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(54) Tape label printer and method for printing identical multicolor labels

(57) Tape label printer including a tape having a lengthwise direction; a plurality of ribbon cassettes detachably mountable in the tape label printer and each housing an ink ribbon in one of a plurality of print colors; a print unit including a print head for printing on the tape using at least one of the ink ribbons housed in the ribbon cassettes; movement unit for moving the tape in its lengthwise direction relative to the print head; input unit for inputting a variety of commands and an information set including symbols; print color setting unit for setting one of the plurality of print colors to each symbol of the information set inputted using the input unit; print number setting unit for setting a print number of times the information set is to be printed; a memory for storing the information set, the print colors set by the print color setting unit, and the print number of times; and multicolor print control unit for controlling the print unit and the movement unit to print on the tape, starting at an initial position of the tape, symbols set by the print color setting unit with a same color of the plurality of colors the print number of times set by the print number setting unit, to rewind the tape to the initial position, and to repeat printing and rewinding until all symbols of the information set have been printed.

FIG. 11 (a)

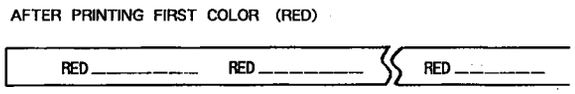


FIG. 11 (b)

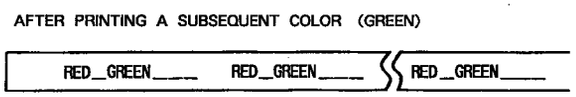
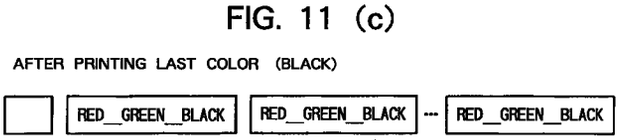


FIG. 11 (c)



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a tape label printer and particularly to a tape label printer for printing characters or symbols in a plurality of colors.

2. Description of the Related Art

U.S. Patent 5,188,469 describes a tape-shaped label printer, which prints characters and marks, such as alphabetic characters and symbols, on a tape printing medium. The label printer is suitable for making labels to adhere to the backs of file folders. A variety of tape cassettes housing a print tape, which serves as a print medium, and an ink ribbon are available to print labels in various colors and with various widths. To change the print color or the width of the label to be produced, the tape cassette in the label printer is changed to one housing a tape with the desired width and an ink ribbon of a desired color.

Japanese Utility Model Application (KOKAI) No. HEI-3-74956 describes a composite cassette used in a label printer for preparing tape-shaped labels. The composite cassette includes an independent tape cassette and a ribbon cassette. The tape cassette houses a tape, which serves as a print medium, and is freely detachably mounted in the printer. The ribbon cassette, which houses an ink ribbon, is freely detachably mounted in the tape cassette. Various ribbon cassettes are available for housing various colored ribbons. This configuration allows printing of labels in various colors.

SUMMARY OF THE INVENTION

It is conceivable to modify the tape printer described in Japanese Utility Model Application (KOKAI) No. HEI-3-74956 to enable multicolor printing. For example, printing could first be performed on the tape in one color using one ribbon cassette. Then the print tape could be rewound to where printing was started previously. After replacing the present ribbon cassette with one housing a different color ink ribbon, printing could be repeated using the different ribbon cassette. Therefore by changing ribbon cassettes in order, a multicolor label could be produced.

However, there is a problem with this method in that when preparing several copies of a label comprising the same information set to which has been set optional print colors for each character or symbol of the information set, it is necessary to change ribbon cassettes and rewind the print tape in the same order for each tape label so that operations become complex and time consuming.

It is an objective of the present invention to overcome the above-described problem and provide a tape label printer for reducing the number of times a tape must be rewound and the number of times ribbon cassettes must be changed when printing, for a plurality of times, an information set including symbols and characters set with a plurality of print colors, thereby reducing time required for printing operations.

According to one aspect of the present invention, a tape label printer includes a tape having a lengthwise direction; a plurality of ribbon cassettes detachably mountable in the tape label printer and each housing an ink ribbon in one of a plurality of print colors; a print means including a print head for printing on the tape using at least one of the ink ribbons housed in the ribbon cassettes; movement means for moving the tape in its lengthwise direction relative to the print head; input means for inputting a variety of commands and an information set including symbols; print color setting means for setting one of the plurality of print colors to each symbol of the information set inputted using the input means; print number setting means for setting a print number of times the information set is to be printed; a memory for storing the information set, the print colors set by the print color setting means, and the print number of times; and multicolor print control means for controlling the print means and the movement means to print on the tape, starting at an initial position of the tape, symbols with one of the plurality of colors set by the print color setting means the print number of times set by the print number setting means.

With this configuration, when an information set is to be printed a plurality of times, all symbols set with a first same color are printed at the same time for the number of times the information set is to be ultimately printed.

Further, the multicolor print control means can also be designed to control the print means and the movement means to rewind the tape to the initial position and to repeat printing and rewinding until all symbols of the information set have been printed in all colors set by the print color setting means.

In this way, the print tape is rewound and the presently-mounted ribbon cassette is exchanged for one housing an ink ribbon in a subsequent color to be printed. Printing is then performed in the next and subsequent colors in the same manner as described above. Therefore, the number of times ribbon cassettes must be exchanged and the number of times the tape must be rewound can be reduced, thereby improving operability of the tape label printer.

To this configuration can be added a printable number setting means set with a maximum print length of a single printing operation and for calculating a printable number of times the information set can be printed within the maximum print length. In this case, the multicolor print control means can be designed to control the print means and the movement means to print on the tape, starting at the initial position of the tape, symbols with one of the plurality of colors symbols set by the print color setting means the printable number of times

set by the printable number setting means, to rewind the tape to the initial position, and to repeat printing and rewinding until all symbols of the information set have been printed the print number of times set by the print number setting means.

With this configuration, when an information set is to be printed a plurality of times, all symbols set with the same color are printed at the same time for the printable number of times. Afterward, the print tape is rewound and the ribbon cassette is exchanged for a subsequent one. Printing is performed in the next color in the same manner as described above. These processes are repeated until a predetermined number of times to be printed has been reached. Therefore, shift in print position caused by feed error can be prevented and the number of times ribbon cassettes must be exchanged and the number of times the tape must be rewound can be reduced, thereby improving operability of the tape label printer.

According to another aspect of the present invention, a tape label printer includes a plurality of ribbon cassettes detachably mountable to the tape label printer and each housing an ink ribbon in one of a plurality of colors; a tape having a lengthwise direction; a print means including a print head for printing on the tape using an ink ribbon of a mounted ribbon cassette of the plurality of ribbon cassettes; movement means for moving the tape in its lengthwise direction relative to the print head; input means for inputting a variety of commands and an information set including symbols; print color setting means for setting one of at least a first color and a subsequent color of the plurality of print colors to each symbol of the information set inputted using the input means; print number setting means for setting a print number of times the information set is to be printed; a memory for storing the information set, the at least one of the first color and the subsequent color set by the print color setting means, and the print number of times; and multicolor print control means for controlling the print means and the movement means to print, starting at an initial position of the tape, symbols of the information set set with the first color for the print number of times set by the print number setting means, to rewind the tape to the initial position, and to print symbols of the information set set with the subsequent color the print number of times set by the print number setting means.

According to still another aspect of the present invention, a method of printing a multi-color information set a plurality of times to produce a plurality of tape labels printed with the same information set, includes the steps of inputting an information set including symbols; setting one of a plurality of print colors to each symbol of the inputted information set; setting a print number of times the information set is to be printed; printing, on the tape for the print number of times, all symbols of the information set set with a particular one of the plurality of print colors using an ink ribbon in the particular one of the plurality of print colors; and printing, on the tape for the print number of times, all symbols of the information set set with another of the plurality of print colors using an ink ribbon in the another of the plurality of print colors.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the invention will become more apparent from reading the following description of the preferred embodiment taken in connection with the accompanying drawings in which:

Fig. 1 is a plan view showing a tape label printer according to the present invention;
Fig. 2 is a plan view showing a thermal printing mechanism of the tape label printer shown in Fig. 1, while the thermal printing mechanism is in a printing condition;
Fig. 3 is a plan view showing a detachable tape cassette mountable in the thermal printing mechanism of Fig. 2;
Fig. 4 is a plan view showing a detachable ribbon cassette mountable in the tape cassette of Fig. 3;
Fig. 5 is a plan view showing the thermal printing mechanism and a drive system for driving the tape cassette and the ribbon cassette, the thermal printing mechanism being in the print condition;
Fig. 6 is a plan view showing the thermal printing mechanism and the drive system when the thermal printing mechanism is in a tape rewind condition;
Fig. 7 is a block diagram showing a control system of the tape label printer;
Fig. 8 is a flowchart representing a multi-color print routine
Fig. 9 is a flowchart representing a last color print routine and a print tape cutting routine;
Fig. 10 is schematic view showing an information set including symbols;
Fig. 11 (a) is a schematic view showing a tape printed with symbols set with a first color;
Fig. 11 (b) is a schematic view showing the tape printed with symbols set with a subsequent color;
Fig. 11 (c) is a schematic view showing the tape printed with symbols set with a last color; and
Fig. 12 is a schematic view showing relationship of various positions on the tape.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A tape label printer according to a preferred embodiment of the present invention will be described while referring to the accompanying drawings wherein like parts and components are designated by the same reference numerals to avoid duplicating description.

