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2,759,114	8/1956	Rolli et al.	310/29
3,049,990	8/1962	Brown et al.	101/93
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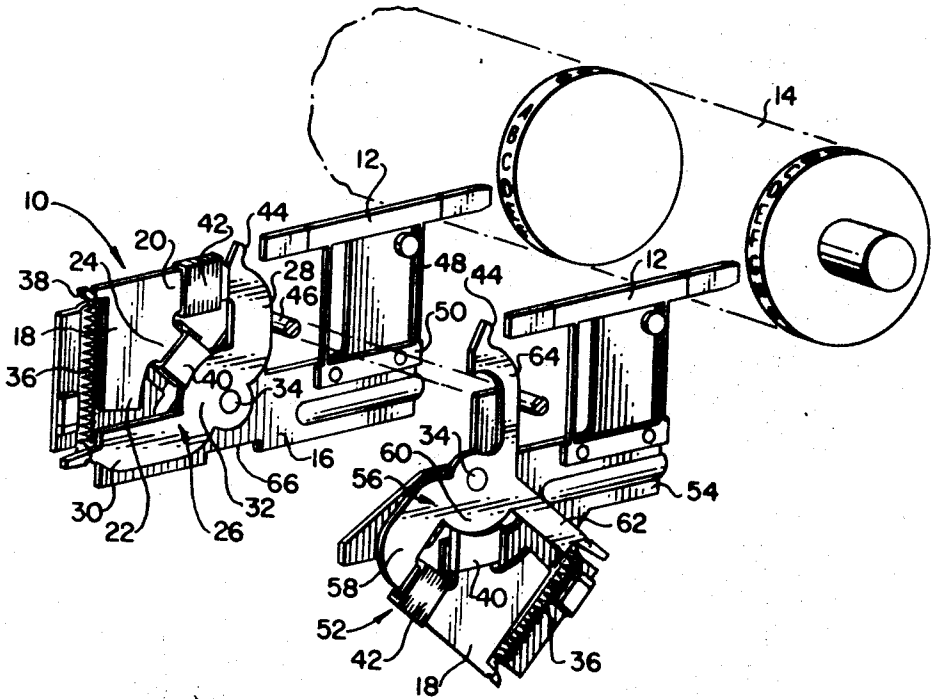
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Attorneys—Louis A. Kline, Albert L. Sessler, Jr. and Elmer Wargo

[54] **ELECTROMAGNETIC DRIVE FOR PRINT HAMMERS**
2 Claims, 6 Drawing Figs.
[52] U.S. Cl..... **101/93 R,**
335/234
[51] Int. Cl..... **H01f 7/04**
[50] Field of Search..... **101/93 f;**
335/234, 230, 235; 310/29, 21, 32
[56] **References Cited**
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ABSTRACT: A transducer having a permanent magnet which holds a rotatable armature against the bias of a spring when the transducer is in a ready, or home, position. A coil, when energized, neutralizes the holding effect of the permanent magnet, permitting the spring to move the armature to an operative position, where it strikes a print hammer with which the transducer may be associated. The transducer is designed to produce switched magnetic fields to hold the armature in either the ready position or the operative position, making the transducer bistable. The armature is reset to the home position by an external mechanical return bar.



