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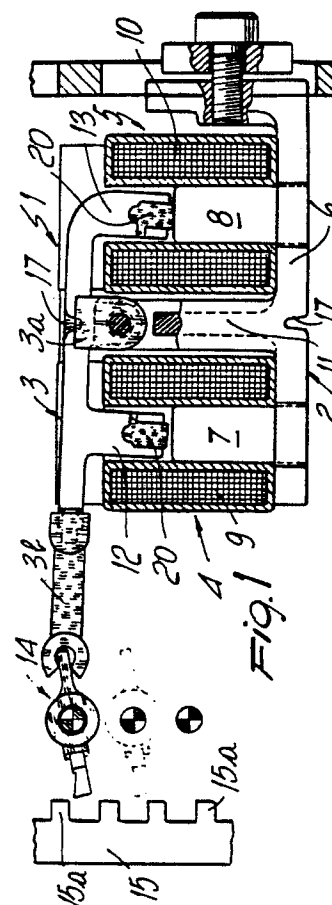
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54 **High speed electromagnetic actuator, particularly for selection devices in knitting machines for hosiery and the like.**

57 The present invention relates to a high speed electromagnetic actuator (1), particularly for selection devices in knitting machines for hosiery and the like. The actuator (1) comprises a frame (2) oscillably supporting a lever (3) having a portion pivotally connected to the frame (2) and at least one electromagnet (4,5) which acts on the lever (3), to cause oscillation thereof; the lever (3) has at least one ledge (12,13) made of ferromagnetic material which extends in the direction of the nucleus (7,8) of the electromagnet (4,5). A synthetic, anti-wear, anti-magnetic material (20) is moulded at least on the reciprocally facing portions of the cited ledge (12,13) and the nucleus (7,8) of the electromagnet (4,5).



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HIGH SPEED ELECTROMAGNETIC ACTUATOR, PARTICULARLY FOR SELECTION DEVICES IN KNITTING MACHINES FOR HOSIERY AND THE LIKE.

The present invention relates to a high speed electromagnetic actuator, particularly for selection devices in knitting machines for hosiery and the like.

Electromagnetic actuators are known which, due to their reduced bulk and high speed of actuation, are particularly suitable for controlling selection devices in knitting machines for hosiery and the like.

Some types of electromagnetic actuators substantially comprise a frame which oscillably supports a lever having a portion pivotally connected to the frame and an electromagnet which acts on the lever so as to cause its oscillation in one direction, while the return oscillation is effected by a permanent magnet.

Electromagnetic actuators are also known which utilize two electromagnets acting in opposite directions on the lever to effect its oscillation in both directions.

In order to achieve actuation of sufficiently high speed without overloading the windings of the electromagnet or of the electromagnets, the lever usually has ledges which extend in the direction of the nucleus of each electromagnet.

Between the nucleus of the electromagnet and the ledge is interposed a member of anti-magnetic material, usually phosphor bronze, which has the double function of absorbing the impact of the ledge and impeding adhesion of the ledge to the electromagnet.

With the increase in actuation speed required, in particular in selection devices in knitting machines for hosiery and the like and with numerous cycles of oscillation, it has been found that there is excessive wear of the member interposed between the ledge and the nucleus of the electromagnet.

The main aim of the present invention is to solve the above-mentioned problems by providing an electromagnetic actuator which is more reliable in use, and which has an increased working life and a faster actuating speed with respect to known types.

Within the above aim, an object of the invention is to provide an actuator which can withstand very high actuation speeds without incurring excessive heating.

Another object of the present invention is to provide an actuator having a structure which is easy to manufacture and which has a bulk which permits its installation in knitting machines for hosiery, even of small diameter and having a number of feeds.

This aim as well as these and other objects

which will become apparent hereinafter are achieved by a high speed electromagnetic actuator, particularly for selection devices in knitting machines for hosiery and the like comprising a frame oscillably supporting a lever having a portion pivotally connected to said frame and at least one electromagnet acting on said lever, to cause oscillation thereof, said lever having at least one ledge made of ferromagnetic material and extending in the direction of the nucleus of said electromagnet, characterized in that a synthetic, anti-wear, anti-magnetic material is moulded at least on the reciprocally facing portions of said ledge and said nucleus.

