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DE - B - 1 287 833
GB - A - 1 359 925
US - A - 3 643 595
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Hammer bank assembly

The present invention relates to a hammer bank assembly for use in a printing mechanism and in particular to a hammer bank assembly comprising a frame; a plurality of printer magnets secured to said frame parallel to one another and spaced apart a predetermined distance; a plurality of print hammers interleaved with said magnets, each of said print hammers including a body comprising a pair of thin metal flag panels and a wire coil sandwiched between said flag panels, a pair of crossed spring wires extending from said panels, each of said spring wires being connected to a different end of said coil, and a foot section through which said spring wires extend, said foot section being secured to said frame.

In high-speed, moving-type impact printers of the kind typically employed in data processing systems, a separate print hammer is situated at each print position across a row of type. Hammer bank assemblies for this purpose are described in US—A—3,643,595 (Helms et al) and US—A—3,983,806 (Ishi), and in copending EP Patent Application No. 80104704.4 filed August 9, 1980 and published as EP—A—0,024,049 (Art. 54(3)EPC).

Such hammer bank assemblies utilize a plurality of print hammers each having a flat, electrically conductive coil disposed in a generally rigid housing or body having an impact tip at one end and supported by a pair of crossed spring wires at the other end. The springs provide electrical contact to the coil, and aid in restoring the hammer to its rest position subsequent to impact. In the hammer bank assembly, each hammer is situated between a pair of stationarily mounted flat permanent magnets. When a current flows through the coil, the resultant magnetic field interacts with the field of the permanent magnet, resulting in a force which propels the hammer towards the type font and the medium being printed. The basic configuration and operation of such a printing hammer is set forth in US—A—3,279,362 (Helms). Other hammers are shown in US—A—3,279,364 (Helms), US—A—3,643,595 (Helms, et al) and US—A—3,983,806 (Ishi).

Print hammers and hammer bank assemblies of the type disclosed above have proven to be very effective in use, have exhibited high reliability and long lifetime as measured in the number of impact operations between replacement, and have gained widespread acceptance. However, new designs for hammer bank assemblies require hammers which have an even longer lifetime and which exhibit different operating characteristics than prior art hammers. Typically, in the prior art, hammer bank assemblies were designed such that the crossed spring wires were flat and very rigid in the,

horizontal direction, thus preventing any side to side motion of the hammers (US—A—3,279,362). The body of each hammer was located between a pair of magnets, and the rigidity of the crossed spring wires served to keep the body in the correct spaced position between two magnets. If, however, the body of the hammer were to come in contact with the side of a magnet, the friction between the body and the magnet would interfere with the performance of the hammer. Therefore, it was critical that the hammers be accurately mounted so as to not contact either of the magnets which surround them.

It is the objective of the present invention to overcome the above explained problems of the prior art assemblies and more particular to provide a hammer bank assembly wherein the friction existing between the magnets and the print hammers interleaved therewith is reduced to a controllable low amount so that the lifetime of the hammers is increased and the performance of the hammers improved, while the accurate mounting of the hammers becomes less critical.

For achieving this objective in a hammer bank assembly of the kind specified above the invention is characterized in that said spring wires are arranged and configured so as to be relatively flexible in a direction lateral to their direction of travel when energized in said hammer bank assembly, and in that one side of each body is biased against an adjacent magnet to thereby accurately position the hammers and whereby a predetermined low amount of friction will exist between the hammers and magnets. The intended lateral flexibility reduces friction between the hammers and the magnets and biasing each hammer body against an adjacent magnet results in a very low amount of friction preventing uncontrollable interference with the performance of the hammer and increasing reliability.

A low friction coating, e.g. a woven glass tape may be wrapped around the housing of the hammer in order to further reduce friction.

The housing of the hammer may be designed with a bottom section which is formed so that the spring wires enter it in a substantially perpendicular fashion. This serves to reduce the concentration of stress in the spring wires when the hammer is actuated. In addition, the foot section may also be designed so that the spring wires enter it substantially perpendicularly, so as to reduce concentration of stress in spring wires.

