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[56]

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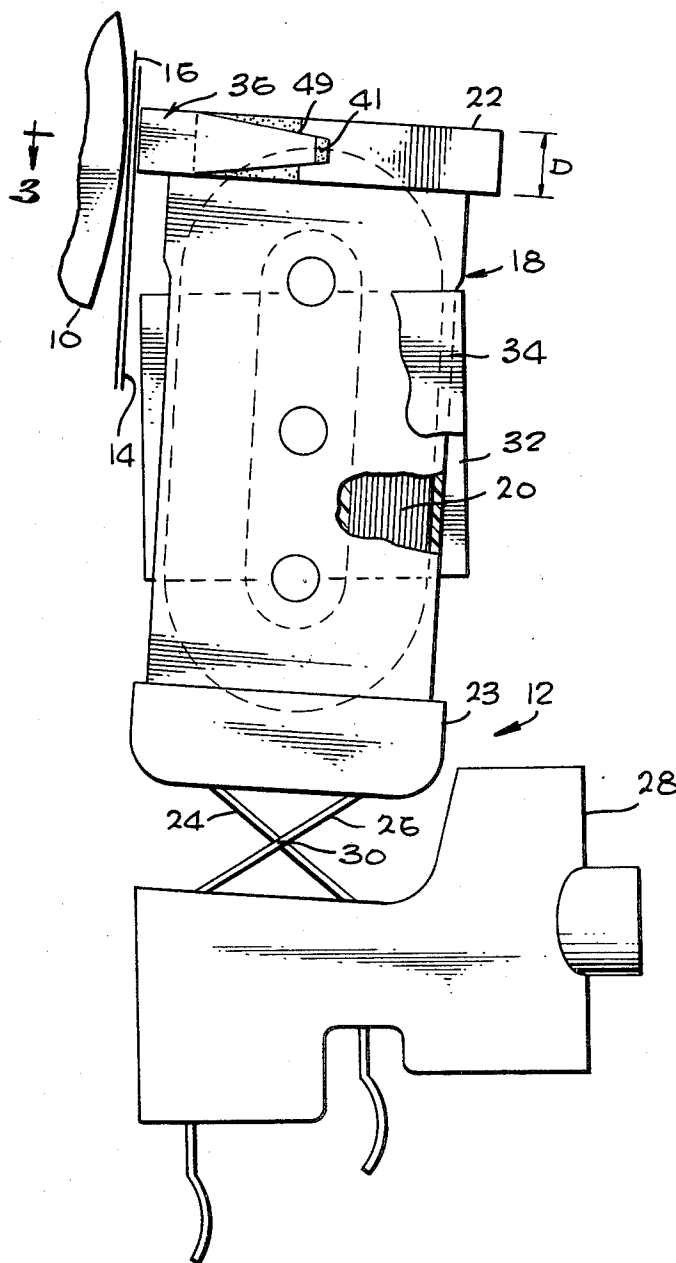
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