Further features and advantages of the invention will become apparent from the following description of a preferred, but not exclusive embodiment of the actuator according to the invention, illustrated in the accompanying illustrative, non-limitative drawings, wherein;

Figures 1 and 2 are partially cut-away side elevation views illustrating the electromagnetic actuator according to the invention in two different working positions, and as applied to a selection device, which is only partially illustrated;

Figures 3 and 4 are perspective detail views of the lever according to the invention, respectively before and after the application of anti-magnetic, anti-wear material;

Figure 5 is a perspective view of the lever;

Figures 6 and 7 are perspective views of the portion of the lever pivotally connected to the frame, respectively before and after the application of the synthetic, anti-wear material;

Figure 8 is a perspective view of another portion of the lever according to the invention;

Figure 9 is a section of figure 4, taken along the section line IX-IX and

Figure 10 is a section of figure 7, taken along the section X-X.

With reference to the cited figures, the electromagnetic actuator according to the invention, generally indicated by the reference numeral 1, comprises a frame 2 oscillably supporting a lever 3 pivotally connected to the frame and an electromagnet, which acts on the lever for causing its oscillation.

Advantageously, in order to render the achievement of very high operating speeds possible, two electromagnets 4 and 5 are provided which act in opposition on the lever 3, so as to cause oscillation thereof in both directions with equal oscillation speeds.

More precisely, the frame 2 is made of fer-

romagnetic material and has a base side 6 wherefrom extend, in a substantially perpendicular direction, two ledges 7 and 8 which constitute the two nuclei of the electromagnets 4 and 5, around which are arranged the electric windings 9 and 10.

Between and parallel to the two ledges 7 and 8 extends a third ledge 11, supporting at its end remote from the base 6 the lever 3 pivotally connected thereto at its intermediate portion.

In this way the lever 3 is substantially parallel to the base 6 of the frame and advantageously has two ledges 12 and 13, which extend from the same side of the lever but from the opposite parts with respect to its fulcrum, in the direction of the nuclei 7 and 8 of the electromagnets.

According to the invention, on at least one of the reciprocally facing portions of the lever and of the nuclei of the electromagnets 4 and 5 a synthetic anti-wear, anti-magnetic material 20 is moulded.

In the illustrated embodiment, the synthetic anti-wear, anti-magnetic material is moulded on the free end of the ledges 12 and 13, but it could be moulded on the nuclei of the electromagnets so as to efficiently effect an anti-shock and anti-adhesion action between the ledges 12 and 13 and the nuclei of the electromagnets.

From experimental tests, it has been found that the materials which best fulfil the requisites of moulding and anti-wear are glass-fibre reinforced nylon, carbon fibre, and nylon reinforced with a compound commercially known by the name Molikote, which has optimum self-lubricating characteristics.

Advantageously, the lever 3 has an intermediate portion 3a pivotally connected to the frame 2 and made of a moulded, synthetic, anti-wear and anti-magnetic material to thus reduce wear at the point of oscillable connection between the lever and the frame.

Also the longitudinal end 3b of the lever 3 for coupling with the device to be actuated, in the illustrated case a selection device constituted by the selection lever 14 oscillatable to interfere with or to avoid interference with the butts 15a of the selectors 15 in a knitting machine, can advantageously be made of moulded synthetic, anti-wear and anti-magnetic material with a bifurcated conformation for coupling with the relative selection lever.

The above-cited materials may also be used for the intermediate portion 3a and for the longitudinal end 3b of the lever 3 with the advantage of having, particularly for the intermediate portion an optimum lubrication, and for the extremity 3b an extremely low weight which permits the achievement of high actuation speeds.

For anchoring the synthetic anti-wear material

to the lever 3, the remainder of which is made of a single piece of ferromagnetic material, recesses or holes generally indicated by the reference numeral 16 are provided, which define undercuts in the moulding of the material.

The frame 2 and the lever 3, as mentioned heretofore, are made of ferromagnetic material and constitute two magnetic circuits each powered by an electromagnet. Advantageously, in order to create preferential routes in the circulation of the magnetic flux, i.e. to divide as much as possible these ferromagnetic circuits to avoid dispersions, the base side of the frame 2 and the lever 3 have, at the third ledge 11 of the frame, a reduction in thickness 17. More precisely, in the case of the lever 3, the reduction in thickness may affect only the ferromagnetic material. Thus, there is one magnetic circuit constituted by the ledge 12 of the lever, a portion of the lever, the third ledge 11, a portion of the base side of the frame and the ledge 7 of the frame, and a second magnetic circuit constituted by the ledge 13 of the lever, a portion of the lever, the third ledge 11, a portion of the base of the frame and by the ledge 8 of the frame.