In order to achieve the maximum deflection of the springs with minimum stress, the hammer is designed so that the spring wires cross at a point which makes their length above the crossing point unequal to their length below the crossing point. The relative lengths are

controlled so that the springs have a relatively constant bending moment along their entire length.

In order to reduce and dampen the recoil motion of the hammers after actuation, weights which surround the wires may be included.

By utilizing the above features, hammer bank assemblies having substantially different operational characteristics from those of the prior art may be produced. Rather than having relatively rigid hammers which must be extremely accurately located in the space between magnets of a hammer bank assembly, the use of hammers which are also flexible in a lateral direction, permits the hammers to be deliberately biased against the magnets. If the magnets are accurately located in the assembly, the hammers will in turn be accurately positioned.

In the drawings:

FIGURE 1 is a perspective view of the print hammer used in the present invention;

FIGURE 2 is a front section view of the print hammer shown in FIG. 1;

FIGURE 3 is a perspective view of a wire coil used in the print hammer;

FIGURE 4 is a plan view of a flag which forms a part of the print hammer;

FIGURE 5 is a side view of the print hammer;

FIGURE 6 is a perspective view of a portion of the hammer bank assembly embodying the present invention; and

FIGURE 7 is a front plan view showing the relationship between print hammers and magnets in the hammer bank assembly.

The following detailed description is of the best presently contemplated mode of carrying out the invention. This description is not to be taken in a limiting sense but is made merely for the purpose of illustrating the general principles of the invention since the scope of the invention is defined by the appended claims.

A print hammer 10 as used in the present invention is shown in FIGURES 1 and 2. The hammer 10 consists of a body or coil housing 12 containing a flat coil 32 (FIGURE 3) sandwiched between a pair of flags 26 and 28 (described below) and embedded in a molding compound such as a structural epoxy. The central portion of the coil housing 12 may have a typical thickness on the order of 0,89 mm. The hammer 10 includes an impact end 14 which has an enlarged thickness, typically on the order of 2,54 mm, and includes a forwardly projecting impact tip 16.

Projecting diagonally in opposite directions from an enlarged bottom end 18 of the housing 12 are a pair of spring wires 20 and 22, each having a round cross section. The spring wires 20 and 22 are laterally separated from one another so that they do not touch at their apparent crossover location shown at 21 in FIGURE 1. This separation may be seen more clearly in FIGURE 2. The spring wires 20 and 22 pass through, and are embedded in, a foot

member 24 formed of the same molding compound as the coil housing 12. The lower ends 20A and 22A of the spring wires 20 and 22 project below the foot member 24 and are available for electrical connection to the hammer 10.

Referring now to FIGURES 2, 3 and 4, the flags 26 and 28 are punched from thin metal strips. By way of example, the flags 26 and 28 may be formed of aluminum having a thickness of 0,1 mm. In addition, the flag 28 includes an embossed or raised locating portion or core 30 in its central area corresponding in size to the interior 32c of the coil 32, which serves to accurately locate the coil 32 with respect to the flag 28. The inner lead 32A of the coil 32 is connected to the spring wire 22 by means of a flat strip 34. The outer lead 32B is connected directly to the spring wire 20. The actual construction steps involved in manufacturing the hammer 10 are fully described in DE—OS 29 49 294.

Referring to FIGURE 5, it can be seen that the lower portion 18 and the foot section 24 are shaped so that the spring wires 20 and 22 enter them generally perpendicularly. When the hammer coil 32 is energized by applying current through the spring wires 20 and 22 and the hammer 10 is impacting the spring wires 20, and 22 will flex a great deal, thus causing the generation of a large amount of stress in spring wires 20 and 22. By forming the lower portion 18 and the foot 24 so that the spring wires 20 and 22 enter them generally perpendicularly, the concentration of stress in the wire housing junction is greatly reduced. This allows spring of smaller diameter (and therefore lower spring constant) to be used, thus increasing the efficiency of the hammer components.

