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3,289,575

HIGH SPEED PRINTER HAMMER ASSEMBLY

Filed Jan. 8, 1964

3 Sheets-Sheet 1

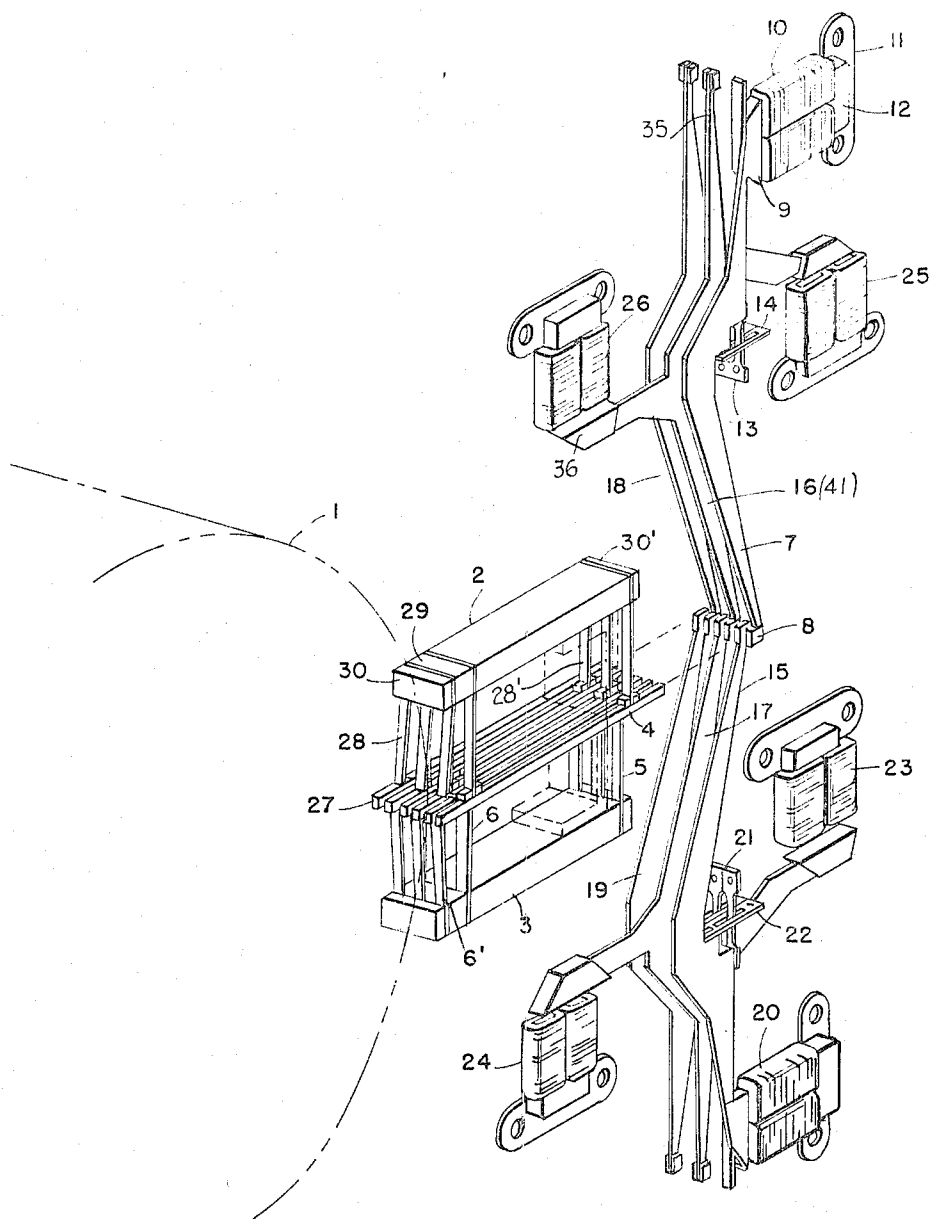


FIG 1

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3 Sheets-Sheet 2

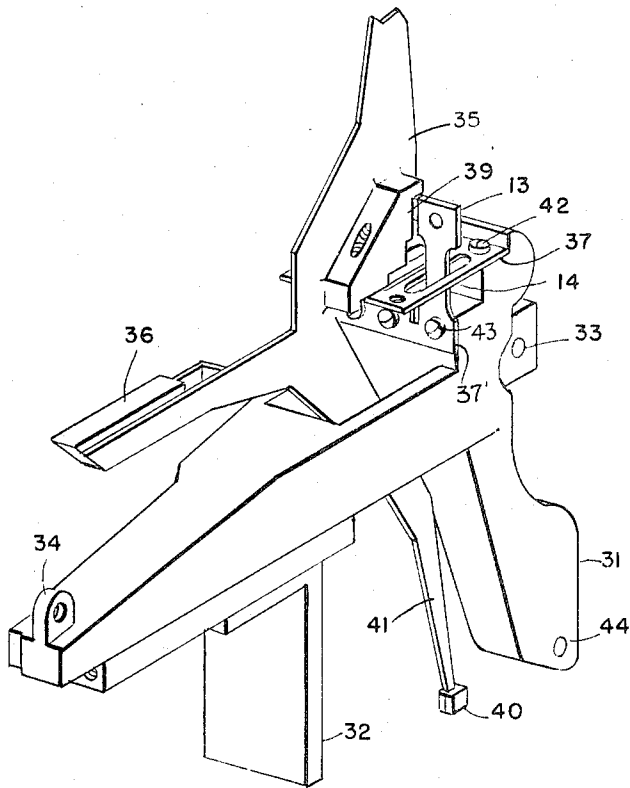


FIG. 7

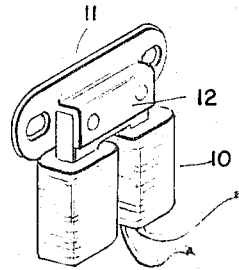


FIG. 6

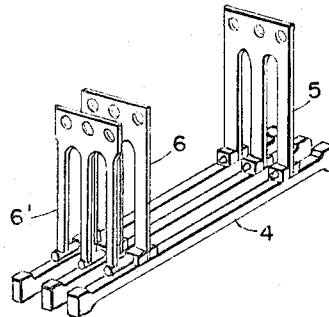


FIG. 5

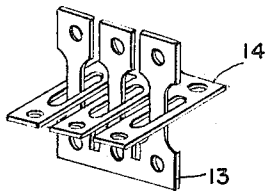


FIG. 2

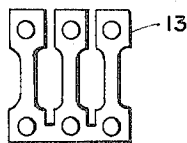


FIG. 3

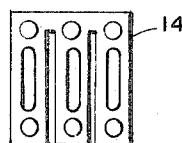


FIG. 4

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3 Sheets-Sheet 3

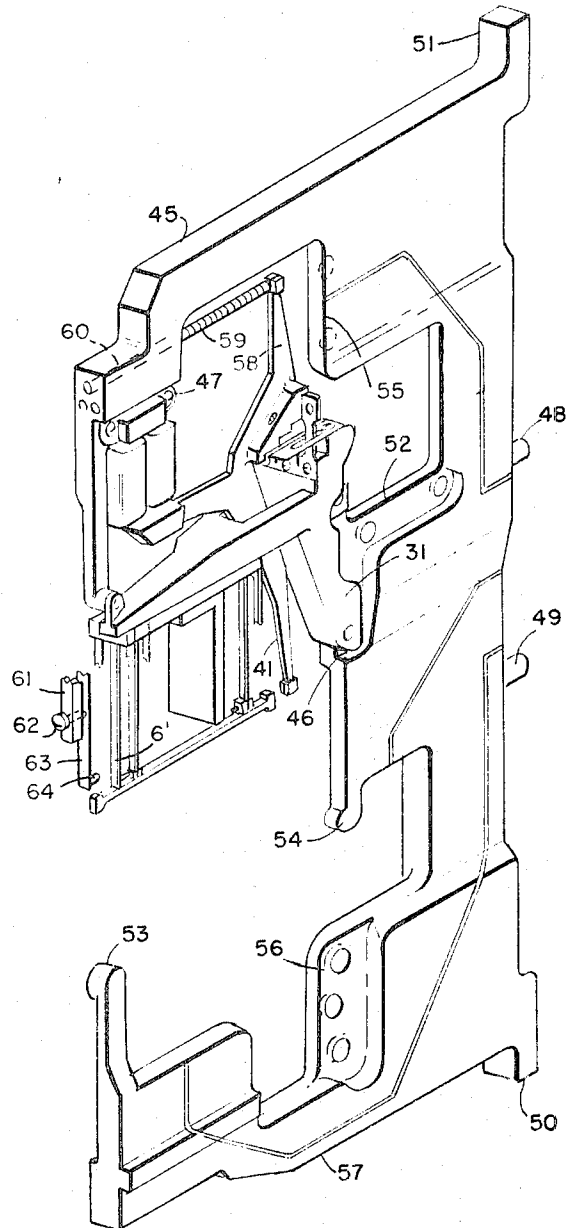


FIG. 8

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HIGH SPEED PRINTER HAMMER ASSEMBLY
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5 Claims. (Cl. 101-93)

The present invention concerns high speed printers and, in particular, novel printing hammer means for such printers.

The present invention is particularly concerned with, although not limited to, that type of printing device having a continuously rotating typewheel cooperating with a plurality of electromagnetically operated printing hammers. The paper is fed between the typewheel and the hammers, and at appropriate times the several hammers are independently actuated to print the different characters involved. This arrangement is now well known in the art as a means for printing the output of electronic computers and the like. While such printers are widely used, many problems remain to be solved. In addition, many operating characteristics of such printers are badly in need of improvement. Furthermore, more exacting requirements are being introduced almost daily as, for example, requirements for greater speed of operation and for greater reliability. The operation of the printing hammers is basic to these problems and the state-of-the-art is constantly being pushed in this area.

