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(54) **Backstop for print lever actuator.**

(57) A print lever actuating mechanism (24) of the electromagnetic type is disclosed. An armature/print lever assembly (23) pivots about the innermost leg (16) of a three-legged stator. A coil (19) for energizing the assembly is disposed about a first one (17) of the outer legs while the other outer leg (15) limits movement of the armature/print lever assembly so as to maintain the air gap (18) between the first outer leg and the armature/print lever assembly (23) constant and fixed. No other mechanisms or adjustments are required to achieve and maintain a desired air gap.

EP 0 113 006 A2

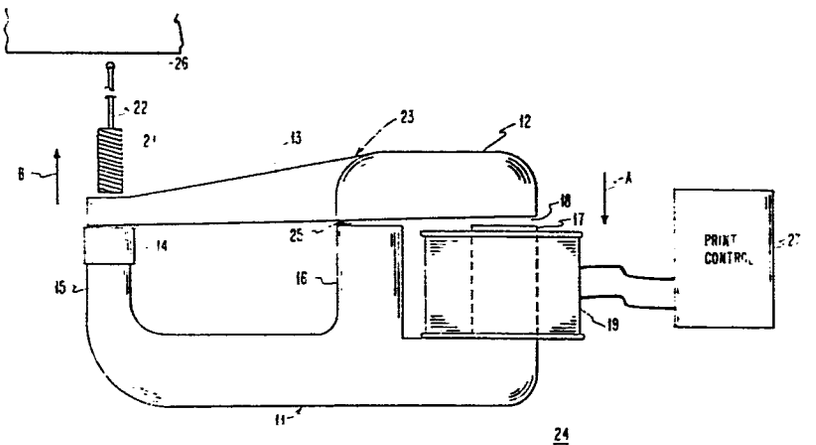

FIG. 1

Description

BACKSTOP FOR PRINT LEVER ACTUATOR

Technical Field

This invention relates to a print lever actuator mechanism and, more especially, such a mechanism wherein a critical air gap is maintained fixed without need for manual adjustement.

Background Art

Conventional high speed printers typically use electromagnetic means to actuate the individual print elements. Whether the printer uses a hammer with type elements or uses print wires to effect an information mark, the individual print elements are propelled toward the print medium under an electromagnetic force. Such an electromagnetic force may be produced by a coil wrapped around a stator. When current is passed through the coil, an electromagnetic field is produced. This electromagnetic field causes a metal body, commonly known as the armature, which is located an air gap away from the section of the stator around which the coil is wound to be attracted to it. A print lever arm may be connected to the armature or it may be used as the armature itself so that a print element, which is located on the opposite side of the armature from the coil, may be propelled towards a print medium whenever the coil is energized. The print element may be attached to the print lever arm or it may be positioned adjacent to but separated from the print lever arm. In the latter arrangement, upon energization of the coil the armature is attracted to the coil-wound section of the stator and the print lever arm is thrust forward striking the print element and causing it to impact the print medium.

A problem that arises in the use of electromagnetic actuators is that the dimension of the air gap, i.e., the distance between the armature and the coil wound stator must be

maintained fixed. This distance is critical in order to insure that the armature and hence the print element is activated only when a predetermined amount of current is passed through the coil. If the air gap is allowed to vary, the armature may not energize when it should and conversely, may energize when it should not.

Previous attempts to solve this problem use a screw mechanism to adjust the position of the print lever arm so as to achieve a desired air gap. See, for example, U-S- A 3,166,010 to Fradkin. The screw mechanism may either be attached to, or separated from, the print lever arm. A problem associated with this approach is that the screw mechanism must be manually adjusted so as to achieve a desired air gap. This adjustment may be required more than once over the useful life of a print lever arm. In a printer with as many as eighteeen print lever arms, this manual adjustment requirement becomes both expensive and time-consuming. It would be most desirable to have a mechanism for achieving a critical air gap wherein no manual adjustment is required and wherein the critical air gap is maintained fixed throughout the useful life of a print lever arm.

Accordingly, it is an object of this invention to provide an improved print lever actuator mechanism.

It is another object of this invention to provide a print lever actuator mechanism wherein a critical air gap is maintained fixed without need for manual adjustment.

It is still another object of this invention to provide a print lever actuator lever mechanism wherein an arm of a stator limits movement of the print lever arm so as to maintain a fixed critical air gap.

