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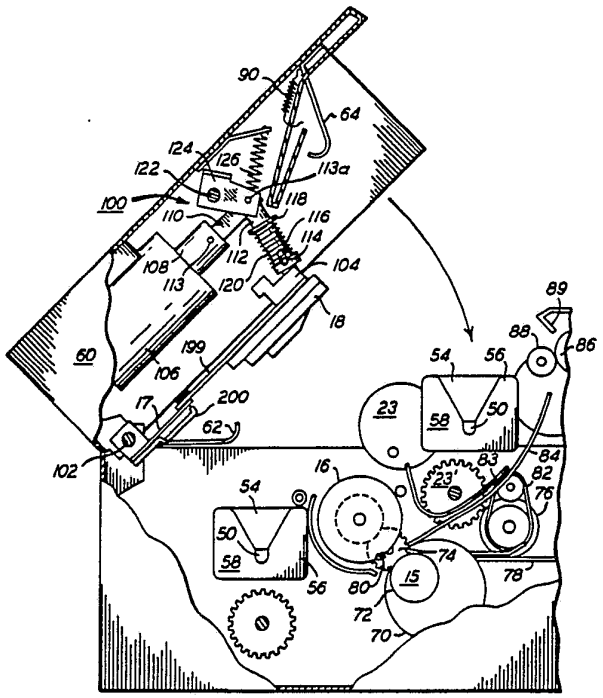
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(54) Title: COMPLIANT HEAD LOADING MECHANISM FOR THERMAL PRINTER



(57) Abstract

A compliant head loading mechanism (100) for a thermal printer which compliantly loads a thermal print head (18) against a carrier (14) and a receiver (12) mounted on the platen (16) to uniformly apply pressure across the width of the receiver (12).

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COMPLIANT HEAD LOADING MECHANISM FOR THERMAL PRINTER

Technical Field

The present invention relates to thermal printers having mechanisms for causing a print head to compliantly load a dye carrier against a receiver which is supported on a platen (drum).

Background Art

In a typical thermal printer, a web-type carrier containing a repeating series of spaced frames of different colored heat transferable dyes is spooled on a carrier supply spool. The carrier is paid out from the supply spool and rewound on a take-up spool. It moves through a nip formed between a thermal print head and a dye-absorbing receiver. The receiver is in turn supported by a platen in the form of a drum. The print head engages the carrier and presses it against the receiver. The receiver may for example be coated paper and the print head is formed of, for example, a plurality of heating elements. When a particular heating element is energized, it is heated. In the presence of heat and pressure, dye from the carrier is caused to transfer to the receiver. The density or darkness of the printed color dye is a function of the energy delivered from the heating element to the carrier. These types of thermal printers offer the advantage of "true continuous tone" dye density transfer. This result is obtained by varying the energy applied to each heating element, yielding a variable dye density image pixel on the receiver.

The web-type carrier often includes a repeating series of spaced yellow, magenta and cyan dye frames. The carrier is typically formed of a very thin, flexible dye carrying member having a thickness that can be on the order of 6 μm. First, the yellow frame in the carrier is moved to a

position under the print head. The print head is lowered to apply pressure on the carrier and while the print platen is advanced, the heating elements are selectively energized to form a row of yellow image pixels in the receiver, which is moved by the drum under the print head. This printing of the yellow dye is repeated line-by-line until the entire yellow dye image is formed in the receiver. Next, the magenta carrier frame is moved under the print head. The receiver is advanced to align the starting point of the yellow dye image with the print head heating elements. The print head is lowered and both the receiver and the magenta carrier frame are simultaneously moved through the nip as the heating elements are selectively energized and a magenta image is formed superimposed upon the yellow image. Finally the cyan dye carrier frame and the receiver dye image starting point are moved under the print head, and the heating elements are again selectively energized so that a cyan dye image is formed in the receiver superimposed upon the yellow and magenta dye images. The yellow, magenta and cyan dye images combine to form a color image. The print head must apply uniform pressure across the width of the receiver in order to provide a high quality print. Several factors can cause a nonuniform pressure to be applied as the head loads the carrier against the receiver. For example, because of the differences in tolerances in manufacture of the head and the receiver, there is often not a uniform pressure applied across the width of a receiver by a head as it loads or presses a carrier against the receiver. This can adversely affects printing quality.

