United States Patent

[11] **3,543,906**

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[54] **SOLENOID CONTROLLED PRINTING HAMMER MECHANISM**
1 Claim, 4 Drawing Figs.

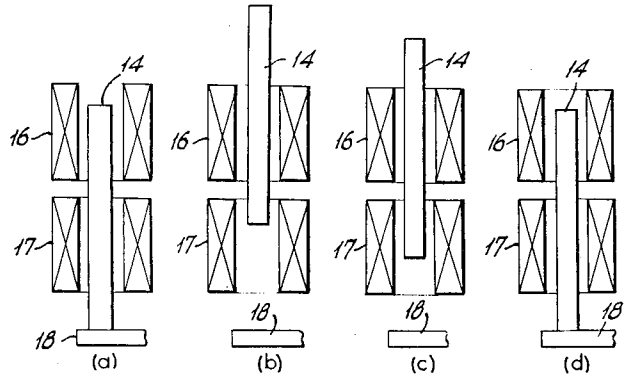
[52] **U.S. Cl.** **197/49;** 101/93; 335/256
[51] **Int. Cl.** **B41j 9/24**
[50] **Field of Search** 197/49; 101/93; 335/256

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ABSTRACT: A printing mechanism which forms printing impressions on a print medium by a hammer element in conjunction with constantly moving character type. The mechanism includes two solenoids mounted end-to-end and having alined openings therethrough. The hammer element moves entirely under the influences of magnetic fields generated by the solenoids from electric currents supplied and controlled by electronic circuitry.

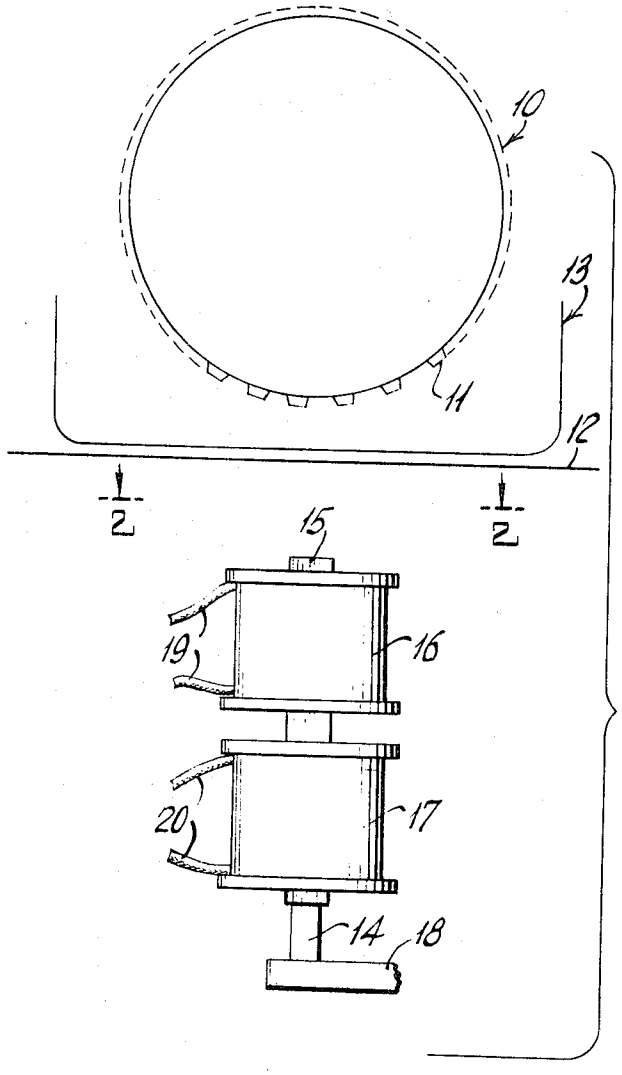


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Sheet 1 of 2

Fig. 1.



