June 8, 1965 U. W. AUER 3,188,532

ELECTROMAGNET WITH BALANCED ARMATURE

Filed Aug. 6, 1963 2 Sheets-Sheet 1

FIG. 1

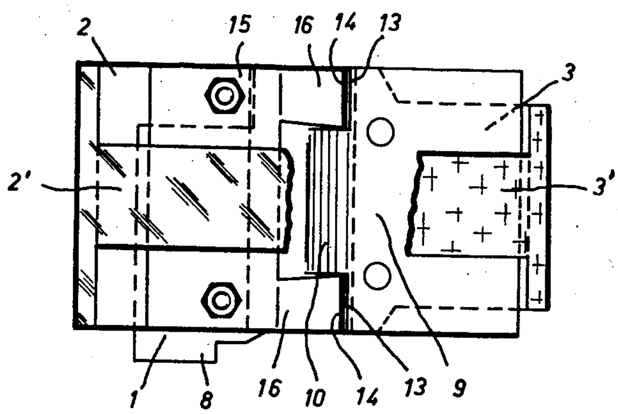

FIG. 2

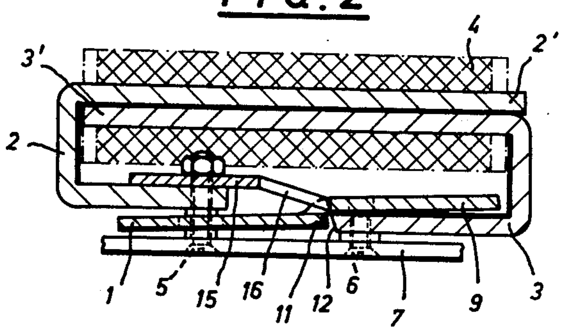

FIG. 3

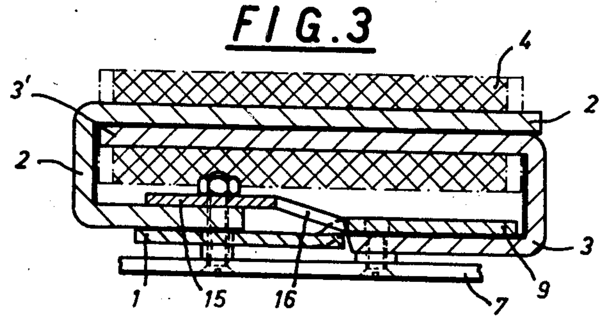

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FIG.4

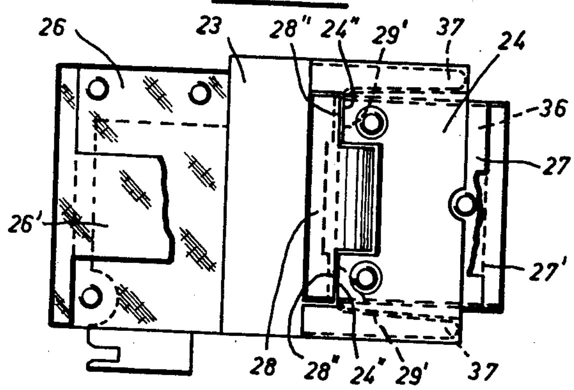


FIG.5

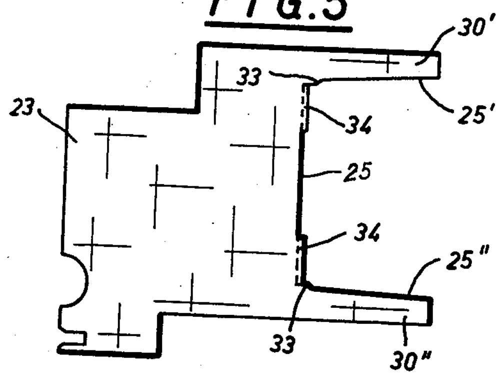


FIG.6

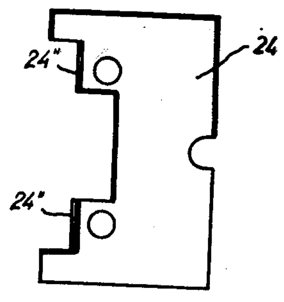
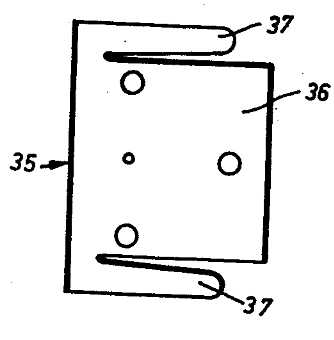


