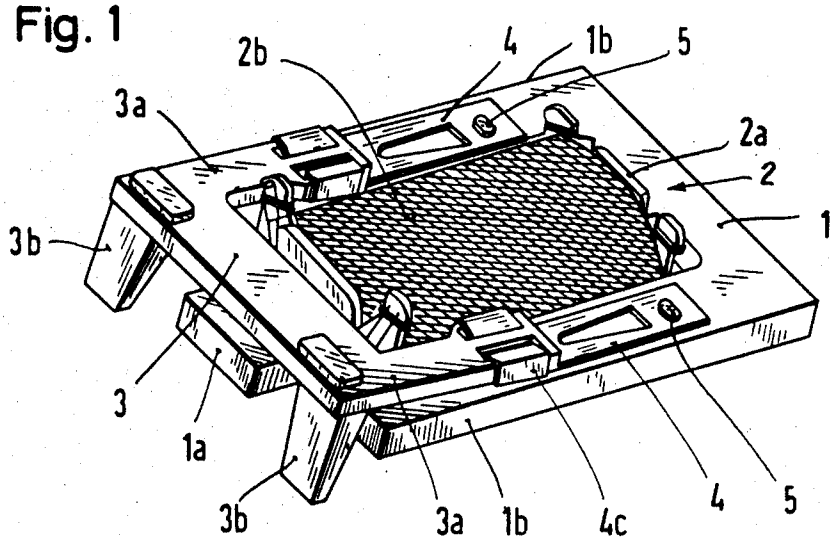


Fig. 2

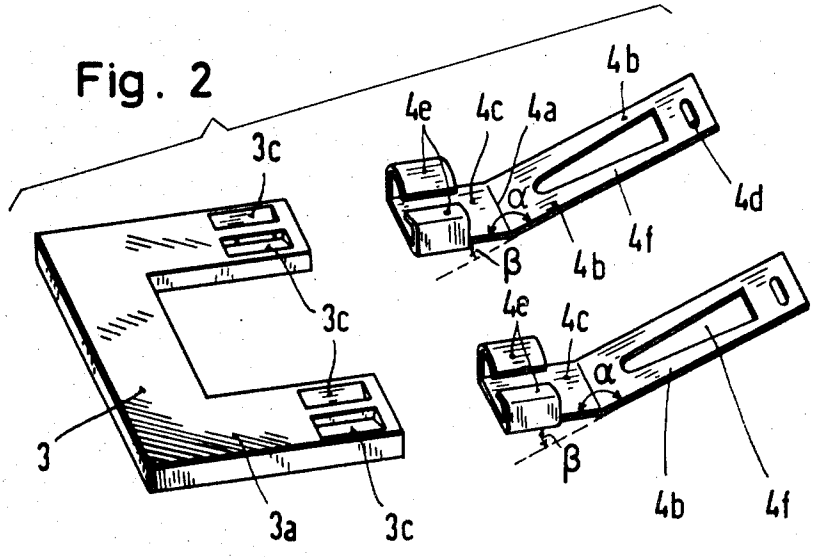


Fig. 3a

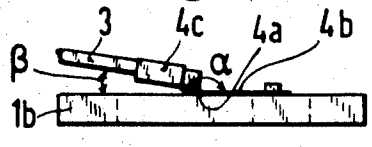
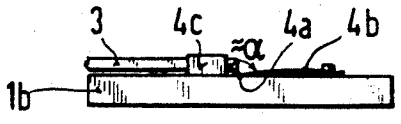


Fig. 3b



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ELECTROMAGNET ASSEMBLY FOR RELAYS

This invention relates to electromagnet assemblies for relays, and is more particularly concerned with the operative connection of the armature and the yoke in such an assembly.

Heretofore electromagnet assemblies employing U-shaped armatures have been employed in various types of construction, and in several embodiments it has been proposed to support the armature by leaf springs on the yoke and such leaf springs have taken various forms. Disadvantages in the prior arrangements have been largely due to the fact that connection of the springs to the armature has been by means of riveting or welding, with the development of undesirable stresses due to the rigid connections. In addition, there has been the disadvantage that the numerous operations thus required and necessitating close tolerances in production has resulted in high cost due to slow production rate.

An important object of the present invention is to overcome the foregoing and other disadvantages, defects, inefficiencies, shortcomings and problems in prior structures, and to attain important advantages and improvements in the construction of electromagnet assemblies, and more particularly in the connection of the armatures to the yokes in such assemblies.

Another object is to provide leaf spring mounting of armatures in electromagnet assemblies wherein the springs are free from undesirable warpage or tension.

A further object of the invention is to provide a new and improved simplified mounting of armatures in electromagnet assemblies especially suitable for relays.

Still another object of the invention is to provide new and improved attachment of the biasing leaf springs to the arms of U-shaped armatures for electromagnet assemblies.

