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(71) Applicant: International Business Machines Corporation
Old Orchard Road
Armonk, N.Y. 10504(US)

(72) Inventor: Akers, Albert Lee
Rt. 4, Box 79X
Nicholasville, KY 40356(US)

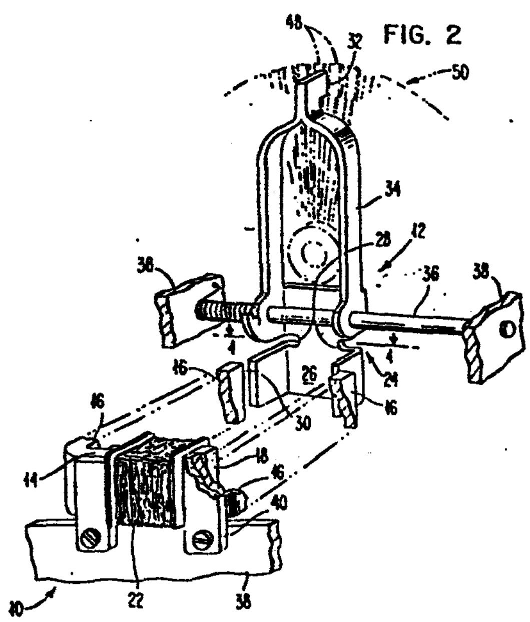
(72) Inventor: Yount, William Richard
865 East High St.
Lexington, KY 40502(US)

(74) Representative: Siccardi, Louis
Compagnie IBM France Département de Propriété Industrielle
F-06610 La Gaude(FR)

(54) **Print hammer and drive for daisy wheel printer.**

(57) A printing mechanism is disclosed which has an oscillatable hammer (34) which carries on the first end an impacting surface (32) for striking a printing element (50) and on the opposite end thereof, a magnetically attractable armature structure (24) generally formed in a U-shape such that the legs of the U extend in a plane perpendicular to the axis (36) of oscillation. An electromagnet assembly (10) is fabricated to mate with and accept the legs of the hammer armature (24) between similar U-shaped legs (16) of the electromagnet armature (14) to provide a substantially constant air gap during the movement of the hammer armature (24) into the magnetic field of the magnet armature (14). The electromagnet (10) may be enhanced by providing a flux concentrating core member (18) magnetically coupled with and surrounded by the coil (22) of a magnet thereby concentrating the flux flow through small air gaps into which the legs of the U-shaped hammer armature (24) may be attracted.

FIG. 2



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PRINT HAMMER AND DRIVE FOR DAISY WHEEL PRINTER

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Field of the Invention

The invention relates to the field of print assemblies and in particular print assemblies for daisy wheel printing mechanism.

Background of the Invention

In daisy wheel printers having a multi-spoked wheel, each carrying a character type face, magnets have heretofore been used to create the impact between the typefont and the record page. Magnets of many different types have been used to accomplish this impacting. A magnet assembly which has a core or moving armature where the magnet is aligned with the print position and is the core of the solenoid, which is magnetically driven to physically impact the print element is one type of magnet used to create the impacting. This type magnet assembly is typically referred to as a ballistic hammer.

Magnets with a moving armature which extends from the coil have likewise been used to act against a movable hammer member, thus projecting the hammer into impacting contact with the print element.

A third type arrangement involves a clapper type magnet wherein the clapper is attracted toward the magnet structure and the clapper through a physical extension thereof acts against and pushes a hammer toward the print element.

An example of the clapper type magnet which then forces a hammer into contact with a printing element is illustrated in US-A-3,670,647.

For rapid printing, it is desired that the hammers have a low mass but this usually dictates a relatively low impact force.

In order to secure satisfactory printing quality, it is necessary to maintain at least a certain minimum impact force or printing force to transfer the imaging material for the ribbon to the record page. Another known alternative is a depending magnetic appendage integral with the hammer. Attraction of the depending appendage on a hammer causes the impacting of the hammer onto the printing element to effect printing. This requires very precise adjustment of the magnet position and is at best a compromise arrangement because the need to have a substantial throw of the hammer to effect the kinetic energy necessary for quality printing is inconsistent with the need to maintain the air gap between the coil and the armature at a minimum in order to effect the maximum possible force onto the hammer. GB-A-993,833 illustrates a print hammer arrangement wherein the appendage is attracted to the magnet and also shows the very small degree of travel which the hammer has in this type assembly.