Another problem is concerned with wear of the lifting mechanism. As the carrier is advanced through the nip position, the print head is raised. It is lowered during printing. This should be

accomplished with precision and repeatability to insure color image registration. The print head lifting mechanism should not wear or it may cause non-uniform print density.

Disclosure of the Invention

Accordingly, it is an object of the invention to provide an improved thermal print head positioning mechanism.

This object is achieved in a thermal printer by a mechanism which compliantly loads a print head against a carrier and a receiver mounted on a platen during a printing operation, comprising:

a) a flexure mounted at one end;

b) a mounting bracket including the head and a pin and being fixed to said flexure;

c) a loading rod having a slot for receiving said pin so that said pin can translate in said slot;

d) a compression spring engaging said rod and said pin; and

e) means coupled to said rod and effective to move said rod downwardly from an unloaded position into a loaded position where the head engages the carrier and said compression spring compliantly loads the head against the carrier and the receiver mounted on the platen to apply a uniform pressure across the width of the receiver.

Features and advantages of this invention include:

the flexure can be stamped out of a piece of flat material;

the flexure of the compliant head loading mechanism provides many cycles of operation without wear or deterioration;

the preloaded compression spring delivers the correct amount of loading force; and

the mechanism constrains the loaded head in four degrees of freedom and permits motion in two degrees of freedom.

Brief Description of the Drawings

Fig. 1 is a schematic side-elevational view of a thermal printer employing one embodiment of the present invention;

Fig. 2 is a schematic side-elevational view similar to Fig. 1 but showing the printer top open, in position to receive a cartridge of dye carrier material;

Fig. 2A is an enlarged side view of the flexure and print head shown in Fig. 2;

Fig. 2B is a top view of the elements shown in Fig. 2A; and

Fig. 3 is a broken away exploded perspective of the dye carrier cartridge shown in Fig. 1.

Modes of Carrying Out the Invention

Referring to Fig. 1, it can be seen that the thermal printer 10 utilizes a receiving member in the form of a card 12, which is secured by clamp 80 to a rotatable drum 16, which is mechanically coupled to a drive 15. The drive 15 continuously rotates the drum and thus feeds successive portions of card 12 past a print head 18. The print head 18 is attached to a bracket 199, which is connected to the forward end of a pivotably mounted flexure 17 made of spring steel (see also Fig. 2B). The rear end of flexure 17 is pivotably connected to the printer mainframe. As shown in Fig. 2B, the flexure 17 is in the form of a bifurcated member. During a printing cycle, the flexure is flexed and the head can be raised and lowered.

Print head 18 has a plurality of heating elements (not shown) which press a dye carrier member 14 against the receiver member 12 and forms a printing nip. The carrier member 14 is mounted in a cartridge 20 and is driven along a path from a cartridge supply spool 21 (see Fig. 3) onto a take-up spool 22 by a printer drive 23 which includes a gear

23', which drives a cartridge gear 24 on the spool 22. The drive 15 continuously advances the receiver 12 and the carrier 14 (via frictional engagement with the receiver at the printing nip) relative to the line of heating elements of the print head 18 as the heating elements are selectively energized. The drive 23 provides carrier take up after leaving the nip. A rotating member 24 guides the carrier 14 as it leaves the supply spool 21 and enters the printing nip. This member 24 is freely rotatable to prevent scuffing or scratching of the carrier 14 prior to the printing nip. A guide member 25 guides the carrier 14 after it exits the printing nip and before it is delivered to the take-up spool 22. Member 25 need not rotate as it contacts the dye carrier after printing.

The carrier 14 can be formed of a repeating series of thermally transferable dyes. Each series may include frames of yellow, magenta and cyan dye frames. One series is used to print a full colored image in the receiver 12. In this disclosure, the term dye refers to a colored material which transfers from the carrier to a receiver in response to energy applied by the individual heating elements of the print head 18.