Yet another object of the invention is to improve the attainment of desirable close tolerances in a simplified and economical manner.

A yet further object of the invention is to provide a new and improved electromagnet armature and yoke connecting spring arrangement which is long-lived and has safety features against premature deterioration or failure.

Other objects, features and advantages of the invention will be readily apparent from the following description of a preferred embodiment thereof, taken in conjunction with the accompanying drawing, although variations and modifications may be effected without departing from the spirit and scope of the novel concepts embodied in the disclosure, and in which:

FIG. 1 is an isometric view of an electromagnet assembly embodying features of the invention;

FIG. 2 is an exploded assembly view of the armature and supporting biasing springs for the armature;

FIGS. 3*a* and 3*b* are schematic side elevational views of the assembly showing the armature in the normal or at rest and working positions relative to the yoke.

An electromagnet assembly especially useful for relays, pursuant to the present invention, comprises a generally E-shaped yoke **1** operatively mounting an exciting structure **2** and a generally U-shaped armature **3** attached to the yoke through the medium of biasing springs **4**. The exciter structure comprises an electrical coil assembly **2***a* having its exciting winding **2***b* mounting on and about the shank of a pole piece arm **1***a* of

the yoke with a pole shoe extension of this arm attractively facing the cross bar of the armature **3** from the opposite end portions of which extend identical co-extensive legs **3***a* which face side arms **1***b* of the yoke. In addition, the opposite end portions of the armature cross bar carry rigidly mounted relay contact spring actuating finger elements **3***b* which function when the system is excited and the armature is drawn toward the pole shoe to trip contacts of the associated relay (not shown).

Mounting of the armature **3** on the yoke **1** through the biasing springs **4** is in such a manner that normally the armature is biased away from the pole shoe so that the tripper fingers **3***b* release the relay contacts. To this end, the biasing springs **4** are constructed from spring sheet metal of high magnetic permeability in the form of elongated leaf springs which are as nearly as practicable identical and have a bend **4***a* transversely thereacross dividing the same into a mounting body portion **4***b* and an angularly related armature-supporting leg **4***c*. In the distal end portion of each of the spring body portions is provided a transversely elongated hole **4***d* within which is engaged a similarly shaped rivet **5** by means of which the respective spring body is secured fixedly to the supporting yoke arm **1**b. Through this arrangement the springs are secured positively against turning relative to the supporting yoke arm as well as flat against the arm. For attaining the desired bias of the armature **3**, the free spring legs **4***c* project at an obtuse angle α relative to the respective mounting body portions **4***b* and the degree of this angle determines the reset position of the armature.

A new and improved connection of the armature legs **3***a* to the supporting spring legs **4***c* comprises means which will avoid tensioning the springs and essentially simplify the mounting, as compared to prior arrangements. For this purpose, each of the spring legs **4***c* is provided on its distal end portion with self-retaining armature leg gripping means desirably in the form of a generally claw-like structure each having a pair of complementary opposite side extension gripping claw flanges **4***e* bent upwardly and inwardly, as shown, and receptive of the associated armature leg therebetween. To effect a positive interlock against displacement of the armature legs from the retaining flanges **4***e*, the armature legs are provided with respective recesses **3***c* into which the free end portions of the flanges **4***e* are retainingly engaged. To avoid weakening the armature legs, the recesses are simply indentations in the associated face of the respective armature legs into which the interlocking end portions of the flanges **4***e* are turned. In this manner, the faces of the armature legs **3***a* opposite to the indentation recesses **3***c* are flat and are in flatwise face-to-face engagement with the spring legs **4***c* and the interlocking claw flanges **4***e* hold the armature legs in firm, inescapable engagement with the spring legs.

Normally the spring legs **4***c* hold the armature **3** in the spaced relation to the yoke **1** as shown in FIGS. **1** and **3***a*, and more particularly at an angle β to the plane of the adjacent yoke face. This angle is adapted to be controlled by a stop (not shown) in the associated relay for the most efficient operating relationship to the associated relay contact springs. For example, although the spring legs **4***c* may have a normal capacity of bias-

ing the armature 3 to a maximum value of 180° minus the angle α, the stop in the relay assembly may actually hold the armature in a position which is approximately midway between the maximum β angle position of FIG. 3*a* and the excited operating position of FIG. 3*b* where the armature is electromagnetically drawn to and held substantially parallel to the supporting yoke.

