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(54) **DIRECT SOLENOID DRIVE IMPRINTING MECHANISM.**

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(56) References cited:

DE-A- 3 330 563	**GB-A- 1 395 444**
US-A- 2 927 676	**US-A- 3 001 624**
US-A- 3 306 416	**US-A- 3 712 212**
US-A- 3 900 094	**US-A- 3 998 153**
US-A- 4 220 085	**US-A- 4 378 733**
US-A- 4 407 595	**US-A- 4 476 781**

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Description

The present invention relates to an apparatus for imprinting sheet material with characters according to the preamble of claim 1.

More particularly, a solenoid driven embossing mechanism of this type can be used for embossing information onto a common credit card.

Automated embossing systems have found wide acceptance in the field. Two such systems are disclosed in U. S. Pat. Nos. RE 27,809 to Drillick and 3,820,454 to Hencley et al and U. S. Pat. No. 3,820,455.

U. S. Pat. Nos. 4,271,012, 4,180,338 and 4,088,216 all show a system utilizing a pair of embossing heads in a card transport mechanism for rapidly positioning a card to receive characters from punch and die members carried by punch and die wheels. The characters are applied to various embossing locations on the surface of a card. The application of the embossing forces to the punch and die members is, in all of the systems shown in the patents listed above, by a motorized cam driven, continuously oscillating bail arm mechanism for mechanically driving the punch and die members. Such systems are mechanically complex and quite heavy because of the necessity of providing extremely strong mechanical structures for mechanically developing and coupling the embossing forces to the punch and die elements. Such prior art structures are not particularly helpful for use in simple and common lower volume applications where machines having reduced physical size and weight and lower cost are particularly necessary.

In a known imprinting apparatus (DE-A-3330563) the printing elements are connected via a linkage to a plunger which is cam shaft driven to move the printing elements into contact with the sheet material, whereupon the imprinting force is applied to the plunger by a solenoid.

Accordingly, it is an object of this invention to provide apparatus for embossing sheet material which provides the embossing function in a more simple and effective manner, wherein the apparatus is of reduced size and weight relative to what has been previously available.

According to the invention, the object is solved by the features of claim 1. The subclaims characterize further particularly useful features. Accordingly the cooperating punches and dies are inserted in slots positioned about the circumference of punch and die wheels rotatable in synchronism with each other to permit positioning of a selected punch and die pair on both sides of sheet material positioned in an emboss location and improved embossing pressure applying mechanism. The mechanism includes at least one solenoid mechanism mounted on the frame and constructed and arranged for effecting linear movement of punch and die members along an embossing axis when the solenoid is energized from a first position to a second position by application of a suitable voltage; linkage means coupled to the shaft of each of the solenoid means and including drive pin means for imparting motion, along the embossing axis, of the solenoid shaft to an embossing element, the linkage means also including spring restraining means for retaining the solenoid shaft in the first unactuated condition; and driver means for applying voltage for energizing the solenoid means to apply a selected character to sheet material positioned in the embossing area.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of the important elements of the embossing mechanism shown in section taken vertically through the rotational axis of the printwheel with some elements not sectioned for illustrative purposes.

FIG. 2 is a sectional view taken along the line 2-2 of FIG. 1.

FIG. 3 is a sectional view taken along line 3-3 of FIG. 1.

FIG. 4 is a schematic electrical diagram of the solenoid drive circuitry.

FIG. 5 is a sectional view taken along the line 5-5 of FIG. 1.

FIG. 6 is a fragmentary sectional view of an alternate embodiment of an embossing mechanism utilizing only a single solenoid and is the view that would be seen viewing along the line 6-6 of FIG. 5.

FIG. 7 is a sectional view of another embodiment of the embossing mechanism with the section taken in the same manner as FIG. 1.

FIG. 8 is a sectional view of yet another embodiment of the embossing mechanism with the section taken in the same manner as FIGS. 1 and 7.

FIG. 9 is a sectional view of a further embodiment of the embossing mechanism with the section taken vertically through the rotational axis of the printwheel.

FIG. 10 is a sectional view of a still further embodiment of the embossing mechanism with the section taken in the same manner as in FIG. 9.

FIG. 11 is a sectional view of an additional embodiment of the embossing mechanism with the section taken in the same manner as in FIG. 9.

FIG. 12 is a sectional view of a further alternative embodiment of the embossing mechanism with the section taken in the same manner as in FIG. 9.

DETAILED DESCRIPTION OF THE PREFERRED

EMBODIMENTS

In the several embodiments of the invention shown, parts common to the several embodiments may be identified by the same reference characters.

FIG. 1 shows the important elements of one of the preferred embodiments of the direct solenoid drive embossing mechanism 10. The punch and die embossing elements of the basic embossing system are similar to what is shown in U. S. Pat. No. 4,271,012 and U. S. Pat. No. 4,519,600, both of which are assigned to the assignee of the present invention. In those and other prior art embossing mechanisms, a pair of type element wheels 12 and 14 are mounted on a common shaft 16 and secured by set screws 18 located in hubs 20. Of course, use of a single shaft 16 is not necessary since other means can be utilized to synchronize the rotation of wheels 12 and 14, even if they are mounted on separate but coaxial shafts. Shaft 16 is supported on frame 22 by bearings 24. Shaft 16 is driven by positioning mechanisms as shown in U. S. Pat. No. 4,271,012 so that appropriate pairs of punch elements, such as 26, on wheel 14 and die elements, such as 28, on wheel 12 are positioned for embossing. FIG. 2 shows the embossing punch 26 aligned with an aperture 25 in a stationary guide plate 27. Guide plates 27 define an embossing area 30 between them.

A suitable card or sheet material 32 is positioned with the area to be imprinted located in the embossing area 30. The card handling mechanism shown in U. S. Pat. Nos. 4,271,012 or 4,519,600, for example, provides a suitable mechanism for positioning card 32 and moving it through embossing area 30 to receive a series of embossed characters from punch and die members 26 and 28 and other selected punch and die members carried by wheels 14 and 12.

In prior patents such as U. S. Pat. Nos. 4,271,012 and 4,519,600, the embossing pressure was applied to punch and die members 26 and 28 using a complex mechanical mechanism driven by a pair of oscillating continuously motor driven bail arms utilizing a complex mechanical linkage to bring force from the movement of the continusouly oscillating bail arms to the punch and die members. In the preferred embodiment of the present invention, a variety of greatly simplified solenoid actuated drive mechanisms have been devised to eliminate the use of the motor cam and continuously driven oscillating bail arms and the complex mechanical linkages, relying instead upon the considerable embossing forces which can be developed by an improved linear solenoid.

In the preferred embodiments shown in FIGS. 1 through 6, linear solenoids 40 are each secured to frame 22 with their shafts 42 projecting and aligned with the axis of linear movement of punch and die members 28 and 26 into and away from embossing area 30. Suitable linear solenoids 40 are manufactured by Ledex Inc., 801 Scholz Drive, Vandalia, Ohio 45377, and described as axial solenoids Part Nos. 189987 or 187790.

In FIG. 1, shaft 42 is secured in an inner sleeve 44 which may be adhesively secured to shaft 42 using a set screw, by shrink fit or by the use of a suitable adhesive. Alternatively, shaft 42 can be threaded to threadably engage inner threads on outer sleeve 50. Sleeve 44 has a set of outer threads 46 which engage corresponding threads 48 on the inner wall of outer sleeve 50. Outer sleeve 50 is secured to inner sleeve 44 using a set screw 52 which can be tightened to apply pressure to the threads of inner sleeve 44. In order to protect the threads 46 of inner sleeve 44, a plastic plug 53 is inserted in the hole in outer sleeve 50 before set screw 52 is inserted, thereby providing a resilient locking action which is not likely to damage outer threads 46 of inner sleeve 44. Outer sleeve 50 has a hardened driver pin 56 mounted in front of it which is slidably supported in a plain bearing 58 inserted in an aperture 60 of frame 22 as can be seen in FIGS. 1 and 2. Drive pin 56 is formed of a suitable hardened material to withstand the repeated impacts with punch and die members 26 and 28 as the embossing mechanism is operated.

