PRINT HAMMER ASSEMBLY FOR HIGH SPEED PRINTERS

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This invention relates to an improved print hammer assembly for a high speed printer, and more particularly to improvements in print hammer assemblies of the type disclosed and claimed in U.S. Patent No. 2,940,385 to Frank R. House, entitled "High Speed Printer," issued June 14, 1960, and assigned to the assignee of the present application. It is the principal object of the present invention to provide an improved print hammer assembly having an increased useful life, for use in high speed printing equipment in which it is required to form print images on a moving strip of paper by impressing the paper, with an extremely brief impact, upon selected type characters on the surface of a continuously-revolving print wheel.

According to the aforementioned patent, very high-speed printing is carried out by rotatively driving a multiple-column print wheel, in each column of which is engraved a set of characters, such as an alphabet and the cardinal numbers, and striking the paper against selected characters as they pass a printing station. A synchronizing generator is drivenly connected with the print wheel and emits a stream of pulses corresponding to the arrival of each character in printing position, which pulses are used to produce energization of any of a plurality of magnetically-operated hammers to imprint an inked ribbon and paper against selected characters in any column of the print wheel. The print wheel is caused to rotate at high speed, and the movements of the print hammers between a rest position and a printing position must necessarily be extremely rapid, on the order of a few microseconds. If the hammer terries in the printing position for any appreciable time interval, a smeared character will be produced. Further, it is vital that upon the completion of the return stroke to rest position, its momentum be absorbed so that it will not rebound to strike the paper a second time; otherwise a "ghost" impression may be produced, spaced slightly from the original impression. Further, it is necessary that the mechanism exhibit an extremely long useful life in terms of the number of cycles of operation which can be attained.

The aforementioned patent to House provides a hammer bar suspension incorporating a flexible reed which pivotally mounts the hammer bar in a frame, a separate leaf spring which is secured in the frame and slingly engages the bar to bias it toward rest position, and closely-fitting recesses formed in the frame for guiding the bars in their pivotal movements, thus to prevent side ways motion from the desired paths. It has been found in practice that this system operates quite satisfactorily and affords a very considerable period of useful life. However, a limiting factor in the life span is the frictional sliding which takes place between the return spring and the hammer bar.

As previously stated, it is the primary object of my invention to further increase the useful life of a hammer assembly, and it is a related object to provide a friction-less hammer suspension whereby the limiting factor of return-spring friction is obviated. It is a further object to provide a simplified hammer assembly requiring fewer elements, which nevertheless provides a materially increased life in terms of cycles of useful operation. It is a further object to provide a hammer assembly with improved means for damping the rebound of a print hammer from the rest position on its rapid return from a printing position. Further objects and advantages of the invention will become apparent as the following description proceeds.

Briefly stated, according to a preferred embodiment of the invention, I mount the hammer bar pivotally in the frame means, solely by means of a leaf spring which is pre-stressed by its mountings to continuously bias the bar toward a rest position in engagement with a rest stop. The utilization of the leaf spring as the sole pivotal mounting, guide, and return spring for the hammer bar, eliminates friction and results in a life span which runs into hundreds of millions of cycles in actual practice. In a preferred form, the pre-stressing of the leaf spring is accomplished by securing it on complementary mounting surfaces on the frame and bar which are inclined with respect to one another so as to flex the leaf spring about the pivotal axis of the bar even in its rest position. Movement of the hammer bar toward the printing position further flexes the leaf spring in a direction to increase the return bias. In consequence, rebounding movement is opposed by a positive bias even in the rest position. However, an electromagnet provided to drive the bar to printing position must overcome this bias, and the bias is therefore held at a minimum compatible with effective prevention of rebound.

According to a further feature, a resilient stop is provided for absorption of the momentum of the returning hammer and has adjustable positioning means. The rest position of the hammer is determinative of its flight time toward the printing position, which must be equal for all the hammer assemblies of a multiple-column printer, to attain this end, I mount the resilient stop upon a flexible leaf which is pre-stressed away from the printing position, and position the leaf by means of a rod threadedly supported in the frame, so that any back-lash movement is prevented. The position of the resilient rest stop can thereby be precisely fixed to permit accurate control of the hammer flight time.

