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Description

This invention relates to a print hammer assembly employing an electromagnetic actuator to drive a hammer element against a print platen or against an adjacent print element, to thereby cause said print element to strike an adjacent platen.

The invention is more particularly concerned with a print hammer assembly of the kind which comprises a support structure pivotally mounted about an axis adjacent a print platen, a magnetically attractable plunger mounted by a rigid support means on said support structure, a print hammer mounted by leaf spring means, on said support structure, the plunger and the hammer being spaced apart angularly about said axis, and an actuator capable of being energised to create a magnetic field so as to attract said plunger and thereby rotate said support structure about the pivot axis and so cause the hammer to make an impact with the print platen or with an interposed print element.

A print hammer assembly of this kind is described in US—A—3 968 744, and consists of a light weight moulded hammer having a rigid support member which carries a magnetically attractable armature and which is formed integrally with a pair of flexure members. The flexure members carry an impact tip which constitutes the hammer. On energisation of a solenoid, the armature is attracted directly to one of its poles, the armature being prevented from contacting the pole only by virtue of an intervening shim. As the armature moves towards the solenoid, the flexure members carry the impact tip in free flight towards the print position, and a back-up portion of the support member adjacent one of the flexures carries a shock-absorbing pad to dampen the rebound of the impact tip and to prevent a return rebound.

Another print hammer arrangement is described in US—A—3 459 976, in which a rotary electromagnetic actuator causes a support arm carrying a hammer element to swing towards a print platen. The motion of the support arm is arrested by a suitably positioned stop, and a resilient extension of the support arm, on which the hammer element is mounted, is "flicked" towards the print platen so as to make a brief impact with it.

A disadvantage of such print hammer assemblies is that audible noise attributed to impacts is relatively high. More specifically, not only does the hammer element impact the print element against an adjacent platen, but the armature impacts the pole piece of the electromagnetic actuator, or the support arm impacts the stop. Since the armature and pole pieces of the actuator, or the support arm and stop, are generally metallic, it will be appreciated that the noise level is significantly increased over that attributable solely to impact of the hammer element against the print element.

Printers are known where the dwell time of a print element forcing a marking medium against an adjacent platen due to the force of a hammmer element against the print element can be increased by increasing the mass of the hammer element. An increase in dwell time increases the quantity of marking material released and improves the quality of the printing. However, this arrangement has the disadvantage of increasing the flight time of the hammer element, thereby correspondingly decreasing the maximum printing speed. A further disadvantage is that of increasing the kinetic energy of impact, which may result in decreased life of the print elements, or require that the print elements be fabricated of a more durable, and thus more costly, material.

One way of increasing dwell time is to have the hammer make multiple strikes at each printing position. US—A—3 547 028 describes an apparatus in which the striking member of a printer is a harmonically vibratable reed excited by an electromagnet. This reed likewise impacts a pole piece during its vibration.

The present invention is intended to provide a print hammer assembly which is quieter in operation than known assemblies, and which gives a longer dwell time of the print hammer, but which overcomes the above described disadvantages of known assemblies.

The invention accordingly provides a print hammmer assembly of the kind specified which is characterised in that the actuator is located alongside a space in which said magnetic field is created and through which said plunger is free to travel on energisation of the actuator, without contacting the pole pieces thereof so that further rotational movement of the support structure after said impact is restrained only by the leaf spring means, and that the masses of the hammer and plunger are selected in relation to the properties of the leaf spring means so as to produce more than one of said impacts for each energisation of the actuator.

In view of the above arrangement, it will be appreciated that the only noise generated is that which is attributable to the impact of the print element by the hammer element against an adjacent platen. There is no initial impact of armature or pole piece against other pole pieces, which significantly reduces the overall impact noise.

It will further be appreciated that since the plunger is being magnetically forced through a space between the pair of magnetizable members, the relative distance between the plunger and each of the magnetizable members is not critical, since the total force will be substantially the same regardless of whether or not these two distances differ. More specifically, the driving force is related to the addition of the two gap distances on either side of the plunger and the geometry of the plunger. If the distance between plunger and each of the magnetizable members is different, the driving force will essentially be the same as when the plunger is centered, since the sum of the two distances will always be the same.

It will also be appreciated that, since the driving

force is related to the geometry of the total gap area swept, as opposed to being inversely proportional to the square of an ever decreasing gap size, as in the arrangement where an armature is attracted directly to a pole piece, much less energy need be expended to achieve the requisite print quality with either system. More specifically, the significant amount of electrical power required to actuate the armature of prior art devices is not required. A substantially lower level of power can be used, thereby conserving energy. Additionally, the geometry of the sweeping gap approach of this invention permits the hammer element to experience maximum acceleration early in the hammer stroke, thus cutting down the overall flight time.

It will also be appreciated that the mass of the hammer element is not increased to effect an increased dwell time. Rather, a dual mass system (the plunger and the hammer element) is employed, wherein the means for coupling together the two masses includes means cooperating with the first mass for increasing the dwell time. There is thus no decrease in the flight time of the hammer element and increase in kinetic energy of impact. By arranging the plunger and hammer element such that the hammer element will strike a print element against a platen while the plunger continues to travel in the same direction, the resiliency of the spring assembly will retain the hammer element against the print element and platen for a longer period of time than had the hammer element been allowed to immediately rebound, as in the case of ballistic hammer assemblies. The increased dwell time also enables the peak impact force to be reduced without loss in print quality, thereby enabling lower cost print element, such as plastic print elements, to be employed.

Because the hammer element impacts the print element and interposed marking medium against the platen more than once for each "hammer energization", the impacts can be achieved at lower peak force levels, thereby enabling the use of lower cost (e.g., thermo-plastic) print elements and the like, while maintaining high print quality and normal printing speeds.