Turning particularly to Fig. 3, we see an exploded view of the cartridge 20 for the web-type carrier 14. The cartridge includes a body 30 which may be formed of injection molded plastic. The body 30 includes two pairs of identical, spaced-apart flanges 32a and 32b. Each of the flanges includes detents 34. Each detent is adapted to rotatably capture a spindle 36 of its corresponding spool. The detent 34 is composed of two integral spring members 34a and 34b which deflect apart when a spindle 36 is inserted. After insertion, the spring members return to their free position and the spindle 36 is free to

rotate but is spatially retained within its corresponding flange. Both the take-up 22 and supply 21 spools are identical in construction and so only one need be described. Each of these spools includes a cylindrical portion 38 about which the web-type carrier 14 is wound. Guard members 39 and 40 are respectively secured to the opposite ends of the central portion 38. Their purpose is to align the spooled carrier 14 on the cylindrical portion 38 between them. As shown, the spindles 36 extend outwardly from their respective guide members 39 and 40 and terminate in a free end. A gear member 24 is fixed to a spindle 36 and disposed between guide member 40 and the free end of a spindle 36. The gear 24 tooth design is such that a portion extends out beyond the face of the gear in a direction parallel to the axis of spindle 36. Two adjacent teeth form a groove along the face of the gear 24 nearest to the free end of the spindle 36. A coil spring 48 urges each spool so that the face grooves of the gears 24 engage ribs 50 formed on flange 34b to prevent the spools from rotating when the cartridge is removed from the printer. This is especially advantageous during handling as it prevents the carrier 14 from unwinding.

As shown in Figs. 1 and 2 when mounting the cartridge 20, the spools are inserted into slots 50 formed in mounting blocks 58. Each mounting block 58 supports a spindle 36. There are four identical mounting blocks 58 for the four spindles 36. A top portion 60 of printer mainframe 10 is pivotable on a hinge means 102 and can be raised to its open position to insert a cartridge 20. When the cartridge 20 is inserted into the thermal printer, spindles 36 on the gear end of the two spools 21 and 22 engage a cam surface 54 on a mounting block 58 and flange 32a engages a flat surface 56 on two mounting

blocks 58 to properly locate the cartridge. As the cartridge is urged by downward closing top 60, springs 62 and 64 contact the top of cartridge 20 to retain the cartridge in the located position. Fig. 1 shows this closed position with cartridge spindles 36 fully seated in slots 50. The interaction of mounting blocks 58 and the cartridge spring 48 cause the disengagement of gears 24 from ribs 50 thus unlocking the cartridge.

As shown in Fig. 1, the cartridge gears 24 mesh with printer gears 23' and 68, respectively. Advantageously the gear 68 can be made part of a drag assembly for imparting a retarding force to the supply spool 21. The drive 15 includes a motor 70 and a gear transmission assembly 72 and a drive gear 74 which rotates the drum 16. The motor 70 can selectively rotate the drum in either a print (clockwise) or eject (counter-clockwise) direction.

The thermal printer 10 also includes a receiver-feed motor (not shown) which drives a tapered rubber roller 76. The roller 76 forms a nip with a flat plate 78. The receiver card 12 is delivered by a feeder mechanism (not shown) into this nip. The card is then propelled into clamp 80 of the drum 16, which is shown in its closed position.

After the drum 16 has rotated a receiver though its three printing cycles past the print head, a colored image has been formed on the receiver 12. The motor 70 then reverses its direction of rotation and the drum 16 rotates in the eject direction. The clamp 80 opens and the card 12 is fed into a nip provided between a belt 82 and a guide member 83 in a pre-ejection path. The belt 82 is driven by a motor (not shown) and propels the receiver into another nip provided between a rubber roller 86 and a plastic idler roller 88. The card 12 is deflected by guide member 89 and driven into a hooked free end portion

of a spring 90. The spring 90 is stretched as the card 12 is driven out of the nip formed by members 86 and 88. Once the trailing edge of card 12 clears such nip, the stretched spring 90 contracts and restoring force propels the card 12 out of the thermal printer print side up onto the top of a stack of cards 12 in a collection zone. The action of the guide members turns the card and so later in the eject cycle in accordance with the present invention it will be delivered print side up to a stack.