A restraining spring 62 is seated in aperture 60 of frame 22 so that one end bears upon the frame 22 while the other end bears upon a grip ring 64, which is attached to drive pin 56. Alternatively, drive pin 56 can have a projecting shoulder or head, rather than ring 64, to hold spring 62. Spring 62 is a compression spring which biases the linkage elements and solenoid shaft 42 into a rest position so that drive pin 56 is normally spaced from the head of punch and die members 26 and 28, thereby permitting wheels 12 and 14 to be rotated without interference to position selected punch and die sets for embossing. The restraining force of spring 62 is preferably kept at as low a level as possible to facilitate the adjusting of the solenoid current to minimize impact noise as described in more detail below.

When the selected pair of punch and die elements 26 and 28 are positioned in the embossing area, solenoid 40 is actuated to drive shaft 42 toward the embossing area, thereby moving inner sleeve 44, outer sleeve 50 and drive pin 56 toward the embossing area, striking punch or die member 26 or 28 and forcing it into engagement with card 32 in embossing area 30. If sufficient travel of shaft 42 occurs and a sufficient force is developed, the card will be embossed with the character defined by the punch and die members 26 and 28.

An important advantage of the direct solenoid driven embossing mechanisms of this invention is that there need be no long delay between the time that the selected embossing area of the card is in position and the application of the punch and die to the card. In the prior art systems using continuously rotating bail arms, there is an inherent delay between the positioning of the card and the time when the bail arms are in the proper position to apply the embossing force. In such systems, each character is delayed by about one-half cam rotation for each character. In the present system, solenoid 40 can be energized as soon as the card is in position to receive the character, and a shorter time is required to emboss a series of characters.

Because solenoid 40, if actuated with a single electrical drive pulse, provides a very sharp impact between driver pin 56 and punch or die element 28, in addition to the noise as the solenoid reaches its internal stop, an extremely noisy embossing operation occurs, unless modifications are made to the solenoid drive. This is due in part to the fact that the solenoid armature and linkage have a considerable mass which is moving at a relatively high speed at the time that it overcomes the compression force of spring 62 and impacts the surface of card 32.

In order to prevent noisy operation, it has been determined that the solenoid 40 should be energized in two stages. In the first stage of energization, sufficient voltage is applied to the solenoid for sufficient time merely to allow drive pin 56 to engage punch or die member 26 or 28 and bring it into contact with the surface of card 32. After punch 26 and die 28 have been brought into contact with card 32, solenoid 40 is energized again for a longer time interval to apply force to the punch and die member to emboss the card. Because punch and die 26 and 29 are already in contact with card 32 when the embossing force is applied, the loud impact noise of the printing elements striking the card is avoided and the pressure applying step necessary for completion of the embossing operation occurs with little noise. The impact of the movable solenoid shaft 42 against the internal stop is also reduced because the control of the energization pulse reduces the velocity of the moving parts without reducing the embossing force. Using an extremely short interval for the first voltage application to solenoid 40 results in a much lower impact force between the face of the type element and card 32 and therefore reduces the total noise of the operation without degrading the quality of the embossing. It also may allow for longer life of the mechanical embossing elements.

Application of the embossing command voltage in two parts to accomplish quiet embossing can be performed by the control circuitry of the embossing machine. After the proper punch and die pair are in the emboss area 30 and card 32 is correctly positioned, the emboss command voltage may be applied to solenoid 40. It has been found that optimum operation for typical plastic card stock occurs when the initial voltage application lasts for approximately 4 msecs. followed by a period when no voltage is applied for approximately 5 msecs. and then the voltage is applied for a further 75 to 100 msecs. to complete the embossing operation. Approximately 200 msec. is required to return the elements to their rest position at the completion of the embossing operation.

A suitable circuit for driving solenoid 40 in response to a two part command signal is shown in FIG. 4. In that Figure, a full-wave rectifier comprised of diodes D1 through D4 rectifies the AC voltage applied to input terminals 80. The full wave rectified DC voltage is filtered by resistor R1 and capacitors C1 and C2. The voltage is then further filtered by resistor R2 and capacitor C3 and limited to zener diode D6 and applied to the collector of a photocoupled transistor 82 which in turn controls the flow of current to resistor R3 which develops the voltage for controlling field effect transistor Q1 which provides the power switching action for the winding of solenoid 40. A flyback diode D5 suppresses the inductive voltage transient when switch Q1 is turned off with a strong current flowing in solenoid winding 40.

The circuit in FIG. 4 operates by turning the NPN transistor of photocoupled transistor 82 ON when light is received from photodiode 84 in the photoconductor package in response to actuation of LED 84 by the presence of a command voltage on terminals 86. The input to input terminals 86 which can be provided by an output port of the computer used to control the operations of embossing mechanism 10 or by any other suitable analog or digital circuitry which can provide the desired short initial pulse to allow the type elements to move into contact with the card surface with minimum impact force and then to apply the full embossing force after the type elements are in contact with the surface of the card, thereby minimizing the noise created by a full force impact of the type elements into the surface of a card.

The matching of the command signal for the solenoid can also be used to vary the embossing force and to form smaller characters in a short interval, while larger characters receive more force and a longer cycle time. With the solenoid of the preferred embodiment, nearly 50 msec. is required to allow the magnetic field to fully build up. Since the embossing force is directly proportional to the field strength, the full 50 msec. is required to emboss characters like a capital "8" which requires about 1100N [250 pounds] of embossing force. A

simple "." requires between 200N [50 pounds] and 400N [100 pounds] of embossing force. That force can be built up in about 20 msec. The embossing forces can be matched to the character being embossed by varying the time duration of the excitation to solenoid 40 or by monitoring the current wave shape to solenoid to determine when plunger 42 has stopped moving. The command applied to terminals 86 can have a different length for each character in accordance with stored information in the electronic circuitry (not shown) used to select the characters and to otherwise control the operation of the machine.

Between embossing operations, it is of course necessary to move drive pin 56 away from the type elements and to make certain that the type elements have been retracted from the face of card 32. The type elements may each be provided with return springs as shown in FIG. 8C of U. S. Pat. No. 4,271,012, to assist them in returning to their rest position as shown in FIG. 1, separated from the surface of card 32. In FIG. 1, return springs 29 can be mounted in each type element to provide a spring for returning the type element to the rest position.

In order to provide a more positive return force, a retractor plate 90 is attached to a retractor arm 92 using an attachment screw 94. Retractor arm 92 is in turn secured to outer sleeve 50 using a screw 96 and washer 98. Retractor arm 92 hooks the flange 31 of the punch 26 or die 28 and positively retracts that element from the embossing position as solenoid 40 is deenergized. The engagement of the retractor and die element 28 is shown in FIG. 5. An oversized slot 99 in retractor arm 92 permits adjusting the extension of retractor plate 90. Use of retractor plate 90 may obviate the need for the individual return springs 29. A reverse current could also be applied to solenoid 40 to allow for a quicker return of plunger 42 thereby yielding faster cycle time.

For each of the embodiments shown, it will be seen that it is not necessary for adequate embossing to utilize two solenoids 40 as shown in FIG. 1. It has been found that adequate operation at slower speeds occurs if one of the two solenoids 40 is replaced by a cam 100, as shown in FIG. 6, the protruding surface of which forces one of the two cooperating embossing elements 26 or 28 toward embossing area 30 and card 32 while the other element is driven by solenoid 40 in the manner shown in FIG. 1. Cam surface 100 which replaces one of the solenoids 40 shown in FIG. 1 forces each of the type elements 26 or 28 toward card 32 as shaft 16 is rotated to move the type elements on the type wheel past the cam surface.

FIG. 7 shown another embodiment of the embossing mechanism utilizing a modified coupling arrangement for linear solenoids aligned with the axis of movement of the punch and die elements 26 and 28, respectively. In FIG. 7, linear solenoids 40 are long stroke linear solenoids which move shaft 42 a significantly greater distance upon actuation than solenoids 40 shown in FIGS. 1 through 6. In FIG. 7, solenoid plungers 42 are accelerated along the axis of movement of punch and die print elements 26 and 28 when solenoids 40 are actuated. Plungers 42 then strike drive pins 56 which, in turn, are driven against the print elements 26 and 28 to move them into embossing or imprinting contact with card 32. As distinguished from the embodiment shown in FIGS. 1 through 6, the embosser shown in FIG. 7 applies the embossing force during a relatively short time interval with a large embossing force. The embossing energy is provided by the kinetic energy of plungers 42 and drive pins 56 as they move against punch and die members 26 and 28. Plungers 42 are accelerated to a relatively high velocity by solenoids 40. Since the amount of energy imparted to print elements 26 and 28 is dependent upon the square of the velocity of the impacting parts, the print elements 26 and 28 are capable of providing a significant embossing force which may be suitable for embossing metal, cards which require more embossing force such as cards 32, for example. Plastic cards can, of course, also be embossed.