As shown in Fig. 1, a tape label printer 1 includes a housing 2. A keyboard 3 is provided at the front (i.e., to the lower part of Fig. 1) of the housing 2. The keyboard

3 includes a variety of function keys and symbol keys. The symbol keys are for inputting symbols, characters, and numbers, referred to collectively as symbols hereinafter. A liquid crystal display 4 capable of displaying inputted symbols and a cassette cover 5 are provided directly to the rear of the keyboard 3. A thermal print mechanism 10 shown in Figs. 2, 5, and 6 is disposed to the interior of the housing 2 in correspondence with the cassette cover 5. A slide knob 6 is provided for opening the cassette cover 5 to expose the thermal print mechanism 10. The thermal print mechanism 10 includes a thermal head 12 having a row of thermal elements (not shown in the drawings) for printing rows of print dots on the print tape 22 in a direction perpendicular to a direction (to be described later) in which the print tape 22 is moved. A cutter knob 8 for cutting a printed tape 22 (to be described later) is provided to the left of the cassette cover 5. A printed print tape 22 can be cut by depressing the cutter knob 8 downward.

Next, an explanation of a tape cassette 20 detachably mountable in the thermal print mechanism 10 and of a ribbon cassette 30 detachably mountable in the tape cassette 20 will be provided while referring to Figs. 2 through 4. A tape spool 23 on which the print tape 22 is wound is rotatably provided inside the tape cassette 20. A tape feed roller 24 feeds the print tape 22 from the tape spool 23 and transports it in a tape feed direction, and in an arc path as guided by a plurality of guides, to pass directly in front of the thermal head 12 and then be discharged out of the tape cassette 20.

A ribbon spool 33 on which is wound an ink ribbon 32 and a ribbon take up spool 34 for winding up the ink ribbon 32 are rotatably provided in the ribbon cassette 30. The ink ribbon 32 wound around the ribbon spool 33 temporarily approaches into parallel alignment with the print tape 22 when in opposition with the thermal head 12, then is bent at a substantially acute angle by a separation portion 35 to separate from the print tape 22 and then to be wound up on the ribbon take up spool 34.

The ribbon cassette 30 comes in a variety of types with ink ribbons 32 in black, red, blue, and other colors and in widths of 12, 18, 24, and 32 mm. A detection hole group 36 for detecting a type of ribbon cassette 30 and formed from a combination of a maximum of six detection holes 36a is formed at a corner of the ribbon cassette 30.

Next, an explanation of a movement mechanism 40 capable of moving the print tape 22 and the ink ribbon 32 in a feed direction, which is a print direction, and of moving the print tape 22 in a rewind direction, which is the opposite of the print direction, will be provided while referring to Fig. 5. The following components are rotatably supported on a body frame 11: a tape take up cam 41 engagable with a central portion of the tape spool 23; a ribbon take up cam 42 engagable with a central portion of the ribbon take up spool 34; and a tape drive cam 43 engagable with the tape feed roller 24. The thermal head 12 is also provided with an upright posture on the body frame 11. A detection switch group 82 including six switches for detecting presence and absence of the six detection holes of the detection hole group 36 is provided to the body frame 11. The six switches output a ribbon detection signal according to the combination of individual switch signals.

A tape drive motor 44 made from a step motor is attached to the right edge of the body frame 11. Gears 46 through 54 are each rotatably supported so as to engage in series starting with a drive gear 45 of the tape drive motor 44. The gear 46 and gear 47 are integrally formed to each other. Also, the gear 49 and the gear 50 are integrally formed to each other and fixed to a lower tip of the ribbon take up cam 42. Further, the gear 51 is formed integrally with a gear 55 positioned above the gear 51. The tape drive gear 53 is attached to the tape drive cam 43. That is, rotation of the tape drive motor 44 is transmitted to the tape drive cam 43 via the gears 45 through 53. Resultant rotation of the tape feed roller 24 attached to the tape cassette 20 moves the print tape 22.

On the other hand, a base tip of a swing lever 56 is supported in a space between the integrally formed gears 51 and 55 so as to be applied with an appropriate amount of friction resistance between the gears 51 and 55. A planetary gear 57 constantly in engagement with the gear 55 is rotatably supported on the swing lever 56. Further, a tape take up gear 58 is fixed to the lower tip of the tape take up cam 41.

As indicated by arrows in Fig. 5, when the tape drive motor 44 is driven to rotate in a clockwise direction for normal printing, so that the gear 51 rotates in the clockwise direction, then the swing lever 56 also pivots in the clockwise direction, so that the planetary gear 57 does not engage with the tape take up gear 58. Because in this condition the tape take up cam 41 is able to rotate freely and because the ribbon take up cam 42 is rotated in the counterclockwise direction, the print tape 22 wound about the tape spool 23 is fed out and taken up on the ribbon take up spool 34.

A platen roller 60 is disposed in opposition to the thermal head 12. A tape feed subroller 61 is disposed in opposition with the tape drive cam 43. The rollers 60 and 61 are rotatably supported on a roller holder 62. The roller holder 62 is pivotally supported on a support shaft 63 provided with an upright posture on the body frame 11. In association with opening and closing of the cassette cover 5, the roller holder 62 switches between a print position, indicated in Fig. 5, when the cassette cover 5 is closed and a release position, indicated in Fig. 6, when the cassette cover 5 is opened. When the roller holder 62 is switched into the print position, the platen roller 60 presses against the thermal head 12 through the print tape 22 and the ink ribbon 32 and also the tape feed subroller 61 presses against the tape feed roller 24 through the print tape 22. At this time, a platen gear (not shown in the drawings) fixed to the lower tip of the tape feed subroller 61 is in engagement with the gear 54. Also, a subgear (not shown in the drawings) fixed to the lower tip of a tape feed subroller 66 is in

engagement with the tape drive gear 54.

Next, an explanation of a tape detector 70 provided to the left edge of the body frame 11 will be provided while referring to Fig. 2. Guide members 73, 74 for sealing a pair of sensor housing chambers 71, 72 are formed integrally with the housing 2. A light-emitting element 75 is attached to one of the sensor housing chambers 71. A light-receiving sensor 76 is attached to the other sensor housing chamber 72. A slit 77 through which the print tape 22 can pass is formed between the guide members 73, 74. Small-diameter light passages 73a, 74a are formed at confronting positions of the guide members 73, 74. The sensor light emitted from the light-emitting element 75 passes through the light passages 73a, 74a formed in the sensor housing chambers 71, 72 respectively and travels toward the light-receiving element 76. That is, whether or not the print tape 22 exists at the tape detection sensor 78 is detected according to whether or not the sensor light is blocked.

As shown in Fig. 2, when printing is executed, first a tape cassette 20 is mounted in the thermal print mechanism 10 and a ribbon cassette 30 is mounted in the tape cassette 20. Then the cassette cover 5 is closed, thereby switching the roller holder 62 to the printing position. In this condition, when the tape drive motor 44 is driven in the normal printing direction, the gears 45 through 54 are rotated in their respective predetermined rotation directions indicated by arrows in Fig. 5. The platen roller 60 and the tape feed subroller 61 are both rotated in the counterclockwise direction. Also, the tape feed subroller 61 and the tape feed roller 24 are rotated in synchronization. Therefore, after the print tape 22 is printed on by the thermal head 12, it is transported past the tape detector 70 and a tape cutting mechanism 80, also disposed to the left side of the body frame 11, and discharged out of the tape label printer 1.

At this time the tape take up cam 41 is able to rotate freely so that the print tape 22 wrapped on the tape spool 23 is fed out without resistance. Simultaneously the rotation of the platen roller 60 feeds ink ribbon 32 from the ribbon spool 33 in synchronization with the print tape 22. Also, the ribbon take up cam 42 is rotated by rotation of the ribbon take up gear 49 so that the ink ribbon 32 is wound up onto the ribbon take up spool 34, which is in engagement with and rotated by rotation of the ribbon take up cam 42.