In Fig. 1, a head positioning system 100 is shown in a downward nip-pressing position. In Fig. 2, the top mainframe portion 60 is shown in a raised position to permit loading of a cartridge 20, and the mechanism 100 is shown in a retracted position, which will be explained shortly. When actively positioned by the system 100, the head 18 urges the carrier 14 and receiver 12 located between the nip of drum 16 and print head 18, into intimate contact (for printing and drive transmission).

As noted earlier, the head 18 is mounted to the bracket 199 which in turn is fixedly mounted to flexure 17. Flexure 17 is pivotally mounted on rod 102 to permit its free end to be raised and lowered. An extension 104 of the bracket 199 is connected to the mechanism 100 in the following manner. A solenoid 106 includes a movable plunger 108, which when the solenoid is energized is retracted as shown in Fig. 1. When solenoid 106 is de-energized, it is extended as shown in Fig. 2. A link member 110 is pinned to plunger 108 by a pin 113 and is pinned to loading rod 112 by a pin 113a. A pin 114 is fixed to extension 104 and rides or translates in a slot 116 formed in the loading rod 112. Attached to the rod 112 is a ring 118 which supports one end of a preloaded compression spring 120 mounted about the rod 112. The pin 114 engages the opposite end of the

spring 120. The preloaded compression spring 120 compliantly urges the head downward. The hole in extension 104 is slightly larger than the diameter of pin 114. This arrangement allows the head 18 to rotate about a roll axis shown in Fig. 2B. This axis is tangent to the drum at the nip and orthogonal to the heat line formed by the heating elements of the print head at the print zone. The compliance of the flexure 17 about the axis of rod 102 permits the print head to be raised and lowered by the mechanism 100. A pin 122 extends through two spaced flanges of a U-shaped member 124 (only one face of a flange is shown). The pin is fixed into the frame of the top 60. A tension spring 126 urges the mechanism 100 to the unloaded position shown in Fig. 2 when the solenoid 106 is de-energized.

The operation of the mechanism 100 will now be described. With the top 60 shown in its raised position, the mechanism 100 is in its unloaded condition with solenoid 106 de-energized. An operator now loads a cartridge 20 and closes the top 60. Once the receiver 12 is in position under the thermal head 18, the solenoid 106 is energized and retracts the plunger 108. Link 110 is driven to the left. This causes the U-shaped member 124 to rotate in a clockwise direction and the loading rod 112 is driven downwardly against the urging of spring 126 causing the head to engage the carrier. The spring 120 drives against the pin 114 which causes the head 18 to compliantly load the carrier 14 against the receiver 12 with predetermined pressure across the width of the receiver 12.

When head 18 is in the loaded position shown in Fig. 1, and drum 16 is rotating in the clockwise print direction, a counter clockwise moment is induced on head 18. An anti-pitch support member 200 contacts the rear of mounting bracket 199 in this

position and resists this counter clockwise moment by applying a vertical force at its point of contact with the center of bracket 199. This causes the head 18 to become exactly constrained in a stable pitch plane defined by the heat line or line of contact of the head with the drum 16 and the point of contact of the anti-pitch support 200 with mounting bracket 199.

Industrial Applicability and Advantages

A feature of the arrangement is that the head load pressure is a result of the compression of spring 120 and not the result of a fixed member. This compliance automatically adjusts for manufacturing tolerances of the print head, drum, carrier thickness, receiver thickness and positioning parts of system 100.

The load pressure is also uniform across the width of the receiver due to the compliance of the flexure 17 which allows the head 18 to roll as required to press uniformly against the drum.

Claims:

1. Compliant head loading mechanism for a thermal printer which compliantly loads a thermal print head against a dye carrier and a receiver mounted on a platen to form nip at a heat line, characterized by:

a) a flexure mounted at one end;

b) said head being fixed to said flexure and having a pin;

c) a loading rod having a slot for receiving said pin so that said pin can translate in said slot;

d) a compression spring engaging said rod and said pin; and

e) means coupled to said rod and effective to move said rod downwardly from an unloaded position into a loaded position where the head engages the carrier and said compression spring compliantly loads the head against the carrier and the receiver mounted on the platen to constrain said print head for rotation about a roll axis tangent to the drum at the nip and orthogonal to the heat line, whereby a uniform pressure is applied along the heat line across the width of the receiver.