Referring further to FIGURE 5, it may be seen that the foot section 24 includes a pair of mounting pegs 36 and 38. The pegs are offset from one another such that the peg 36 is aligned (i.e., coplanar) with the spring wire 20 and the peg 38 is aligned with the spring wire 22. The mounting pegs 36 and 38 are utilized to accurately mount each individual print hammer in a hammer bank assembly. As shown in FIGURE 6, a hammer bank mounting assembly includes a frame having a rear vertical portion 40, to which a plurality of spaced parallel magnets 41 are secured, and a forwardly-extending horizontal portion 42. Formed in the horizontal portion 42 are a group of front parallel equally-spaced slots 44 and rear parallel equally-spaced slots 46. The front slots 44 are offset with respect to the rear slots 46 by an amount equal to the offset between the mounting pegs 36 and 38 of a hammer. The hammers are mounted in the hammer bank assembly by passing the lower portions 20A and 22A of the spring wires through the slots 46 and 44 respectively, and fitting the pegs 36 in a slot 46 and the tab 38 in a slot 44. The pegs 36 and 38 fit snugly in the slots 46 and 44

and therefore serve to accurately position the hammer within the assembly. Details of the hammer bank assembly are fully described in EUROPEAN Patent application Serial No. 80104704.4.

Referring now to FIGURE 7, when the hammers are mounted in the hammer bank assembly, they are interleaved with the magnets 41. In prior hammer bank assemblies, the hammers were positioned so that their sides would not touch the magnets while the hammers were at rest. In addition, the hammers were made side stiff so that their energization would not cause them to move sideways and scrape against the magnets as they impacted against the printing medium. In the assembly shown in FIGURE 7, however, each hammer 10 is mounted so that its body 12 is biased against the side of a magnet 41. Because the spring wires 20 and 22 have a round cross section, they are relatively flexible in the horizontal direction (indicated by arrow 48). It should be noted that spring wires having a substantially square cross-section would also be flexible in the horizontal direction. By biasing the hammers 10 against the magnets 41, a known and small amount of friction is created. Since this friction is known, it may be taken into account when designing for the motion of the hammers 10 when they are energized. That is, the motion of the hammers 10 will be predictable and consistent despite the fact that they touch the magnets 41. Because the wires 20 and 22 have a round cross section and are relatively flexible, the amount of friction created is relatively low and thus does not greatly impede the motion of the hammers. By deliberately designing the hammer bank assembly such that the hammers are in contact with the magnets and planning on a certain amount of friction, the criticality of positioning of the hammers so that they do not touch anything as they move is eliminated. By making the spring wires 20 and 22 flexible in the direction indicated by the arrow 48, and by biasing the hammers 10 against the magnets 41, a hammer bank assembly which achieves high accuracy in printing but has a low degree of criticality in manufacturing tolerances may be achieved. In order to further reduce the amount of friction between the magnets 41 and the hammers 10, a woven glass tape 50 (FIGURE 1) impregnated with a low friction material such as that sold under the trademark Teflon may be applied to the sides of the body 12.

Referring again to FIGURE 5, a weight 52 is shown attached to each of the spring wires 20 and 22. When the hammer 10 is energized, it will move forward and the tip 16 will impact against a paper and cause a character to be printed. When the impact tip 16 strikes the paper (and type font located behind the paper), its forward motion halts. At this point, however, the hammer 10 still has a great deal of stored energy. The striking of the paper will cause the pivot point of the hammer to move from the

crossing point 21 of the springs 20 and 22 to the impact tip 16. Thus, after the impact tip 16 strikes the paper, a great deal of energy will be stored in the springs 20 and 22. They will then recoil and oscillate until the hammer 10 returns to rest at its equilibrium position. Without the weights 52, the hammer 10 will recoil to such an extent that more stress will be placed on the springs 20 and 22 than during actual impact. The addition of the weights 52 acts to limit the initial amount of recoil and dampen the subsequent oscillations of the springs 20 and 22. The addition of the weights 52 to the springs 20 and 22 will not change their spring constants, but will influence their natural frequencies and mass. The recoil motions of the springs 20 and 22 are therefore reduced.