While the specification concludes with claims particularly pointing out the subject matter which I regard as my invention, it is believed that a clear understanding may be gained by the following detailed description of a preferred embodiment thereof, referring to the accompanying drawing, in which:

FIG. 1 is a plan view of a hammer module incorporating a plurality of hammer assemblies;

FIG. 2 is a view in elevation and partially in section, showing a print hammer in a rest position; and

Referring to the drawings, the module includes a series of print hammers having impact faces for impressing a moving web of paper against type faces (not shown) arranged in corresponding columns on a surface of a print roll, substantially as shown and described in the aforementioned House patent. The individual hammers of the module are spaced apart to admit hammers of a corresponding but opposed module between them, so that each of a closely-spaced series of rows of type characters may have operative relationship with a corresponding hammer. As described in the aforementioned House patent, the hammers in the opposed module are interspersed with the spaced-apart hammers.

Each hammer 10 is formed in one end of an elongated hammer bar 18, and is provided at its opposite end with a ferromagnetic portion 20, which may be separately formed and secured to the bar as by brazing. The bar proper and the hammer portion 10 are preferably formed of steel. The hammers are mounted in a frame generally designated at 22, which is an assembly of a base.
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For energizing the hammers, the ferromagnetic portions 20 extend across pole pieces 34 of coils 36, which are connected for selective energization by control means which may be as described in the aforementioned House patent, and of which no further description is therefore believed necessary. Alternate ones of the hammer bars have their ferromagnetic portions 20 in right-angular relation to the bars proper, in order to provide sufficient space in the limited width of the machine frame to accommodate the coils 36 associated with each of the closely-spaced hammers. These bars contain extending portions 21 which are used as spring mounts as described below.

The pole pieces 34 are mounted in suitable recesses 38 formed in the frame, by means of threaded fasteners 40. A thin film 42 of resilient material is preferably placed over the surface of each bar confronting the face of a pole piece 34, to avoid direct contact and to reduce wear deriving from the impact of the bars. Energization of the coils 36 produces a pivotal movement of the print hammer to printing position, as shown in Fig. 3.

The improved hammer assembly includes a series of leaf springs 44, one being associated with each hammer, and separated from one another in the assembly by guides 48. The leaf springs are secured to the slotted block 26 by means of a plate 52 and screws 54, in overlying engagement with a shim 58. The plate 52 causes all springs 44 to be rigidly secured to the block 26 as mounting screws 54 are tightened. Each spring is secured at its free end upon an inclined surface 56 formed on the portion 20 or 21 of a corresponding hammer by means of a plate 58 and screw 60. It should be noted that in the rest position shown in Fig. 2, the surfaces 56 are inclined to the common base portion 46 of the leaf springs at an angle thereby flexing the individual leaves about an unsupported pivot portion P, which extends across a gap between the block 26 and the portions 20 or 21 of the bars. The unsupported portions include and define pivotal axes of the bars, extending transversely to the movement. In consequence of the flexure of the leaf springs, they are pre-stressed in the rest position to bias the bars counter-clockwise as viewed in Fig. 2, toward the rest position. Energization of the electromagnets 34, 36 to drive the hammers to the print position shown in Fig. 3, increases the angle of inclination to a value B indicated in Fig. 3, thereby increasing the return bias. The leaf springs 44 act as the sole guides, pivotal supports, and return springs for the hammers. The block 26 is formed with slots 62 receiving the bars 18, but these afford considerable clearance, as they do not serve to guide the bars, this being the function solely of the leaf springs.

The movements of the hammer bars are limited by stop means comprising stop screws 64, for determining the printing position, and resilient members 66 for determining the rest position. The stop screws 64 are threaded in common in a nylon nut 68 mounted in the stop block 28, for adjustment to a printing position, which must be substantially uniform for all hammers. To minimize the period of engagement of the hammer faces 12 with the paper 14, the parts are so positioned relative to one another that the hammer 10 does not engage the stop screws 64 when the ferromagnetic portion 20 first engages the pole pieces 34, but the momentum of the hammer is relied upon to produce a whipping motion of the bar 18, carrying the hammer the remaining distance to the stop screws. A very rapid initial return is thereby ensured.