After the embossing force is applied to punch and die members 26 and 28, a restoring force is provided by spring 62 which bears upon frame 22 at one end and a retaining clip 102 mounted at the end of drive pin 56 which was struck by plunger 42 to effect the embossing operation. As was the case with the embodiments shown in FIGS. 1 through 6, the embodiment shown in FIG. 7 provides a relatively simple linkage since the solenoids used to generate the embossing force provide their linear output force along the axis of movement of embossing elements 26 and 28.

FIG. 8 shows another form of embossing mechanism utilizing rotary solenoids 104, rather than linear solenoids 40, to generate the embossing forces. Solenoid 104 has an output shaft 106 which is rotated upon actuation of the solenoid. Shaft 106 drives a link 108 which is pivotally connected to a further link 110 which is, in turn, pivotally connected to drive pin 56 which is supported in an oil-lite bearing 58 which defines an aperture through frame 22 for supporting shaft 56 for linear oscillatory motion along the printing axis of punch and die print elements 26 and 28. As shown in FIG. 8, rotation of shaft 106 of rotary solenoids 104 moves the linkage formed of links 108 and 110 from the solid line positions shown in FIG. 8 to the positions shown in phantom outline. As shaft 106 rotates to move the linkage, it can be

seen that drive pins 56 are forced into contact with punch and die members 26 and 28, thereby applying a suitable embossing force to those members to form a character on card 32. As distinguished from the structure shown in FIG. 7, the structure shown in FIG. 8 operates relatively quietly because there is no impact between a rapidly moving relatively massive element, such as shaft 42, and drive pin 56. Because the distance between drive pin 56 and punch and die members 26 and 28 is relatively small, there is little acceleration of drive pin 56 before it engages print elements 26 and 28 so the impact noise is held to a minimum. Depending somewhat upon the speed of actuation of solenoids 104, the structure shown in FIG. 8 may apply a somewhat lesser embossing force over a longer time duration than does the impact embosser structure shown in FIG. 7.

In order to drive the structure shown in FIG. 8 from the position shown in dotted outline to the position shown in solid line, it is necessary to have a force applied by rotary solenoids 104 in a direction opposite to that it was applied at the time that they were actuated to initiate the embossing operation. Such a force can be provided by a spring bias arrangement which would return the linkage to the initial position. Although it is less desirable, the embossing operation can be accomplished with a solenoid which is selectively energized between embossing steps and uses spring force to effect the embossing when the energization is removed. The mechanism can alternatively be provided by a double-acting solenoid which, when actuated in the reverse direction, drives from the position shown in dashed outline to the initial position to effectuate a second embossing operation.

In FIG. 9, a further embodiment of the solenoid driven embossing mechanism is shown. As was the case with the other forms of the embossing mechanism, the punch and die elements 26 and 28 are mounted in the same manner relative to card 32. A single linear solenoid 40 drives a shaft 42 which is connected to a pair of links 120 and 122 which are in turn pivotally connected at one end to links 120 and 122 and have adjusting screws 130 and 132 inserted in suitable threaded openings at their other ends. Links 124 and 126 are pivotally supported at a location between the ends by suitable clevis and bearing arrangements 134 and 136, respectively. When shaft 42 of solenoid 40 is actuated to retract shaft 42 into the body of solenoid 40, links 120 and 122 move from the position shown in solid lines in FIG. 9 to the position shown in dashed lines, forcing the bottom ends of links 124 and 126 away from the axis of shaft 42 and forcing adjusting screws 130 and 132 into pressure applying contact with punch and die elements 26 and 28 to emboss the surface of card 32. As was the case with the structure shown in FIG. 8, solenoid 40 can either be a double-acting solenoid to apply an embossing force each time shaft 42 moves between the two positions illustrated or, alternatively, solenoid 40 can be single-acting with a biased restoring spring to return shaft 42 to the initial position after an embossing cycle when the printwheels 12 and 14 are positioned so that no punch and die members 26 and 28 are engaged by adjusting screws 130 and 132 during the portion of the cycle when the solenoid returns to its initial position.

FIG. 10 also illustrates an embossing mechanism where a single solenoid is used to provide the embossing force for both the punch and die members. As distinguished, however, from the embodiment shown in FIG. 9, the embodiment shown in FIG. 10 utilizes a rotary solenoid 104 which drives a shaft 106 which is, in turn, connected to a link 108 which is pivotally connected to one end of a connecting link 110, the other end of which is pivotally connected to a sliding shaft 112 which is restrained for movement along an axis perpendicular to that of shaft 106. Further links 140 and 142 are pivotally connected to sliding shaft 112 which is restrained from movement other than along the axis of track 114. As shaft 106 and link 108 are rotated from the position shown in solid line in FIG. 10 to the position shown in dashed line, sliding shaft 112 and links 140 and 142 attached thereto are moved from the solid line position to the dashed line position illustrated and further links 124 and 126 pivot such that adjusting screws 130 and 132 engage print elements 26 and 28 and emboss a character on card 32. As was the case with the rotary embosser embodiment shown in FIGS. 8 and 9, the embodiment in FIG. 10 can be operated either in a double-acting mode utilizing separate coils to drive the rotary solenoid to and from each of the two operating positions or, alternatively, the solenoid can be single-acting with a return spring returning the mechanism to an initial position after a character is embossed and the printwheel is rotated to move print elements 26 and 28 out of line with the adjusting screws 130 and 132 at the ends of links 124 and 126.

FIG. 11 is an additional embodiment of the embossing mechanism utilizing a pair of rotary solenoids 104 which couple their rotary action to drive forces applied to type elements 26 and 28 utilizing links 124 and 126. Each of the rotary solenoids 104 drives shaft 106 which is rigidly connected to one end of link 108, the other end of which is pivotally connected to one end of link 110, the other end of which is pivotally connected to the end of link 124 or 126 which is opposite to the end to which adjusting screw 130 or 132 is attached. As was the case with the other rotary solenoid embodiments, solenoid 104 can either be single or

double acting.

FIG. 12 shows a simplified rotary solenoid linkage where rotary solenoids 104 drive shafts 106 which are directly connected to one end of link 108, the other end of which carries adjusting screws 130 and 132. Solenoids 104 are actuated to rotate shaft 106 and link 108 to apply direct embossing force to punch and die elements 26 and 28 to adjusting screws 130 and 132. These solenoids can either be double-acting to return them to the initial position or can be biased to return to their initial position using spring force after the actuating energy is removed.

For each of the embossing embodiments shown, it can also be seen that it is not necessary to have punch and die elements installed in wheels 12 and 14 in all applications. In some applications, it will be found that a punch and anvil set is the desired combination to carry out embossing operations with a carbon release paper positioned between the punch type elements and the card to print a character into the surface of the card while the reverse side of the card is supported by the movable anvil element having a flat surface. The solenoid embossing mechanism according to the present invention provides superior results in that application as well as the other applications illustrated.

It will be seen that the preferred and alternative embodiments of the present invention as described herein are not the only forms in which the present invention provides superior results. Other linkage arrangements can be utilized without departing from the scope of the invention which is limited only by the following claims:

Claims

1. An apparatus for imprinting sheet material with characters including a plurality of cooperating print elements (26, 28) inserted in slots positioned about the circumference of cooperating print wheels (12, 14) rotatable in coordination with each other on a frame (22) to permit positioning of a pair of print elements (26, 28) with one element on each side of sheet material (32) positioned in an imprinting area; and an imprinting force applying mechanism comprising,

a) a solenoid (40) mounted on the frame (22), the solenoid having a shaft (42) and being constructed and arranged when energized for effecting movement of the shaft (42) from a first to a second position;

b) linkage means (44, 50, 56) coupled to the shaft of the solenoid constructed and arranged for imparting motion, along the imprinting axis, to a print element of a pair of print elements (26, 28); and

c) solenoid driver means for selectively applying energy to the solenoid (40) to move the shaft between the first and second positions, thereby imprinting a selected character to sheet material positioned in the imprinting area,

characterized in that the driver means including means for energizing the solenoid in two stages, the first of which energizes the solenoid to bring the linkage means (44, 50, 56) into contact with the print element and moves the print element (26, 28) into contact with the sheet material (32) and the second of which energizes the solenoid to apply imprinting force to the print element thereby to reduce the noise of the imprinting operation, the force applied by the solenoid to the print element in the second stage being greater than the force applied by the solenoid to the print element in the first stage.

