United States Patent [19]

Hadam

[11] **3,815,065**

[45] **June 4, 1974**

[54] **MAGNETIC ARMATURE FOR MAGNETIC ARRANGEMENTS SUBJECT TO IMPACT STRESSES**

[76] Inventor: **Wilhelm Hadam,** Bellinostr. 115, 7410 Reutlingen, Germany

[22] Filed: **Dec. 11, 1972**

[21] Appl. No.: **313,692**

[30] **Foreign Application Priority Data**

Dec. 10, 1971 Germany 2161377

[52] **U.S. Cl.** .... **335/257,** 335/277, 66/50 R, 66/75

[51] **Int. Cl.** **H01f 7/08**

[58] **Field of Search** .... 335/259, 257, 277, 264, 335/267; 66/50 R, 75

[56] **References Cited**

UNITED STATES PATENTS

2,935,663	5/1960	Pollak	335/259
3,564,870	2/1971	Glaunsinger	66/50 R
3,621,422	11/1971	Macy	335/267 X
3,713,059	1/1973	Tada	335/259

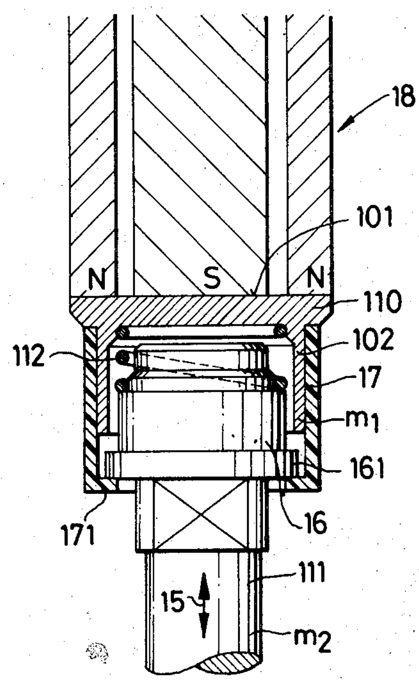
Primary Examiner—George Harris

Attorney, Agent, or Firm—Larson, Taylor & Hinds

[57] **ABSTRACT**

A magnetic armature particularly adapted for use with magnet devices which are subject to impact, such as, electro-retaining magnets for knitting machines, includes a magnetic armature head of relatively small mass which is resiliently connected to a magnetic armature body of larger mass. The resilient connection can be provided by a spring or by an intermediate member such as a rubber connector rigidly secured to both the armature head and body.