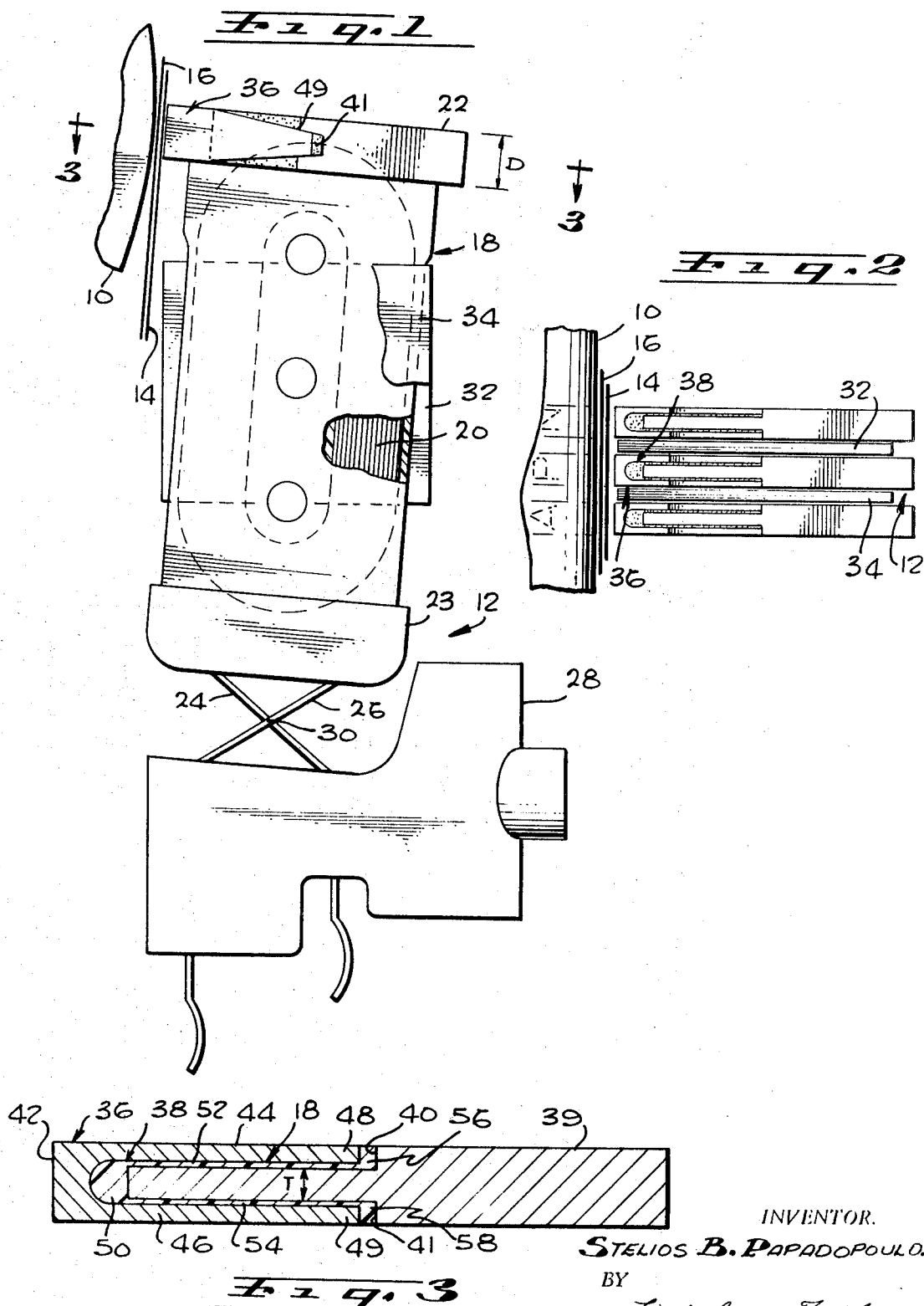
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[54] **HAMMER FOR IMPACT PRINTING DEVICE**
8 Claims, 3 Drawing Figs.