The lack of kinetic energy in the hammer is partially overcome by the attraction force of the magnet acting on the hammer appendage and thereby augments the forces of the hammer with the magnetic force to effect the printing. This augmentation, as well as a rapid restore time for the hammer, requires that the air gap between the coil and the armature never go to a zero dimension.

Summary of the Invention

It is an object of the invention to attain significant printing element impact forces for quality printing with a lightweight magnetically oscillated hammer.

It is another object of the invention to substantially increase the extent of oscillation of the hammer under the influence of the magnet to permit the hammer to completely withdraw from the plane of the daisy wheel print element, while improving the kinetic energy levels of the hammer.

The above objects are accomplished and the shortcomings of the prior art overcome by the forming of at least an appendage on an oscillatory print hammer such that the appendage forms an armature.

The appendage is generally planar in shape and lies in a plane substantially perpendicular to the oscillatory axis of the print hammer.

The magnet comprises a magnet armature and a coil surrounding at least a portion of the magnet armature, the latter being formed to have a first and second end portions extending outwardly from said coil and forming a magnetic path into which said appendage may be attracted.

According to a preferred embodiment, the magnet armature forms a U shape and the legs thereof form a span of the magnetic path into which the hammer appendage may be attracted.

The complementary construction of the hammer armature and the magnet armature allow a longer throw or stroke of the hammer armature as it is magnetically attracted by the magnet while at the same time maintaining a more uniform force exerted on the hammer armature throughout its movement.

Drawing

Fig. 1 is a top view of the magnet and hammer armatures.

Fig. 2 is a perspective partially exploded view of the printing assembly including the magnet and hammer armatures.

Fig. 3 is a graphical representation of force displacement curves of a clapper-type magnet and the magnet and hammer armature structure of the present invention.

Detailed Description of the Invention

As can best be seen in Figs. 1 and 2, the printing assembly is comprised of an electromagnet assembly 10 and a hammer assembly 12 which constitutes an impact element for impacting a print element 50. Magnet assembly 10 is comprised of an armature 14 further comprising legs 16. The legs 16 are formed or bent to be substantially perpendicular to the central member of the armature 14. Magnetically coupled and positioned within the channel formed by the U-shaped armature 14 is core member 18.

Core member 18 is fashioned from a permeable iron mass and is magnetically coupled to, by side to side contact with, the armature 14. The length of core member 18 is fashioned to leave a small gap 20 on each end thereof between legs 16 and core member 18. Core member 18 is likewise fashioned such that its dimensions cause the outer surface thereof to coincide approximately with the length of legs 16. The insertion of core member 18 into the channel of the U-shaped armature 14 tends to concentrate flux flow through gaps 20 from the legs 16 of armature 14 which acts as the poles thereof.

The core member 18 and the armature 14 could, if desired, be fabricated as a single unitary piece.

Wrapped around armature 14 and core member 18 is a coil of wire 22 which may be energized to create the magnetic field to attract the hammer armature 24.

The hammer armature 24 is formed as a magnetically permeable appendage depending from and formed as a part of the hammer assembly 12. The hammer armature 24 is a relatively light weight thin piece of material formed in a U-shaped channel. The U-shaped channel is comprised of a span 26 and legs 28 extending from said span 26. The legs 28 are perpendicular to span 26, spaced apart substantially the width of said span 26, and of sufficient length to extend into gaps 20 but to prevent span 26 from contacting coil 22 or core member 18 when fully attracted by the magnet assembly 10.

As can best be viewed in Fig. 4, at the point of rest where the hammer is withdrawn to its inactive rest position, where it is substantially spaced from the plane of the print elements or petals 48 of the daisy wheel print element 50, the tips of legs 28 of the hammer armature 24 are approximately aligned with the tip of the magnet armature 16. Since gap 20 is formed by legs 16 and core member 18 and each extend substantially the same distance from the central hammer of armature 14, the flux path is caused to deviate only slightly between legs 16 and core member 18 in order to pass through leg 28 of the hammer armature 24. Each air gap between leg 16 and leg 28 and leg 28 and core member 18 is preferably in the order of .010 inch or approximately .25 mm. These air gaps will remain substantially constant throughout the movement of hammer armature 24 toward the electromagnet assembly 10. The leg 28 will continue to be attracted into gap 20 until such time as the magnetic center of leg 28 is magnetically coaligned with the magnetic center of leg 16, at which point leg 28 extends approximately 3/4 of the way to the end of gap 20 defined by bridge 14. Any effort to move hammer armature 24 beyond this aligned point will result in a magnetic braking of the hammer at that point and the holding of the hammer in that position so long as the coil 22 is energized.