On the other hand, when the print tape 22 is to be rewound, first the user opens the cassette cover 5 so that the roller holder 62 switches to the release position. The user then takes out the ribbon cassette 30. When the tape drive motor 44 is driven in the rewind direction, the gears 45 through 55 are rotated in their respective predetermined directions indicated by the arrows of Fig. 6. Rotation in the counterclockwise direction by the gear 51 pivots the swing lever 56 in the counterclockwise direction, thereby bringing the planetary gear 57 into engagement with the tape take up gear 58. As a result, the tape take up cam 41 rotates in the counterclockwise direction so that the print tape 22 is taken up by the tape spool 23. Although the ribbon take up gear 49 rotates in the clockwise direction, the ink ribbon 32 is not rewound because the ribbon cassette 30 has been removed.

A control system for the tape label printer is configured as shown in a block diagram of Fig. 7. To an input/output interface 93 of a control device CD is connected the keyboard 3; the tape detection sensor 78; a cutting detection switch 81 for detecting movement of the cutter knob 8 to a cutting position; the detection switch group 82; a display controller (LCDC) having a video RAM for outputting display data to the liquid crystal display (LCD) 4; a drive circuit 84 for driving the thermal head 12; and a drive circuit 85 for driving the tape drive motor 44.

The control drive CD is configured from a CPU 90; the input/output interface 93; a font RAM 91; a ROM 92; and a RAM 100, all connected to the CPU 90 via a bus 94 such as a data bus. For each of a plurality of characters of the symbols, the font RAM 91 stores display dot pattern data and stores print dot pattern data for a plurality of print text character sizes.

The ROM 92 stores in correspondence with code data of symbols inputted from the keyboard 3, a display drive control program for controlling the display controller 83; a print control program for producing dot pattern data required for printing symbols stored in a text memory 101 (to be described later); a print drive control program for, in regards to the produced dot pattern data, outputting dot pattern data for each single dot row serially to the thermal head 12 and outputting drive pulses to the tape drive motor 44; and a preset maximum printing length. The maximum print length is determined based on the precision of the movement mechanism 40. Further, the ROM 92 stores a ribbon detection table for detection of a ribbon color and ribbon width of the ink ribbon 32 based on a ribbon detection signal outputted from the detection switch group 82, which is made up of a first through sixth detection switches.

The text memory 101 of the RAM 100 stores an information set, which includes symbols inputted from the keyboard 3. As will be described later, a user uses the keyboard 3 to set one of a plurality of print colors to each symbol of the information set. Therefore, each symbol is stored in the text memory 101 in correspondence with data for its set print color. A color number memory 102 stores the total number of print colors set to all symbols of the information set. A print color order memory 103 stores data on the order at which print colors are set to symbols of the information set. A print number memory 104 stores print number data representing a number of times that the information set is to be printed as indicated by a user. A printable number memory 105 stores printable number data representing a number of times printing is possible.

Next, an explanation of processes performed during a multi-color print routine performed by the control device CD of the tape label printer will be provided while referring to the flowchart of Fig. 8. It should be noted

that individual steps of the flowchart will be referred to in the drawings and in the following text as Si, wherein i represents 10, 11, 12, and the like.

First, initialization processes for initializing the control device CD and the thermal print mechanism 10 are performed in S10. Then an input screen prompting input of print format, and margin to be provided before and after printed portions of labels, and further prompting input of an information set including optional symbols to be printed is displayed on the liquid crystal display 4. Print format, margin amount, and the information set inputted in accordance with these indications are stored in the text memory 101 in S11. This example will be explained assuming that "RED GREEN BLACK" shown in Fig. 10 was inputted as the information set. In this case, the symbols of the information set comprise alphabetic characters.

Next, in S12 a print color setting routine is performed for setting a number of colors, an order of colors, and a range to be subjected to these settings. In this example, the color number is set to three colors, that is, red, green, and black. The color order is set so that red is printed first, green is printed second, and black is printed last. Said differently, red is the first color and green and black are subsequent colors. Alternatively, the red and green colors could be considered lead colors, and black considered the last color. Then subject ranges are set to symbols of the information set. In this example, the user sets the color red to the symbols "RED" and the color green to the symbols "GREEN." Once the two colors red and green are set in this manner, the rest of the information set, that is, the symbols "BLACK," is automatically set to be printed in black ink, because black is the last color of the color order. This automatic setting of the last color is performed by subtracting the ranges of the lead colors from the total range of the information set. The remainder is set as the range for the last color. Next, in S13 a print number setting routine is performed for using the keyboard 3 to input and set how many times the information set is to be printed. In this example, the print number PN is set to ten times in order to produce ten labels printed with "RED GREEN BLACK."

Next, a printable number setting routine is performed in S14. In this routine, the number of times that the information set can be printed within the range of the maximum print length is calculated. During multi-color printing, after symbols set with one color are printed, the print tape is rewound and then symbols set with a subsequent color are printed. The longer the length of print tape 22 printed on in a single continuous printing operation, the greater the cumulative error generated by the movement mechanism 40 during the single printing operation. When the tape is rewound and printed for a subsequent color, if the cumulative error is too large, then positions printed on near the end of different printing operations can be shifted out of alignment relative to each other. To ensure accuracy of printed positions, the maximum printing length of the tape label printer of the present embodiment is preset to 200 mm. Therefore, the length of print tape 22 printed on in a single printing operation should be less than 200 mm. In this example, the overall length of a single label is 35 mm including 25 mm for the information set and 5 mm each for both the front and rear margin amounts. Therefore, the printable number LN is five times (i.e., 35 mm x 5 times = 175 mm > 200 mm).

Next, a print start routine is performed in S15. This routine is started by depressing a print start key provided to the keyboard 3. The tape drive motor 44 is driven in the normal printing direction and the print tape 22 is transported in the printing direction until a tape detection signal from the tape detector 70 changes from indicating no tape is present to indicating that tape is present, that is, until the front edge of the print tape 22 is aligned with the tape detection sensor 78. At this point, the portion of the print tape 22 in opposition with the row of thermal elements of the thermal head 12 is set as an initial printing position. In the tape label printer of the present embodiment, as shown in Fig. 12, a distance of 15 mm separates a tape detection portion P1, which is the front edge of the print tape 22 detected by the tape detection sensor 78, and a tape cutting position P2, which is defined by the tape cutting mechanism 80. Also, a distance of 25 mm separates the tape cutting position P2 and the initial printing position P3, which is defined by the row of thermal elements in the thermal head 12.

Next, a ribbon color confirmation routine is performed in S16. In this routine, whether or not a ribbon cassette 30 of the print color corresponding to the color order is mounted is determined by the ribbon detection signal. When the correct ribbon cassette 30 is not mounted, then a message indicating which color ribbon cassette 30 must be mounted is displayed on the liquid crystal display 4.

Next, whether or not the print color is the last color is determined in S17. If not the last color (S17:NO), then a set color print routine is performed in S18. In this routine, the print number PN is compared with the printable number LN. When the print number PN is equal to or greater than the printable number LN, then symbols set to the set color are printed a number of times equal to the printable number LN only. On the other hand, when the print number PN is less than the printable number LN, then symbols set to the set color are printed the full print number PN.

Next, a ribbon cassette removed confirmation routine is performed in S19. In this routine, is it determined based on a ribbon detection signal whether or not a ribbon cassette 30 has been removed. When it is determined that the ribbon cassette 30 is mounted, then a message indicating that the ribbon cassette 30 must be removed is displayed on the liquid crystal display 4.

Next, a tape rewind routine is performed in S20. In this routine, the tape drive motor is driven in the tape rewind direction and the print tape 22 rewound until the tape detection signal from the tape detector 70 changes

from indicating the presence of tape to indicating absence of tape, that is, until the front edge of the print tape is aligned with the tape detection sensor 78. This allows printing to be performed in a second color from the same initial printing position as for the first color. Then processes for the next color are again performed by returning. to the ribbon color confirmation routine of S16.

Then, in the determination processes of S17, when the color is the last color (S17:YES), then a last color print routine and a print tape cutting routine are performed in S21. In these routines, the print number PN is compared with the printable number LN. When the print number PN is equal to or greater than the printable number LN, then symbols set with the last color are printed only the printable number LN. On the other hand, when the print number PN is less than the printable number LN, then symbols set with the last color are printed the full print number PN. In both these cases, however, when a predetermined cutting position reaches the tape cutting mechanism 80, then printing operations are interrupted and the cutting operations are performed on the print tape 22 to produce labels in a number equal to the print number PN or the printable number LN whichever is smaller.

Details of the last color print routine and the print tape cutting routine will be described based on the flowchart of Fig 9. First, printing of one dot row and feed of the print tape 22 one dot row's distance are performed in S210. It should be noted that printing also includes processes performed on margin portions, wherein the tape is only fed and not printed on. Next, whether or not a position to be cut of the tape 22 has reached the cutting position P2 is determined in S211.