Each time the hammer 10 is energized, a stress is placed on the springs 20 and 22 as they are deflected. In order to increase the life of the hammer 10, the maximum stress at any point on the springs for a given deflection should be minimized. Deflection of the springs 20 and 22 can be accomplished either by applying a single force to the spring or by applying a bending moment or combination of both. Although any method will cause the desired amount of deflection at any particular point, the stress which will be placed upon the spring will be vastly different. When a single force is utilized the stress placed upon the spring 20 near the foot 24 will be very high, since the maximum bending will occur near the foot 24. When a bending moment is utilized however, the maximum stress placed upon the spring 20 at any point will be much lower, since the curvature of the spring 20 will be spread over its length rather than concentrated near the foot 24.

In prior hammer designs, the crossing point 21 was located in the middle of the springs and spring deflection was accomplished in a fashion resulting in an uneven distribution of stress in the spring. In the present design, however, the springs 20 and 22 are oriented such that deflection is caused by the application solely of a bending moment. This results in lower stress and longer life. The use of a bending moment to cause deflection of the springs 20 and 22 is accomplished by controlling the dimensions of the springs and the position of their crossing point 21 (i.e., the length of the portion of the springs 20 or 22 above the crossing point relative to the length of the portion below the crossing point). Basically, the crossing point is positioned such that the portion below it is longer than the portion above it. Thus, in FIGURE 5, the upper portion 20b of the spring 20 is shorter than the lower portion 20c. The control of the crossing point in this manner assures that the spring 20 will be flexed by a bending moment rather than by a single force, thus minimizing stress on the spring 20. The design results in a constant bending moment being applied along the length of the springs,

resulting in an even stress distribution along the length of the springs.

In summary, the present invention is directed to an improved print hammer for use in a hammer bank assembly of a high-speed printer or the like. The hammer includes several new features which enable a significant improvement in performance to be achieved. Crossed spring wires which are used to support the hammer body have a round cross section, thereby rendering the hammer body relatively flexible in the horizontal direction. This permits the hammers to be mounted so that they are biased against the magnets in a hammer bank assembly. This bias creates a known small amount of friction, which may be taken into account in the design of the system. The hammer body and foot member of the hammer are designed so that the spring wires supporting the body are attached to the body and foot in a substantially perpendicular fashion, thereby reducing concentration of stress in the spring wires. The foot includes molded mounting pegs which aid in accurately mounting the hammers in a hammer bank assembly. One of a pair of metal flags, which form the body of the hammer and sandwich a coil, includes a raised mounting surface to aid in accurately locating the coil in the hammer assembly. In addition, weights located on the springs are utilized to dampen the recoil motion of the supporting springs after the hammer has impacted against a character.

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.

Claims

1. A hammer bank assembly comprising: a frame; a plurality of printer magnets (41) secured to said frame parallel to one another and spaced apart a predetermined distance; a plurality of print hammers (10) interleaved with said magnets (41), each of said print hammers including a body (12) comprising a pair of thin metal flag panels (26, 28) and a wire coil (32) sandwiched between said flag panels, a pair of crossed spring wires (20, 22) extending from said panels, each of said spring wires being connected to a different end (32A, 32B) of said coil, and a foot section (24) through which said spring wires extend, said foot section being secured to said frame, characterized in that said spring wires (20, 22) are arranged and configured so as to be relatively flexible in a direction (48) lateral to their directions of travel when energized in said hammer bank assembly, and in that one side of each body is biased against an adjacent magnet to thereby accurately position the hammers and whereby a predetermined low amount of friction will exist

between the hammers and magnets.

2. The hammer bank assembly of Claim 1, characterized by low friction coating (50) attached to the sides of the flag panels (26, 28) to thereby further reduce friction between the hammer (10) and said magnets (41).

3. The hammer bank assembly of Claim 2, characterized in that said coating is a tape (50) which is made of woven glass.

4. The hammer bank assembly of Claim 1, characterized in that said spring wires (20, 22) have a substantially square cross-section.

5. The hammer bank assembly of Claim 1, characterized in that spring wires (20, 22) have a substantially circular cross-section.