Some of the problems associated with printing hammer design include mechanical alignment, speed of response, uniformity of impact forces and flight time, transient response, power sensitivity, temperature sensitivity, interaction between driving coils, operating life, and spacing. In accordance with the present invention significant improvements have been made in all of these design areas. According to the present invention the hammer actuators are flat stampings readily and precisely made which are mounted by means of leaf springs doing away with alignment problems associated with pivots and other types of bearings. The spring mounting has been found to improve the transient response of the hammers and to greatly prolong their useful life. Adjustable hammer damping and rebound adjusting means as well as for setting the initial magnet air-gap are provided. The stacking arrangement providing six hammers to a module permits greater spacing between physically adjacent drive coils. It has been found that when this spacing is increased the coupling between coils decreases at a very rapid rate. The greater spacing also permits omitting shielding which has been found to greatly increase the power sensitivity of the hammer drive, an important advantage.

Accordingly, one object of the present invention is to provide methods of and means for greatly improving and simplifying the construction and operation of high speed printing hammers and printing hammer assemblies.

Another object is to simplify the alignment procedures required for accurate operation of high speed printing hammers.

Still another object is to provide faster operating and longer life high speed printing hammers and high speed printing hammer assemblies.

A further object is to provide printing hammers which operate with improved transient characteristics.

A still further object is to provide printing hammers and printing hammer assemblies in which interaction

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and shielding problems are minimized and power sensitivity is increased.

These and other objects of the present invention will be apparent from the detailed description of the invention given in connection with the various figures of the drawing.

In the drawing:

FIGURE 1 is a view of a four hammer module in accordance with the present invention with mounting means omitted to permit a clear showing of the arrangement of parts.

FIGURE 2 is a view of the crossed springs used to mount three hammer actuating arms.

FIGURES 3 and 4 are plan views of the two flat springs used in the assembly shown in FIG. 2.

FIGURE 5 is a perspective view of three hammers with their supporting springs in accordance with the present invention.

FIGURE 6 is a perspective view of a magnet and coil assembly suitable for use in the device in accordance with the present invention.

FIGURE 7 is a perspective view of a supporting member for three hammer actuators showing one hammer actuator in place in accordance with the present invention.

FIGURE 8 is a perspective view of a frame suitable for mounting six hammer actuators and their magnets showing one three actuator mounting member and one hammer actuator in place.