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101/379
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[50] Field of Search..... 101/93
(RC), 109, 368, 379, 380, 376

ABSTRACT: A hammer assembly useful in printing apparatus, for impacting against a character drum. The hammer is constructed to withstand abusive operation as for example, when no paper or ribbon covers the drum. The assembly comprises a hammer tip which is joined to the rest of the hammer assembly by an easily compressed buffer material such as an elastomer.





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HAMMER FOR IMPACT PRINTING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to high-speed printing apparatus and more particularly to impact devices for use therein.

2. Description of the Prior Art

One form of high-speed printer utilizes a rotating character drum, a bank of hammers opposite the drum, and paper and inked ribbon webs between the drum and hammers. Each hammer can be propelled toward the drum as a particular character moves to a position opposite the hammer, to print that character on the paper. U.S. Pat. No. 3,279,362 describes one type of assembly wherein the hammer body is supported on a pair of spring members that permit hammer rotation from a rest position to an impact position, the spring members also conducting current to a coil in the hammer body.

In order to achieve high-speed printing, the character drum may be rotated at a high speed such as 1,800 revolutions per minute for a drum about 3 inches in diameter. The hammer tip must provide a low contact time during which it presses the paper and ribbon against the drum. If the drum moves more than about 7 mils (thousandth of an inch), smearing will be apparent, while a maximum of 3 or 4 mils is desirable for very sharp printing. This necessitates a brief contact time such as 25 microseconds. As a result, large current pulses are used to accelerate the hammer to a high speed such as 150 inches per second at impact. In addition, the hammer tip as well as the character drum, is made of a rigid material such as steel.

High speed printers may sometimes accidentally be run without paper or a ribbon. Under these conditions, the hammer tip strikes directly on the drum. This causes very high stresses on both the hammer and drum, and after a short period of such abuse, the hammer tip may crack and the drum may be damaged. In addition, in the above-described hammers which are supported by conductive spring members, the hammer tip moves down by several thousandths of an inch while it is in direct contact with the rotating drum. It is found that this downward movement can, under certain circumstances, introduce a permanent set or deformation in the spring members and will induce such high stresses in the spring members, that they will fail.

OBJECTS AND SUMMARY OF THE INVENTION

One object of the present invention is to provide a printing hammer assembly which can better withstand operation under abuse conditions.

Another object is to provide a printing hammer assembly of maximum life.

In accordance with the present invention, a printing hammer is provided which includes a tip portion joined to the hammer body by an elastic joining material. The elastic material has a considerably lower stiffness than the tip or hammer body. It therefore acts as a buffer which prevents the immediate transfer of energy from the body to the tip when the tip strikes a rigid material. Thus, when the tip strikes directly on the steel character drum, with no paper or ribbon between them, the buffer prevents the tip from applying a high peak force to the drum. However, the stiffness of the buffer material is much greater than the stiffness of the paper and ribbon, and it transmits force from the hammer body to the tip as though they were rigidly joined when the tip strikes the paper. Thus, the tip impacts on the paper with a high peak force to produce a dark impression on the paper, and the tip quickly springs away from the paper so that the time of contact therewith is not excessive.

In a preferred embodiment of the invention, the hammer body has the form of a thin plate and the tip is of U shape with the legs of the U disposed on either side of the body. An elastomeric material such as a polyurethane is disposed along the inside of the legs and base of the U-shaped tip to join it to the hammer body. In addition to its elastic properties, the polyurethane layer provides damping to reduce vibrations.

The novel features of the invention are set forth with particularity in the appended claims. The invention will be best understood from the following description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view of a hammer assembly constructed in accordance with the invention;

FIG. 2 is a plan view of the hammer assembly of FIG. 1; and FIG. 3 is a sectional view taken on the line 3-3 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in the FIGS., the printer comprises a character drum 10 and a row of printing hammer assemblies such as assembly 12. The drum has raised characters arranged in tracks on its surface, each track corresponding to a different position on a line to be printed. Thus, if a maximum of 132 characters are to be printed across any one line, the printing drum 10 will preferably include 132 tracks. The drum rotates at a high speed so that all characters on a track repeatedly pass a position directly opposite the hammer assembly 12. The hammer assembly is thrust at the drum just as a desired character thereon is arriving at a position opposite the tip of the hammer. The hammer strikes the paper 14 and ribbon 16 hard against the drum to print the character on the paper, the drum serving as a rigid backing member to support the paper. The contact time or time during which the tip presses the ribbon and paper against the drum, is very short so that the drum does not move appreciably during this interval.

The hammer assembly comprises a flat body portion 18 including a flat multiturn coil 20 therein, an outer end 22, and an inner end 23. A pair of electrically conductive spring members 24 and 26 support the inner end of the hammer body on a mounting foot 28. The spring members also carry currents from a source (not shown) to the coil 20. The spring members allow the body 18 to pivot about an axis of rotation at 30. The rotation of the hammer assembly is produced by the interaction of the magnetic field established by current flowing through the coil 20, and the field of a pair of thin permanent magnets 32 and 34 positioned on opposite sides of the coil. When a current pulse is delivered to the coil 20, the hammer assembly rotates so that a tip 36 mounted on the outer end of the assembly strikes the paper and ribbon against the drum. The spring members immediately return the hammer assembly to its initial position.