2. The apparatus of claim 1, wherein the solenoid (40) includes at least one winding and one restraining spring means (62) and the solenoid driver means includes means for actuating the winding to move the shaft in one direction from one of the first and second positions to the other of the first and second positions and the restraining spring means is coupled for returning the shaft to the original of the first and second positions.

3. The apparatus of claim 1 or 2, wherein the driver means applies voltage to the solenoid (40) for a time duration selected to produce an imprinting force consistent with the size and complexity of the character to be imprinted.

4. The apparatus of any of claims 1 to 3, wherein the linkage means (44, 50, 56) also include mechanical means (90) for engaging the type element (26, 28) for retracting it into the printwheel at the conclusion of a character embossing step when the solenoid (40) returns to the first position and ceases to apply imprinting force.

5. The apparatus of any of claims 1 to 4, wherein both of the print elements are driven by the solenoid.

6. The apparatus of any of claims 1 to 4, where one of the cooperating printing elements (26, 28) is driven by the solenoid (40) and the other is moved by the action of cam means (100) positioned adjacent the imprinting area and adapted for moving only those print elements

in the vicinity of the embossing area from the printwheels for engagement with the solenoid driven print element.

7. The apparatus of any of claims 1 to 6, wherein the linkage means includes slidably supported drive pin means (56) aligned with the imprinting axis and having one end thereof adjacent the print element, the linkage means constructed and arranged for coupling movement of the shaft of the solenoid to the print element.

8. The apparatus of claim 7, wherein the linkage means is constructed and arranged for allowing the shaft (42) of the solenoid (40) to initially move independently of the drive pin means (56) and for impacting the drive pin means to transfer kinetic energy from the shaft of the solenoid to the drive pin means.

9. The appratus of claim 1, wherein the solenoid (40) is a linear solenoid mounted beneath the printwheels (12, 14) having its shaft movable between the first and second position along an axis perpendicular to and intersecting the rotational axes of the printwheels and wherein the linkage means includes a beam (124, 126) pivotally mounted on the frame (22), a first end of the beam constructed and arranged for engaging one of the printing elements, the other end of the beam being coupled to the shaft of the solenoid means by a link (120, 122) constructed and arranged for causing the first end of the beam to apply imprinting force to the printing element when the shaft moves between the first and second positions.

10. The apparatus of claim 9, wherein the linkage means includes beams (124, 126) for coupling movement of the solenoid shaft to the printing elements of both printwheels.

11. The apparatus of claim 1 wherein the solenoid is a rotary solenoid (104) mounted beneath the printwheels and having a crank arm (108) coupled at one end to the shaft (106) and pivotally coupled at the other end to a slidable member (112) constrained from movement along an axis perpendicular to the shaft and wherein the linkage means includes a beam (124, 126) pivotally mounted on the frame, a first end of the beam constructed and arranged for engaging one of the printing elements, the other end of the beam being coupled to the slidable member by a link (140, 142) constructed and arranged for causing the first end of the beam to apply imprinting force to the print element when the shaft of the rotary solenoid moves from a first to a second rotational position.

12. The apparatus of claim 1, wherein the solenoid includes at least one rotary solenoid (104) mounted beneath the printwheels, the shaft (106) is moveable between first and second rotational positions, the linkage means includes a beam (124, 126) pivotally mounted on the frame, a first end of the beam being constructed and arranged for engaging one of the print elements, the other end of the beam being coupled to the shaft of the rotary solenoid by a link (108, 110) constructed and arranged for causing the first end of the beam to apply imprinting force to the print element when the shaft moves between the first and second rotational positions.

13. The apparatus of claim 1, wherein the solenoid comprises at least one rotary solenoid mounted on the frame adjacent the print wheels, the linkage means having a crank arm coupled at one end to the shaft positioned such that the other end engages the print element to apply an imprinting force thereto when the rotary solneoid is moved from a first rotational position to a second rotational position.

14. The apparatus of any of claims 1 to 13, wherein the shaft of the solenoid comes substantially to a halt between the first and second steps.

15. The apparatus of any of claims 1 to 14, wherein the first and second stages are separated by a predetermined time interval.

16. The apparatus according to any of claims 1 to 15, wherein the imprinting force applied during the second stage is selectively variable depending on the character imprinted.

Revendications

1. Appareil pour le gaufrage d'un matériau en feuille avec des caractères incluant une pluralité d'éléments d'impression (26, 28) coopérant entre eux insérés dans des fentes positionnées sur la circonférence de roues d'impression (12, 14) coopérant entre elles et montées en rotation de façon coordonnée l'une par rapport à l'autre sur un bâti (22) de façon à permettre le positionnement d'une paire d'éléments d'impression (26, 28) avec un élément de part et d'autre du matériau en feuille (32) positionné dans une zone de gaufrage ; et un mécanisme d'application d'une force de gaufrage compre-

nant,

a) un solénoïde (40) monté sur le bâti (22), le solénoïde présentant un arbre (42) et étant conçu et réalisé pour permettre, lorsqu'il est alimenté, le mouvement de l'arbre (42) d'une première vers une seconde position ;

b) des moyens de liaison (44, 50, 56) couplés à l'arbre du solénoïde conçus et réalisés pour permettre le mouvement d'un élément d'impression d'une paire d'éléments d'impression (26, 28) le long de l'axe de gaufrage; et

c) des moyens de pilotage du solénoïde permettant d'appliquer de façon sélective de l'énergie au solénoïde (40) de façon à déplacer l'arbre entre la première et la seconde positions, et ainsi de gaufrer un caractère sélectionné sur le matériau en feuille positionné dans la zone de gaufrage,

caractérisé en ce que les moyens de pilotage incluent des moyens pour exciter le solénoïde selon deux niveaux, le premier de ces niveau excitant le solénoïde afin d'amener les moyens de liaison (44, 50, 56) en contact avec l'élément d'impression et afin de placer l'élément d'impression (26, 28) en contact avec le matériau en feuille (32) et le second de ces niveaux excitant le solénoïde afin d'appliquer une force de gaufrage à l'élément d'impression et ainsi de réduire le bruit de l'opération de gaufrage, la force appliquée par le solénoïde à l'élément d'impression dans le second niveau étant plus grande que la force appliquée par le solénoïde à l'élément d'impression dans le premier niveau.

2. Appareil selon la revendication 1, dans lequel le solénoïde (40) inclut au moins un enroulement et un moyen de maintien à ressort (62) et dans lequel les moyens de pilotage du solénoïde incluent des moyens de commande de l'enroulement pour que celui-ci déplace l'arbre dans une direction allant de l'une de la première et de la seconde positions vers l'autre de la première et de la deuxième positions et dans lequel le moyen de maintien à ressort est couplé pour rappeler l'arbre dans la première ou la seconde position originale.

3. Appareil selon la revendication 1 ou 2, dans lequel les moyens de contrôle appliquent un voltage au solénoïde (40) pendant un temps choisi pour produire une force de gaufrage en rapport avec la taille et la complexité du caractère à gaufrer.

4. Appareil selon l'une quelconque des revendications 1 à 3, dans lequel les moyens de liaison (44, 50, 56) incluent également des moyens mécaniques (90) accueillant l'élément de frappe (26, 28) permettant de le rétracter dans la roue d'impression lorsqu'à la fin d'une étape de bosselage d'un caractère, le solénoïde (40) retourne dans la première position et cesse d'appliquer une force de gaufrage.

5. Appareil selon l'une quelconque des revendications 1 à 4, dans lequel les deux éléments d'impression sont pilotés par le solénoïde.

6. Appareil selon l'une quelconque des revendications 1 à 4, dans lequel l'un des éléments d'impression (26, 28) coopérant entre eux est piloté par le solénoïde (40) et l'autre est déplacé par l'action d'un système de came (100) positionné de façon adjacente à l'aire de gaufrage et adapté pour déplacer seulement ceux des éléments d'impression situés au voisinage des zones de bosselage des roues d'impression pour permettre l'engagement de l'élément d'impression piloté par le solénoïde.