FIG. 1 shows the relative arrangement of hammers and actuators making up a six hammer module to print in conjunction with a type drum 1 shown in dot-dash partial outline. The six hammers are spring suspended, three hanging down from mounting block 2 and three standing up from mounting block 3. For example, hammer 4 which is a rod-like piece of metal is supported from mounting block 3 by means of springs 5, 6 and 6' while hammer 27 is hung from mounting block 2 by means of springs 28 and 28' and a third spring corresponding to spring 6 for the other hammer but which cannot be readily seen. The mounting blocks 2 and 3 are made up of main portions with one removable portion at one end as 30' for clamping one row of springs and two removable portions at the other end as 29 and 30 for clamping two rows of springs. When one end of any of these hammers is tapped at its end which is remote from the type drum, it moves in free flight to press a printing medium, not shown, against a predetermined type face on the type drum. The spring suspension of the hammers allows them to move freely with essentially no friction to deliver the kinetic energy imparted at one end to the printing point at the type drum surface.

The hammer actuators are flat metal arms as, for example, arm 7 having an enlarged end 8 for striking its corresponding hammer and an enlarged end 9 for receiving efficient attractive force from its driving magnet consisting of core 12, coils 10 and a mounting bracket 11. The actuator arm 7 is suspended by means of crossed flat springs 13 and 14 mounted on a mounting device shown in FIG. 7. When magnet core is magnetized by passing current through coil 10, the enlarged end 9 of arm 7 is pulled toward the core 12 and arm 7 pivoting around supporting springs 13 and 14 enlarged end 8 moves into contact with the outer end of hammer 4 imparting to it a flying motion toward the type drum 1 where it presses the printing medium, not shown, against a predetermined type face, not shown, carried on the surface of the drum.

It can be seen that the crossed flat springs 13 and 14 provide a stiff and inflexible mounting in two mutually perpendicular directions while allowing spring biased but otherwise free and substantially frictionless motion in a third direction perpendicular to the two directions of stiffness. In a similar manner springs 13 and 14 support the two additional arms 16 and 18 to be actuated by magnets 26 and 25 respectively and adapted to strike two additional hammers of the group of six illustrated. Three more actuating arms 15, 17 and 19 are shown interleaved with the three just described and supported by crossed springs 21 and 22. These arms are actuated by magnets 20, 24 and 23 respectively and serve to strike the remaining hammers of the six shown. The supporting method and means for the actuator arms is shown in FIGS. 7 and 8.

FIG. 2 is a perspective view of the crossed spring assembly consisting of springs 13 and 14 showing how they are cut-out and notched to permit the crossed arrangement.

FIG. 3 shows a plan view of spring 13 illustrating how it is cut-out to interleave with spring 14 and notched to permit assembly with spring 14 as shown in FIG. 2.

FIG. 4 similarly shows a plan view of spring 14 illustrating how it is cut-out to interleave with spring 13 and notched to permit assembly with spring 13 as shown in FIG. 2. The cut-out portions and notching of springs 13 and 14 not only provide means for easy assembly but these cut-outs and notches provide a simple means for controlling the stiffness of these springs. The mounting holes adapted to permit screw fastening to the spring mountings also permit a slight adjustment of the hammer actuator position in two dimensions for accurate alignment purposes.

FIG. 5 shows a group of three hammers. These three interleaved with three more similar hammers go to make up the total of six hammers in one module assembly. (FIG. 1 shows the six hammer assembly with corresponding numbering.) These three hammers as illustrated by hammer 4 are held in rigid parallel relationship by suspension springs 5, 6 and 6'. The spring mounting provides rigidity in two directions while permitting substantially frictionless motion in one direction which is the direction along the axis of the hammer. The ends of the hammers may be enlarged somewhat to provide enlarged striking areas at each end.

FIG. 6 shows a perspective view of a typical electro-magnet used to impart motion to the hammer actuators. This electromagnet is a simple frame 11 holding two coils 10 embracing two iron cores 12.

FIG. 7 is a perspective view of hammer actuator mounting member which provides a seat for the crossed springs 13 and 14. This mounting member will generally consist of a casting 31 including a lug 32, mounting and locating holes 33, 34 and 44, and mutually perpendicular seating areas 37 and 37' where springs 13 and 14 may be secured as by screws 43 and 42 respectively. A mounting block 39 is provided for attaching arm 35 to springs 13 and 14. One hammer actuator 35-41 is shown mounted on springs 13 and 14. This actuator includes hammer impulse enlarged end 40 and magnet armature end 36.