9 Claims, 5 Drawing Figures



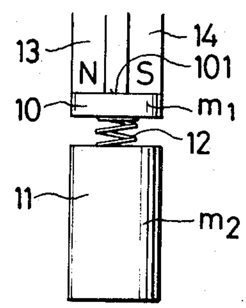

13
14
N
S
101
10
m_1
12
11
m_2

Fig. 1

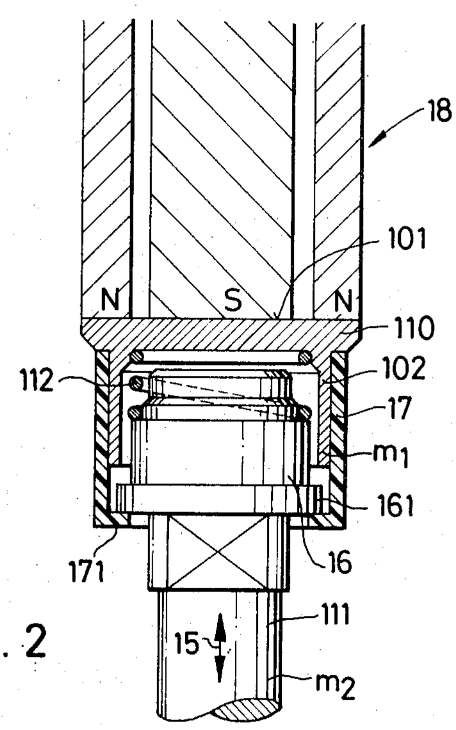

18
101
N
S
N
110
112
102
17
m_1
161
171
16
111
15
m_2

Fig. 2

Fig. 3

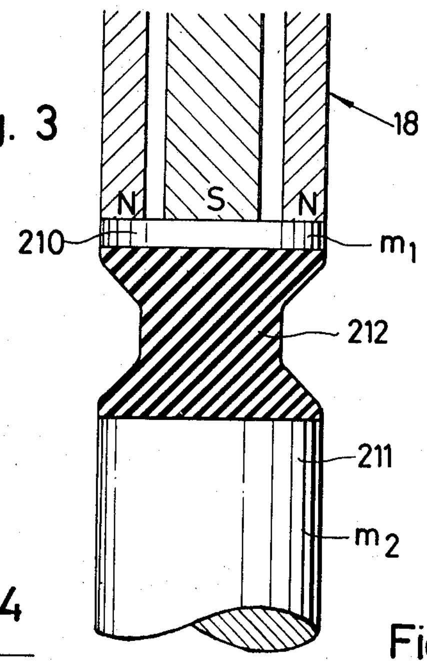


Fig. 4

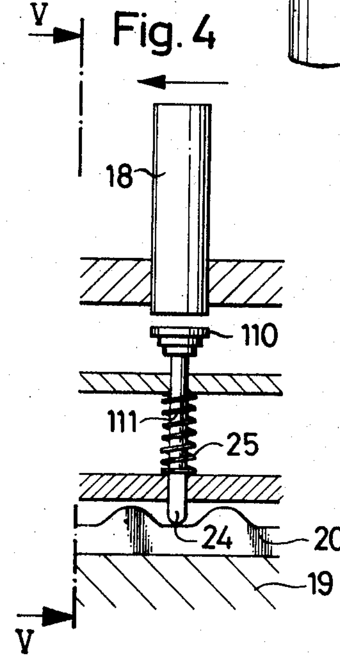
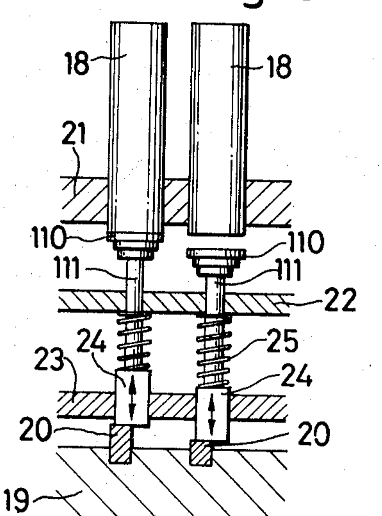


Fig. 5



MAGNETIC ARMATURE FOR MAGNETIC ARRANGEMENTS SUBJECT TO IMPACT STRESSES

FIELD OF THE INVENTION

The present invention relates to a magnetic armature particularly adapted for use in magnetic apparatus subject to impact stresses. Thus, for example, the invention is applicable to electro-retaining magnets of knitting machines, wherein the magnet armatures are connected to movable members of relatively large mass.

BACKGROUND OF THE INVENTION

The tractive force of a magnet, that is, the force of the magnetic field created by a magnet, drops very sharply as the armature is moved from the corresponding magnetic core or magnetic poles. Further, the strength of the magnetic field which is required to attract a released armature is a multiple of the force of the magnetic field required to hold or retain an armature in position. For this reason, an electromagnet, wherever possible, is constructed in the form of a so-called retaining magnet wherein the armature is mechanically "presented," i.e., movable into position relative thereto, by mechanical springs or the like, and, for the purpose of saving energy, is designed to create a field strength which, although adequate to hold the armature presented thereto, is nevertheless insufficient to attract a released armature. If the armature of such a retaining magnet has a relatively large mass, or if the armature is applied at a high velocity against the pole surfaces of the retaining magnet, there is a danger that the armature will rebound from the magnet and thereby be separated or released from the pole surfaces. This can mean that the armature will be incapable of being subsequently attracted to the pole surfaces because of the inadequate strength of the magnet, notwithstanding the face that the latter is energized. The danger of a relatively heavy armature being irretrievably detached or separated from an energized retaining magnet also exists when the entire magnetic apparatus, the actual retaining magnet, or even the armature alone, is subject to impact.

It is also noted that the disadvantage discussed is of increased severity in the situation wherein a magnetic armature is arranged obliquely with respect to the core or pole of a retaining magnet and non-parallel to the bearing surface thereof, or where the armature is moved to various distances during mechanical handling so the effect of separation from the magnetic core or poles is magnified.

SUMMARY OF THE INVENTION

In accordance with the present invention the shortcomings of prior art magnetic armatures discussed above are overcome and an armature provided which is capable of being held with a greater degree of security against release by impact, or accidental mechanical disturbances, without increasing the power of the magnet.

In its broader aspects, the present invention concerns the provision of an improved magnetic armature adapted to seat against or engage the magnetic core or pole shoes of a magnet, which armature comprises a magnetic "head" of a relatively small mass which is resiliently connected to a magnetic armature "body" of a larger mass.