FIG.7



3,188,532
ELECTROMAGNET WITH BALANCED ARMATURE

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The present invention has for its object an electromagnet which distinguishes from all prior electromagnets through the fact that its stationary section is no longer connected with the movable section of the armature through a rotary axis constituted by a shaft or rod subjected to wear and friction. By cutting out the conventional pivotal connection by means of a rotary shaft, it is possible not only to do away with the necessity of exerting a certain force for overcoming friction during the travel executed by the armature, but it is also possible to obtain a magnetic closing between the stationary and movable sections of the magnetic circuit, which is far better than in all prior cases.

In the electromagnet according to the invention which includes a rocking armature and at least one stationary yoke, the movable armature is fitted after the manner of a scale beam between the ridges of the yoke and of a bridge while one of said parts, to wit, the armature and the yoke, is partly bent and partly cut off so that the ridges of the bent part formed by said cut off face on the one hand the slightly bevelled ridge of the other part which has not been deformed through bending and on the other hand the also slightly bevelled ridge of the bridge connected with said part which has not been deformed through bending.

Inasmuch as the armature is designed in a manner such that it lies at least approximately in equilibrium with reference to its pivotal axis, the force required for shifting the armature is reduced to a minimum and furthermore the protection against shocks is increased.

The accompanying drawings illustrate, by way of example, two embodiments of the invention. In said drawings:

FIG. 1 is a view of a first embodiment of the electromagnet with partly cut off parts,

FIGS. 2 and 3 are transverse sectional side views of the electromagnet illustrated in FIG. 1 for two terminal positions of the movable armature,

FIG. 4 is a plan view corresponding to FIG. 1, of a second embodiment of the electromagnet and

FIGS. 5, 6 and 7 illustrate separate parts of the electromagnet according to FIG. 4.

The electromagnet according to FIGS. 1, 2 and 3 includes a movable armature 1 associated with two yokes 2 and 3 and their cores 2′ and 3′ carrying the windings 4 surrounding these two cores. The whole arrangement is secured to a casing section 7 by means of screws 5 and 6 extending through the corresponding yokes. In FIG. 1, the cores 2′ and 3′ are shown as partly broken off and the winding is not illustrated. The transversely projecting section 8 of the movable armature serves for securing the member to be controlled and shifted and which is constituted for instance by a lever intermittently shifting the input wheel of an impulse counter.

Now the movable armature 1 is partly bent and partly cut off so that one half 9 of the armature projects over the yoke 3 while the ridges 11 formed by the cutting off of said armature and appearing to either side of the deformed medial section 10 of the armature on the other half of the armature face the bevelled ridge 12 of the yoke 3. The armature thus executed is held fast against any shifting by the bridge 15 secured to the yoke 2 by

the screws 5, whereas the bevelled ridges 14 of the two bent lateral projections 16 formed on either side of the bridge and extending to either side of the deformed medial section 10 of the armature abut against the ridges 13 of that half 9 of the armature which projects underneath the yoke 3.

Thus the movable armature 1 is positioned on the one hand by the ridges 12 of the yoke 3 and on the other hand by the projections 16 of the bridge 15 and thereby there is allowed a short angular movement for the armature round an axis extending along the inner transverse edge of the yoke 3. The bridge 15 with its projections 16 is made of a non-magnetic material and is secured in a manner such that the clearance with reference to the armature, may be adjusted through a shifting of the bridge.