As shown in Fig. 12, the first position to be cut is at the front edge of a first label, that is, at the initial printing position P3. To move the position to be cut of the tape 22 to the cutting position P2 of the tape cutting mechanism 80, the print tape 22 is fed from the initial printing position P3 for the distance separating the initial printing position P3, which is defined by the thermal head 12, and the tape cut position P2 in the tape cutting mechanism 80. The next position to be cut is the rear edge of each subsequent label. Each time the print tape 22 is fed by the length of one label, starting from the first cutting position, then a position to be cut reaches cutting position P2 of the tape cutting mechanism 80.

It should be noted that the feed amount of the print tape 22 can be measured by counting drive pulses transmitted to the tape drive motor 44.

When a portion to be cut reaches the cutting portion (S211:YES), then the tape cutting routine is performed in S213. In this routine, a message prompting a user to cut the tape is displayed on the liquid crystal display 4. After it has been confirmed by the cutting detection switch 78 that the print tape 22 has been cut by operation of the cutter knob 8, then the program proceeds to a determination routine in S212.

When it is determined in the previous determination routine of S211 that a portion to be cut has not reached the cutting portion (S211:NO), then whether or not printing and cutting operations have been performed for a predetermined number of times is determined in S212. The predetermined number of times is determined as the smaller of the print number PN compared with the printable number LN, or the printable number LN if the print number PN and the printable number LN are the same. If printing and cutting operations are not complete (S212:NO), then the program returns to S210, where one dot row's worth of printing and tape fed processes are performed. When the printing and cutting operations are completed (S212 YES), then the program proceeds to the determination routine of S22 shown in Fig. 8.

Next, whether or not the print number has been reached is determined in S22. In this example, whether or not the print number has been reached is determined by whether or not the print number PN is greater than the printable number LN. If the print number has not been reached (S22:YES), then a print number reset routine is performed in S23. Here, the printable number LN is subtracted from the print number PN and the print number PN is reset to the difference. Afterward, the print start routine of S15 is again performed.

In this way, multi-color printing processes are repeatedly performed until tape labels printed with the information set are printed in the set print number PN. When it is determined that the print number PN has been reached (S22:NO), then the multi-color printing routine is completed.

In the example of the present embodiment, as shown in Fig. 11, "RED _____ _____" is first printed in red ink on the print tape 22 five times. Then the print tape 22 is rewound and "___ GREEN _____" is printed in green ink on the print tape 22 five times. Then, the print tape 22 is again rewound and "___ _____ BLACK" is printed in black ink on the print tape 22 five times. However, in this last operation, the print tape is first transported 25 mm from the initial printing position and then print tape cutting operations are performed. Printing is then continued. However, each time the print tape is transported 35 mm, printing is stopped and print tape cutting operations performed. Multi-color printing processes are repeated until a total of 10 printed labels are produced.

When these processes are being performed, the ribbon cassette is exchanged a total of six times and the print tape is rewound a total of four times. Therefore, the number of times the ribbon cassette is exchanged and the print tape rewound can be decreased compared with conventional tape label printers. As a result, a plurality of multi-color print labels can be produced efficiently in a short time.

While the invention has been described in detail with reference to specific embodiments thereof, it would be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention, the scope

of which is defined by the attached claims.

Claims

1. A tape label printer (1) comprising:

   a tape (22) having a lengthwise direction;
   a plurality of ribbon cassettes (30) detachably mountable in the tape label printer and each housing an ink ribbon (32) in one of a plurality of print colors;
   a print means (10) including a print head (12) for printing on the tape using at least one of the ink ribbons housed in the ribbon cassettes;
   movement means (40) for moving the tape in its lengthwise direction relative to the print head;
   input means (3) for inputting a variety of commands and an information set including symbols;
   print color setting means for setting one of the plurality of print colors to each symbol of the information set inputted using the input means;
   print number setting means for setting a print number of times the information set is to be printed;
   a memory (100, 101, 102, 104) for storing the information set, the print colors set by the print color setting means, and the print number of times; and
   multicolor print control means (90) for controlling the print means and the movement means to print on the tape, starting at an initial position of the tape, symbols with one of the plurality of colors set by the print color setting means the print number of times set by the print number setting means.

2. A tape label printer as claimed in claim 1, wherein the multicolor print control means (90) controls the print means (10) and the movement means (40) to complete printing in one color of the plurality of colors set by the print color setting means the print number of times set by the print number setting means before printing in another color of the plurality of colors,
   preferably rewinding the tape (22) to the initial position and to repeat printing and rewinding until all symbols of the information set have been printed, preferably in all colors set by the print color setting means.

3. A tape label printer as claimed in claim 1 or 2, further comprising printable number setting means set with a maximum print length of a single printing operation and for calculating a printable number of times the information set can be printed within the maximum print length; wherein the multicolor print control means (90) controls the print means (10) and the movement means (40) to print on the tape (22), starting at the initial position of the tape, symbols with one of the plurality of color symbols set by the print color setting means the printable number of times set by the printable number setting means, to rewind the tape (22) to the initial position, and to repeat printing and rewinding until all symbols of the information set have been printed the print number of times set by the print number setting means,
   the maximum print length preferably corresponding to precision of the movement means (10).

4. A tape label printer (1) comprising:

   a plurality of ribbon cassettes (30) detachably mountable to the tape label printer and each housing an ink ribbon (32) in one of a plurality of colors;
   a tape (22) having a lengthwise direction;
   a print means (10) including a print head (12) for printing on the tape using an ink ribbon of a mounted ribbon cassette of the plurality of ribbon cassettes;
   movement means (40) for moving the tape in its lengthwise direction relative to the print head;
   input means (3) for inputting a variety of commands and an information set including symbols;
   print color setting means for setting one of at least a first color and a subsequent color of the plurality of print colors to each symbol of the information set inputted using the input means;
   print number setting means for setting a print number of times the information set is to be printed;
   a memory (100, 101, 102, 104) for storing the information set, the at least one of the first color and the subsequent color set by the print color setting means, and the print number of times; and
   multicolor print control means (90) for controlling the print means and the movement means to print, starting at an initial position of the tape, symbols of the information set set with the first color for the print number of times set by the print number setting means, to rewind the tape to the initial position, and to print symbols of the information set set with the subsequent color the print number of times set by the print number setting means.

5. A tape printer as claimed in claim 4, wherein the memory further stores a maximum print length of a single printing operation;
   further comprising printable number setting means for calculating a printable number of times the information set can be printed within the maximum print

length stored in the maximum print length memory; and
wherein the multicolor print control means (90) compares the printable number of times calculated by the printable number setting means with the print number of times set by the print number setting means and, when the print number of times is greater than the printable number of times, controls the print means (10) and the movement means (40) to print symbols set with the first color the printable number of times, to rewind the tape (22) to the initial position, to print the symbols set with the subsequent color the printable number of times, and to repeat printing and rewinding operations until the information set is printed the print number of times, the maximum print length preferably corresponding to precision of the movement means.

6. A tape printer as claimed in claim 3 or 5, further comprising a print number reset means for, after the multicolor print control means (90) determines that the print number of times is greater than the printable number of times and controls the print means (10) and the movement means (40) to print the information set in the first color and in the subsequent color the printable number of times, calculating a difference between the printable number of times and the print number of times and resetting the print number of times to the difference.

7. A tape label printer as claimed in one of claims 1 to 6, wherein:
the memory (100, 103) further stores a color order in which colors are set to the symbols of the information via the print color setting means; and
the print color setting means sets, based on input from the input means (3), a range of symbols affected by lead colors or the first color and the subsequent color of the color order, respectively, and, to set a range for a last color of the color order, subtracts the range of lead colors or the first color and the subsequent color, respectively from a range of the information set.

8. A tape label printer as claimed in claim 7, further comprising:

ribbon color checking means for detecting a ribbon cassette (30) mounted in the tape label printer and determining, based on the color order stored in the memory (100, 103), whether color of an ink ribbon (32) housed in the ribbon cassette matches a color set to symbols to be printed,
and preferably informing means (4) for informing that the ribbon cassette is incorrect when the ribbon color checking means determines that the color of the ink ribbon does not match the color set to symbols to be printed.

9. A tape label printer as claimed in one of claims 1 to 8, further comprising:

tape cut detector (78) for detecting when the tape (22) is cut;
tape cutting control means for determining completion of each printing of symbols set with the subsequent color and stopping printing processes until the tape cut detector detects that the tape is cut,
and preferably informing means (4) for informing that the tape should be cut after the tape cutting control means stops printing processes.

10. A tape label printer as claimed in one of claims 4 to 9, wherein the subsequent color includes more than one color.

11. A tape label printer as claimed in one of claims 1 to 10, wherein the movement means (40) moves, in association with the tape (22), the ink ribbon (32) of the ribbon cassette (30) mounted in the tape label printer; and further comprising:

a ribbon cassette detector for detecting whether a ribbon cassette is mounted in the tape label printer when the tape is to be rewound; and
informing means (4) for informing, when the ribbon cassette detector detects the ribbon cassette is mounted when the tape is to be rewound, that the ribbon cassette must be removed before the tape is rewound.