In addition to the above advantages, the provision of multi-impact per single energization also contributes to a reduction in noise, since the peak impact forces are less. Further, the two impacts occur relatively rapidly, thereby reducing or avoiding settling of the print element and incumbent in accuracy problems. Still further, there is no transverse movement of the print element between multiple strikes per single energization which could cause "ghosting" and the like, due to the control achieved by impacting more than one per single energization.

As yet another advantage, the multi-impact approach of this invention is less susceptible to voids of the marking medium in the printed character, i.e., the second impact fills in at least some of the voids that may have been left in the printed character following the first impact. This advantage provides another basis for using lower cost print elements.

In a preferred embodiment of the invention, the leaf spring means comprises a pair of non-parallel leaf springs.

By offsetting the pair of leaf springs relative to one another, so that they are non-parallel, the effect of altering the location of maximum impact force following initial impact may be amplified over the effect achieved by using parallel leaf springs. This is accomplished due to the trapezoidal configuration of the offset leaf springs as connected to the hammer element at one end and to support structure at the other end. The trapezoidal configuration imparts a more pronounced shift in maximum impact force location following initial impact than would a strict parallelogram formed by parallel leaf springs. Consequently, more pronounced misalignments of the platen axis may be compensated for through the use of offset leaf springs in the arrangement above-described.

A print hammmer assembly in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a partial side elevation view of an exemplary carriage assembly of a serial printer having mounted thereon a "daisy-wheel" print wheel and a hammer assembly, and being adapted to carry a ribbon cartridge (not shown);

Figure 2 is a front perspective view of the hammer assembly depicted in Figure 1;

Figure 3 is a front plan view of a portion of the hammer assembly as depicted in Figure 2;

Figure 4 is a partial side elevation view of the hammer assembly, print wheel and platen as depicted in Figure 1, showing the hammer assembly upon retraction from a first impact;

Figure 5 is the same view as Figure 4, but this time showing the hammer assembly upon advancement toward a second impact;

Figure 6 is the same view as Figures 4 and 5, but this time showing the hammer assembly upon retraction from the second impact;

Figure 7 is a partial side elevation view of a modified hammmer assembly, together with an adjacent print wheel and platen, showing the hammer assembly during a first impact;

Figure 8 is the same view as Figure 7, but this time showing the hammer assembly during a second impact; and

Figures 9 and 10 are oscilloscope traces showing the relative relationships among travel of the hammer element, actuator coil current, impact force of the hammer element, and time.

A print hammer assembly 10 in accordance with the present invention is shown in Figure 1 mounted to a carriage assembly 12, which may be of the general type disclosed in the aforementioned U.S. Patent No. 4,037,532. The carriage assembly 12 is thus adapted to transport not only the hammer assembly 10, but also a rotatable print wheel 14 of the "daisy-wheel" type and a ribbon cartridge (not shown) to selected

positions along a predefined linear path parallel to the axis of rotation of a cylindrical support platen 16 mounted adajacent the carriage assembly 12.

The carriage assembly 12 comprises an outer carriage frame 18 and an inner carriage frame 20. The inner carriage frame 20 may be pivotably mounted to the outer carriage frame 18 by means of a suitable pivot bolt 22 extending through the side walls of the frames 18 and 20. The outer carriage frame 18 is preferably fixed in position in a manner to be described below, and the inner carriage frame 20 is pivotable about bolt 22 relative to frame 18. Thus pivoting action enables replacement and substitution of print wheels in a manner well known in the art. Suitable means (not shown) are provided for locking the inner carriage frame 20 in each of two positions, i.e., a print wheel loaded position (shown in Figure 1) and a print wheel loading position (not shown), wherein the frame 20 would be pivoted clockwise relative to the position shown in Figure 1.

As shown in Figure 1, the outer carriage frame 18 has a pair of aligned openings 24 formed in the respective side walls of frame 18 adjacent the front end of the carriage assembly 12, and a pair of aligned recesses 26 formed in such respective side walls adjacent the rear end of the carriage assembly 12. The openings 24 and recesses 26 are each adapted to receive in locked relation a linear bearing assembly which may be of the type disclosed in U.S. Patent No. 3,985,404. The pair of linear bearing assemblies are adapted to receive a corresponding pair of guide rails mounted parallel to the axis of the platen 16 and along which the carriage assembly 12 rides.

A print wheel motor 28 is mounted by suitable means (not shown) to the inner carriage frame 20. The motor 28 controls the speed and direction of rotation of the print wheel 14 in order to bring a desired print or character element 30 thereon to a stationary printing position in alignment with the platen 16 and a hammer element 32 included in the hammer assembly 10. The motor 28 has a shaft 34 projecting forwardly of the inner carriage frame 20. A hub portion 36 forms part of the shaft 34 and is adapted to be received in the central opening (not shown) of the print wheel 14. An exemplary print wheel is generally disclosed in U.S. Patent No. 3,954,163.

Also mounted to the inner carriage frame 20 by means to be described below is the hammer assembly 10 of the present invention. As best shown in Figures 2 and 3, the hammmer assembly 10 includes a support structure or frame 38 which defines a first mass and is desirably of generally trapezoidal shape with a pair of inwardly projecting finger portions 40 and 42 coupled at their upper ends by a bridge portion 44. Affixed to the outer surface of the bridge 44, or formed as an integral part thereof, is a plunger 46, which is desirably of a ferromagnetic material, such as soft iron. The finger portions 40 and 42 are coupled at their lower ends by generally U-shaped attachment portion 48 having opposing side wall flange portions 50 and 52. The flange portions 50 and 52 include respective aligned openings 51 and 54 formed therein. The openings 51 and 54 are adapted to accommodate a pivot rod (not shown) that projects through both openings 51 and 54 and a corresponding pair of openings 56 (Figure 1) in the side walls of the inner carriage frame 20. In this manner, the support frame 38 is pivotably mounted to the inner carriage frame 20.