Disclosure of the Invention

The present invention relates to a print lever actuating mechanism of the electromagnetic type. A coil wound around one leg of a stator causes an armature assembly to be attracted to the coil wound leg when current is passed through the coil. A print lever arm is connected to the armature such that when the coil is energized and the armature attracted to the coil wound leg, the print lever arm is thrust forward causing a print element to impact on a print medium. When the coil is deenergized, the end of the armature adjacent to the coil wound leg is located the width of an air gap away from the leg.

The stator of the instant invention has three legs. A coil is wound around a first leg of the stator. The armature/print lever arm assembly pivots about the innermost leg of the stator. The third leg of the stator functions as a backstop to limit the movement of the armature/print lever arm assembly such that the width of the air gap is maintained fixed. The length of the third leg is determined by the width of the air gap that is required. As the air gap width increases, the length of the third leg correspondingly decreases. Once the stator has been manufactured and a complete actuator mechanism assembled, no manual adjustments are required to either set or maintain the width of the air gap.

A piece of molded rubber or other resilient material is mounted on the end of the third leg to absorb the force of the armature/print lever arm assembly as it rebounds after being thrust forward. The print lever arm and armature may be formed in one piece so that the print lever arm is, in effect, the armature. Alternately, the print lever arm may be connected to the armature so that when the armature is activated, the print lever arm is likewise activated. The three legs of the stator may be collinear or they may be offset from one another depending on the particular design of the printer.

Brief Description of the Drawing

Fig. 1 illustrates the print lever actuating mechanism of the instant invention.

Best Mode for Carrying Out the Invention

Referring to Fig. 1, there is shown a print lever actuating mechanism 24 of the electromagnetic type having armature 12 mounted atop stator 11. Print lever arm 13 is shown connected to armature 12. As noted above, armature and print lever arm 13 may be formed in one piece or may be two separate pieces connected into one armature assembly 23 as shown. Stator 11 comprises three separate legs 15-17. Coil 19 is disposed about leg 17. Armature assembly 23 pivots about leg 16 while backstop 14 is mounted on the end of leg 15. Air gap 18 is the distance between the end of leg 17 and armature 12 when coil 19 is unenergized and print lever arm 13 is resting against backstop 14 on the end of leg 15. Upon energization of coil 19, by print control 27, print wire 22 is thrust forward to impact upon print medium 26. Spring assembly 21 causes print wire 22 to rebound from the print medium. Although Fig. 1 shows print wire 22, any type of print element that impacts a print medium may be employed to practice the instant invention.

In the preferred embodiment, armature 12 is constructed of a plurality of laminations of magnetic iron while print lever arm 13 is constructed of a one-piece section of spring steel. Print lever arm 13 is connected to armature 12 by a plurality of small rivets not shown so as to form armature assembly 23. Armature assembly 23 is then fastened to leg 16 at pivot point 25 using a plastic hinge (not shown). One section of the plastic hinge is fastened to the underside of armature assembly 23 while the other section of the plastic hinge is fastened to the adjacent side of leg 16.

The operation of print lever actuating mechanism 24 will now be explained in more detail. During non- print times, when no information is desired to be printed, print lever actuating

mechanism 24 is at rest and its position is as shown in Fig. 1. At this time, either no current is flowing through coil 19 or insufficient current is flowing through coil 19 to cause any movement of armature assembly 23 from the rest position. Armature 12 is separated from leg 17 by a distance equal to air gap 18. The width of air gap 18 is determined by the length of leg 15 at the time of manufacture. As the length of leg 15 is decreased, armature assembly 23 pivots about leg 16 so as to increase the width of air gap 18. Conversely, as the length of leg 15 is increased, the width of air gap 18 decreases. Since the length of leg 15 will not change after stator 11 has been manufactured, the width of air gap 18 remains fixed after actuating mechanism 24 has been assembled.

In the preferred embodiment of the present invention, legs 16 and 17 are of equal length while leg 15 is of some length shorter than that of legs 16 and 17. The exact length of leg 15 is determined by the width of air gap 18 that is desired. An optimum range for the width of air gap 18 is 0,2/0,5 millimeters.

Stator 11 may be manufactured, for example, by grinding down legs 16 and 17 until the top surfaces, also known as the pole faces, which are adjacent to armature 12 lie in the same plane. The top surface or pole face of leg 15 adjacent to print lever arm 13 may then be ground down to a predetermined distance below the plane of legs 16 and 17. The thickness of backstop 14 must be taken into account when grinding down leg 15. The sum of the thickness of backstop 14 and the length of leg 15 determines the width of air gap 18. Although the preferred embodiment employs backstop 14, the invention may also be practiced without it. In that case, the width of air gap 18 is determined solely by the length of leg 15. By using the three- legged stator as shown in Fig. 1, no adjustment ever needs to be made in actuator mechanism 24 in order to achieve and maintain a desired air gap. Additionally, no further adjustment mechanisms are required after stator 11 has

been manufactured in order to achieve and maintain the desired air gap.