2. The mechanism as set forth in claim 1, wherein said means includes spring means engaging said rod to cause it to move to said unloaded position and solenoid actuated means effective when actuated to cause said rod to move said loaded position against the urging of said spring means.

3. Compliant head loading mechanism for a thermal printer which compliantly loads at a print zone the heating elements of a print head against a dye carrier and a receiver mounted on a platen to form a nip at a heat line, comprising:

a) a flexure pivotably mounted at one end to permit said other end to be raised and lowered;

b) a mounting bracket including the head and a pin and being fixed to said flexure so that said head can be raised and lowered;

c) a loading rod having a slot for receiving said pin so that said pin can translate in said slot;

d) a compression spring engaging said rod and said pin; and

e) means coupled to said rod and effective to move said rod downwardly from an unloaded position into a loaded position when the head is lowered so that the head engages the carrier and said compression spring compliantly loads the head against the carrier and the receiver mounted on the platen to constrain said print head for rotation about a roll axis tangent to the drum at the nip and orthogonal to the heat line, whereby a uniform pressure is applied along the heat line across the width of the receiver.

4. The mechanism as set forth in claim 3, wherein said means includes spring means engaging said rod to cause it to move to said unloaded position and solenoid actuated means effective when actuated to cause said rod to move said loaded position against the urging of said spring means.

5. The mechanism as set forth in claim 4 further including an anti-pitch support for engaging the bracket to constrain the print head in a pitch plane defined by the heat line and the point of contact of the support and the bracket.