7. Appareil selon l'une quelconque des revendications 1 à 6, dans lequel les moyens de liaison incluent des moyens de plaquage montés glissables (56) alignés avec l'axe de gaufrage et présentant une extrémité adjacente à l'élément d'impression, les moyens de liaison étant conçus et réalisés pour coupler le mouvement de l'arbre du solénoïde à l'élément d'impression.

8. Appareil selon la revendication 7, dans lequel les moyens de liaison sont conçus et réalisés pour permettre à l'arbre (42) du solénoïde (40) de se déplacer initialement de façon indépendante des moyens de plaquage (56) puis pour marteler les moyens de plaquage de façon à transférer l'énergie cinétique de l'arbre du solénoïde aux moyens de plaquage.

9. Appareil selon la revendication 1, caractérisé en ce que le solénoïde (40) est un solénoïde linéaire monté au-dessous des roues d'impression (12, 14) présentant son arbre mobile entre la première et la seconde positions le long d'un axe perpendiculaire aux axes de rotation des roues d'impression et formant une intersection avec ceux-ci et dans lequel les moyens de liaison incluent un rayon (124, 126) monté pivotant sur la bâti (22), une première extrémité du rayon étant conçue et réalisée pour accueillir l'un des éléments d'impression, l'autre extrémité du rayon étant couplée à l'arbre du solénoïde par une liaison (120, 122)

conçue et réalisée pour permettre à la première extrémité du rayon d'appliquer une force de gaufrage sur l'élément d'impression lorsque l'arbre est déplacé entre la première et la seconde positions.

10. Appareil selon la revendication 9, dans lequel les moyens de liaison incluent des rayons (124, 126) permettant de coupler le mouvement de l'arbre du solénoïde aux éléments d'impression des deux roues d'impression.

11. Appareil selon la revendication 1, dans lequel le solénoïde est un solénoïde tournant (104) monté au-dessous des roues d'impression et présentant un bras de manivelle (108) couplé à une extrémité à l'arbre (106) et couplé de façon pivotante à l'autre extrémité à un élément glissable (112) forcé en mouvement le long d'un axe perpendiculaire à l'arbre et dans lequel les moyens de liaison incluent un rayon (124, 126) monté pivotant sur le bâti, une première extrémité du rayon étant conçue et réalisée pour accueillir l'un des éléments d'impression, l'autre extrémité du rayon étant couplée à l'élément glissable par une liaison (140, 142) conçue et réalisée pour permettre à la première extrémité du rayon d'appliquer une force de gaufrage à l'élément d'impression lorsque l'arbre du solénoïde tournant se déplace en rotation de la première vers la seconde positions.

12. Appareil selon la revendication 1, dans lequel le solénoïde inclut au moins un solénoïde tournant (104) monté au-dessous des roues d'impression, l'arbre (106) étant mobile en rotation entre une première et une seconde positions, les moyens de liaison incluant un rayon (124, 126) monté pivotant sur le bâti, une première extrémité du rayon étant conçue et réalisée pour accueillir l'un des éléments d'impression, l'autre extrémité du rayon étant couplée à l'arbre du solénoïde tournant par une liaison (108, 110) conçue et réalisée pour permettre à la première extrémité du rayon d'appliquer une force de gaufrage sur l'élément d'impression lorsque l'arbre se déplace en rotation entre la première et la seconde positions.

13. Appareil selon la revendication 1, dans lequel le solénoïde comprend au moins un solénoïde tournant monté sur le bâti adjacent aux roues d'impression, les moyens de liaison présentant un bras de manivelle couplé à une extrémité à l'arbre positionné de telle sorte que l'autre extrémité accueille l'élément d'impression afin d'appliquer une force de gaufrage sur celui-ci lorsque le solénoïde tournant est déplacé en rotation d'une première position dans une seconde position .

14. Appareil selon l'une quelconque des revendications 1 à 13, dans lequel l'arbre du solénoïde s'arrête de façon substantielle entre la première et la seconde étapes.

15. Appareil selon l'une quelconque des revendications 1 à 14, dans lequel le premier et le second niveaux sont séparés par un intervalle de temps prédéterminé.

16. Appareil selon l'une quelconque des revendications 1 à 15, caractérisé en ce que la force de gaufrage appliquée durant le second niveau varie de façon sélective en fonction du caractère gaufré.

Patentansprüche

1. Vorrichtung zum Prägen von Zeichen in Blech mit mehreren zusammenwirkenden Prägeelementen (26, 28), die in Schlitze am Umfang von zusammenwirkenden Prägerädern (12, 14) eingesetzt sind, die abgestimmt aufeinander an einem Rahmen (22) drehbar sind, um ein Element von zwei Prägeelementen (26, 28) auf jeder Seite des Bleches (32) in einem Prägebereich zu positionieren; und mit einem Mechanismus zum Aufbringen einer Prägekraft, der aufweist

a) einen Magnet (40) am Rahmen (22) mit einem Schaft (42), der bei Erregung des Magneten aus einer ersten in eine zweite Lage bewegbar ist,

b) einer an dem Schaft des Magneten befestigten Verbindung (44, 50, 56) zum Übertragen der Bewegung längs der Prägeachse auf eines der beiden Prägeelemente (26, 28) und

c) einen Magnetantrieb zum Zuführen von Energie an den Magnet (40) zur Bewegung des Schafts zwischen der ersten und zweiten Position und zum Prägen des im Prägebereich angeordneten Bereiches mit einem ausgewählten Zeichen, dadurch gekennzeichnet, daß der Magnetantrieb Mittel zum Erregen des Magneten in zwei Stufen aufweist, wobei die erste Stufe den Magneten erregt, um die Verbindung (44, 50, 56) in Berührung mit dem Prägeelement zu bringen und das Prägeelement (26, 28) in Berührung mit dem Blech (32) zu bewegen, und die zweite Stufe den Magneten erregt, um Prägekraft auf das Prägeelement auszuüben, um den Lärm des Prägevorgangs zu

verringern, wobei die von dem Magneten auf das Prägeelement in der zweiten Stufe ausgeübte Kraft größer ist als die vom Magneten auf das Prägeelement in der ersten Stufe ausgeübte Kraft.

2. Vorrichtung nach Anspruch 1, wobei der Magnet (40) mindestens eine Wicklung und eine dämpfende Feder (62) aufweist und der Magnetantrieb Mittel zum Aktivieren der Wicklung aufweist, um den Schaft in einer Richtung von jeweils einer der beiden Positionen in die andere der beiden Positionen zu bewegen und die dämpfende Feder zum Zurückholen des Schafts in die Ursprungsposition der beiden Positionen vorgesehen ist.

3. Vorrichtung nach Anspruch 1 oder 2, wobei der Magnetantrieb an den Magneten (40) eine Spannung für eine Zeitdauer anlegt, die so ausgewählt ist, daß eine für die Größe und Komplexität des prägenden Zeichens entsprechende Prägekraft erzeugt wird.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, wobei die Verbindung (44, 50, 56) mechanische Mittel (90) zum Erfassen des Typenelements (26, 28) aufweist, um dieses nach Beendigung des Prägevorgangs in das Prägerad zurückzuholen, wenn der Magnet (40) in die erste Position zurückkehrt und das Ausüben von Prägekraft beendet.

5. Vorrichtung nach einem der Ansprüche 1 bis 4, wobei beide Prägeelemente von dem Magnet angetrieben sind.

6. Vorrichtung nach einem der Ansprüche 1 bis 4, wobei eines der zusammenwirkenden Prägeelemente (26, 28) von dem Magnet (40) angetrieben ist und das andere von einer Nokkenvorrichtung (100) bewegbar ist, die im Prägebereich angeordnet ist und nur jene in der Nachbarschaft des Prägebereichs liegenden Prägelemente aus dem Prägerad in Eingriff mit dem vom Magnet betätigten Prägelement bewegt.

7. Vorrichtung nach einem der Ansprüche 1 bis 6, wobei die Verbindung einen mit der Prägeachse fluchtenden, verschiebbar angeordneten Antriebsstift (56) aufweist, der mit einem Ende neben dem Prägeelement angeordnet ist, wobei die Verbindung zur Kupplung des Magnetschafts mit dem Prägeelement ausgebildet ist.