The resilient connection may be implemented so that the connection is stressed in one direction only or is stressed in both directions. In the latter instance, the magnetic armature head may be resiliently connected to the armature body for free movement, this, for example, being achieved by an intermediate connecting layer between the magnetic armature head and the armature body which is resiliently deformable under strain or compression.

It is noted that the magnetic armature body need not necessarily be a separate entity but can, where appropriate, comprise a machine part which is magnetically-responsive and which is of any required form, the machine part being resiliently connected to a corresponding magnetic armature head.

Magnetic armatures constructed in accordance with this invention may advantageously be used in various fields including electrical control systems for knitting machines in which the armatures of the electromagnets, and particularly the electro-retaining magnets, are connected to movable members of relatively large mass and hence subject to impact loads. In these instances, such a movable member can, for example, take the form of a rod or bolt or be provided with a bolt which is mounted for movement towards a retaining magnet against spring bias and is provided with a resiliently connected armature head adapted to be applied against the magnet.

It is also noted that tests have confirmed the extraordinary effectiveness and impact-resistance of magnetic armatures constructed in accordance with the present invention.

Other features and advantages of the invention will be set forth in, or apparent from, the detailed description of the preferred embodiments found hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified, diagrammatic, side elevational view of a magnetic armature constructed in accordance with the principles of the invention;

FIG. **2** is a side elevational view, partially in section, of one practical embodiment of the improved magnetic armature of the invention;

FIG. **3** is a side elevational view, similar to that of FIG. **2**, of a second practical embodiment of the invention;

FIG. **4** is a fragmentary, part sectional, side elevational view of a flat knitting machine which incorporates a magnetic armature of the form depicted in FIG. **2**; and

FIG. **5** is a part-sectional view taken along line V — V of FIG. **4**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. **1**, a simplified version of the armature of the invention is shown which illustrates the principles underlying the invention. As shown, a magnetic armature is broken into a magnetic armature head **10** of a small mass, denoted m_1, and an armature body **11**, of a larger residual mass m_2, and a spring **12** is used to connect the head **10** and the body **12** together. The face of the armature, denoted **101**, is provided on the armature head **10** and is applied against a pair of pole shoes denoted **13** and **14**. (Alternatively, as discussed above, the armature surface can be applied against the core of an electromagnet.) As mentioned, the braking up of the armature into separate, resiliently connected masses provides substantially improved impact resistance capabilities.

In the practical embodiment illustrated in FIG. 2, the armature body of the larger mass m_2 is constituted by a bolt **111** which is movable in the directions of the double arrow **15** and is provided at its magnet end with a piston **16**. A cylinder **17**, which is arranged concentrically around the piston **16** and which is, like piston **16**, preferably constructed of a light plastic, includes at one end an inwardly-directed rim **171**. Rim **171** engages a shoulder **161** formed on piston **16** and thereby serves an abutment for the piston **16** within the cylinder **17**. A hollow cylindrical shank **102** of an armature plate **110** is received in the cylinder **17**, plate **110** corresponding to the armature head **10** of smaller mass shown in FIG. 1. The face **101** of the plate **110** is applied against, or engages, a magnet which generally designated **18** in FIG. 2. Arranged within the cylinder **17** and the concentric cylindrical shank **102** of the magnetic plate **110** is a compression spring **112** which bears at one end against the piston **16** and at the other end against the rear or inner side of the plate **110**.

In the embodiment under consideration, the compression spring **112** constitutes the resilient coupling between the bolt **111** (of larger mass m_2) and the armature plate **110** (of smaller mass m_1) and is only effective from the rest position when the bolt **111** moves towards the electromagnet **18**. The arrangement of the cylinder **17** and the magnetic plate **110** is, however, so constructed that a limited degree of pivoting thereof relatively to the longitudinal axis of the bolt **111** can take place so that the abutment face **101** of the plate **110** is flush against the pole shoes of the electromagnet **18** when the magnetic armature is energized. This construction enables very exact distance and length tolerances to be achieved and affords a high degree of security against the effects of impacts exerted on the bolt **111**, principally in the direction towards the electromagnet **18**.

In the practical embodiment of the invention illustrated in FIG. 3, a magnetic armature head, in the form of a plate **210**, is freely or universally movable and is coupled resiliently to a magnetic armature body **211** for every direction of movement. This coupling is effected by an intermediate resilient body **212**, which is preferably constructed of rubber and which is accordingly in the nature of a rubber spring. The rubber body **212** is rigidly connected by suitable means, such as an adhesive or vulcanization, to both the magnetic armature head **210** and the armature body **211**. Moreover, the rubber body **212** may be stressed in tension or compression, the arrangement shown in FIG. 3 affording protection against impact in every direction. The magnetic armature head **210** is constructed in plate form to enable seating against the pole shoes of the electromagnet **18** and can be connected to the rubber body **212** in a preliminary operation to constitute a unitary structure which is subsequently connected to the magnetic armature body **211**. The latter may be of any desired shape, although in this embodiment, attention must be paid to certain longitudinal tolerances of the overall system during the mechanical movement of the magnetic armature.