12. A method of printing a multi-color information set a plurality of times to produce a plurality of tape labels printed with the same information set, comprising the steps of:

inputting an information set including symbols;
setting one of a plurality of print colors to each symbol of the inputted information set;
setting a print number of times the information set is to be printed;
printing, on the tape (22) for the print number of times, all symbols of the information set set with a particular one of the plurality of print colors using an ink ribbon (32) in the particular one of the plurality of print colors; and
printing, on the tape for the print number of times, all symbols of the information set set with another of the plurality of print colors using an ink ribbon in the another of the plurality of print colors.

13. A method as claimed in claim 12, further comprising the steps of:

transporting the tape (22) to an initial position

with relation to a print head (12) before printing in the particular one of the plurality of print colors; and

rewinding the tape to the initial position before printing in the another of the plurality of print colors,

preferably repeating printing and rewinding until all symbols of the information set have been printed the print number of times,

setting a maximum print length of a single printing operation,

calculating a printable number of times the information set can be printed within the maximum print length, and

repeating printing and rewinding until all symbols of the information set have been printed the printable number of times.

14. A method as claimed in claim 12 or 13, further comprising the steps of:

detecting presence of a ribbon cassette (30) before rewinding; and

indicating that the ribbon cassette should be removed before rewinding.

15. A method as claimed in one of claims 12 to 14, further comprising the steps of:

storing a color order in which colors are set to the symbols of the information set;

setting a range of symbols affected by lead colors of the color order; and

subtracting the range of the lead colors from a range of the information set in order to set a range for a last color of the color order,

preferably detecting type of a ribbon cassette (30),

determining, based on the stored color order, whether color of an ink ribbon (32) housed in the ribbon cassette matches a color set to symbols to be printed, and

informing that the ribbon cassette is incorrect when it is determined that the ink ribbon housed in the ribbon cassette does not match the color set to symbols to be printed.