8. Vorrichtung nach Anspruch 7, wobei die Verbindung derart ausgebildet ist, daß der Schaft (42) des Magneten (40) anfänglich unabhängig von dem Antriebsstift (56) bewegbar ist und an den Antriebsstift anschlägt, um kinetische Energie von dem Magnetschaft auf den Antriebsstift zu übertragen.

9. Vorrichtung nach Anspruch 1, wobei der Magnet (40) ein unterhalb der Prägeräder (12, 14) angeordneter linearer Magnet ist, dessen Schaft zwischen der ersten und zweiten Position in einer Achse bewegbar ist, die rechtwinklig die Drehachsen der Prägeräder schneidet, und wobei die Verbindung einen am Rahmen schwenkbar gelagerten Hebel (124, 126) aufweist, dessen erstes Ende eines der Prägeelemente erfaßt, und dessen anderes Ende mit dem Magnetschaft über ein Gelenk (120, 122) gekuppelt ist, das so ausgebildet ist, daß das erste Ende des Hebels auf das Prägeelement eine Prägekraft ausübt, wenn sich der Schaft zwischen der ersten und zweiten Position bewegt.

10. Vorrichtung nach Anspruch 9, wobei die Verbindung Hebel (124, 126) zum Kuppeln der Bewegung des Magnetschaftes zu den Prägeelementen beider Prägeräder aufweist.

11. Vorrichtung nach Anspruch 1, wobei der Magnet ein unterhalb der Prägeräder angeordneter rotierender Magnet (104) ist, ein Kurbelarm (108) mit einem Ende mit der Welle (106) des Magneten und an dem anderen Ende mit einem Schiebeglied (112) gekuppelt ist, das an einer Bewegung in einer rechtwinklig zur Magnetwelle liegenden Achse gehindert ist, und wobei die Verbindung einen schwenkbar am Rahmen angeordneten Hebel (124, 126) aufweist, dessen erstes Ende eines der Prägeelemente erfaßt und dessen anderes Ende mit dem Schiebeglied über ein Gelenk (140, 142) gekuppelt ist, das so ausgebildet ist, daß das erste Ende des Hebels eine Prägekraft auf das Prägeelement ausübt, wenn die Welle des drehbaren Magneten von einer ersten in eine zweite Drehlage gelangt.

12. Vorrichtung nach Anspruch 1, wobei der Magnet mindestens einen drehbaren, unterhalb der Prägeräder angeordneten Magnet (104) aufweist, die Welle (106) zwischen einer ersten und zweiten Drehlage bewegbar ist, die Verbindung einen am Rahmen schwenkbar angeordneten Hebel (124, 126) aufweist, dessen erstes Ende eines der Prägeelemente erfaßt und dessen anderes Ende mit der Welle des drehbaren Magneten über ein Gelenk (108, 110) gekuppelt ist, das so ausgebildet ist, daß

das erste Ende des Hebels eine Prägekraft auf das Prägeelement ausübt, wenn die Welle sich zwischen der ersten und zweiten Drehlage bewegt.

13. Vorrichtung nach Anspruch 1, wobei der Magnet mindestens einen am Rahmen neben den Prägerädern angeordneten drehbaren Magnet aufweist, die Verbindung einen Kurbelarm aufweist, der mit einem Ende an der Welle derart gekuppelt ist, daß das andere Ende das Prägeelement erfaßt, um eine Prägekraft auf dieses auszuüben, wenn sich der drehbare Magnet aus einer ersten Drehlage in eine zweite Drehlage bewegt.

14. Vorrichtung nach einem der Ansprüche 1 bis 13, wobei die Welle bzw. der Schaft des Magneten zwischen der ersten und zweiten Stufe im wesentlichen zu einem Halt gelangt.

15. Vorrichtung nach einem der Ansprüche 1 bis 14, wobei die erste und zweite Stufe von einem vorbestimmten Zeitintervall voneinander getrennt sind.

16. Vorrichtung nach einem der Ansprüche 1 bis 15, wobei die in der zweiten Stufe ausgeübte Prägekraft abhängig von dem zu druckenden Zeichen wahlweise veränderlich ist.

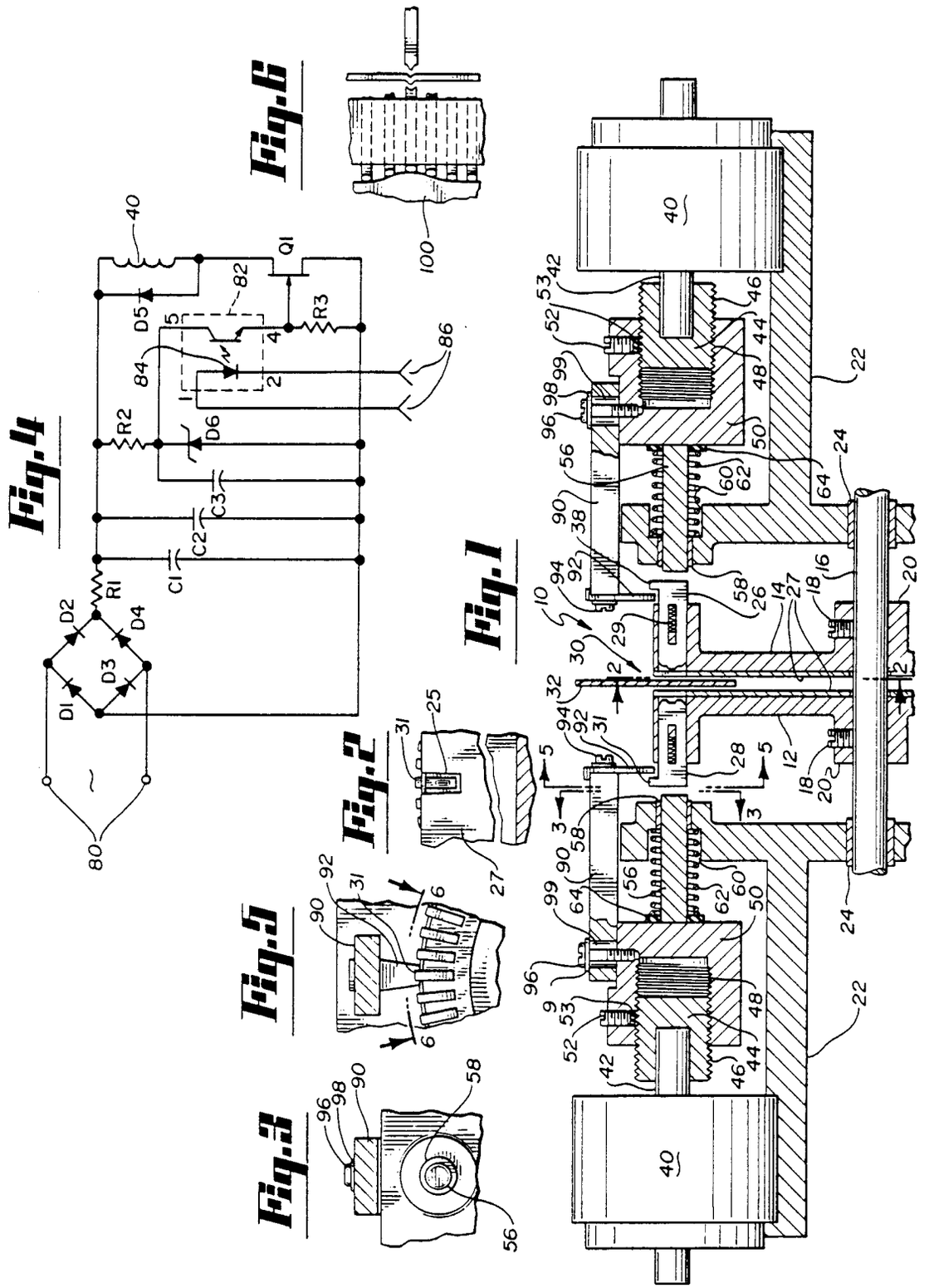
Fig.1
Fig.2
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Fig.4
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Fig.6
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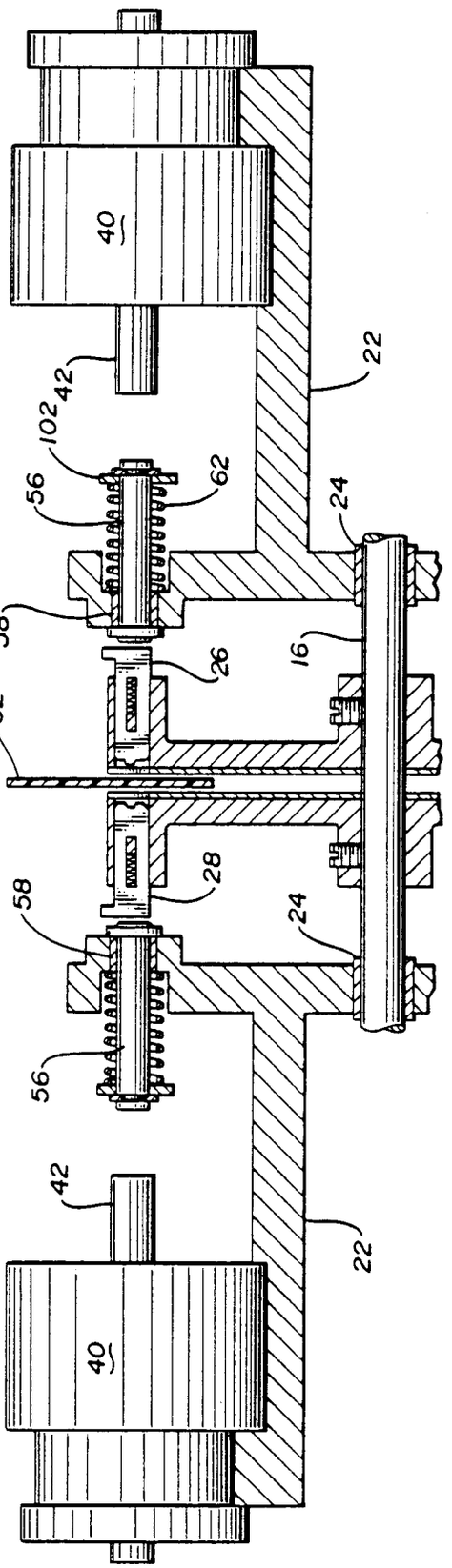
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Fig. 7