In accordance with the invention, the tip 36 of the hammer assembly is coupled to the outer end 22 of the body by means of a buffer layer 38 of elastic material. The tip is of U-shape with a base 42 at the front of the hammer body and with legs 44 and 46 extending rearwardly along the sides of the body. The back ends 48 and 49 of the legs 44 and 46 are tapered. An enlarged portion 39 is provided behind the tip. Tapered slots 40 and 41 are formed in the portion 39 for receiving the tapered ends 48 and 49 of the tip legs 44 and 46. The buffer layer 38 includes a thick portion 50 between the base of the tip and the front of the coil section, and thin layer portions 52 and 54 between either leg of the tip and the hammer body. Two other buffer portions 56 and 58 are positioned in the slots 40 and 41, against the ends of the tip legs.

The buffer layer 38 is constructed of an elastic material which can adhere well to the tip 36 and body portion 18. The buffer material has a lower modulus of elasticity than that of the tip and of the character drum. Accordingly, when the tip impacts directly on the character drum, which occurs during abusive operation, the buffer material absorbs the energy of the moving hammer body. This prevents the tip and hammer body from acting as a single rigid unit that would apply a large peak force to the hammer body and character drum. Instead, the buffer portions 50, 56 and 58 compress while the portions 52 and 54 elongate under the shearing force (they undergo shearing strain). The maximum force applied by the tip 36 of the character drum 10 is therefore considerably lower than

would be applied if the tip were fixed to the coil section by a relatively inelastic material.

In addition to the prevention of large peak striking forces when the tip impacts directly on the drum, the buffer prevents damage to the spring members 24 and 26 that support the hammer body. When the tip strikes directly on the drum, it moves with a tangential component of the drum, so it is forced down perhaps several thousandths of an inch. The buffer layer 38 absorbs this downward motion, obviating the introduction of permanent set and high stresses in the spring members 24 and 26. The spring members are of a material such as brass which has a modulus of elasticity (of about 15×10^6), which is on the same order of magnitude as that of steel (about 30×10^6), and which is considerably greater than that of the buffer material. Thus, the buffer absorbs brief downward impulses instead of transmitting them entirely to the spring members. In order to permit absorption of such downward forces, a substantial depth D of the base 42 and much of the tip legs 44 and 46 is provided, the depth D preferably being at least twice the thickness T of the body portion which it straddles.

The buffer material has a higher modulus of elasticity than that of the paper-ribbon sandwich when it and the paper-ribbon sandwich are stressed to the degree encountered in normal printing operation. Accordingly, when the tip impacts on the paper and ribbon, the buffer material is relatively stiff compared to the paper-ribbon sandwich, and readily transmits force from the body to the tip, instead of absorbing most of the shock. The maximum force applied by the tip 36 to the paper is therefore high to achieve a dark ribbon impression. The relatively small compression of portions 50, 56 and 58 of the buffer material, and small elongation or shear of the portions 52 and 54 enables the tip to quickly spring away after the paper is printed upon, to achieve small contact time and therefore negligible smearing of the printed character.

The buffer material preferably has a stiffness or modulus of elasticity at least four times greater than that of the paper-ribbon sandwich, so that there is a negligible decrease of maximum impact force over that achieved with a solid hammer construction without buffer. Also, so long as the buffer material has a stiffness at least twice that of the paper-ribbon sandwich, the contact time will not be substantially greater than for a solid hammer construction, although the maximum impact force may be reduced appreciably. As pointed out above, the buffer material also preferably has a stiffness which is only a fraction of the stiffness of the tip, character drum, and spring members to prevent damage under abuse conditions.