Referring to FIGS. **4** and **5**, there are shown, in somewhat diagrammatical form, magnetic armatures of the type illustrated in FIG. **2**, together with associated retaining magnets, incorporated in the machine carriage of a flat knitting machine for needle selection purposes. As illustrated, a portion of a needle bed **19**, in which a cam bar **20** is secured, is shown. A carriage, which includes the portions of a mounting plate **21**, a guide plate **22** and a cam plate **23** shown in FIGS. **4** and **5**, is caused to travel over needle bed **19** in a known manner. A plurality of electromagnets **18** are arranged in the mounting plate **21**, although, for simplicity, only two such electromagnets have been illustrated.

The electromagnets **18** are provided with magnetic armatures of a form corresponding to that illustrated in FIG. **2**, and hence include a bolt-form magnetic armature body **111** and a magnetic armature plate **110** of relatively smaller mass which is resiliently coupled thereto. The bolts **111** are each provided with a vertically movable sliding shoe **24** at the end thereof opposite to the corresponding magnet **18**. Each of the bolts **111** (and its associated shoe **24**) is held against the cam bar **20** by means of a compression spring **25** when the magnet **18** is de-energized. The compression springs **25** surround the bolts **111** and are interposed between the underside of the guide plate **22** and the upper ends of the shoes **24**. The cam bar **20** produces a continuously repeating presentation of a magnetic armature against its associated electromagnet **18** by causing the armature plate **110** to move into contact with the pole of that magnet. In the embodiment under consideration, the magnet system comprises a permanent magnet with soft iron pole shoes which can be strengthened by electrical energization through a coil providing a permanent magnetic field and can be weakened by a controllable counteracting field to release the spring-biased armature. Impacts, which in this case take place principally in a direction away from the magnetic armature body **111** and towards the electromagnet **18**, cannot bring about release of the magnetic armature because of the resilient arrangement of the magnetic armature plate.

It will be appreciated by those skilled in the art that although the invention has been described relative to exemplary embodiments thereof, variations and modifications can be effected in these embodiments without departing from the scope and spirit of the invention.

I claim:

1. A magnetic armature for magnet devices subject to impact wherein the face of the armature is positioned against the magnetic means of the magnet device which attracts the armature, said armature comprising a magnetic armature head of relatively small mass which lies adjacent to the magnetic means and abuts the magnetic means upon energization of the magnetic device, a magnetic armature body of a larger mass relatively remote from the magnetic means and means for resiliently connecting said armature head to said armature body.

2. A magnetic armature as claimed in claim **1** wherein said resilient connecting means provides free movement of the armature head.

3. A magnetic armature as claimed in claim **2** wherein said resilient connecting means comprising an intermediate resilient member located between said armature head and said armature body for rigidly connecting said armature head to said armature body, said member being resiliently deformable under tension and compression.

4. A magnetic armature as claimed in claim 3 wherein said intermediate resilient member is constructed of rubber.

5. A magnetic armature as claimed in claim 1 wherein said magnetic armature comprises a rod-like member including a piston connected to the end thereof towards the magnetic device, said armature further including a cylinder connected to the armature head into which said piston projects and said piston including an abutment for limiting the axial movement thereof within said cylinder, said resilient means comprising a compression spring located between said piston and said head.

6. A magnetic armature as claimed in claim 5 wherein said piston and said cylinder are constructed of a lightweight plastic.

7. A magnetic armature as claimed in claim 6 wherein said cylinder includes a lip which cooperates with said abutment to limit the axial movement of the piston.

8. A magnetic armature as claimed in claim 1 in combination with a needle selection system including electro-retaining magnets, wherein the armature body is associated with a bolt-like movable member of relatively high mass which is mounted for movement against spring forces towards a corresponding electro-retaining magnet, said armature head being adapted to abut said magnet.

9. A magnetic armature as claimed in claim 1 in combination with needle selection system, including electro-retaining magnets, wherein the said armature body comprises a movable bolt member, said system including means for mounting said bolt member for movement towards a corresponding retaining magnet, said spring means for opposing the movement of said bolt member, said armature head being resiliently held in abutment against said magnet.

* * * * *