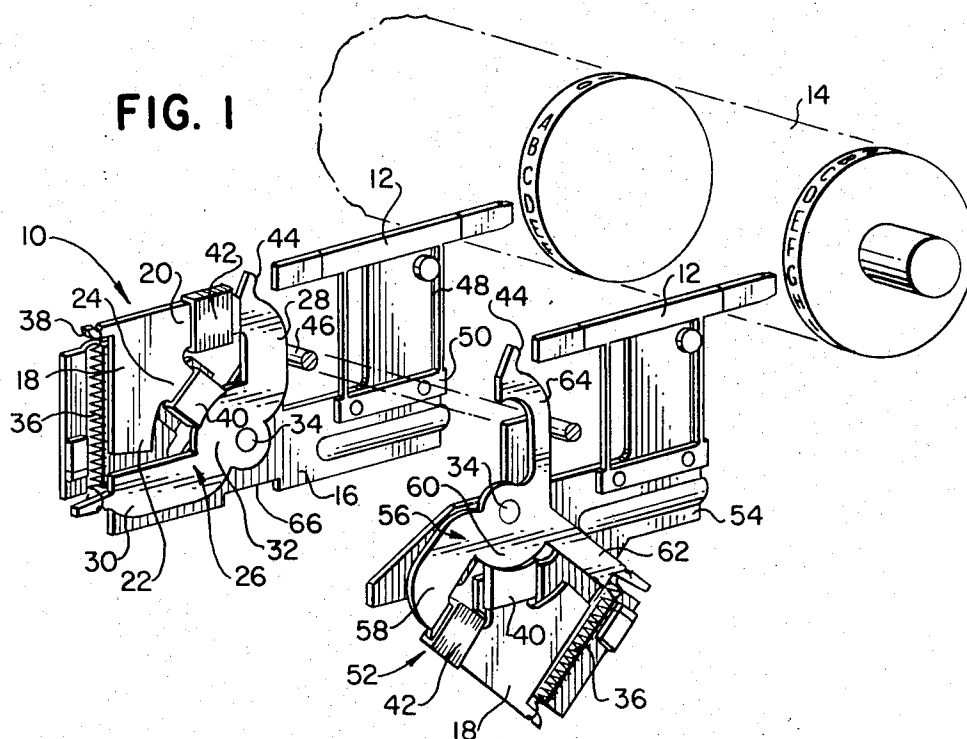


FIG. 2a

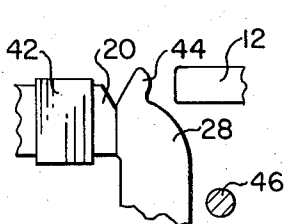


FIG. 2b

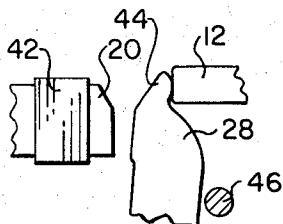


FIG. 2c

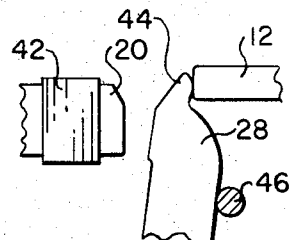


FIG. 3a

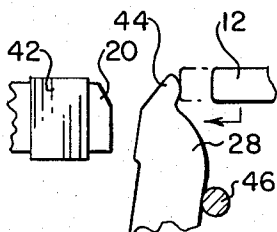
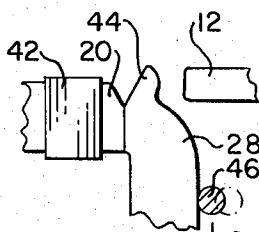


FIG. 3b



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ELECTROMAGNETIC DRIVE FOR PRINT HAMMERS

BACKGROUND OF THE INVENTION

This invention relates to a polarized transducer which may be used to actuate a print hammer in a print column module for a high-speed printer.

High-speed printers of the type using a print hammer to strike a character on a revolving type drum require extremely rapid hammer action which must be accurately timed with the rotation of the drum. Some of the prior art actuators for effecting the desired hammer action are presented in the disclosure of U.S. Pat. No. 3,049,990, which issued Aug. 21, 1962, on the application of Edgar A. Brown and Gunter H. Schacht.

Applicants' transducer utilizes a permanent magnet means which is switched between first and second magnetic paths therein to make the transducer bistable. The transducer is stable (that is, cocked) during a "power off" condition and does not consume power when idle, nor does it require resetting after a temporary interruption of power thereto, as holding coils require. The switching of the permanent magnet means between the first and second magnetic paths permits individual transducers to be assembled close to one another without interaction thereof. This is a very useful feature of the transducer when it is considered for use in a print hammer module for a high-speed printer. The transducer of this invention is simple in design, economical to manufacture, and adaptable for a high-packing density necessary for print hammer modules of the type described. Because the transducer is bistable, it may be used as a binary memory device.