The operation of the electromagnetic actuator according to the invention is evident, i.e. selective powering of the electric windings 9 and 10 causes oscillation of the lever 3.

It has been found in practice that the electromagnetic actuator according to the invention fully meets the proposed objects in that the adoption of the portions in synthetic anti-magnetic and anti-wear material at the specific zone of the lever achieves a reduction of wear, improved lubrication, and a reduction of the overall weight of the lever which permits the achievement of an extremely high speed of oscillation or actuation response.

Another advantage is that of obtaining optimum balance of the lever with respect to the fulcrum so as to have equal stressing of the electromagnets.

A not least advantage is the extremely small bulk of the actuator which renders it particularly suitable for use in selection devices in knitting machines for hosiery and the like.

The electromagnetic actuator described herein is susceptible to numerous modifications and adaptations, all falling within the purview of the inventive concept; furthermore, all of the details may be substituted by technically equivalent elements.

In practice, the materials used, other than those cited hereinabove, may comprise technically equivalent materials, according to requirements and the state of the art.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have

any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. A high speed electromagnetic actuator (1), particularly for selection devices in knitting machines for hosiery and the like comprising a frame (2) oscillably supporting a lever (3) having a portion pivotally connected to said frame (2) and at least one electromagnet (4,5) acting on said lever (3), to cause oscillation thereof, said lever (3) having at least one ledge (12,13) made of ferromagnetic material and extending in the direction of the nucleus (7,8) of said electromagnet (4,5), characterized in that a synthetic, anti-wear, anti-magnetic material (20) is moulded at least on the reciprocally facing portions of said ledge (12,13) and said nucleus (7,8).

2. Electromagnetic actuator (1) according to claim 1, characterized in that said lever (3) has an intermediate portion (3a) pivotally connected to said frame (2) and two ledges (12,13) extending in the direction of the nucleus (7,8) of two electromagnets (4,5) acting in opposition on said lever (3), for causing oscillation thereof.

3. Electromagnetic actuator (1) according to claims 1 and 2, characterized in that said ledges (12,13) extend from the same side of said lever (3), from opposite parts thereof with respect to the fulcrum of said lever (3).

4. Electromagnetic actuator (1) according to one or more of the preceding claims, characterized in that said lever (3) has a bifurcated longitudinal extremity (3b), for connection to the actuation device (14) with the actuator, made of a synthetic anti-wear material of low specific weight.

5. Electromagnetic actuator (1) according to one or more of the preceding claims, characterized in that said lever (3) has an intermediate portion (3a) made of moulded synthetic anti-wear material.

6. Electromagnetic actuator (1) according to one or more of the preceding claims, characterized in that said lever (3), with the exclusion of said portion (3a) made of moulded synthetic anti-wear material, is made of ferromagnetic material.

7. Electromagnetic actuator (1) according to one or more of the preceding claims, characterized in that said lever (3) has, at the portions (3a) affected by the moulded synthetic anti-wear material, recesses (16) with undercuts for anchoring said moulded synthetic material.

8. Electromagnetic actuator (1) according to one or more of the preceding claims, characterized in that said frame (2) is made of ferromagnetic material and has a base side (6) extending sub-

stantially parallel to the longitudinal extension of said lever (3) with a pair of ledges (7,8), extending in the direction of said lever (3) and constituting the nuclei of said electromagnets (4,5), between said pair of ledges (7,8) there being provided a third ledge (11) oscillably supporting said lever (3).

9. Electromagnetic actuator (1) according to one or more of the preceding claims, characterized in that said base side (6) of said frame (2) at said third ledge (11), and said lever (3) at said intermediate portion (3a), have a reduction in the thickness of the ferromagnetic material for a separation of the lever-frame (2) assembly in two magnetic circuits, each powered by one of said electromagnets (4,5).

10. Electromagnetic actuator (1) according to one or more of the preceding claims, characterized in that said moulded synthetic material comprises carbon fibre.

11. Electromagnetic actuator (1) according to one or more of the preceding claims, characterized in that said moulded synthetic material comprises glass-fibre reinforced nylon.

12. Electromagnetic actuator (1) according to one or more of the preceding claims, characterized in that said moulded synthetic material comprises Molikote reinforced nylon.