The side wall flange portions 52 and 50 of the attachment portion 48 further include respective aligned openings 53 and 55 formed therein. Each such opening is adapted to retain an end of one of a pair of springs 57 (only one shown in Figure 1). The other ends of the springs 57 are mounted to the inner frame 20. The springs 57 cooperate to bias the support frame 38 in a clockwise direction (as shown in Figure 1) such that the support frame 38 is normally biased against a stop (not shown) also mounted to the inner frame 20. The support frame 38 may be pivoted counterclockwise about the pivot rod through openings 56 against the bias of springs 57 upon energization of an electromagnetic actuator 59 forming part of the hammer assembly 10 in a manner to be described below.

Still referring to Figures 2 and 3, the hammer assembly 10 further includes the hammer element 32, which forms part of a second mass 58 that is coupled to the support frame 38 by at least one, and preferably two, leaf springs 60 and 62. The hammer element 32 preferably has a grooved impacting surface 33 that is matable with a corresponding wedge (not shown) formed on the rear surface of each character element 30. In this manner, minor misalignments between the hammer element and the selected character element can be corrected.

The second mass 58 includes three mounting blocks 64, 66 and 68, which are preferably of identical material, and a counter-balanced weight 69 affixed to the mounting block 68. The hammer element 32 projects forwardly from the center of a side surface of the block 64. In the embodiment shown in Figures 1—6, the leaf springs 60 and 62 are substantially identical and normally planar, and are spaced apart in parallel relationship. Additionally, the mounting blocks 64, 66 and 68 are substantially identical in dimensions, except for the hammer element 32 projecting from the mounting block 64. The upper end of the spring 60 is disposed between the mounting blocks 66 and 68, while the upper end of the spring 62 is disposed between the mounting blocks 64 and 66. The lower ends of the springs 60 and 62 are mounted on either side of the attachment portion 48 substantially centered between the side wall flange portions 52 and 54. A pair of mounting blocks 70 and 72 are attached to the lower ends of the springs 60 and 62 and hold them by suitable fastening means (not shown) against the attachment portion 48 of the support frame 38.

Referring to Figures 1—3, the hammer assembly 10 further includes the electromagnetic actuator or solenoid 59. The solenoid 59 has a C-

shaped yoke 74 with a pair of depending legs 76 and 78 each containing an electrically conductive coil 80 and 82, respectively, mounted thereon. The space 84 between the portion of each leg 76 and 78 projecting downwardly from the respective coil 80 and 82 mounted thereon is of sufficient dimensions to accommodate the plunger 46 therein, as shown in Figure 3. With the plunger 46 positioned within the space 84, gaps 86 and 88 are defined between the sides of the plunger 46 and the adjacent legs 76 and 78, respectively. It is a feature of the present invention that the gaps 86 and 88 need not be identical in dimensions, thereby reducing the necessity of critical adjustments with respect thereto. Additionally, the spacing 85 between the upper surface of the plunger 46 and the lower surfaces of the coils 80 and 82 is not critical. The reasons for these non-critical relationships will be described in more detail below.

As shown in Figures 1 and 3, the solenoid 59 is mounted to the inner carriage frame 20 by affixing, through a pair of screws 90, the legs 76 and 78 to a selonoid frame 92, which is itself affixed by means (not shown) to the side walls of the inner carriage frame 20. The support frame 38 and solenoid 59 are normally positioned relative to one another such that a front surface 94 of the plunger 46 normally lies just to the rear of the legs 76 and 78 in alignment with the space 84. In this manner, when the solenoid 59 is energized by passing current through the coils 80 and 82 (clockwise flow through coil 80 and counterclockwise flow through coil 82), the resultant magnetic field established through the space 84 and acting upon the plunger 46 will force such plunger against the bias of the springs 57 through the space 84. This forward movement of the plunger 46 through the space 84 will cause a resultant pivotal movement of the support frame 38 about the pivot rod 56 and thus forward arcuate movement of the hammer element 32 toward the adjacent print element 30 and platen 16.

The operation of the embodiment of the inventon as depicted in Figures 1—6 will now be described with respect to Figures 1 and 4—6. Prior to energization of the solenoid 59, the support frame 38 is in the position shown in Figure 1, with the plunger 46 just slightly rearward of the legs 76 and 78 of the solenoid 59, and with the hammer element 32 spaced rearwardly of the aligned print element 30 of the print wheel 14. It is important that the solenoid 59 be energized for a time period sufficient to cause the plunger 46 to overtravel relative to the point along its path of travel at which the print element 30 and interposed marking medium are initially impacted by the hammer element 32 against the platen 16. This relationship increases the quantity of marking material released, as will be explained in more detail below.

Following energization of the solenoid 59, the plunger 46 begins to move through the space 84, thereby causing the support frame 38 to pivot about rod 56 and thus hammer element 32 to move toward the platen 16. During continued movement of the support frame 38, the hammer element 32 will engage the rear surface of the print element 30 and begin forcing it toward the platen. Eventually, the hammer element 32 will force the print element 30 and an interposed marking medium and record medium, such as an inked ribbon and paper (both not shown), against the platen 16. When this occurs, and due to the overtravel relationship as identified above, the plunger 46 will have moved only partially through the space 84, as shown in Figure 4.