FIG. 2 shows the movable armature 1 in its released condition while FIG. 3 shows it in its attracted condition. The two yokes 2 and 3 include two flat elongated cores 2′ and 3′ which engage in a conventional manner through its opposite ends, the axial opening formed in the winding 4 in a manner such that they lie in superposition therein and thus fill completely said axial opening in the winding. This structure of the cores of the two yokes allows an easy assembling of the whole arrangement.

The partial cutting out and the bending of the armature 1 may be executed in a single operation.

The armature 1 is furthermore executed in a manner such that it lies at least approximately in equilibrium with reference to the above-mentioned pivotal axis and is carried after the manner of a scale beam in equilibrium through its middle and thereby practically no forces of gravity need be overcome when the armature is being lifted. Furthermore this arrangement provides a great protection against shocks.

FIG. 4 illustrates a modification of the electromagnet according to the invention. This embodiment includes, as in the case of the first embodiment illustrated, a movable armature 23 and the two yokes 26 and 27 with their cores 26′ and 27′ which are shown in FIG. 4 as partly broken off.

In contradistinction with the first embodiment however, instead of the armature being partly bent and partly cut out, it is the yoke 27 which is thus bent and deformed. The armature illustrated in FIG. 5 is provided with a recess extending between the tongues 30′ and 30″ along the transverse ridge 25 and the lateral ridges 25′ and 25″ on said tongues 30′ and 30″. The corners of this recess are rounded as shown at 33 and the ridge 25 is provided to either side of its medial section with slightly bevelled portions 34. The yoke 27 engages said recess in a manner such that the bent projecton 28 on said yoke 27 projects underneath the armature 23 and the ridges 29′ formed on either side of the bent yoke 27 face the bevelled ridges 34 along the inner surface of said recess in the armature.

To the tongues 30′ and 30″ of the armature 23, there is secured a bridge 24 which is given the shape illustrated in FIG. 6. Said bridge projects underneath the yoke 27 and faces through its transverse alined ridges 24″ which are also bevelled, the two inner ridges 28″ of the bent projection 28. Said bridge 24 may for instance be secured through spot welding after the introduction of the bent projection 28 into the recess of the armature. In this second embodiment, the movable armature 23 is again positioned after the manner of a balance beam, whereby the weight of the bridge 24 is adapted to balance the armature 23 with reference to the pivotal axis extending substantially along the ridge 25.

In order to further the lifting of the armature 23, it is also possible to provide a spring such as that illustrated by way of example as a spring blade 35, constituted as shown in FIG. 7 by a body 36 and two lateral tongues 37 extending along two opposite sides of said body. Said spring blade is arranged in a manner such that its body lies over the yoke 27 while its tongues 37 engage the corresponding tongues 30′ and 30″ of the armature 23. Said spring, which may also be given any other suitable shape, serves also as a support between the yoke and the casing.

The electromagnet according to the invention is by no means limited to the two embodiments illustrated but it covers in contradistinction any other embodiment of the yoke, of the movable armature and of the bridge falling within the scope of the accompanying claims.

Whereas in the above-described embodiments, the armature or the yoke which has been deformed through bending, is cut out to either side of its bent middle section, it is also possible, conversely, to cut off, for instance, the medial section between two bent marginal sections.

The electromagnet according to the invention distinguishes through a simple execution and assembly, through practically negligible friction and wear and also through an efficient protection against shocks. Furthermore, an excellent closing of the magnetic circuit is obtained between the stationary yoke and movable armature so that the intensity of the energizing current required for the electromagnet may be reduced.

The above-described electromagnets are advantageously used for the actuation of impulse-controlled counters for which it is necessary to obtain a high impulse frequency and a reduced consumption of energy.

What I claim is:

1. An electromagnet comprising at least one stationary coil-carrying yoke including at least one inturned projecting section terminating with a transverse bevelled ridge, a movable armature cooperating with said yoke and provided with at least one recess bounded by a transverse ridge facing the transverse ridge on the yoke, a non-magnetic bridge rigidly secured to the armature and including two lateral slightly bent extensions terminating with transverse bevelled ridges facing the transverse ridge on the armature to form with the bevelled ridge on the yoke a pivotal axis for the armature.