A buffer layer 36 of polyurethane mixed with an adhesive, yielding a mixture referred to as type 113-11 of the Abel Stick Corporation of Gardena, Calif. has been found satisfactory. Hammer assemblies have been constructed with this mixture using a tip 36 with a mass of approximately 0.3 gram, and a body structure of approximately 0.6 gram effective mass at the tip position (an actual total body structure mass of approximately 1.5 grams). The hammer provided a peak force of about 30 pounds on the paper-ribbon sandwich. The hammer was tested under abuse conditions, and no appreciable damage to the hammer, drum, or spring support members was found even after several hours of such operation. In addition, it was found that the life of the hammers under normal operation was increased. Heretofore, the hammer lifetime was limited to about 100 million strokes. Hammers with buffer layers were tested to more than 300 million strokes without any noticeable damage or wear.

Thus, a hammer construction has been described wherein a buffer is provided between a tip portion and body portion of the hammer, to absorb the force otherwise applied by the body to the tip when the tip strikes a hard material such as a character drum of steel. However, the buffer is stiff enough to obviate large absorption of impact force when the tip strikes an easily compressed object such as a paper-ribbon sandwich. The hammer construction prevents damage under abusive operation, and also extends hammer life under normal operation.

Although particular embodiments of the invention have been described and illustrated herein, it is recognized that modifications and variations may readily occur to those skilled in the art, and consequently, it is intended that the claims be interpreted to cover such modifications and equivalents.

I claim:

1. A printing hammer for striking a web backed by a rigid backing member comprising:

a hammer body;

a tip having areas overlapping and abutting said hammer body; and

a buffer of resilient material disposed between said body and tip in said overlapping and abutting areas for transmitting impact force from said body to said tip, said resilient material having a modulus of elasticity lower than the modulus of the portions of said hammer body and tip immediately behind and in front of it.

2. The printing hammer described in claim 1 wherein:

said tip has a portion forward of said body and a pair of legs extending rearwardly on either side of said body; and said buffer is disposed between said body and said tip portion which is forward of said body, and between said body and each of said legs.

3. A printing hammer comprising:

a substantially flat hammer body portion of rigid construction;

a tip of rigid material having an area abutting said hammer and at least one portion overlapping said hammer; and

a layer of elastomeric material substantially more elastic than said tip and body portions, disposed between said tip and body portion in the abutting area and in the overlapping portion.

4. The printing hammer described in claim 3 wherein:

said tip is of substantially U-shape with legs extending on either side of said flat body portion; and said layer of elastomeric material is joined to said body sides and legs of said tip.

5. In a printer including a rotating character member for printing on a web when the web is struck thereagainst by a hammer, the improvement comprising:

a hammer body;

means for moving said body toward and away from said character member;

a tip of rigid material positioned on said hammer body for striking said web against said character member, said tip having areas overlapping and abutting said hammer body; and

buffer means of elastomeric material having a smaller modulus of elasticity than said tip, joining said tip and body in the abutting and overlapping areas to permit limited movement of said tip with a tangential component of said rotating character member when they are in contact, without corresponding movement of said hammer body, whereby to prevent damage by upward or downward movement of said body when no web is present.

6. The improvement described in claim 5 wherein:

said tip includes a front portion positioned forward of said hammer body, and legs extending from said front portion and positioned on either side of said body; and said buffer means is disposed between said body and said front portion and legs of said tip.

7. In a printer including a rotating character member for printing on a web when the web is struck thereagainst by a hammer, the improvement comprising:

a hammer body;

means for moving said body toward and away from said character member;

a tip of rigid material positioned on said hammer body for striking said web against said character member, said tip having a front portion positioned forward of said hammer body and legs extending from said front portion and positioned on either side of said body; and

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buffer means of elastic material disposed between said body and said front portion and legs of said tip, for joining said tip and body to permit limited movement of said tip with a tangential component of said rotating character member when they are in contact, without corresponding movement of said hammer body;
the depth of said legs and of the portion of said buffer means thereagainst being at least twice as great as the thickness of the body portion between said legs, whereby to secure

said tip on said body against large upward or downward impulses when said tip contacts said character member.
8. In a printer as recited in claim 7 wherein said web is a web of paper; and wherein said elastic material of said buffer means has a modulus of elasticity when stressed by the impact of said hammer tip on said web, which is at least twice as great as the modulus of elasticity of said web when it is stressed as said tip strikes it.

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