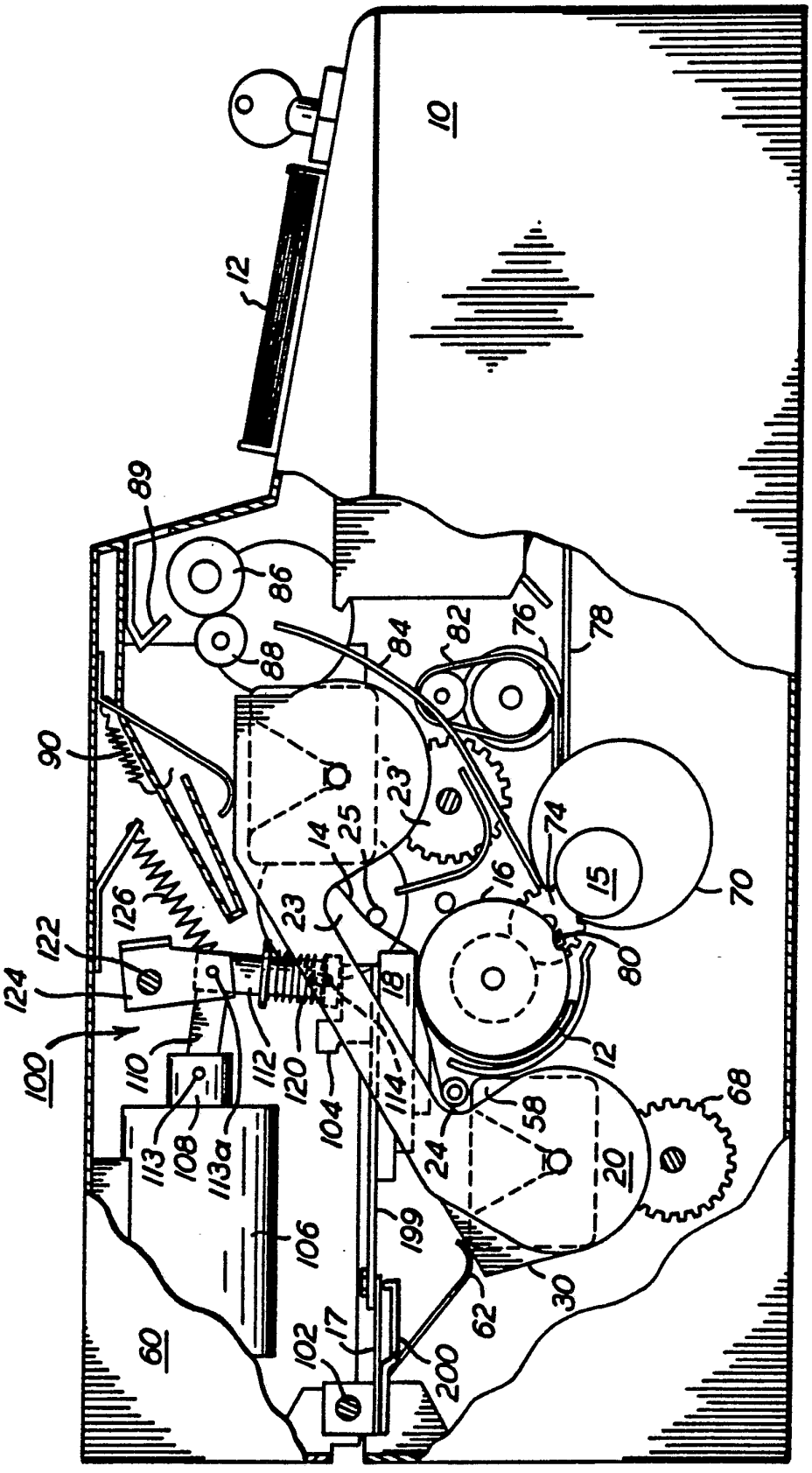

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FIG. 1

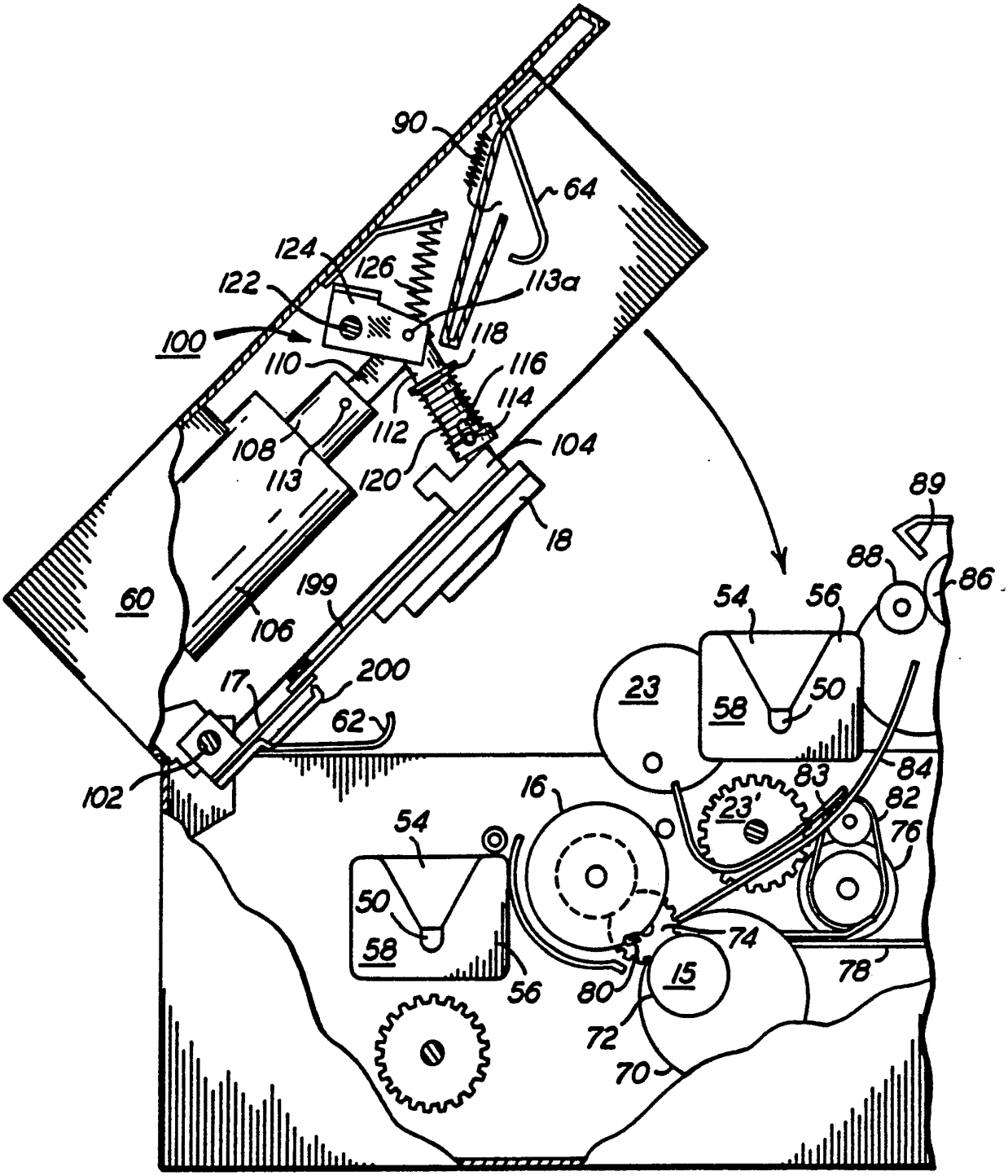