FIG. 1

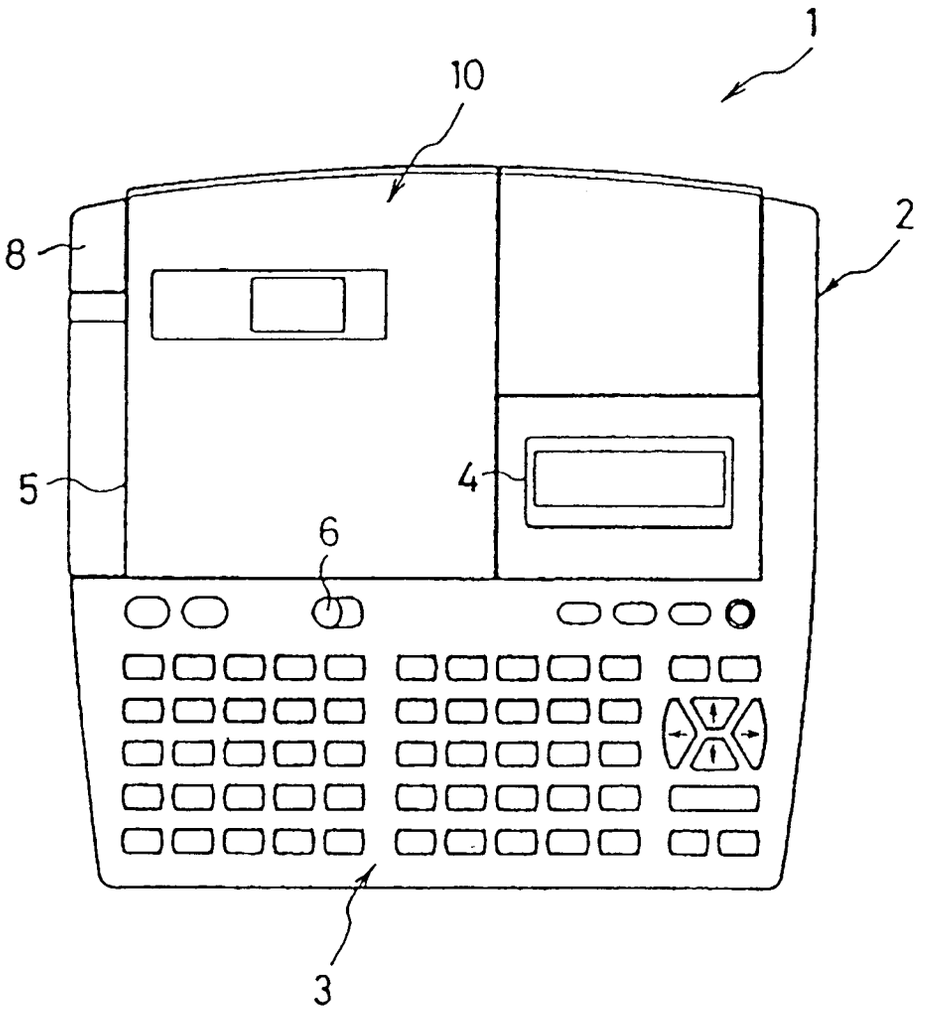


FIG. 2

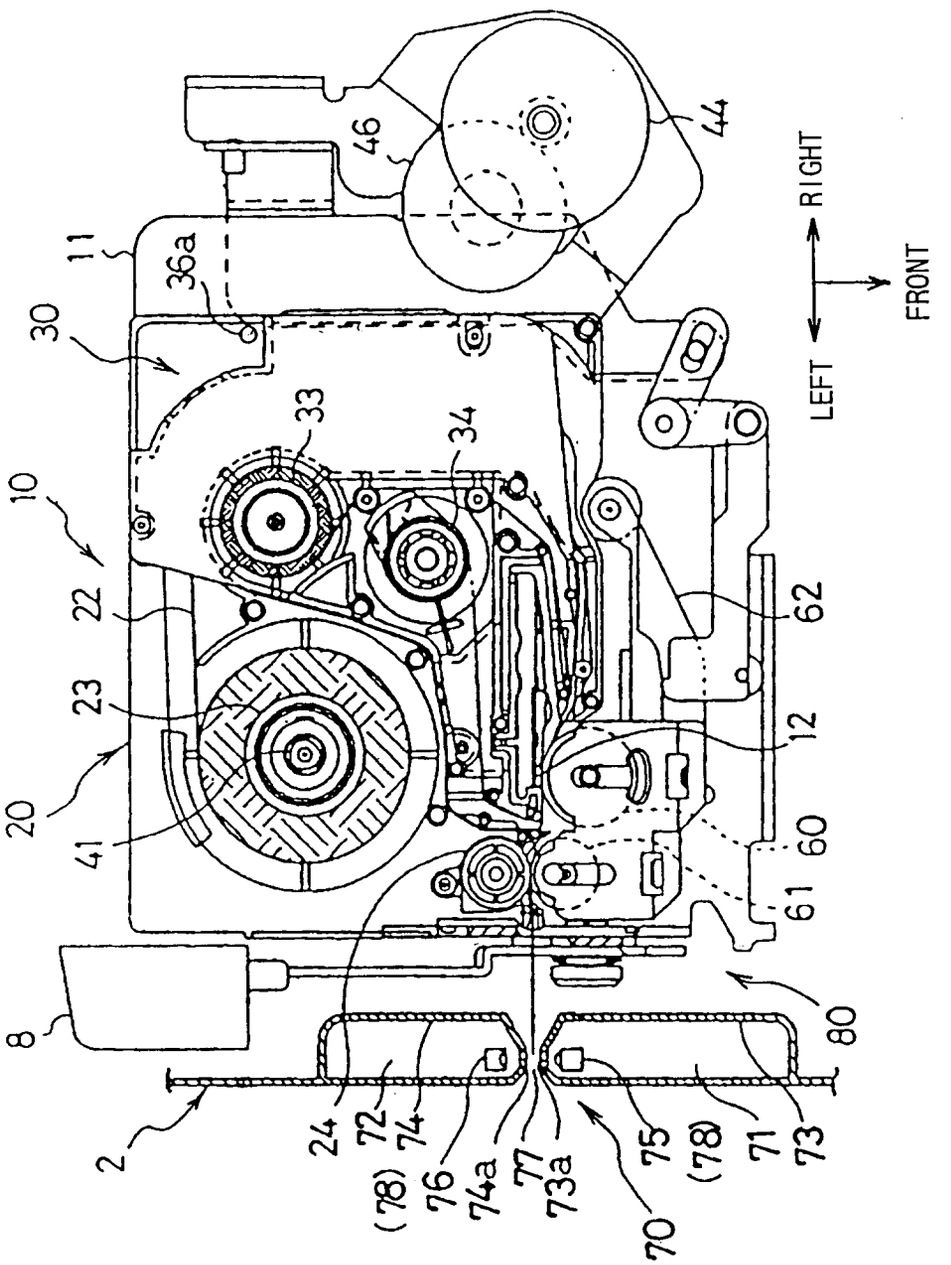

RIGHT
FRONT
LEFT
44
46
11
36a
30
33
34
10
22
23
20
41
62
12
60
61
80
8
2
24
72
74
(78)
76
74a
77
73a
70
75
(78)
71
73

FIG. 3

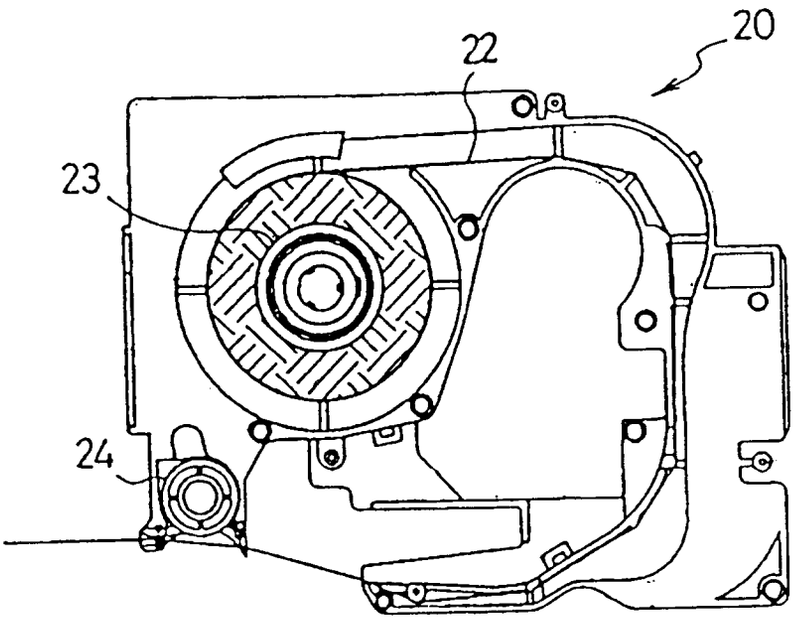


FIG. 4

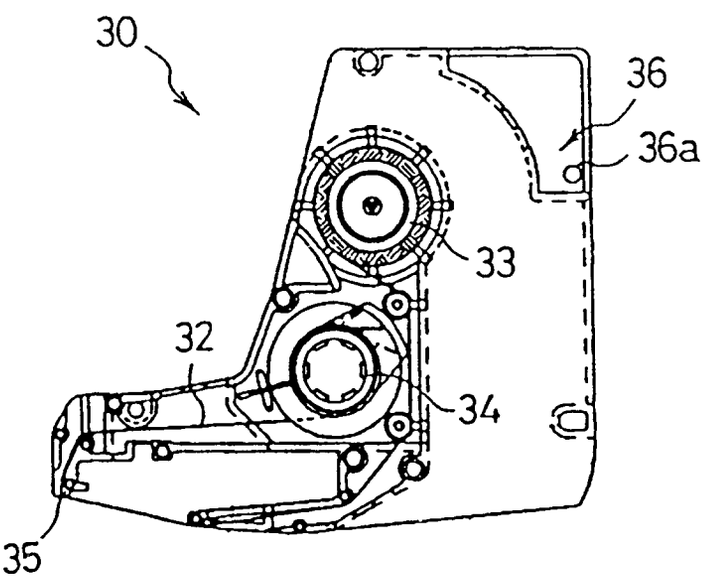


FIG. 5

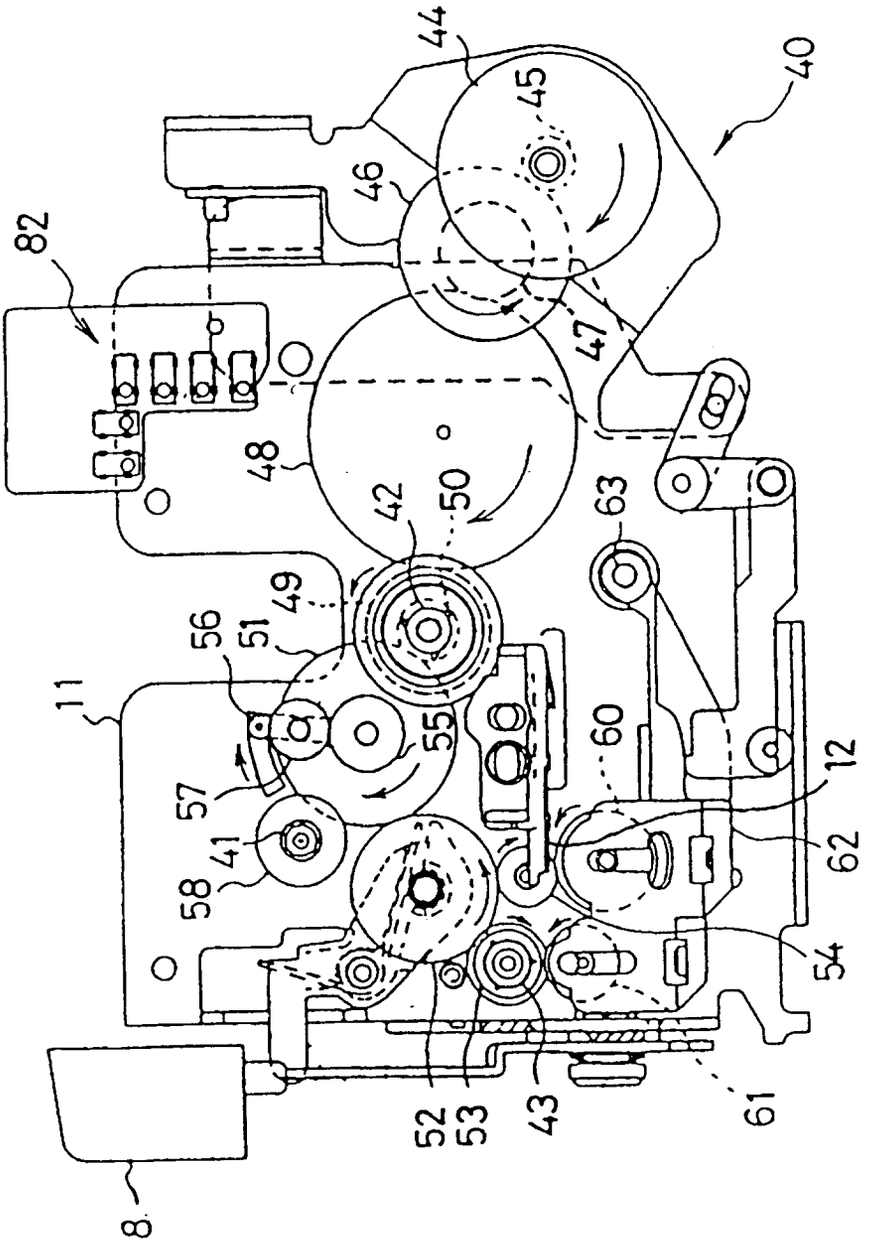

44
45
40
46
82
47
48
42
50
63
49
56
51
11
55
60
12
57
41
62