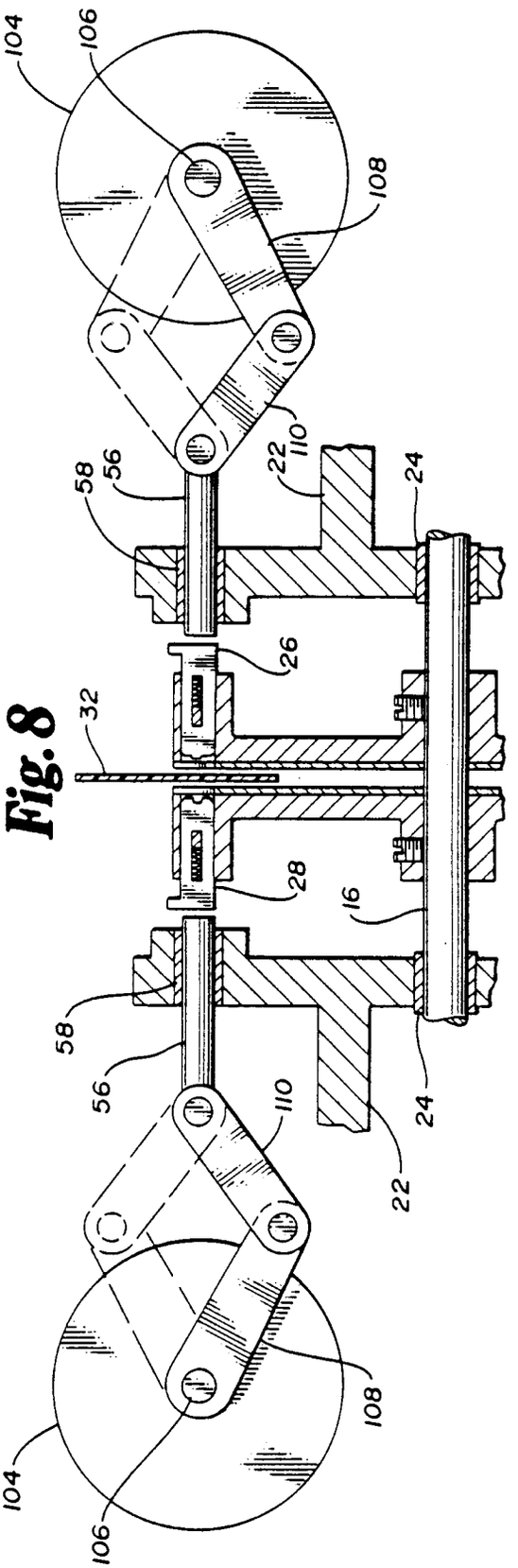
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Fig. 8

Fig. 9

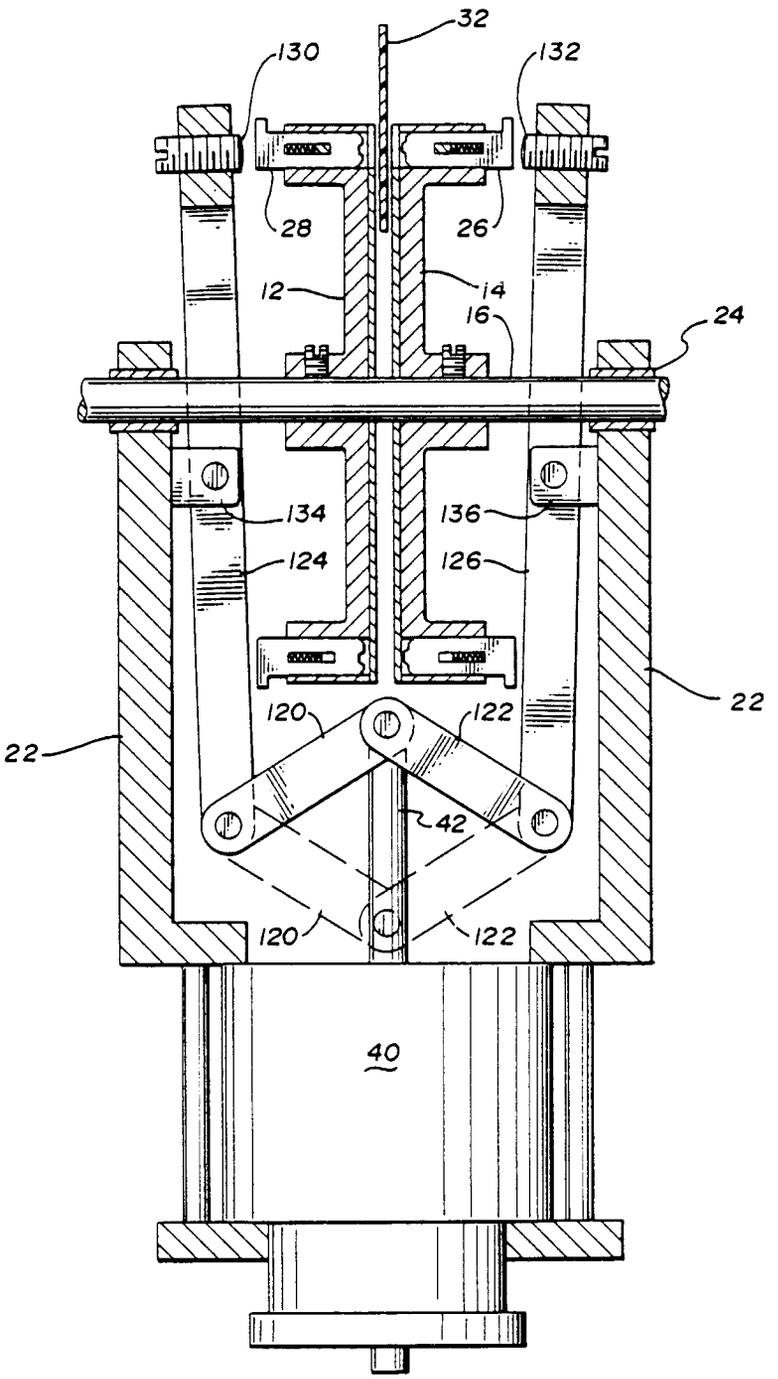
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Fig. 10