6. The hammer bank assembly of one of Claims 1 to 5, characterized in that said foot section (24) is generally rectangular and includes a front mounting peg (38) aligned with one of the spring wires (22) and a rear mounting peg (36) aligned with the other (20) of said spring wires, said pegs (36, 38) serving to accurately locate said hammer (10) in a hammer bank assembly.

7. The hammer bank assembly of one of Claims 1 to 5, characterized in that the bottom portions (18) of said flag panels (26, 28) are encased in a housing (12) of structural epoxy and said foot member (24) is made of structural epoxy, and that said housing and foot member are shaped so that said spring wires (20, 22) enter them substantially perpendicularly to thereby reduce stress on said structural epoxy.

8. The hammer bank assembly of Claim 7, characterized by further including at least one weight surrounding each spring wire (20, 22) to reduce and dampen recoil motion of said hammer (10).

9. The hammer bank assembly of one of Claims 1 to 8, characterized in that the portion of the spring wires (10, 22) above the point (21) where they cross is shorter than the portion of the spring wires between the point where they cross and where they enter the foot section (24), thereby reducing stress on said spring wires.

10. The hammer bank assembly according to one of Claims 1 to 9, characterized in that at least one of said flag panels (26, 28) includes an integrally formed raised coil locating portion for accurately locating the coil between the panels.

Revendications

1. Ensemble de marteaux en ligne comprenant: un bâti, une série d'aimants d'imprimante (41) fixés à ce bâti parallèlement les uns aux autres et espacés d'une distance déterminée, une série de marteaux d'impression (10) placés entre ces aimants (41), chacun de ces marteaux comportant un corps (12) comprenant deux lamelles métalliques (26, 28) et une bobine de fil conducteur (32) serrée entre elles, deux fils ressorts croisés (20, 22) partant de ces lamelles

et connectés chacun à une extrémité (32A, 32B) de la bobine, et un pied (24) traversé par les fils ressorts et fixé au bâti, caractérisé par le fait que les fils ressorts (20, 22) sont placés et conformés de façon à être relativement flexibles dans une direction (48) latérale par rapport à leur direction de déplacement quand ils sont alimentés dans cet ensemble de marteaux, et qu'un côté de chaque corps est rappelé contre un aimant voisin pour assurer un positionnement précis des marteaux, et ce qui fait qu'il existe un faible frottement prédéterminé entre les marteaux et les aimants.

2. Ensemble de marteaux selon la revendication 1, caractérisé par le fait qu'un revêtement à faible frottement (50) est fixé aux côtés des lamelles (26, 28) pour réduire encore le frottement entre le marteau (10) et les aimants (41).

3. Ensemble de marteaux selon la revendication 2, caractérisé par le fait que le revêtement est une bande (50) en tissu de verre.

4. Ensemble de marteaux selon la revendication 1, caractérisé par le fait que les fils ressorts (20, 22) ont une section sensiblement carrée.

5. Ensemble de marteaux selon la revendication 1, caractérisé par le fait que les fils ressorts (20, 22) ont une section sensiblement circulaire.

6. Ensemble de marteaux selon l'une des revendications 1 à 5, caractérisé par le fait que le pied (24) est dans l'ensemble rectangulaire et comporte une cheville de montage avant (38) alignée avec un des fils ressorts (22) et une cheville de montage arrière (36) alignée avec l'autre fil ressort (20), ces chevilles (36, 38) servant à positionner avec précision le marteau (10) dans un ensemble de marteaux en ligne.

7. Ensemble de marteaux selon l'une des revendications 1 à 5, caractérisé par le fait que les parties inférieures (18) des lamelles (26, 28) sont enfermées dans un logement (12) en époxy de construction et le pied (24) est en époxy de construction, et que ce logement et le pied ont une forme telle que les fils ressorts (20, 22) y entrent à peu près perpendiculairement afin de réduire les efforts à laquelle est soumise l'époxy de construction.

8. Ensemble de marteaux selon la revendication 7, caractérisé par le fait qu'il comporte en outre au moins une masse entourant chaque fil ressort (20, 22) destinée à réduire et amortir le mouvement de recul du marteau (10).