58
54
52
53
43
61
8

FIG. 6

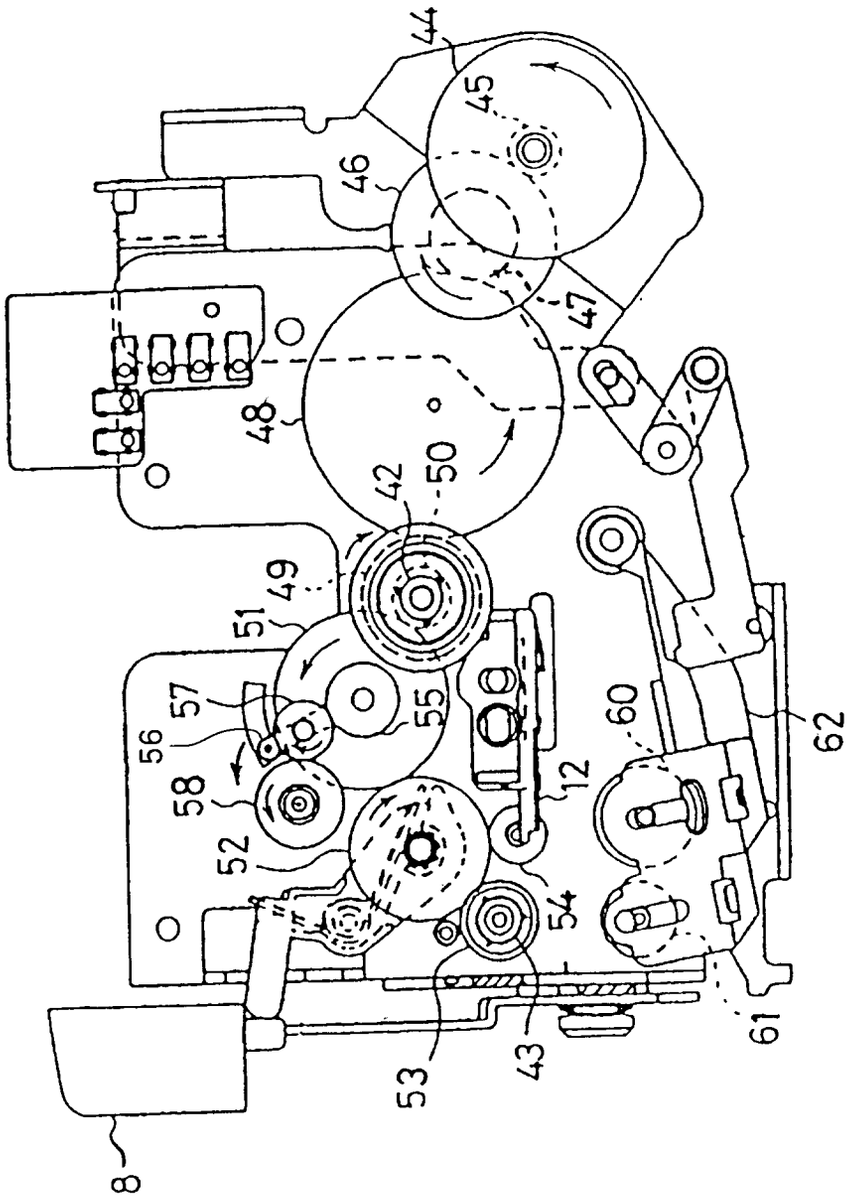


FIG. 7

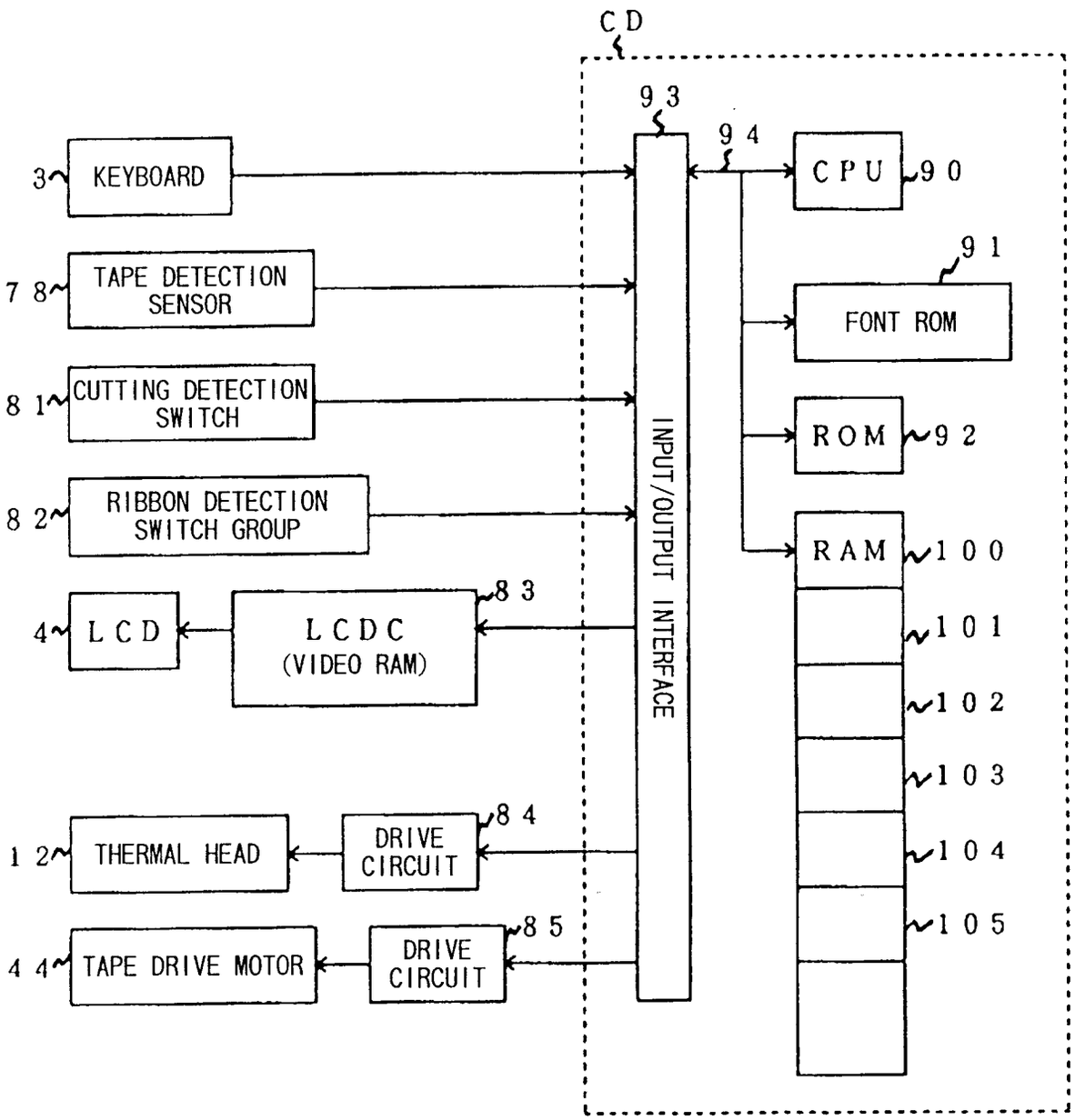

C D
9 3
9 4
3
KEYBOARD
7 8
TAPE DETECTION SENSOR
8 1
CUTTING DETECTION SWITCH
8 2
RIBBON DETECTION SWITCH GROUP
4
L C D
L C D C
(VIDEO RAM)
8 3
1 2
THERMAL HEAD
DRIVE CIRCUIT
8 4
4 4
TAPE DRIVE MOTOR
DRIVE CIRCUIT
8 5
INPUT/OUTPUT INTERFACE
C P U
9 0
9 1
FONT ROM
ROM
9 2
RAM
1 0 0
1 0 1
1 0 2
1 0 3
1 0 4
1 0 5