SUMMARY OF THE INVENTION

This invention relates to a transducer or actuator which may be used in a print column module for a high-speed printer. The transducer includes a frame means and an armature means pivotally mounted thereon, with the armature means being movable between ready and operative positions. Spring means are utilized to urge the armature means towards the operative position. The armature means is releasably held in the ready position by a permanent magnet means which produces first and second magnetic flux paths in cooperation with said armature means. A coil means is utilized to momentarily reduce the flux density in the first flux path to permit the spring means to rotate the armature means towards operative position. The rotation of the armature means towards the operative position is effective to switch the flux path from the first path to the second path, which is effective to hold the armature in the operative position until a mechanical restoring means is used to rotate the armature means against the bias of the spring means to return the armature means to the ready position.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a general perspective view of the transducer or actuator of this invention as used in combination with a ballistic-type print hammer, the print hammer being shown in a "ready," or home, position.

FIGS. 2a and 2c inclusive are side views in elevation showing an armature of the actuator in the process of striking the ballistic-type print hammer shown in FIG. 1.

FIGS. 3a and 3b are side views in elevation showing the armature of the actuator being returned to the "ready," or home, position shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 is a general perspective view of the transducer 10 of this invention in combination with a ballistic-type print hammer 12 to form a print column module for a high-speed printer having a rotating drum 14 with printing characters thereon.

The transducer 10 (FIG. 1) includes a frame means 16, on which a generally planar permanent magnet means and armature means are mounted. The permanent magnet means 18 is fixed to the frame means 16 and includes a first leg portion 20,

a second leg portion 22, and a central leg portion 24 extending therefrom along radial lines as shown. The armature means 26 has a first leg 28 and a second leg 30 positioned generally perpendicular to each other, which legs extend from a center portion 32, which is pivotally joined to the frame means 16 by a pin 34. The free end of the second leg 30 has one end of a tension spring 36 attached thereto, and the other end of the spring is attached to an extension 38 of the magnet means 18. The tension spring 36 urges the armature means 26 to rotate clockwise as viewed in FIG. 1.

The armature means 26 is rotatable from a "ready" position to an "operative" position to strike the print hammer 12 as follows. The permanent magnet means 18 has a permanent magnet 40 secured to its central leg portion 24 as shown. The magnet 40 has a complementary, arcuately shaped recess on one pole thereof to match an arcuate perimeter on the center portion 32 of the armature means 26. The armature means 26 is held in the "ready" position, shown in FIG. 1 (against the bias of the spring 36), by a first magnetic field, which includes the first leg portion 20 and the central leg portion 24 of the magnet means 18, and the center portion 32 and the first leg 28 of the armature means 26. The first leg portion 20 has a coil 42 secured near its end. When the hammer 12 is to be fired, or actuated, the coil 42 is momentarily energized to produce a magnetic field which opposes the first magnetic field to reduce it, thereby permitting the spring 36 to rotate the armature means 26 clockwise (as viewed in FIG. 1). When the armature means is so rotating, a striker area 44 on the first leg 28 of the armature means 26 strikes one end of the hammer 12 to fire it.

As the armature means 26 rotates to its operative position, it is effective to switch the permanent magnetic field of the magnet means 18 from the first magnetic field to a second magnetic field. The second magnetic field includes the second leg portion 22 and the central leg portion 24 of the magnet means 18 and the center portion 32 and the second leg 30 of the armature means 26. The second magnetic field assists the spring 36 and also minimizes "rebounding" of the first leg 28 when it completes its driving of the hammer 12 and abuts against a return bar 46. The second leg 30 of the armature means 26 comes close to but does not contact the second leg portion 22 of the magnet means 18 when the first leg 28 strikes the return bar 46. The return bar 46 is part of a conventional mechanical means (not shown) for restoring the armature means 26 of the transducer 10 to the ready, or home, position. A conventional mechanical means for restoring the print hammers to a home position is shown in FIGS. 1 through 4 of U.S. Pat. No. 3,049,990, cited in the "Background of the Invention." The hammer 12 is conventionally supported on leaf springs 48, which are part of a base portion 50, which is secured to the frame means 16.