Thus, it can be easily seen that as long as leg 28 has not entered gap 20 to the point where it is being braked magnetically, the pull from energization of coil 22 will continue to urge the hammer armature 24 toward the magnet assembly 10 and will exert a magnetic pull onto hammer armature 24 and thus onto the hammer assembly 12. The impact surface 32 of the hammer 34 engages the print element and is then stopped during normal printing, as by a conventional platen of the printer supporting the paper. Hammer 34 is stopped in this manner at a point prior to the point at which magnetic braking occurs as described above.

Electromagnet assembly 10 may be mounted on a carrier 38 which supports hammer 34 by way of the pivot shaft 36 and will require only positioning such that the ends of the legs 28 approximately align centered between the legs 16 of the armature. Mounting of the electromagnet assembly 10 may be accomplished by attaching it to the carrier 38 through mounting tabs 40 or other conventional means.

The advantages of this arrangement with respect to the forces exerted upon the print hammer assembly 12 can best be understood by reference to Fig. 3. Fig. 3 is a force displacement diagram which illustrates the magnetic forces being exerted onto a clapper type armature and the forces exerted upon the hammer armature 24 of the instant invention.

Curve 42 represents a clapper type construction and the forces represented are typical of that type magnet structure. With the clapper in its rest position away from the coil in the order of .100 inch (approximately 2.5 millimeters) the force exerted by the magnet on the armature is a very weak force as indicated by region 44 on curve 42. As distance between the clapper and magnet of the clapper type structure decreases displacement the force increases exponentially until a maximum force is exerted at the point immediately prior to the clapper armature contacting or sealing to the magnet structure. Due to the exceeding short travel of the clapper, adjustments are very critical to secure an adequate impacting force while at the same time preventing the clapper from sealing so that a large secondary opposite acting force may not be required to cause the clapper to release.

Curve 46 is representative of the forces exerted upon the hammer armature as described in this specification at differing distances of displacement from the electromagnet assembly 10. Clearly the force exerted upon the hammer armature 24 at a rest position corresponding to something in the order of .250 to .300 inch (approximately 6,25 to 7,6 mm) displacement from the fully attracted position illustrates that a substantially larger force applied over a much longer travel is available to store substantially greater amounts of energy in the hammer for dissipation at impact.

So long as the impact occurs substantially prior to the zero position which would be the position at which the magnetic centers of the legs 28 of the hammer armature 24 are aligned with the magnetic centers of legs 16 of the magnet armature 14, a magnetic attractive force is present to enhance the impact forces of the hammer.

The existence of a substantial force which may be exerted on the hammer armature 24 at its rest position and the large and more uniform force throughout its travel tend to cause the hammer to accelerate faster, all other factors being equal, and provide for a faster printing operations. Overall time of printing is significantly reduced.

By referring to Fig. 3, it can be seen that the need for precise positioning of the magnet assembly in order to optimize the initial amount of force exerted on the hammer armature 24 is eliminated within a substantial region as compared to the requirement for precise adjustment of both the rest position and the attracted position of the clapper as is clear from curve 42.

CLAIMS

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1. A printing assembly comprising a print hammer (12) and a magnet (10), characterized in that :

   said print hammer (12) has a striking end (32) for striking a print element (50) and an armature (24) for inputting energy to said hammer, and mounting means for mounting said hammer (12) for oscillatory movement about an axis (36) in response to said energy,

   said armature (24) of said hammer (12) comprising a magnetic material formed into at least an appendage (28) generally planar in shape and lying in a plane, and substantially perpendicular to said oscillatory axis (36), and in that said magnet (10) comprises a magnet armature (14) and a coil (22) surrounding at least a portion of said magnet armature, said magnet armature (14) formed to have a first and second end portions (16) extending outwardly from said coil (22) and forming a magnetic path into which said appendage (28) may be attracted.