FIG. 8 is a perspective view of a module frame 45 suitable for mounting the six hammer actuator and magnet means show in FIG. 1 by means of two actuator mounting members one of which is shown in place at 31. This view shows how actuator mounting member 31 is located on studs 45, 46 and 52, one actuator 41 is shown and one magnet 47. A second actuator mounting member to accommodate three more actuators mounts in an inverted position with respect to 31 on studs 53, 54 and 56. Certain other studs and surfaces to permit accurately mounting and locating module frame 45 are shown at 48, 49, 50, 51 and 57. The hammer actuators, as illustrated by actuator 41, include a projecting arm 58 adapted

to be positioned by an adjustment screw 59 turning in a threaded hole 60 in frame 45 the purpose of which is to provide means for adjusting the initial air-gap between the enlarged magnet end of the arm and the magnet (see 9 and 10 in FIG. 1). Damping means are also provided for the hammer springs as the damping pad 64 carried on spring 63, adjustable by means of screw 62 carried by frame part 61 which may be attached to casting 31 in any convenient manner and adapted to contact and damp one or more of the hammer springs (as 5, 6 or 6' in FIG. 1) at a predetermined point in the hammer flight.

It can be seen from FIGS. 1 and 8 that the six element module provides six actuators, hammers and magnets in a relatively thin assembly and at the same time it locates the magnets in widely spaced positions. Also it can be seen that if another similar module is stacked adjacent to the one illustrated that the magnets of the adjacent modules will be laterally spaced center to center by an amount equal to the module thickness plus any space left between modules, in this case a pitch equal to six characters on the drum. It has been found that due to this physical spacing that there is no serious interference between magnets even without shielding of the individual magnets. This not only makes the system easier and cheaper to construct but it reduces the power required to actuate the hammers by a substantial amount. It should be pointed out that the thickness of a six element module must be substantially equal to the total linear displacement of six type faces on the type drum.

From the above description and the various figures of the drawing it will be seen that the present invention provides a high speed printer hammer arrangement having a number of unique characteristics and advantages. The hammers being mounted by means of flat springs extending perpendicular to the rod-like bodies of the hammers provide freely sprung and substantially frictionless freedom in a direction along the axis of the hammer while providing substantial stiffness in the other two mutually perpendicular directions. The flat springs mounting the hammers and the mutually perpendicular flat springs mounting the hammer actuators are conveniently stamped, cut or formed in groups of three for easier mounting and alignment and for saving in cost. The complete module or assembly of six hammers, six hammer actuators and six electro-magnets provides for three sets of the above on one side of the plane of the hammers and three sets on the other side of the same plane. The resulting assembly provides for mounting the six actuating electro-magnets in substantially the same plane. When a number of modules are stacked side-by-side, the lateral positions of these electro-magnets provides spacings from one magnet to its lateral neighbor which are equal to six times the pitch of the characters on the character drum which provides the magnetic decoupling necessary to prevent interaction between magnets. Little or no magnetic shielding being required for these magnets provides a substantial increase in their electromagnetic efficiency.

While only one embodiment and a few modifications of the present invention have been shown and described, many modifications will be apparent to those skilled in the art and within the spirit and scope of the invention as set forth in particular in the appended claims.

What is claimed is:

1. In a high speed printer, the combination of: a plurality of hammers each comprising a linear bar-like element, at least two leaf springs attached to each of said elements, and mounting means for said springs oriented to resiliently hold said linear element directed toward a predetermined printing area on a high speed character drum; an actuator for each of said hammers comprising three arms directed outwardly from two flat mutually perpendicular surfaces, two crossed flat springs one of which is secured to each of said surfaces, mounting surfaces for each of said springs at right angles to each other, wherein the first of said arms is adapted to be magnetically at-

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tracted by an electromagnet, the second of said arms is adapted to strike one end of one of said hammers and the third of said arms is adapted to bear against an adjustable stop to control the gap between the first said arm and its attracting electromagnet when said magnet is deenergized.

2. A combination as set forth in claim 1, wherein said crossed flat springs are formed in groups and are interleaved along their midsections.

3. A combination as set forth in claim 1, wherein said arms of said actuator are directed at angles substantially 90 degrees apart and lie in one plane.

4. A combination as set forth in claim 1, and including a frame device carrying said mounting surfaces.

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5. A combination as set forth in claim 1, and including a third leaf spring for mounting each of said bar-like elements.

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