When information is to be printed, a level of current is caused to flow through coil 19 to produce a magnetic field which attracts armature 12 in the direction of arrow A towards leg 17. The wider air gap 18 is, the stronger must be the magnetic field to attract armature 12 to leg 17. The magnetic force that is required to attract armature 12 to leg 17 is directly proportional to the width of air gap 18 squared, i.e., magnetic force a (air gap)^2. The criticalness of achieving and maintaining a desired air gap 18 arises out of this square law relationship between the width of air gap 18 and the magnetic field produced by the current flow through coil 19. When the amount of current flowing through coil 19 is fixed, as it is in the preferred embodiment herein, whether or not armature 12 is drawn to leg 17 when it should be strongly depends upon the width of air gap 18. If air gap 18 is too wide, the magnetic field will not be strong enough to attract armature 12 to leg 17. If air gap 18 is too narrow, the magnetic field may attract armature 12 to coil 19 when it should not thus effecting a print mark when none is called for. Additionally, if air gap 18 is too narrow, the stroke of armature 12 may not be long enough to accelerate lever arm 13 towards the print medium. The use of the 3-legged stator 11 of the present invention assures that air gap 18 maintains its critical width.

When armature 12 is attracted to leg 17, armature assembly 23 pivots about leg 16 and print lever arm 13 moves in the direction of arrow B. This movement of print lever arm 13 propels print wire 22 and spring assembly 21 toward the print medium with print wire 22 impacting the print medium so as to effect a mark thereon. At this time, the flow of current through coil 19 ceases and thus armature 12 is no longer magnetically attracted to leg 17. The preferred embodiment of the present invention comprises a ballistic type wire matrix printer wherein print wire 22 is used to print an information

mark on a print medium. It will be recognized by those skilled in the art that any type of print element in any type of printer utilizing an electromagnetic actuator may be used to practice the instant invention. For example, a dot band or a chain printer using an electromagnetic actuator may be employed.

After impacting the print medium, print wire 22 under the force of spring assembly 21 rebounds from the print medium back towards its original rest position. The rebounding print wire 22 and spring assembly 21 pushes print lever arm 13 back towards its rest position. The force of spring assembly 21 maintains print lever arm 13 in this position until the next information mark is to be printed. Backstop 14, which is composed of a resilient material such as rubber, absorbs the force of print lever arm 13 as it returns to its rest position. Further, the backstop material does not wear in the print actuator environment. Accordingly, the air gap 18 remains constant.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and detail may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

Claims

1. A ballistic print actuator characterized in that it comprises : a stator having a base leg (11), an inner leg (16), a first outer leg (17), and a second outer leg (15), said inner and outer legs substantially parallel to one another and each extending from the same side of said base leg (11), each of said inner and outer legs having a pole face at the end opposite from said base leg;

a coil (19) disposed upon said first outer leg; and an armature assembly (23) hingedly mounted on the pole face of said inner leg (16) so as to pivot about said inner leg in response to the energization and de-energization of said coil (19),

one end of said armature assembly located an air gap (18) away from the pole face of said first outer leg when said coil is de-energized,

the opposite end of said armature assembly (23) located in contact with the pole face of said second outer leg (15) when said coil is de-energized so as to limit the pivotal movement of said armature assembly away from the pole face of said first outer leg,

whereby said air gap is maintained fixed.

2. A ballistic print actuator according to claim 1 in which said opposite end of said armature assembly (23) is located adjacent to the pole face of said second outer leg (15) ; and a resilient back stop (14) is mounted on the pole face of said second outer leg in contact with said opposite end of said armature assembly so as to limit the pivotal movement of said armature assembly away from the pole face of said first outer leg when said coil is de-energized, whereby said air gap is maintained fixed.

3. A ballistic print actuator according to Claim 2 further comprising: a spring assembly (21) adjacent said opposite end of said armature assembly (23) for biasing said opposite end against said resilient back stop (14) when said coil is de-energized.

4. A ballistic print actuator according to claims 2 or 3, in which :

the opposite end of said armature assembly is located adjacent to the pole face of said second outer leg when said coil is de-energized,

said one end of said armature assembly is in contact with the pole face of said first outer leg when said coil is energized, and

said opposite end of said armature assembly moves forward away from the pole face of said second outer leg when said coil is energized;

a print element (22) is adjacent said opposite end of said armature assembly (23), said print element movable from a non-print to a print position under the force of said opposite end of said armature assembly in response to the energization of said coil;

5. Apparatus according to Claims 1, 2, 3, or 4 wherein said inner leg, and said first and said second outer legs of said stator are collinear.