2. An electromagnet comprising a stationary coil-carrying yoke including a main section and at least one inturned projecting section extending over a fraction of the breadth of said main section and terminating with at least one bevelled ridge, an armature including a main section bounded by a transverse ridge registering with the bevelled ridge on the yoke and two lateral projections extending beyond said main section and a bridge rigidly secured to said lateral projections on the armature and bounded laterally by a bevelled ridge registering with the bevelled ridge on the yoke, the system including the armature and the bridge being adapted to rock round the pivotal axis formed by said bevelled ridge on the yoke and with reference to which the system is balanced.

3. An electromagnet comprising at least one stationary coil-carryiing yoke and including at least one inturned projecting section terminating with a transverse bevelled ridge, a movable armature cooperating with said yoke and provided with at least one recess bounded by a transverse ridge facing the transverse ridge on the yoke, a bridge rigidly secured to the armature and forming with said armature a weight which is balanced with reference to the transverse ridge of the armature, said bridge terminating with transverse bevelled ridges facing the transverse ridge on the armature to form with the bevelled ridge on the yoke a pivotal axis for the armature.

4. An electromagnet comprising a stationary coil-carrying yoke including a main section and at least one inturned projecting section extending over a fraction of the breadth of said main section and terminating with at least one bevelled ridge, an armature including a main section bounded by a transverse ridge registering with the bevelled ridge on the yoke and two lateral projections extending beyond said main section and a bridge rigidly secured to said lateral projections on the armature and bounded laterally by a bevelled ridge registering with the bevelled ridge on the yoke, the system including the armature and the bridge being adapted to rock round the pivotal axis formed by said bevelled ridge on the yoke and with reference to which the system is balanced, and a blade spring fitted between the armature and the yoke, said blade spring having two lateral projections that lie under said lateral projections of said armature.

5. An electromagnet comprising an approximately C-shaped magnetic yoke having two flat inturned end portions directed toward one another and approximately parallel to one another, means for energizing said yoke so that said end portions are of opposite magnetic polarity, and an armature having two opposite flat approximately equal end portions one of which overlies one end portion of said yoke and the other of which underlies the other end portion of said yoke so that said end portions of the armature are on opposite sides of the respective end portions of the yoke, an intermediate portion of said armature being formed to provide oppositely directed transverse edges and said yoke being formed with oppositely directed transverse edges engaging respectively the oppositely directed transverse edges of said armature to provide a transverse pivotal axis for said armature to swing from a released condition in which said end portions of the armature are at a slight angle to the respective end portions of the yoke to an attracted condition, when said yoke is energized, in which said end portions of the armature lie substantially against the respective end portions of the yoke.

6. An electromagnet according to claim 5, in which a non-magnetic bridge piece between said end portions of the yoke has a portion passing through an opening in said armature and a portion providing an edge engaging one of said edges of the armature.

7. An electromagnet according to claim 5, in which said end portions of the armature are approximately parallel and are offset relative to one another.

8. An electromagnet comprising a magnetic yoke having a core portion and flat opposite end portions which are turned in toward one another and are approximately parallel to said core portion, a winding on said core portion, and an armature having two opposite flat approximately equal end portions one of which overlies one end portion of said yoke and the other of which underlies the other end portion of said yoke so as to be between said other end portion and the core portion of said yoke, said end portions of the armature thus lying on opposite sides of the respective end portions of the yoke, an intermediate portion of said yoke being formed to have oppositely directed transverse edges and said yoke being provided with oppositely directed edges engaging respectively the oppositely directed transverse edges of said armature to provide a transverse pivotal axis for said armature to swing from a released condition in which said end portions of the armature are at a slight angle to the end portion of the yoke to an attracted condition, when said yoke is energized, in which said end portions of the armature are approximately parallel and contiguous to said end portions of the yoke.

9. An electromagnet according to claim 8, in which a blade spring fitted between the armature and the yoke has two lateral projections that lie under lateral projections of the armature and bias said armature to released condition.

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