Upon impact of the print element 30 against the platen 16 due to the force of the hammer element 32, the hammer element 32 and print element 30 will experience a first rebound from the platen. The start of this first rebound condition is also shown in Figure 4. It is to be noted, however, that the plunger 46 will continue to travel in a forward direction due to the dynamics of the dual mass-spring configuration notwithstanding the rebound action of the hammer element 32. It should be apparent that the hammer element 32 is capable of rebounding while the support frame and thus the plunger 46 continue to travel forwardly, due to the action of the springs 60 and 62.

Now then, the hammer element 32, and thus print element 30, will each experience a first rebound a predetermined distance from the platen 16. The rebound distance of the hammer element 32 is determined by the siffness and length of the springs 60 and 62, as well as by the ratio of the two masses separated by the springs 60 and 62, and the force of impact, whereas the rebound of the print element 30 is determined by the resiliency of the print wheel spoke bearing the print element 30 and force of the impact.

After the hammer element 32 has completed its first rebound, the now "cocked" springs 60 and 62 will cause the hammer element 32 to again advance in the direction of the platen 16, as shown in Figure 5. At the instant of beginning advancement of the hammer element 32 toward the platen 16, the plunger 46 and support frame 38 are essentially at rest, as also shown in Figure 5. Due to the action of the springs 60 and 62, the hammer element 32 will again force the print element 30 and interposed marking medium against the platen 16. This condition is depicted in Figure 6. During advancement of the hammer element 32 toward the second impact the plunger 46 will begin to retract in a clockwise direction. Following the second impact, the hammer element 32 will rebound a second time, mainly due to the energy released after impact by the viscoelastic material of platen 16. Additionally, the plunger 46 and thus support frame 38 will continue their retract due to the bias of the springs 57 and prior deenergization of the solenoid 59. It must be made clear that the solenoid 59 can be deenergized at any point in time following initial energization, provided the forward driving force imparted to the hammer element 32 is sufficient to achieve the desired multi-impact and

consequent desired release of marking material.

If desired, the overall dwell time of the print element 30 against the platen 16 may be increased by continuously energizing the solenoid 59, including for a finite time after the second impact, thereby further increasing the total quantity of marking material (e.g., ink) released. The dwell time of the first impact may also be increased by stiffening the springs 60 and 62 or increasing the mass of the hammer element 32 and/or the plunger 46. In accordance with the preferred embodiment, two distinct impacts are preferred. It will still be appreciated, however that the overall dwell time is increased by two or more impacts over that which would normally be achieved by a single impact of the prior art hammer assembly disclosed in U.S. Patent No. 4,037,532, since the hammer element of that assembly would immediately rebound following impact. The overall impact time during which marking material is released is obviously greater during a multiple impact condition than a single impact with immediate rebound thereof.

The capability of increasing the overall dwell time, and more importantly increasing the overall quantity of marking material released, has resulted in the capability of reducing the required level of impact force per hit. This has the direct advantage of being able to use somewhat less durable, but considerably lower cost print elements, such as all plastic print wheels, as opposed to metallic or composite metal/plastic wheels, while maintaining high print quality through multi-impacts, and resultant increased overall dwell time and thus increased overall release of marking material. The overall print noise is also reduced without sacrificing print quality.

Referring again to Figures 2 and 3, it will be appreciated that when current is made to flow clockwise through the coil 80 and counterclockwise through coil 82, a resultant magnetic field will be established through the space 84 to force plunger 46 in the direction shown by the arrow in Figure 2. The level of force is related to the addition of the sizes of gaps 86 and 88 and the geometry of plunger 46. Thus, it makes no difference if one of these two gaps is larger in size than the other, since their sum will always be equal, thereby maintaining a desired level of force through the space 84. The need for critical adjustments of the support frame 38 to achieve size identity of the gaps 86 and 88 is thus reduced. Additionally, and as pointed out earlier, the need for critical adjustments of the spacing 85 (Figure 3) is also reduced.

Oscilloscope traces showing the relationships among travel of the hammer element 32, level of current flow through the coils 80 and 82, level of impact force by the hammer element 32, and time, are shown in Figures 9 and 10, for two different profiles of coil current. Hammer element travel was measured with an optoelectric device in which hammer element movement is proportional to output voltage, as shown in Figures 9 and 10. Current flow was measured with a current probe measuring current through the solenoid coils 80 and 82. Lastly, impact force was measured by piezo-electric force transducer positioned beneath the platen covering.

Yet another feature of the hammer assembly 10 is occasioned by the parallelogram defined by the pair of parallel springs 60 and 62 connected at one end to the mass 58, which includes the hammer element 32, and at its other end to the attachment portion 48 of the support frame 38, which defines an additional mass. By reason of this parallelogram and the action of the springs 60 and 62 in relation to the two masses, it was discovered that the hammer element 32 could impact the print element 30 against the platen 16 at different impact angles for each of the multiple (e.g., two) impacts as described above. Whether or not this "heel-toe" effect actually takes place depends upon the stiffness of the leaf springs 60 and 62 and the overall relationship of the springs to the two masses to which they are connected. When the springs are chosen to provide the so-called "heel-toe" effect, there is a counterclockwise movement of the tip of the hammer element 32 following the initial impact and just prior to the second impact. This movement may be amplified by offsetting the springs 60 and 62 further apart at their lower ends than at their upper ends. A somewhat exaggerated example of the latter relationship is shown by springs 60′ and 62′ in Figures 7 and 8. In this embodiment, the springs 60′ and 62′ are interposed at their upper ends between mounting blocks 64′, 66′ and 68′. A trapezoidal configuration is thus defined by the springs 60′ and 62′, mounting blocks 64′, 66′ and 68′, and the attachment portion 48 of the support frame 38 to which the lower ends of the springs 60′ and 62′ are mounted by suitable interposed mounting blocks (not shown). This trapezoidal shape has been found to amplify the counterclockwise movement, or "heel-toe" effect.