FIG. 8

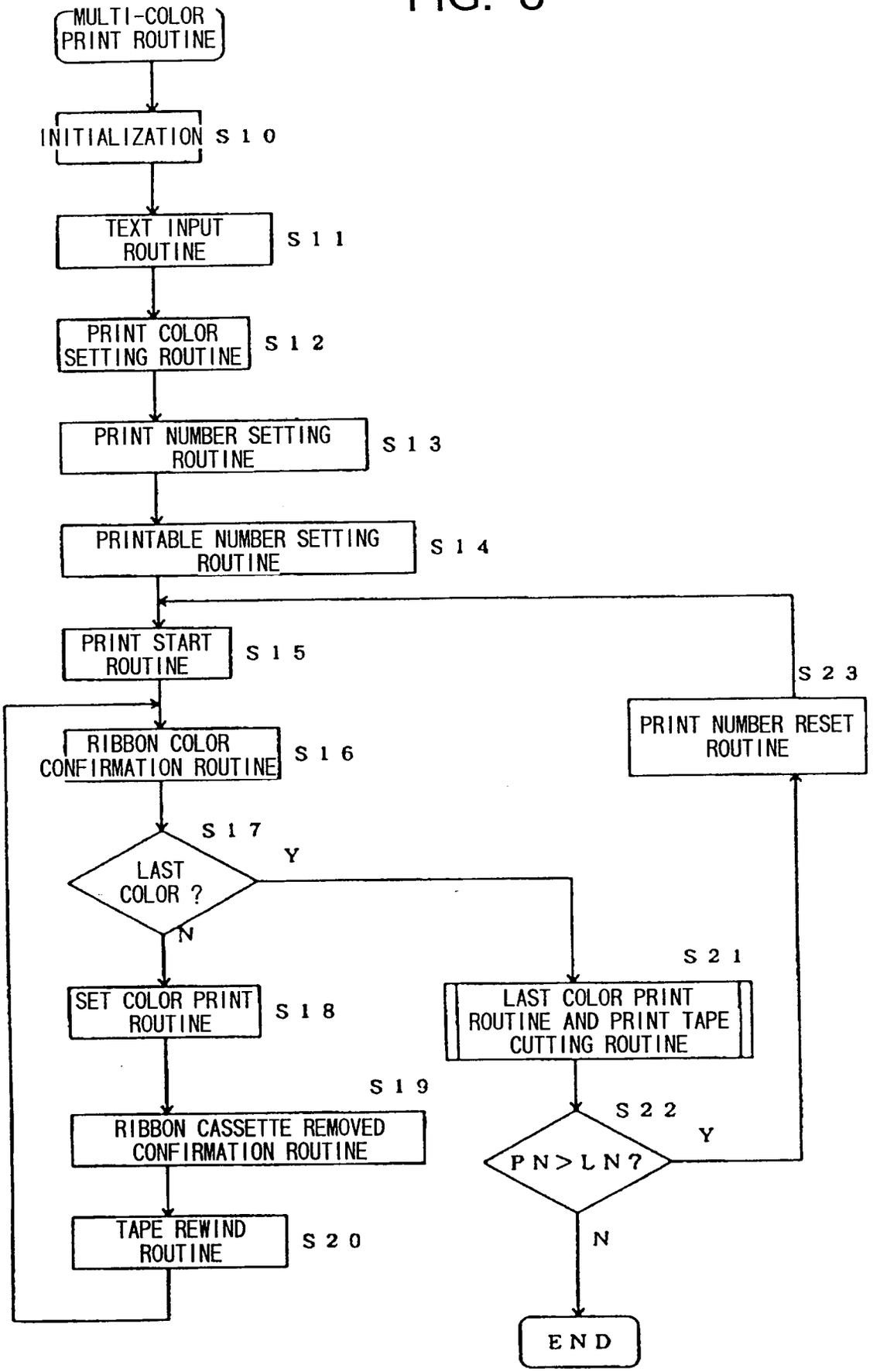

MULTI-COLOR PRINT ROUTINE
INITIALIZATION
S10
TEXT INPUT ROUTINE
S11
PRINT COLOR SETTING ROUTINE
S12
PRINT NUMBER SETTING ROUTINE
S13
PRINTABLE NUMBER SETTING ROUTINE
S14
PRINT START ROUTINE
S15
RIBBON COLOR CONFIRMATION ROUTINE
S16
S17
LAST COLOR ?
Y
N
SET COLOR PRINT ROUTINE
S18
S19
RIBBON CASSETTE REMOVED CONFIRMATION ROUTINE
TAPE REWIND ROUTINE
S20
S21
LAST COLOR PRINT ROUTINE AND PRINT TAPE CUTTING ROUTINE
S22
PN>LN?
Y
N
S23
PRINT NUMBER RESET ROUTINE
END

FIG. 9

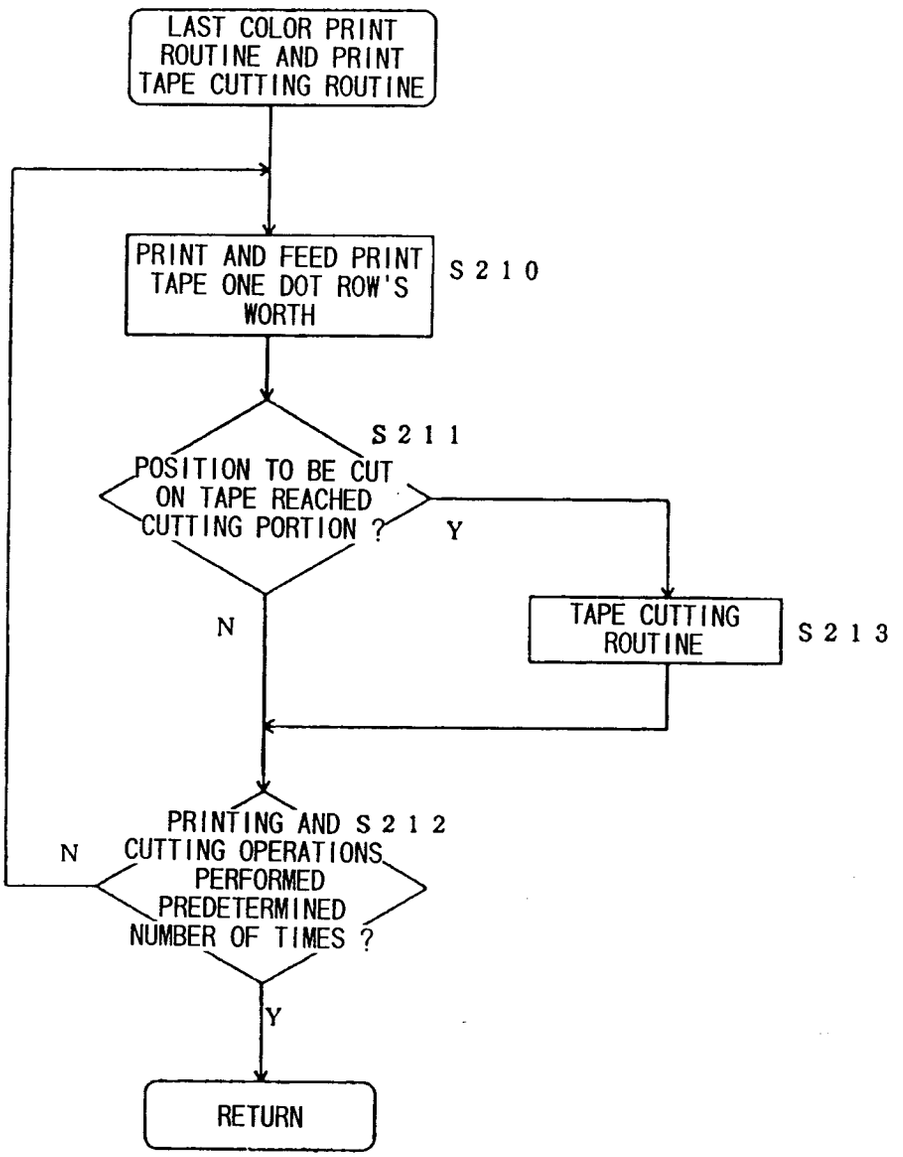


FIG. 10

RED_GREEN_BLACK

FIG. 11 (a)

AFTER PRINTING FIRST COLOR (RED)

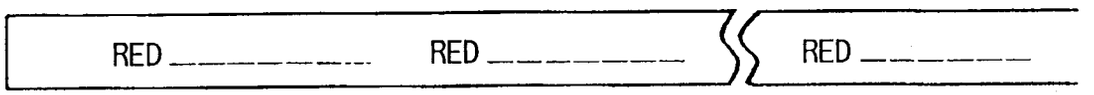


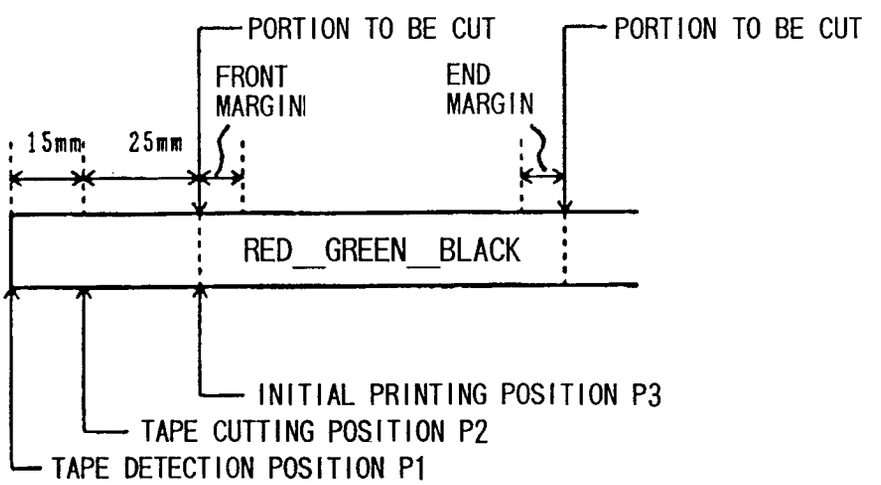
FIG. 11 (b)

AFTER PRINTING A SUBSEQUENT COLOR (GREEN)

FIG. 11 (c)

AFTER PRINTING LAST COLOR (BLACK)

FIG. 12



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 10 8949

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	EP-A-0 573 187 (ESSELTE DYMO N.V.) * the whole document *	1-15	B41J35/16
Y	US-A-4 289 069 (MELISSA ET AL.) * abstract; claim 1 *	1-15	
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 399 (M-1017) [4342] , 29 August 1990 & JP-A-02 151472 (SEIKO EPSON CORP), 11 June 1990, * abstract *	1-15	
A	PATENT ABSTRACTS OF JAPAN vol. 8, no. 96 (M-294) [1533] , 4 May 1984 & JP-A-59 011278 (SHINKOP DENKI K.K.), 20 January 1984, * abstract *	1-15	
A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 217 (M-828) [3565] , 22 May 1989 & JP-A-01 034779 (RICOH CO LTD), 6 February 1989, * abstract *	4,7	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 August 1996	Joosting, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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