By the particular construction and relationship disclosed, the biasing springs 4 are substantially free from objectionable stresses and are least liable to crystalizing strains in operation. As will be observed on comparison of FIGS. 3*a* and 3*b*, in the non-operating condition the spring body 4*b* lies practically flat against the supporting yoke arm 1*b*. During the operating mode when the armature is attracted to the yoke against the spring bias, the bend 4*a* provides a smoothly rolling fulcrum which rides on the underlying yoke arm 1*b* and in the transition from the non-operating or at rest position to the operating position effects a slight upward resilient bowing deflection of the associated spring body 4*b* away from the yoke arm. Such bowing is facilitated and spring resistance of the spring body is softened by a generally trapezoid elongated cut-out 4*f* in the spring body extending from a wider end adjacent to the anchored end portions of the body toward narrowest end adjacently spaced from the fulcrum bend 4*a*. This shape of the recesses effects the cross section of the spring body portion to proportion the load moments therealong, and which may otherwise occur irregularly.

In the embodiment according to the present invention, a valuable safety feature is provided against undesirable stresses in the supporting springs, because there is a small amount of free play permitted in the connection between the armatures 3 and the leaf springs 4 even though they are thoroughly locked together. Another advantage resides in that bearing friction between the armature and the yoke is avoided by reason of the support of the armature by the free spring leg portions 4*c*, and bearing engagement occurring at the fulcrum bends 4*a* which, in effect, roll on the yoke arms 1b during operation movements of the armature. Structural and material tolerance demands are met in a more efficient and economical manner than in prior structures because instead of necessarily taking such demands into account during attachment of the biasing springs to the armature, they can be effected in the production of the respective elements themselves by machine method of mass production manufacture.

It will be understood that variations and modifications may be effected without departing from the spirit and scope of the novel concepts of this invention.

We claim as our invention:

1. In an electromagnet assembly for relays, including an E-shaped yoke with a center pole piece arm carrying an exciting coil and having a pole shoe extension operatively related to a bar armature extending thereacross and provided with a pair of spaced arms held in normally spaced relation to side arms of the yoke by respective biasing leaf springs, the improvement comprising:

integral flange means on the springs gripping the armature legs in a substantially stress-free relation; and

means effecting interlock of the flange means with the armature legs to prevent displacement of the armature legs.

2. An assembly according to claim 1, said interlock means comprising recesses in the armature legs and portions of said flanges turned into said recesses.

3. An assembly according to claim 1, said flange means comprising claw-like cooperating pairs of flanges on the respective springs.

4. An assembly according to claim 3, each of the flanges of each of the pairs of flanges having turned end portions engaged in recesses in the armature arms.

5. An assembly according to claim 1, said flange means and anchoring means permitting slight play in the connection between the armature legs and the springs so that even though the springs and armature legs are thus thoroughly locked together undesirable stresses in springs are avoided.

6. An assembly according to claim 1, said springs each having a body portion and an obtusely angular armature-supporting leg provided with said armature leg engaging flanges, said body portion and said spring leg being connected by a fulcrum bend, and means fixedly connecting the body portion adjacent to its end remote from said bend to the associated yoke arm, whereby the spring legs hold the armature normally biased away from the pole shoe extension and upon energizing the exciting coil to effect drawing of the armature toward the pole shoe extension fulcruming occurs at the fulcrum bend accompanied by upward resilient flexing bending of said body portion.

7. An assembly according to claim 6, including flexure controlling cut-outs in said body portion.

8. In an electromagnet assembly for relays, including an E-shaped yoke with a center pole piece arm carrying an exciting coil and having a pole shoe extension operatively related to a bar armature extending thereacross and provided with a pair of spaced legs held in normally spaced relation to side arms of the yoke by respective biasing leaf springs, the improvement comprising:

said leaf springs including body portions and armature-supporting legs connected together at obtuse angle bends such that with the body portions lying generally parallel with the yoke arms the spring legs extend angularly away from the yoke arms;

means fixedly attaching the body portions adjacent to their free ends to the yoke arms; and

means connecting the spring legs in biasing relation to the faces of the armature legs which face toward the yoke arms;

whereby the angle bend connections between the body portions and spring legs of the respective springs serve as fulcrum bearings in operating movements of the armature.

9. An assembly according to claim 8, including claw-like flanges on said spring legs gripping said armature legs and thereby connecting the armature legs to the spring legs.

10. An assembly according to claim 8, said means securing the body portions to said yoke arms holding the body portions against turning displacement relative to the yoke arms.

11. An assembly according to claim 8, said body portions being resiliently deflectable into bowed relation between said securing means and said fulcrum bends when the armature is deflected toward said pole shoe extension.

12. An assembly according to claim 11, including generally trapezoid-shaped cut-outs in said body portions to facilitate said resilient deflection.

13. An assembly according to claim 8, said springs consisting of a material of high magnetic permeability.

14. An assembly according to claim 8, said spring legs having armature-engaging pairs of gripping flanges in claw-like relation engaging said armature legs, and said armature legs having indentations on the faces thereof which face away from said yoke legs and into which anchoring terminals of said flanges are engaged to hold the armature legs against displacement relative to the spring legs.

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