By reason of the heel-toe effect achieved by either of the two embodiments, it is possible to mount the support frame 38 in such a manner that the hammer element 32 will initially impact predominantly the lower portion of the print element 30, while striking predominantly the upper portion of the print element 30 during the second impact. It should be appreciated, however, that the importance in this relationship is not necessarily in altering the location of impact by the hammer element 32 against the print element 30, but rather altering the location of maximum impact force of the print element 30 against the platen 16. Thus, altering the location of impact of the hammer element 32 against the print element 30 is but one way of achieving the desired result.

The heel-toe effect reduces the need for critical adjustments of the platen 16 to insure that its axis of rotation is completely parallel to the rails (not shown) on which the carriage assembly 12 rides. For example, if the platen axis is skewed relative to the rails in a vertical direction, the top half of characters might not be printed at one end of the

paper while the bottom half might be deleted from the other end. By striking each print element twice, once low and once high, minor misalignments in a vertical direction will be compensated for in the embodiment of Figures 1—6, and more major misalignments will be compensated for in the embodiment of Figures 7 and 8.

Although an embodiment of the invention has been described using a pair of leaf springs 60, 62, a single leaf spring or more than two leaf springs may be employed.

Claims

1. A print hammer assembly comprising a support structure (38) pivotally mounted about an axis adjacent a print platen (16), a magnetically attractable plunger (46) mounted by a rigid support means (42) on said support structure, a print hammer (32) mounted by leaf spring means (60, 62) on said support structure (38), the plunger (46) and the hammer (32) being spaced apart angularly about said axis, and an actuator (59) capable of being energised to create a magnetic field so as to attract said plunger (46) and thereby rotate said support structure about the pivot axis and so cause the hammer (32) to make an impact with the print platen (16) or with an interposed print element (30), characterised in that the actuator (59) is located alongside a space (84) in which said magnetic field is created and through which said plunger (46) is free to travel on energisation of the actuator, without contacting the pole pieces thereof so that further rotational movement of the support structure (38) after said impact is restrained only by the leaf spring means (60, 62), and that the masses of the hammer (32) and plunger (46) are selected in relation to the properties of the leaf spring means so as to produce more than one of said impacts for each energisation of the actuator (59).

2. The print hammer assembly of claim 1 wherein said leaf spring means comprises a pair of non-parallel leaf springs (60', 62').

Revendications

1. Ensemble à marteau d'impression comprenant une structure de support (38) montée en pivotement autour d'un axe contigu à une platine d'impression (16), un plongeur (46) pouvant être attiré magnétiquement, monté par un moyen de support rigide (42) sur la structure de support, un marteau d'impression (32) monté par un moyen de ressorts à lame (60, 62) sur la structure de support (38), le plongeur (46) et le marteau (32) étant espacés angulairement autour de l'axe, et un actionneur (59) capable d'être excité pour créer un champ magnétique permettant d'attirer le plongeur (46) et donc de faire tourner la structure de support autour de l'axe de pivotement et par conséquent provoquer l'impact par le marteau (32) sur la platine d'impression (16) ou un élément d'impression interposé (30), caractérisé en ce que l'actionneur (59) est situé à côté d'un espace (84) dans lequel le champ magnétique est dréé et à travers lequel le plongeur (46) peut se déplacer librement lors de l'excitation de l'actionneur, sans venue en contact avec ses pièces polaires de sorte qu'un mouvement rotationnel ultérieur de la structure de support (38) après cet impact n'est limité que par le moyen de ressorts à lame (60, 62), et les masses du marteau (32) et du plongeur (46) sont choisies par rapport aux propriétés du moyen de ressorts à lame de manière à produire plusieurs impacts lors de chaque excitation de l'actionneur (59).

2. Ensemble à marteau d'impression selon la revendication 1, où le moyen de ressorts à lame comporte une paire de ressorts à lame non parallèles (60', 62').

Patentansprüche

1. Eine Druckhammeranordnung mit einer um eine Achse nahe einer Druckwalze (16) schwenkbar gelagerten Halterungsanordnung (38), mit einem magnetisch anziehbaren Stempel (46), der mittels einer starren Stützeinrichtung (42) an der genannten Halterungsanordnung angebracht ist, mit einem mittels einer Blattfedereinrichtung (60, 62) an der genannten Halterungsanordnung (38) angebrachten Druckhammer (32), wobei der Stempel (46) und der Hammer (32) mit gegenseitigem Abstand im Winkel um die genannte Achse angeordnet sind, und mit einer Antriebseinrichtung (59), die geeignet ist, zur Erzeugung eines Magnetfeldes erregt zu werden, um den genannten Stempel (46) anzuziehen und dabei die genannte Halterungsanordnung um die Schwenkachse zu drehen und so zu bewirken, daß der Hammer (32) einen Schlag auf die Druckwalze (16) oder auf ein dazwischen angeordnetes Druckelement (30) ausübt, dadurch gekennzeichnet, daß die Antriebseinrichtung (59) entlang einem Raum (84) angeordnet ist, in welchem das genannte Magnetfeld erzeugt wird und durch welchen der genannte Stempel (46) sich bei Erregung der Antriebseinrichtung, ohne deren Polstücke zu berühren, frei hindurchbewegt, so daß eine weitere Drehbewegung der Halterungsanordnung (38) nach dem genannten Schlag lediglich durch die Blattfedereinrichtung (60, 62) verzögert wird, und daß die Massen des Hammers (32) und des Stempels (46) im Verhältnis zu den Eigenschaften der Blattfedereinrichtung ausgewählt sind, um mehr als einen der genannten Schläge bei jeder Erregung der Antriebseinrichtung (59) zu bewirken.