2. The printing assembly of Claim 1 wherein said magnet armature (14) forms a U shape and the legs (16) thereof form a span of the magnetic path into which said appendage (28) may be attracted.

3. The printing assembly of Claim 2 wherein said hammer armature end is of a U shape and the legs (28) of said hammer armature end form planes substantially parallel to the plane of said magnet armature legs (16).

4. The printing assembly of Claim 1 wherein said magnet (10) is rigidly positioned relative to said axis (36).

5. The printing assembly of Claim 3 wherein said magnet (10) comprises an armature (14) and a core member (18), said

core member (18) positioned in contact with said armature (14) within the region between said legs (16) of said U shape.

6. The printing assembly of Claim 5 wherein said legs (16) of said U extend to a point wherein magnetic paths are defined between said core member (18) and said legs (16).

7. The printing assembly of Claim 6 wherein said coil (22) surrounds said core member (18) and said armature (14).

FIG. 1

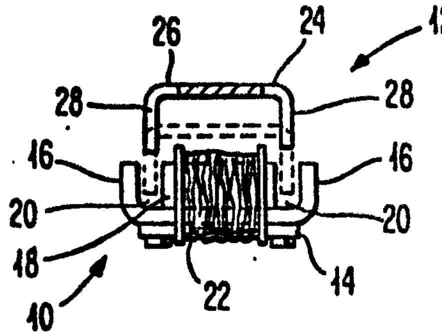


FIG. 2

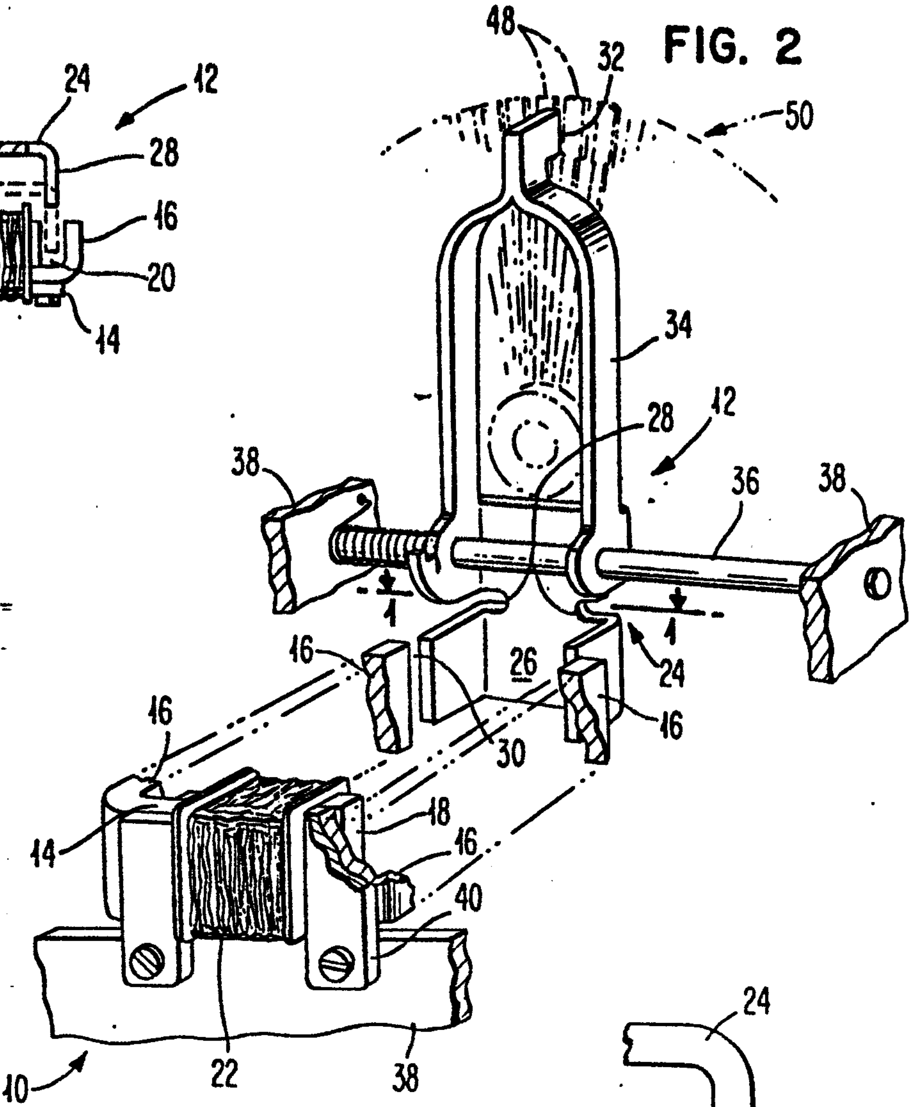


FIG. 4

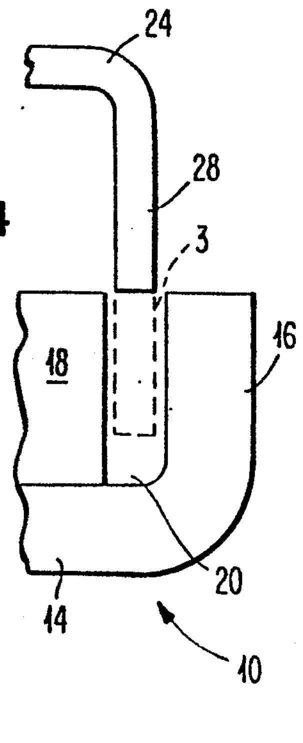
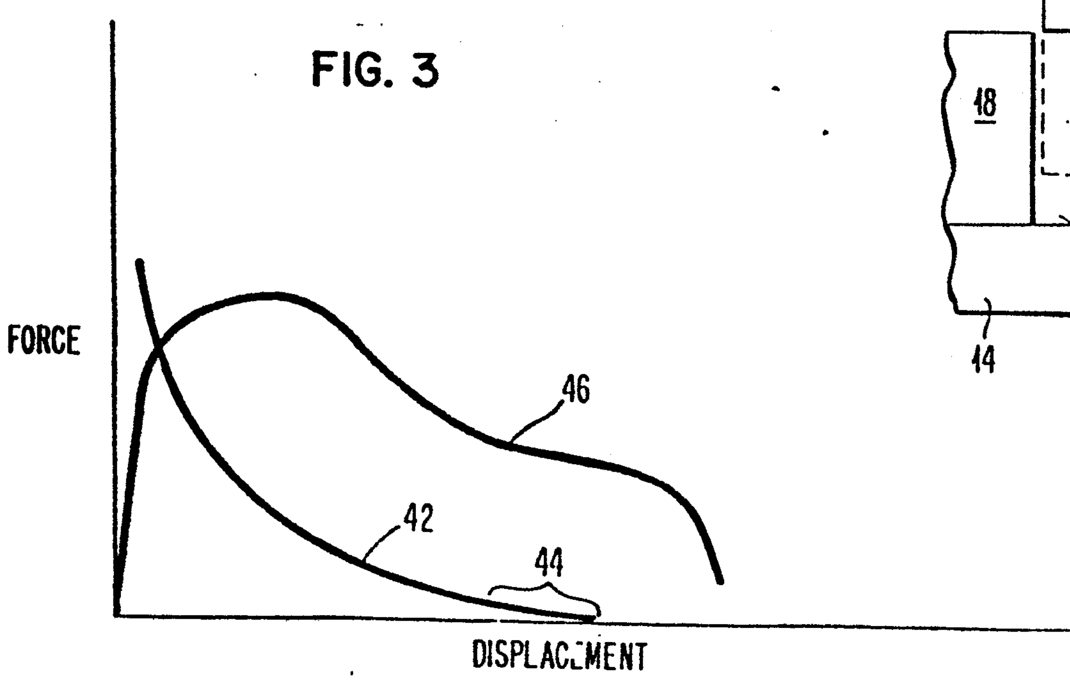


FIG. 3



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EUROPEAN SEARCH REPORT

Application number: EP 85115703.2

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl.4)
A	US - A - 3 714 892 (PERRY) * Totality *	1,3,4	B 41 J 9/38
A	US - A - 4 004 505 (MAGNENET) * Fig. 11,12 *	1,4	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 41 J
H 01 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	06-03-1986	WITTMANN

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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