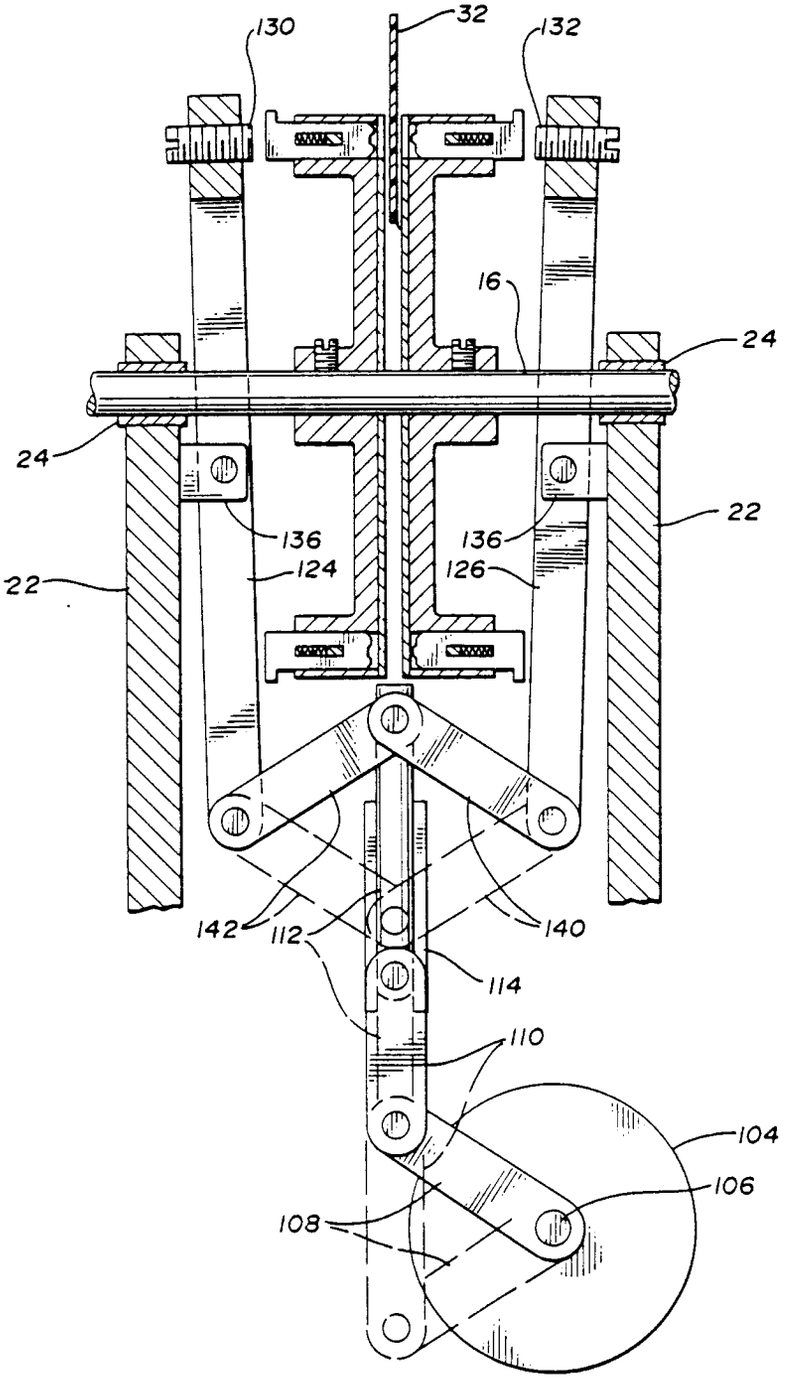
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Fig. 12

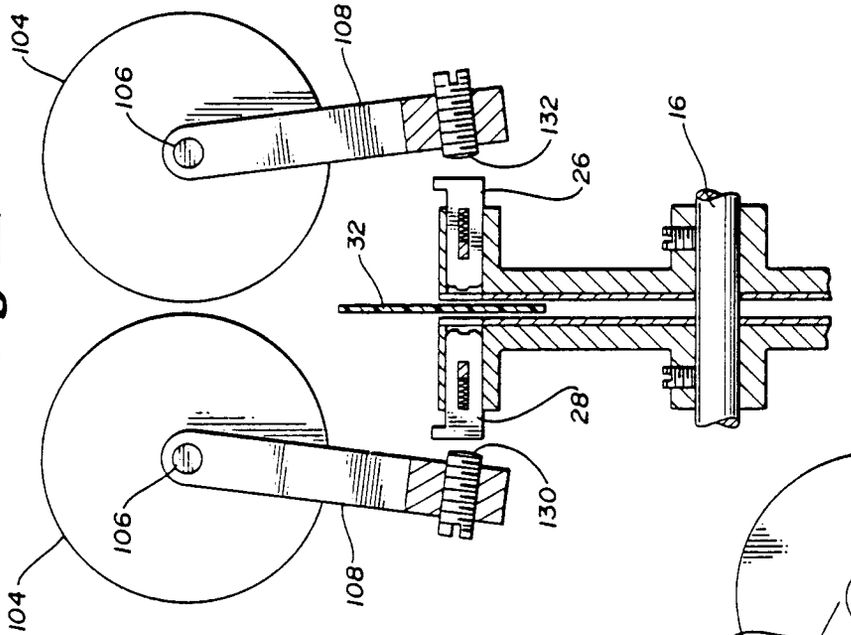
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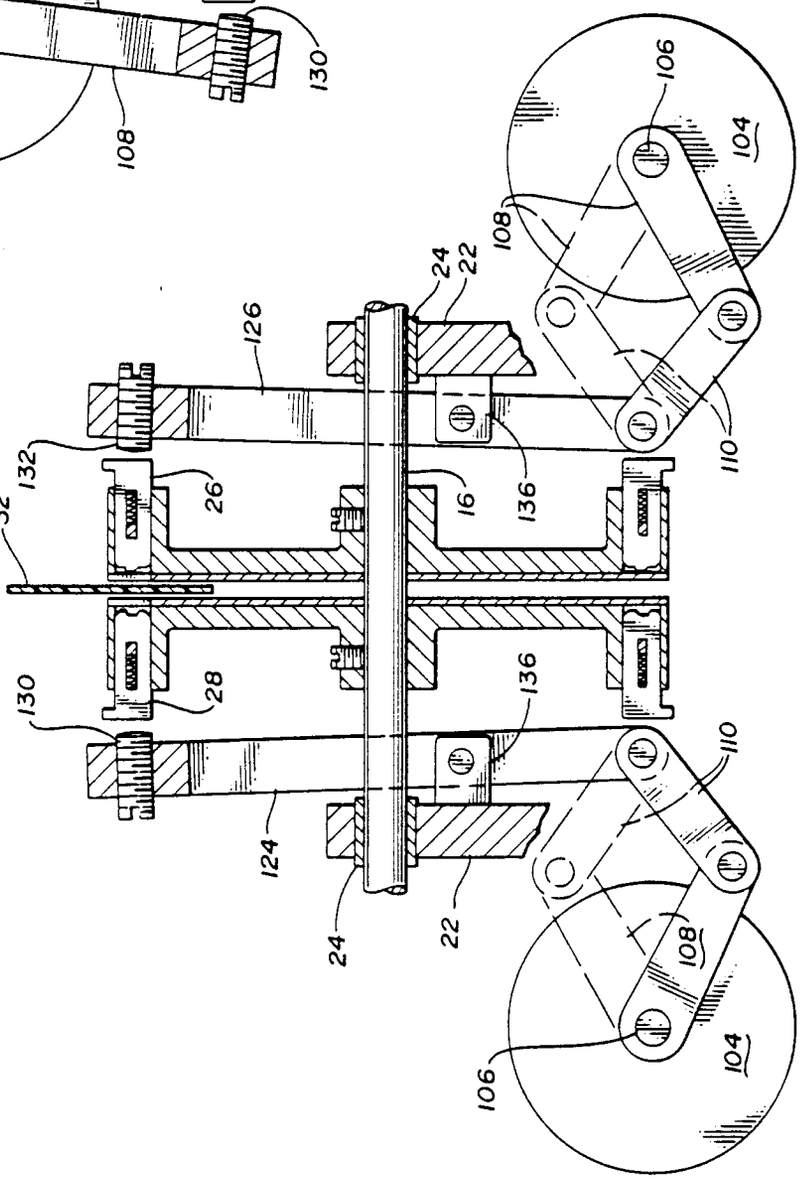
Fig. 11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