2. Die Druckhammeranordnung nach Anspruch 1, in welcher die genannte Blattfedereinrichtung ein Paar nicht-paralleler Blattfedern (60', 62') umfaßt.

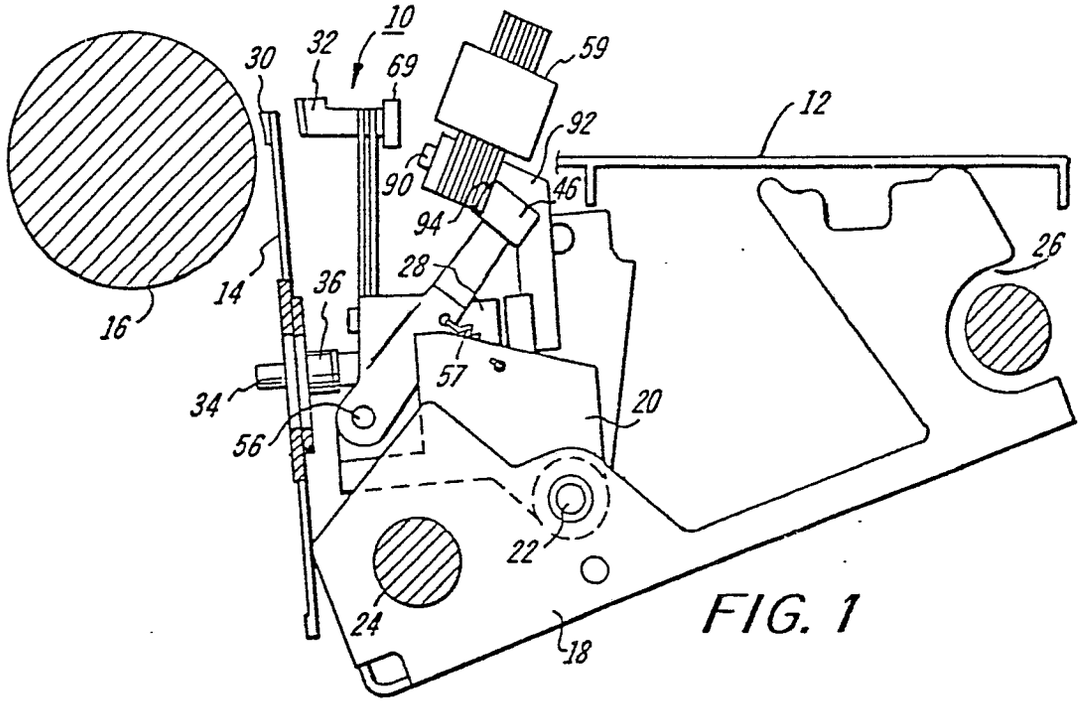

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FIG. 1

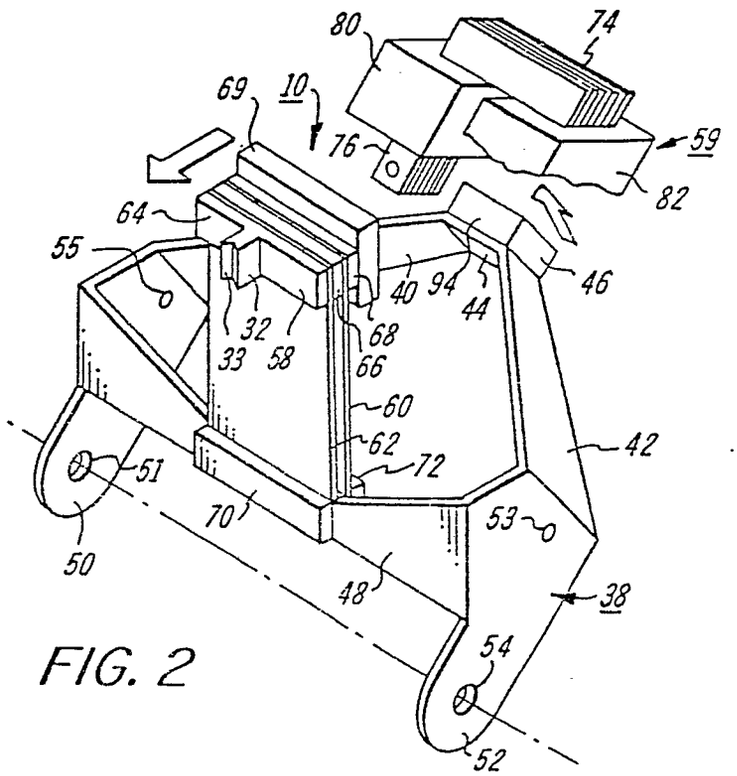

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FIG. 2