6. Apparatus according to Claims 1, 2, 3 or 4 wherein said inner leg and said first outer leg of said stator are of a first length, and said second outer leg is of a second length less than said first length.

7. Apparatus according to Claim 4 wherein said armature assembly further comprises a first section for pivoting about said inner leg and for contacting said first outer leg, and a second section connected to said first section for contacting said resilient back stop and said print element.

8. Apparatus according to Claim 7 wherein said second section comprises a print lever arm.

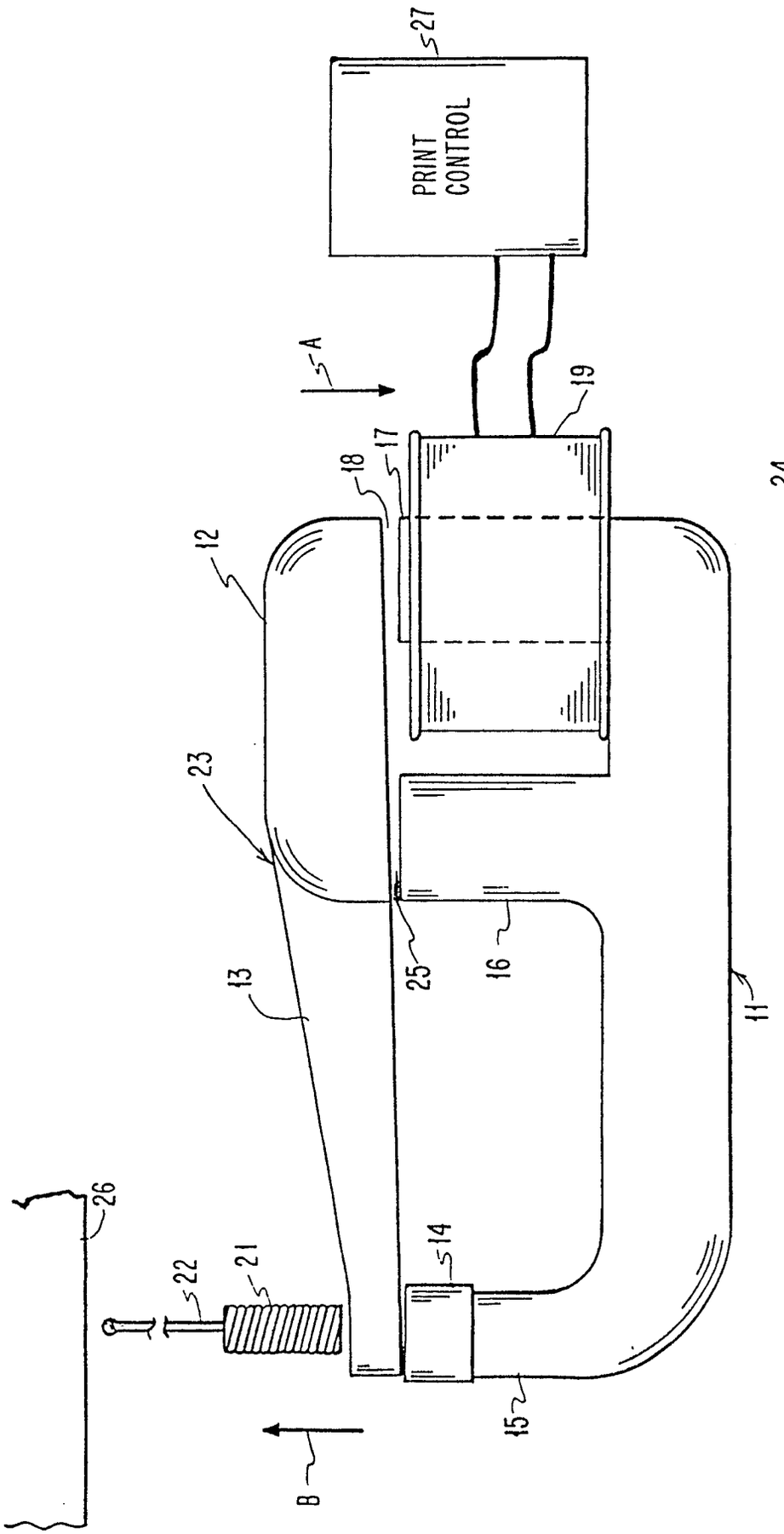

FIG. 1