The motion of the armature means 26 relative to the print hammer 12 is better shown in FIGS. 2a, 2b, 2c, 3a, and 3b. In FIG. 2a, the first leg 28 is shown held against the first leg portion 20 by the first magnetic field, previously mentioned. In FIG. 2b, the coil 42 is shown momentarily energized to permit the spring 36 (FIG. 1) to rotate the armature means 26 so that the striker area 44 contacts the print hammer 12 to drive it towards the drum 14. In FIG. 2c, the first leg 28 abuts against the return bar 46, stopping its progress towards the drum 14. FIG. 3a shows the first leg 28 resting against the return bar 46 and the print hammer 12 departing from the striker area 44. FIG. 3b shows the first leg 28 being returned to the ready position by the return bar 46.

In order to achieve compactness when the transducer 10 is used in a print column module for a high-speed printer, the transducer 10 may be altered as shown by a second transducer 52 (FIG. 1). The transducers 10 and 52 are alternated along a row of print column modules to provide nestability of the modules and thereby achieve compactness.

The second transducer 52 (FIG. 1) is generally similar in construction to the transducer 10; however, there are some differences. The transducer 52 has a frame means 54, to which

the permanent magnet means 18 is secured; however, the magnet means 18 of the transducer 52 is displaced about 90° from the magnet means 18 of the transducer 10 as shown. The armature means 56 of the transducer 52 performs the same function as does the counterpart in the transducer 10; however, the armature means 56 is shaped differently. It has a first leg 58, which abuts against the first leg portion of the magnet means 18 when the transducer 52 is in the ready position, shown. The center portion 60 of the armature means 56 is pivotally joined to the frame means 54 by a pin 34, and a second leg 62 performs the same function as its counterpart 30. The armature means 56 also has a third leg 64, which extends from the center portion 60 and has a striker area 44 on its free end. The third leg 64 is so designed that the striker area 44 travels along an arcuate path similar to that of the area 44 of the leg 28 of the transducer 10 to strike the associated hammer 12 and be returned to the ready position by the return bar 46. The frame means 16 and 54 have conventional aligning notches 66 to align the print modules containing the transducers 10 and 52 along a row of such modules.

What is claimed is:

1. A print hammer actuator comprising:

a frame means;

a print hammer movably mounted on said frame means;

an armature means pivotally mounted on said frame means and movable between a ready position and an operative position where it engages said print hammer causing it to print, an including first and second legs and a central portion having an arcuate perimeter;

spring means for urging said armature means towards said operative position;

magnet means having a first leg portion, a second leg portion, and a central leg portion having a permanent magnet thereon; said magnet having an arcuately shaped recess complementary to said arcuate perimeter on said central

portion of said armature means;

said central portion and first leg of said armature means cooperating with said first leg portion and central leg portion of said magnet means to produce a first magnetic flux path for holding said armature means in said ready position against the bias of said spring means; said central portion and second leg of said armature means cooperating with said second leg portion and central leg portion of said magnet means to produce a second magnetic flux path which assists said spring means in rotating said armature means to said operative position;

coil means mounted on the first leg of the armature means for momentarily reducing the flux density in said first flux path enabling the armature means to be rotated to said operative position by said spring means, the rotation of said armature means from said ready position towards said operative position being effective to switch the flux path of said magnet means from said first flux path to said second flux path;

said first leg of said armature means striking said print hammer when said armature means is rotated to said operative position; and

mechanical means for rotating said armature means back to said ready position from said operative position against the bias of said spring means.

2. The actuator as claimed in claim 1 in which said armature means includes a third leg which is positioned between said first and second legs and which third leg extends from said central portion of the armature means on a side thereof which is opposite from said permanent magnet;

said third leg instead of said first leg of said armature means striking said print hammer when said armature means is rotated to said operative position.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,630,142

Dated December 28, 1971

Inventor(s) Thomas C. Fulks and Mushi Soraya

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 12, after "leg" insert --portion--.

Column 4, line 12, delete "armature" and substitute --magnet--.

Signed and Sealed this

eighteenth Day of November 1975

[SEAL]

Attest:

RUTH C. MASON

Attesting Officer

C. MARSHALL DANN

Commissioner of Patents and Trademarks

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