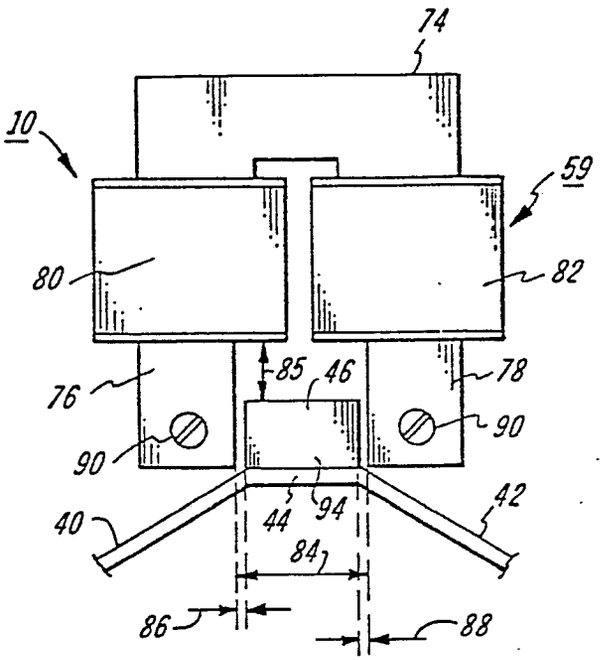

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FIG. 3

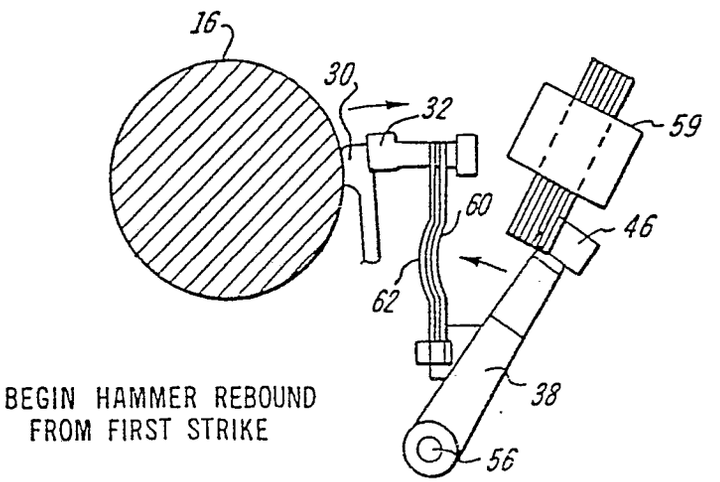
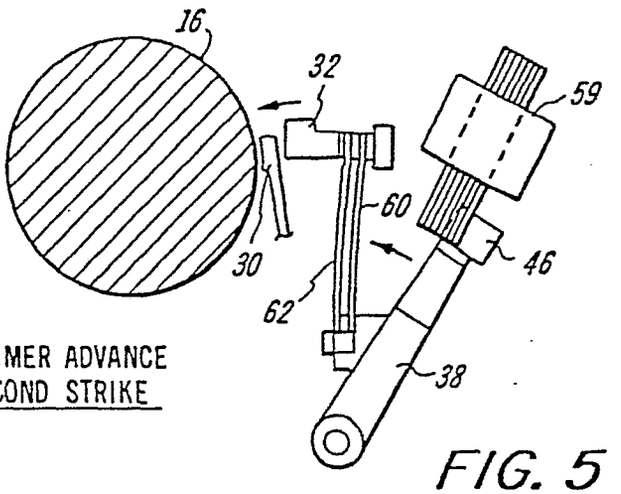
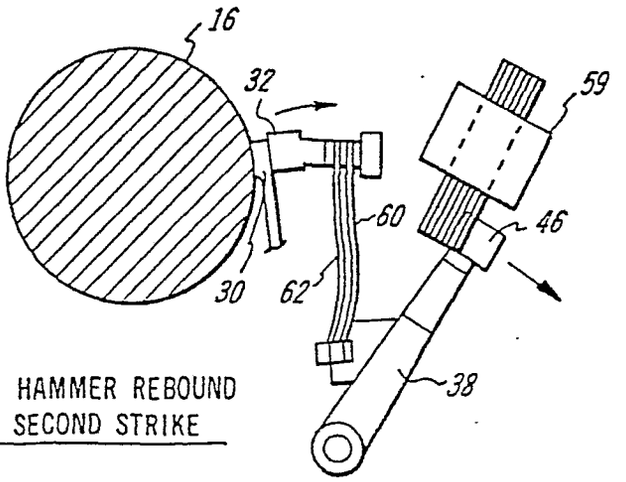

16
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62
38
56
BEGIN HAMMER REBOUND
FROM FIRST STRIKE