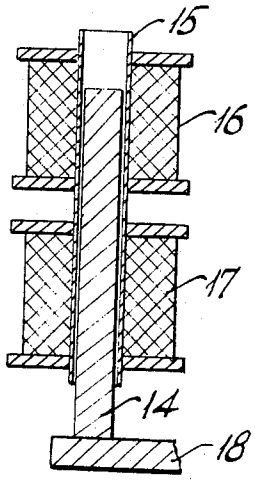


Fig. 3.

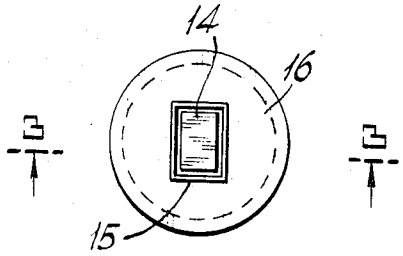


Fig. 2.

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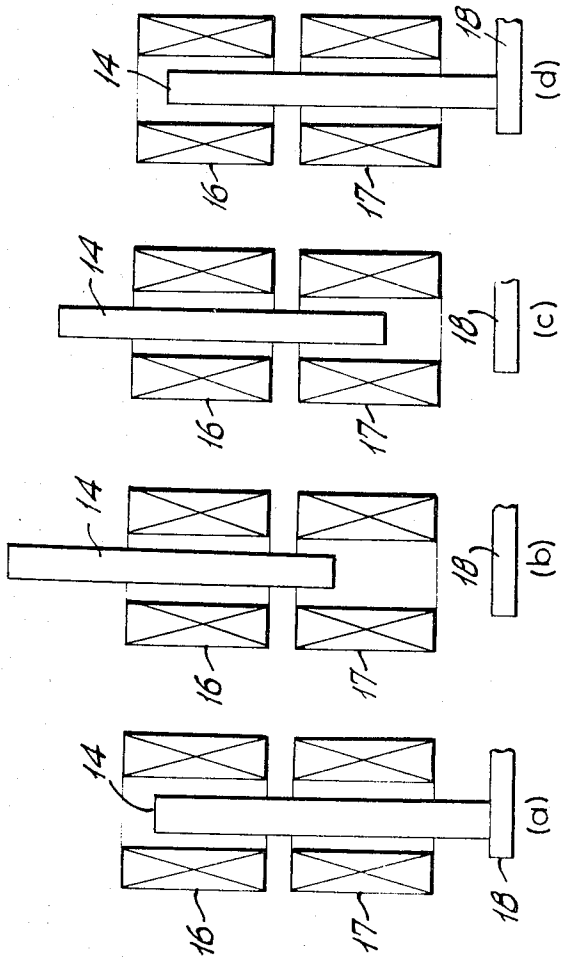


FIG. 4.

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SOLENOID CONTROLLED PRINTING HAMMER MECHANISM

The present invention relates generally to a printing hammer control and apparatus, and in particular, to a solenoid controlled printing hammer for use with a rotating drum upon which type characters are placed.

As disclosed in copending U.S. Pat. application Ser. No 484,514 filed Sept. 2, 1965, now abandoned, high speed printers are employed to provide a readout information from a binary coded input. Such printers make use of a rotary drum or wheel, upon which characters, such as letters, numbers, and symbols, are formed along the outer periphery. To produce the printed information, upon a printing medium a printing hammer is caused to strike against an inked ribbon, the printing medium, and the character wheel.

Because of the high speed required in such printers, the control mechanism of the printing hammer must produce a quick response with little or no transients, while still providing a sufficient impact force upon the printing medium to print out a clearly legible character.

Presently known methods of hammer activation and return include the use of a spring which has the disadvantage of producing transients; that is the printing hammer is not returned to the rest position without resulting damped oscillations. Also, the energy expended by the actuating and return spring absorbs some of the striking energy of the hammer, thereby reducing the impact force of the hammer upon the printing medium.

It is, therefore, an object of the present invention to provide in a high speed printer, a high speed printing hammer activator and return means which overcomes the deficiencies of prior art devices.

It is also an object of the present invention to provide a novel solenoid actuated printing hammer for use in a printing mechanism of the type described, in which both the impelling and return forces on the printing hammer are controlled by external electrical signals such as electrical pulses.