9. Ensemble de marteaux selon l'une des revendications 1 à 8, caractérisé par le fait que la partie des fils ressorts (20, 22) située au-dessus du point (21) où ils se croisent est plus courte que leur partie située entre leur point de croisement et le point où ils entrent dans le pied (24), ce qui réduit les efforts auxquels sont soumis les fils ressorts.

10. Ensemble de marteaux selon l'une des revendications 1 à 9, caractérisé par le fait qu'au moins une des lamelles (26, 28) comporte une partie en relief faisant corps avec elle, destinée au positionnement précis de la

bobine entre les lamelles.

Patentansprüche

5 1. Druckhammerbank, enthaltend: einen Rahmen; eine Vielzahl von Druckmagneten (41), die parallel zueinander und in einem vorgegebenen gegenseitigen Abstand an dem Rahmen befestigt sind; eine Vielzahl von Druckhämmern (10), die mit den Magneten (41) verschachtelt angeordnet sind, wobei jeder der Druckhämmer einen Körper (12) mit zwei dünnen metallischen Fahnenfeldern (26, 28) und einer zwischen den Fahnenfeldern in Sandwichbauweise angeordneten Drahtspule (32), zwei gekreuzte, von genannten Fahnenfeldern abgehende Federdrähte (20, 22), von denen jeder mit einem anderen Ende (32A, 32B) der Spule verbunden ist, und einen Fußteil (24) aufweist, durch den sich die Federdrähte erstrecken, wobei der Fußteil am Rahmen befestigt ist, dadurch gekennzeichnet, daß die Federdrähte (20, 22) so angeordnet und ausgebildet sind, daß sie in einer Richtung (48) quer zu ihrer Bewegungsrichtung bei Erregung in der Druckhammerbank relativ flexibel sind und daß eine Seite jedes Körpers gegen einen benachbarten Magneten vorgespannt ist, wodurch die Hämmer genau positioniert werden und ein vorgegebener niedriger Reibungswert zwischen den Hämmern und Magneten besteht.

2. Druckhammerbank nach Anspruch 1, gekennzeichnet durch einen an den Seiten der Fahnenfelder (26, 28) angeordneten Belag (50) mit niedrigem Reibungskoeffizienten zur weiteren Verringerung der Reibung zwischen dem Hammer (10) und den Magneten (41).

3. Druckhammerbank nach Anspruch 2, dadurch gekennzeichnet, daß der Belag ein Band (50) aus einem Glasfasergewebe ist.

4. Druckhammerbank nach Anspruch 1, dadurch gekennzeichnet, daß die Federdrähte (20, 22) einen im wesentlichen quadratischen Querschnitt haben.

5. Druckhammerbank nach Anspruch 1, dadurch gekennzeichnet, daß die Federdrähte (20, 22) einen im wesentlichen kreisförmigen Querschnitt haben.

6. Druckhammerbank nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß der Fußteil (24) allgemein rechtwinklig ist und einen mit einem der Federdrähte (22) ausgerichteten frontseitigen Montageansatz (38) und einen mit dem anderen (20) der Federdrähte ausgerichteten rückwärtigen Montageansatz (36) aufweist, wobei die Ansätze (36, 28) zum genauen Positionieren des Hammers (10) in einer Druckhammerbank dienen.

7. Druckhammerbank nach einem der Ansprüche 1 bis 9, dadurch gekennzeichnet, daß die unteren Abschnitte (18) der Fahnenfelder (26, 28) in einem Gehäuse (12) aus Bauepoxid eingeschlossen sind, daß der Fußteil (24) aus Bauepoxid besteht und daß das Gehäuse

und der Fußteil so ausgebildet sind, daß die Federdrähte (20, 22) im wesentlichen rechtwinklig in sie eintreten, um dadurch Spannungen auf das Bauepoxid zu reduzieren.

8. Druckhammerbank nach Anspruch 7, dadurch gekennzeichnet, daß jeder Federdraht (20, 22) mit wenigstens einem Gewichtsstück umschlossen ist, um die Rückstoßbewegung des Hammers (10) zu verringern und zu dämpfen.