FIG. 4



BEGIN HAMMER ADVANCE
TOWARD SECOND STRIKE

FIG. 5



BEGIN HAMMER REBOUND
FROM SECOND STRIKE

FIG. 6

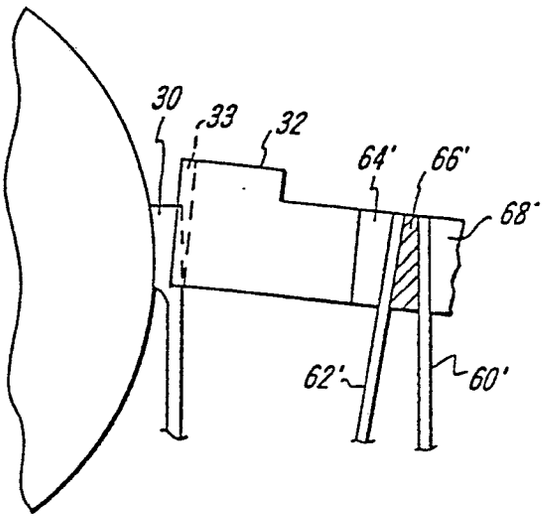


FIG. 7

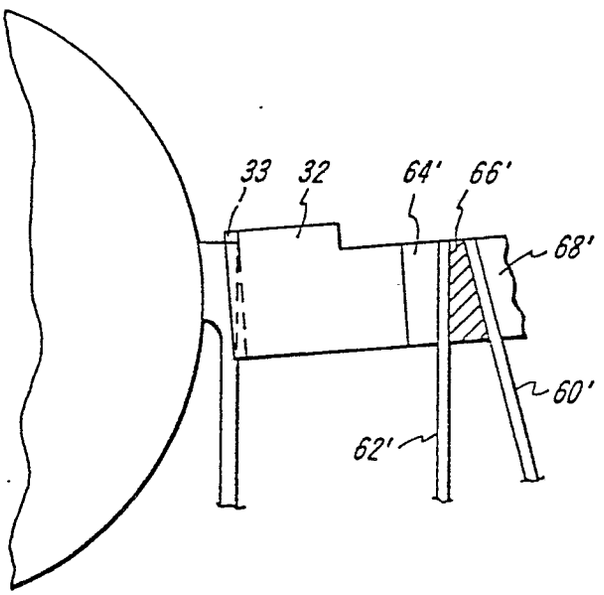


FIG. 8

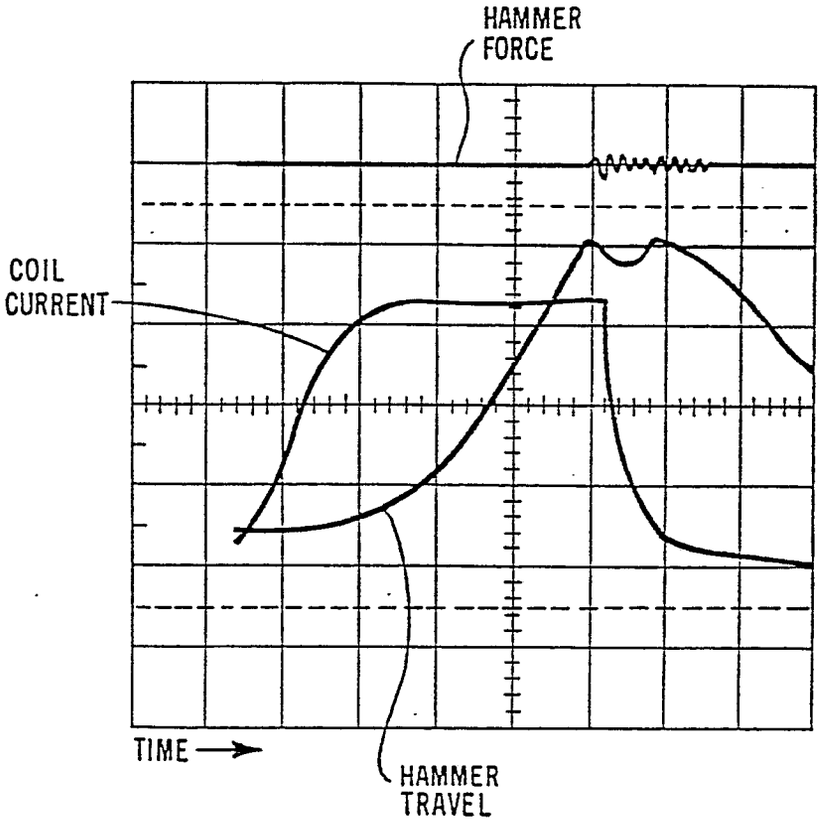


FIG. 9

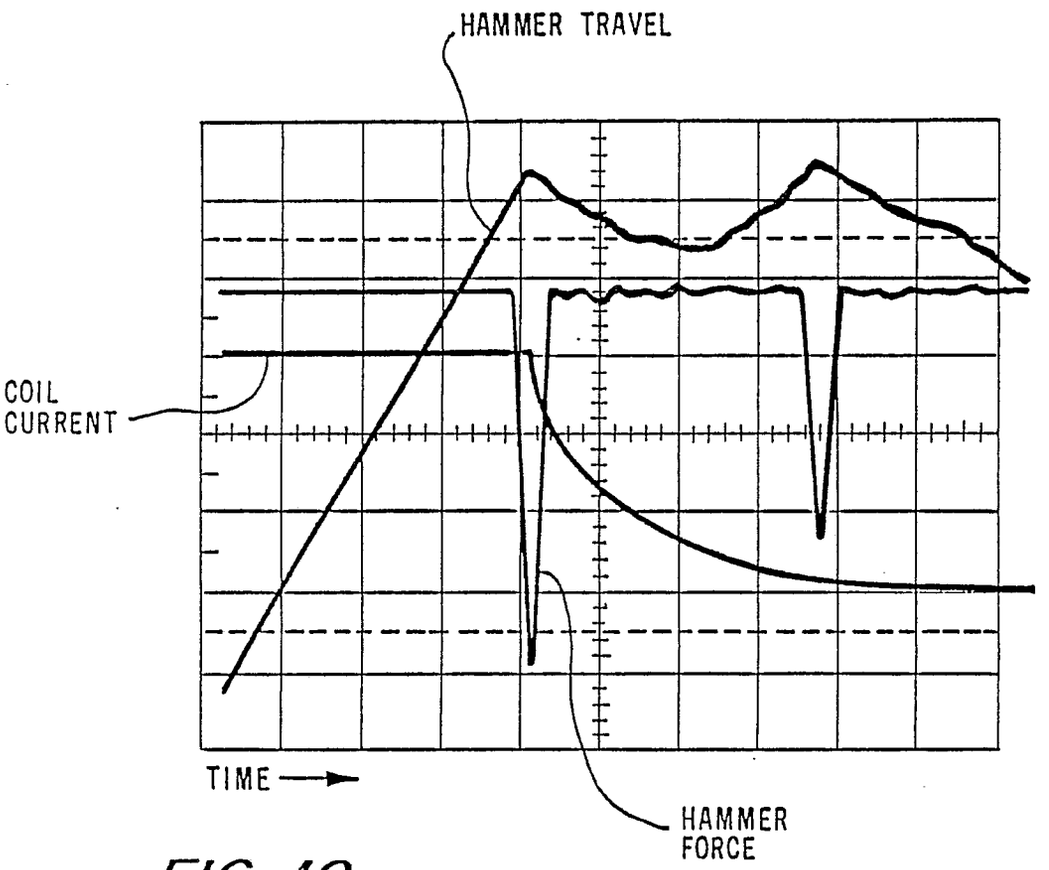


FIG. 10