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FIG. 2

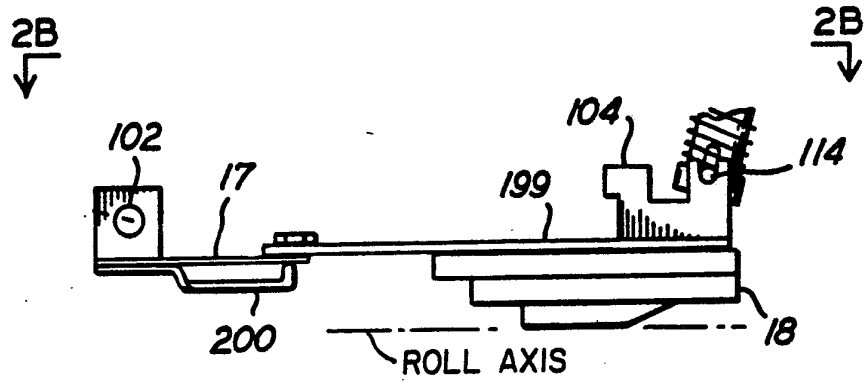
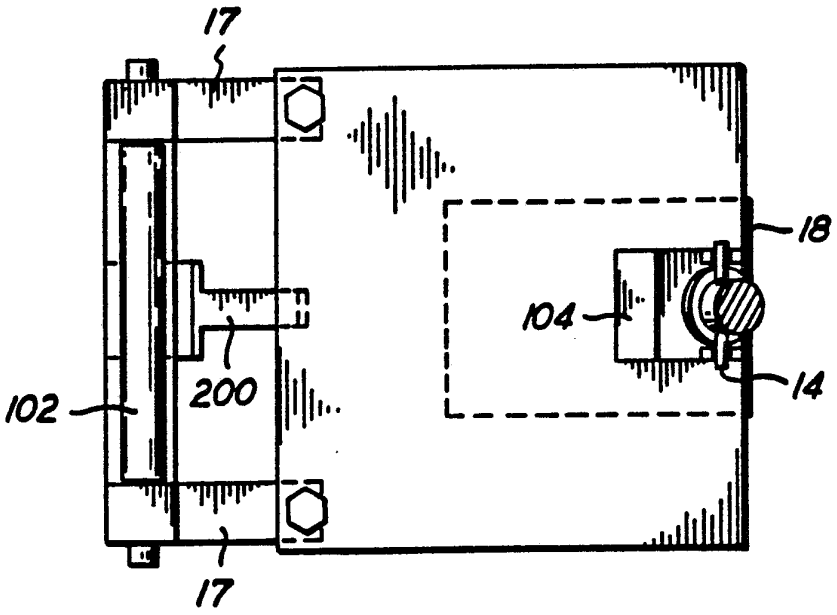