9. Druckhammerbank nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß der über dem Kreuzungspunkt (21) befind-

liche Abschnitt der Federdrähte (20, 22) kürzer ist als der Abschnitt der Federdrähte zwischen ihrem Kreuzungspunkt und deren Eintrittsstelle in den Fußteil (24), wodurch Belastungen der Federdrähte verringert werden.

10. Druckhammerbank nach einem der Ansprüche 1 bis 9, dadurch gekennzeichnet, daß wenigstens eines der Fahnenfelder (26, 28) mit einem angeformten, vorspringenden Spulen-Positionierabschnitt zum genauen Positionieren der Spule zwischen den Feldern versehen ist.

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Fig. 1.

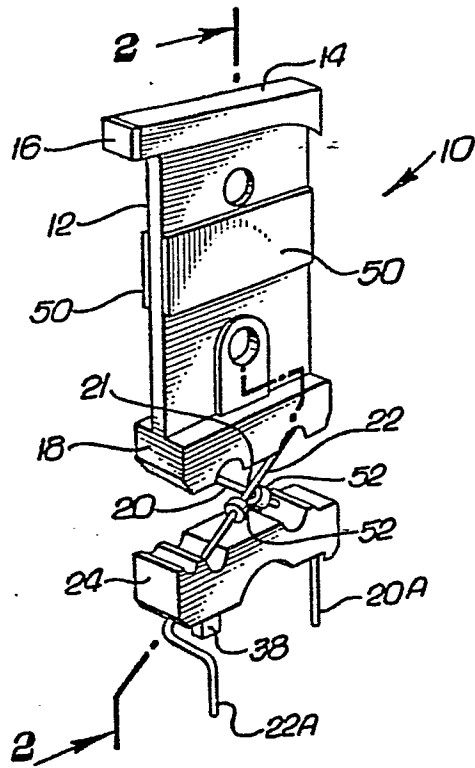


Fig. 2.

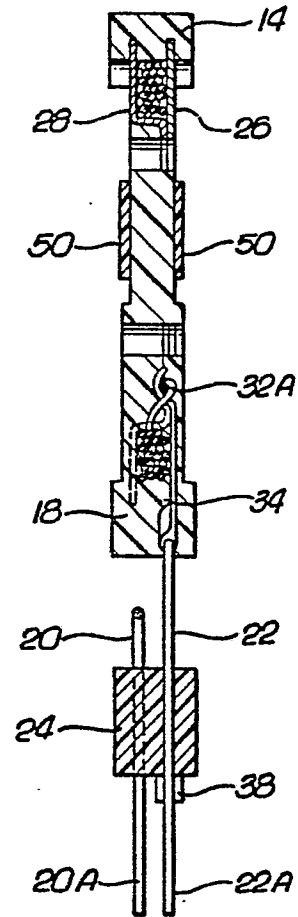


Fig. 3.

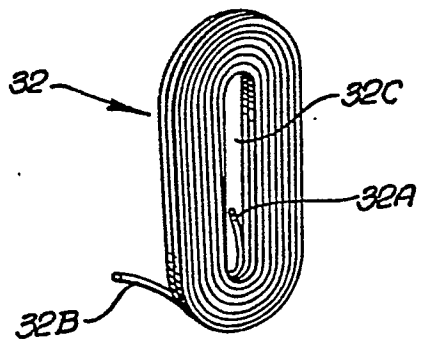


Fig. 4.

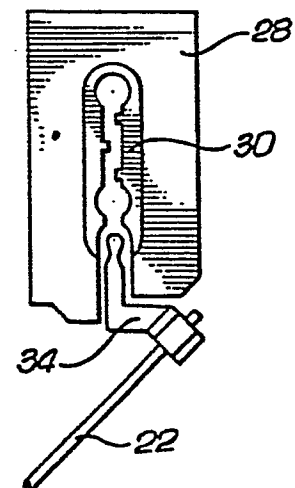


Fig. 5.