A further object of the present invention is to provide in a high speed printer, means for controlling the operation of a printing hammer which requires a minimum of moving parts, thus providing a long and reliable life of the printing equipment.

It is yet a further object of the present invention to provide in a high speed printer, a simple and effective means for operating a printing hammer at high speeds to produce a clear readout in which the movement and impact intensity of the printing hammer is controlled by electromagnetic forces, which are in turn produced by pulse coded electrical signals.

In accordance with the objects of this invention, the printing hammer is made of a ferromagnetic material which is oriented with respect to the central hollow portions of two solenoids, coaxially disposed and in registry with one another. The printing hammer is caused to move in the direction of the printing medium so as to strike against the printing medium through the force created upon the hammer by the electromagnetic field created by one of these solenoids, and is returned to the rest or nonprint position, by the operation of the other solenoid. The timing operation of the solenoids is determined by electrical pulse signals supplied to the solenoids by external electronic control circuitry. Both the impelling force and the return and holding force upon the hammer are produced solely by the forces created by the solenoid fields which act exclusively of one another. That is, only one of the solenoids operates at a given time during the printing sequence.

Further objects and advantages, as well as a more specific description of the invention, may be had from the following specification when studied in conjunction with the enclosed FIGS. in which:

FIG. 1 is a top plan view showing the solenoid control printing hammer as incorporated in a high speed printer, which is shown schematically, showing the relative positions of the printing hammer, with respect to the print medium, ribbon and character wheel;

FIG. 2 is a view of the solenoids and printing hammer taken along line 2–2 of FIG. 1;

FIG. 3 is a sectional view taken along line 3–3 of FIG. 2; and

FIGS. 4 *a*, *b*, *c*, and *d* are schematic diagrams showing the various positions of the printing hammer with respect to the solenoids in a typical print and return operation.

With reference to the FIGS., and in particular FIGS. 1—3, there is shown the inventive hammer control mechanism as employed in a high speed printer of the type described with greater specificity in U.S. Pat. application Ser. No. 484,514 filed Sept. 2, 1965.

In FIG. 1 there is shown in a simplified form, a character wheel **10** upon the outer periphery of which are disposed characters **11**, such as letters of the alphabet, or numbers and symbols, which are to be printed upon a print medium **12**, which passes between a ribbon **13** and a printing hammer **14**. By the operation of a logic circuit (not shown) which is described in the aforesaid application, the operation of the printing hammer **14** is timed to strike against the print medium when the desired character on the character wheel **10** is disposed directly above the hammer **14**, so that the selected character is printed upon the print medium **12** by the striking of the hammer **14** against the ribbon **13** and character **11**.

As shown in FIGS. 2 and 3, the hammer **14**, which is made of a magnetic material such as iron, is disposed within a guide **15**, which is substantially of the same cross-sectional shape as the printing hammer **14**, and is placed within the passageway of two substantially identical solenoids **16** and **17**. Both solenoids are of the type well known in the art and consist mainly of electrical wire wound on a central core. Electrical wires **19** and **20** lead to the external logic circuitry to energize the solenoids **16** and **17** respectively.

As seen in FIGS. 1 and 3, the solenoids **16** and **17** are placed in registry with one another and are mounted along the same longitudinal axis. The hammer **14** is of sufficient length to extend through both of said solenoids when said solenoids are shown in as positioned in FIGS. 1 and 3. In the rest, or nonprinting position, shown in FIGS. 1 and 3, the hammer **14** is held against a stop **18** by the force exerted by the return and hold solenoid **17** which is energized with sufficient current to cause the hammer **14** to be magnetically forced against the stop **18**. In this position the hammer **14** is so oriented that its transverse central axis is somewhat displaced from the central axis of the impelling solenoid **16** as shown in FIG. 2. The actuation of the printing hammer **14** against the print medium **12** is caused by the energization of the impelling solenoid **16** and the deenergization of return and hold solenoid **17**. This is caused by removing the source of current from solenoid **17** and by directing a current to flow through impelling solenoid **16**.