The spacing of the resilient members 66 from the stop screws 64 is critical, as it determines the flight time of the individual hammers, which must be substantially uniform to secure good printing quality. At the same time, it is desired that the rest stops be resilient to prevent rebound by absorbing the momentum of the hammer upon its return to rest position. I achieve precise adjustable posi-

tioning of the resilient members by mounting them upon leaf supports 70, which are cantilevered between the base 24 and the slotted block 26, and whose free ends are bent downwardly to bias the stops away from the printing position; and by positioning these spring-supported stops by means of set screws 72 which are received in bores 76 formed in the base. The set screws 72 are threaded to engage in common in a nylon nut 78 received in the base, to eliminate play. In normal adjusted positions, the leaves 70 are flexed upwardly by the screws 72, and their resulting downward bias holds the members 66 firmly in position. Rebound of the print hammers is thus effectively damped, and their flight time is accurately controlled.

It has been found in practice that the improved print hammer assembly operates effectively over an extremely long life span, running to hundreds of millions of cycles. This longevity is at least partially attributable to the frictionless pivotal suspension and sole support and guidance of the hammer bars afforded by the leaf spring mounting of the hammer bars, and also to the improved resilient rest stop means.

While I have illustrated and described preferred embodiments of my invention by way of illustration, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the true spirit and scope of the invention, and I therefore intend to define in the appended claims without limitation to the details of the illustrated embodiment.

1. A print hammer assembly for a high speed printer comprising a bar having a print portion, one end thereof and a portion of magnetic material at the opposite end thereof, said bar including means forming a spring-mounting surface that is substantially parallel to the axis of that portion of said bar that is adjacent said print portion, frame means formed with a spring-mounting surface, an electromagnet mounted in said frame means, said electromagnet having pole pieces adjacent said magnetic portion and being adapted when energized to pull said magnetic portion toward said pole pieces, a leaf spring having opposite ends secured to said spring-mounting surfaces, said bar and said frame means for connecting said frame means to said bar intermediate the ends of said bar for pivotal movement thereof and for biasing said bar toward a rest position, said frame means having opposed rest stop means and printing stop means coacting with said bar to limit said bar to pivotal movement between a rest position and said printing position, said electromagnet being constructed and arranged when energized to pivot said bar to said printing position, said rest stop being positioned to incline said spring-mounting surfaces with respect to one another in the rest position of said bar thereby to flex said leaf spring about said pivotal axis into a pre-stressed condition, biasing said bar against said rest stop means in said rest position to prevent rebound of said bar therefrom upon a return of said bar from said printing position.

2. A print hammer assembly for a high speed printer comprising a bar having a print portion at one end thereof and a portion of magnetic material at the opposite end thereof, said bar being formed with a spring-mounting surface that is substantially parallel to the axis of that portion of said bar that is adjacent said print portion, frame means including means forming a spring-mounting surface, an electromagnet mounted in said frame means, said electromagnet having pole pieces adjacent said magnetic portion and being adapted when energized to pull said magnetic portion toward said pole pieces, a leaf spring having opposite ends secured to said spring-mounting surfaces of said bar and said frame means for connecting said frame means to said bar intermediate the ends of said bar for pivotal movement thereof and for biasing said bar toward a rest position, said frame means having opposed rest stop means and printing stop means coacting with said bar to limit said bar to pivotal movement between a rest position and said printing position, said electromagnet being constructed and arranged when energized to pivot said bar to said printing position, said rest stop being positioned to incline said spring-mounting surfaces with respect to one another in the rest position of said bar thereby to flex said leaf spring about said pivotal axis into a pre-stressed condition, biasing said bar against said rest stop means in said rest position to prevent rebound of said bar therefrom upon a return of said bar from said printing position.
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5. A print hammer assembly as recited in claim 2, together with means for adjustably supporting said resilient member to regulate the stroke of said bar, said supporting means comprising a stop adjustably mounted in said frame, and a leaf spring carrying said resilient member, cantilevered in said frame, and engaged between said resilient member and said stop.

References Cited by the Examiner

UNITED STATES PATENTS

2,940,385 6/1960 House 101—93
3,110,250 11/1963 Fradkin 101—93
3,126,823 3/1964 Benson 101—93
3,144,821 8/1964 Drejza 101—93
3,177,803 4/1965 Antonucci 101—93

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