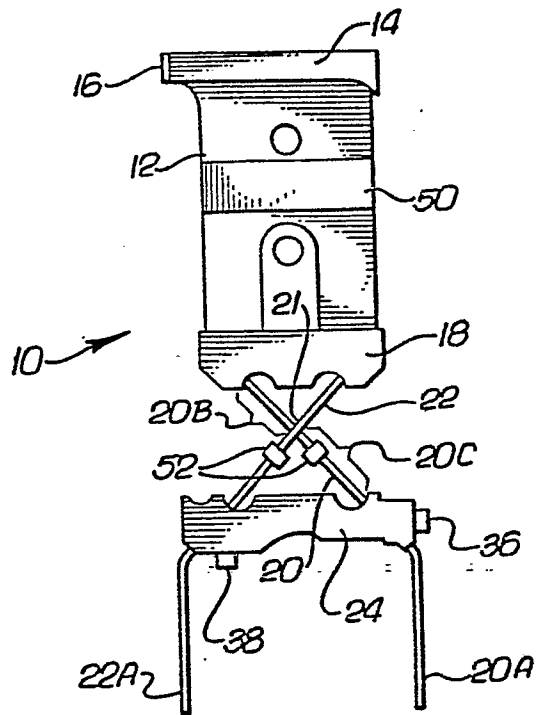


Fig. 7.

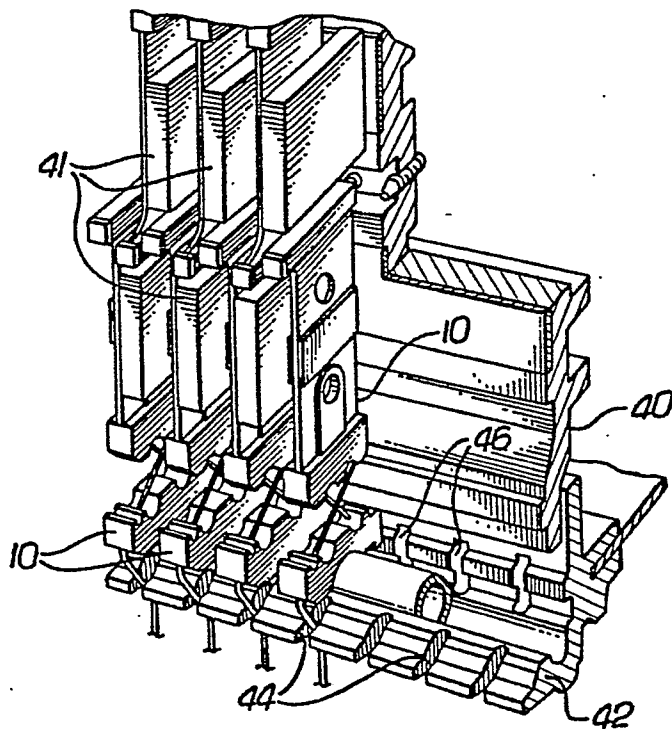
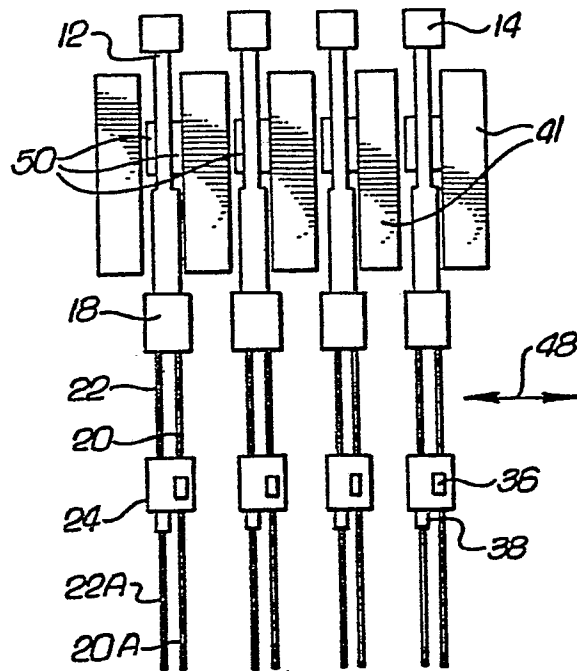


Fig. 6.