The energizing force caused by impelling solenoid **16** causes the hammer **14** to move towards the printing medium **12** and character wheel symbol **11**. Under the influence of the constantly applied magnetic field in the impelling solenoid **16**, hammer **14** ultimately comes to rest with its transverse central axis in line with the central axis of the impelling solenoid **16**. However, a magnetic field of sufficient intensity is provided by the energizing current of solenoid **16**, so as to cause the hammer **14** to overshoot the transverse central axis of the solenoid **16** before coming to rest with its central axis coinciding with that of solenoid **16**. This overshoot is dependent upon the momentum of the hammer **14**, resulting from the intensity of the magnetic field produced by the impelling solenoid **16**, and it is this overshoot which is utilized for making the impression upon the printing medium by the hammer striking against the printing medium, ribbon and character simultaneously. The hammer **14** and impelling solenoid **16** are positioned at a distance from the type face or character on the character wheel **10** so that the hammer **14** will strike the print medium **12** and the ink ribbon **13** to drive them both against the character due to the overshoot produced by the force of impelling solenoid **16**. The dwell time of the hammer impact against the character **11** will be dependent upon the distance set between the character **11** and the distance between the hammer **14** at the time of impact and at the stop position. Therefore, the time required for the hammer to return to a

stop position determines the amount of dwell time during which the hammer is impacted against the printing medium and character.

FIGS. 4, *a*, *b*, *c*, *d*, show the various positions of the hammer **14** with respect to the solenoids **16** and **17** in a typical printing operation.

In FIG. **4***a* the hammer **14** is at rest and is positioned against the stop **18**. The impelling solenoid **16** is unenergized while the return and hold solenoid **17** is energized to hold the hammer against the stop. In FIG. **4***a*, it is clearly seen that the transverse central axis of the hammer **14** is displaced from the transverse central axis of impelling solenoid **16**.

In FIG. **4***b* the hammer **14** is shown in the full overshoot position after being impelled outwardly by the force of the impelling solenoid **16**. In this configuration, impelling solenoid **16** is energized, while hold and return solenoid **17** is simultaneously deenergized.

FIG. **4***c* shows the hammer returning to the rest and hold position with the transverse central axis of the impelling solenoid **16** after having returned from the impact against the print medium. At this time the solenoid **16** is deenergized while solenoid **17** is energized urging the hammer **14** back to the rest position as shown in FIG. **4***d* which corresponds to the position in FIG. **4***a*, thus completing a printing cycle. Means (not shown) are provided whereby, after the printer has been inoperative, a signal is first led to solenoid **17**, causing the hammer **14** to return to the rest position, so that the hammer **14** is always in the rest position prior to the commencing of the printing operation.

It is within the scope of this invention to vary the impact force of printing hammer **14** upon the printing medium, by varying the amount of electric current energizing the respective solenoids, or by varying the size and disposition of said solenoids with respect to character wheel **10**, or with respect to each other.

After a printing operation is performed, the hammer is retained in the rest position by the force exerted by the magnetic field of the return and hold solenoid **17** which turns the hammer back to the rest position and firmly retains it there until the next occasion when a printing signal is received by the impelling solenoid **16**.

While I have shown but one embodiment of my invention I desire, however, that my invention be defined by the scope of the claim which is appended below.

I claim:

1. A printing mechanism having a medium on which printing is placed comprising a plurality of type elements for printing various characters, a movable member on which said type elements are spatially located, said member being movable adjacent to said medium, an elongated printing hammer for striking substantially simultaneously against said medium and a preselected character whereby an imprint is made on said medium, first and second solenoids mounted in end-to-end relationship having alined openings therethrough, said elongated printing hammer being located in said alined openings in both first and second solenoids, a stop adjacent to one end of said printing hammer, means for selectively energizing each of said solenoids, said first solenoid when energized having a magnetic field of sufficient intensity to cause said hammer to overshoot the transverse central axis of said first solenoid and to project beyond the end surface of said first solenoid remote from said second solenoid and to strike against said medium and said selected type element, and said second solenoid when energized withdrawing said hammer away from said element and abutting said stop to a rest position.