FIG. 2A

FIG. 2B



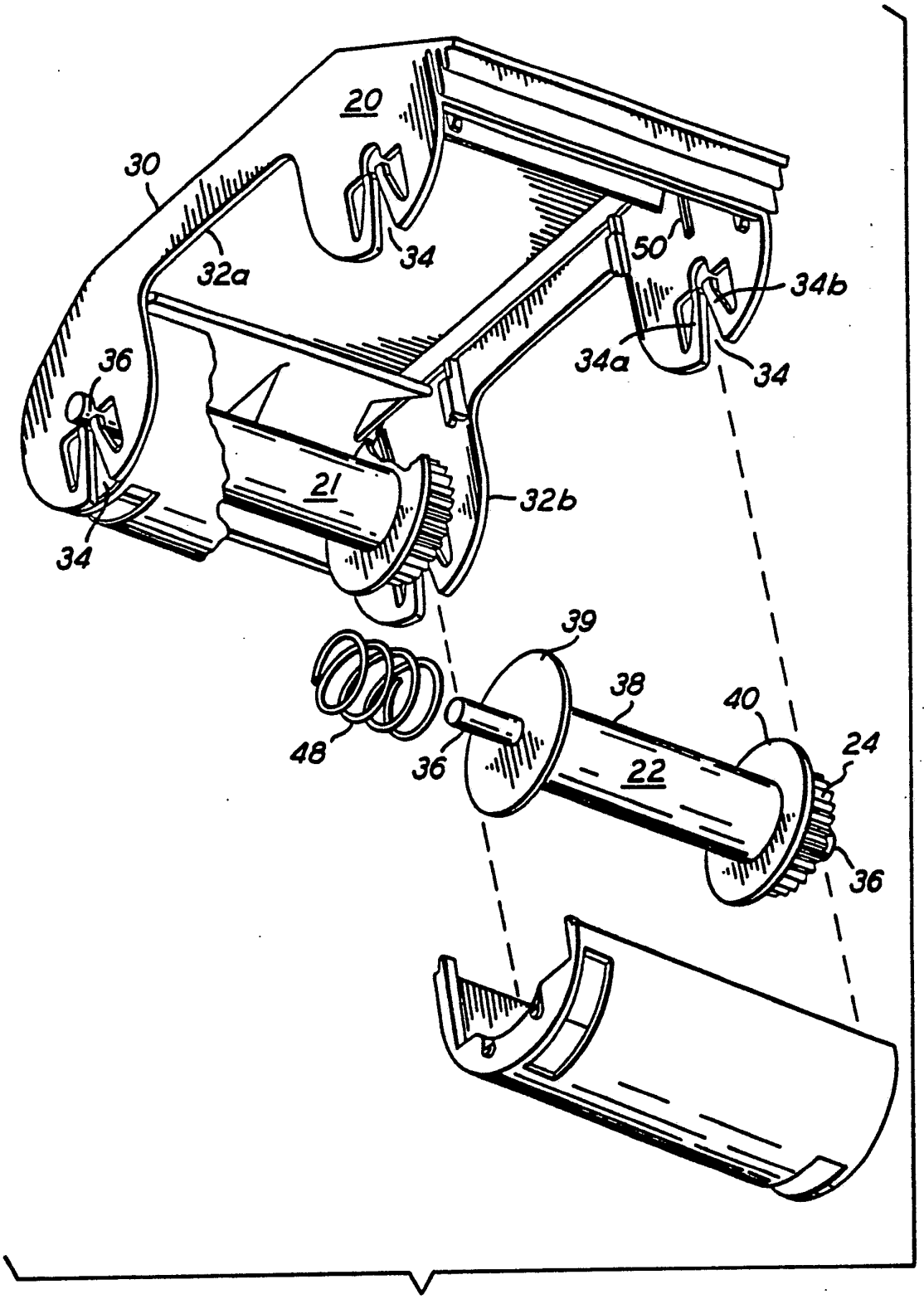


FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 88/00263

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: B 41 J 25/30

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
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Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	US, A, 4639152 (T. YAMAMOTO) 27 January 1987 see column 3, line 52 - column 4, line 25; figures 1-3 --	1-5
A	US, A, 4632585 (Y. OYAMATSU) 30 December 1986 see column 3, lines 14-37; column 6, lines 24-37; figures 12,13 --	1-5
A	US, A, 4507666 (K. KONDO) 26 March 1985 --	
A	US, A, 4300844 (R.W. KEIL) 17 November 1981 --	
A	US, A, 4170422 (F.T. BILEK) 9 Oktober 1979 --------	

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
19th May 1988	30 JUN 1988
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	P.C.G VAN DER PUTTEN

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 8800263 SA 20811

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		JP-A- 60192668	01-10-85
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		FR-A,B 2509667	21-01-83
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US-A- 4170422	09-10-79	None	