

[54] RECORDING APPARATUS

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[51] Int. Cl. H05b 1/100

[58] **Field of Search** 219/216, 508, 543, 388;
346/76 R; 197/1 R; 101/93 C

[56] References Cited

UNITED STATES PATENTS

2,713,822	7/1955	Newman	346/76 R X
2,917,996	12/1959	Epstein et al.	101/93 C
3,496,333	2/1970	Alexander et al.	219/216
3,563,647	2/1971	Kittredge	95/4.5 R X
3,632,969	1/1972	Walkow	346/76 R X

Primary Examiner—C. L. Albritton

Attorney, Agent, or Firm—Fitzpatrick, Cella, Harper & Scinto

[57] **ABSTRACT**

A recording apparatus of the non-impact type comprises a thermal head having a plurality of islands generally disposed in a common plane which are thermally independent and can heat separately and selectively. The apparatus employs a print member composed of a heat-resistant back-up layer and a thin film of an adhesive resin of low melting point disposed over the back-up layer, and also employs a web of recording paper free of any thermosensitive material. When the thermal head and the recording paper are moved relative to each other in one direction, the print member is brought into intimate contact with both of the thermal head and the recording paper. In such position, the islands in the thermal head may be selectively energized to melt the adhesive resin therein and transfer the molten resin to the recording paper, thus accomplishing a print on the recording paper. The thermal head may be an assembly of plural thermal heads arrayed in a row so as to define a print line.

10 Claims, 11 Drawing Figures

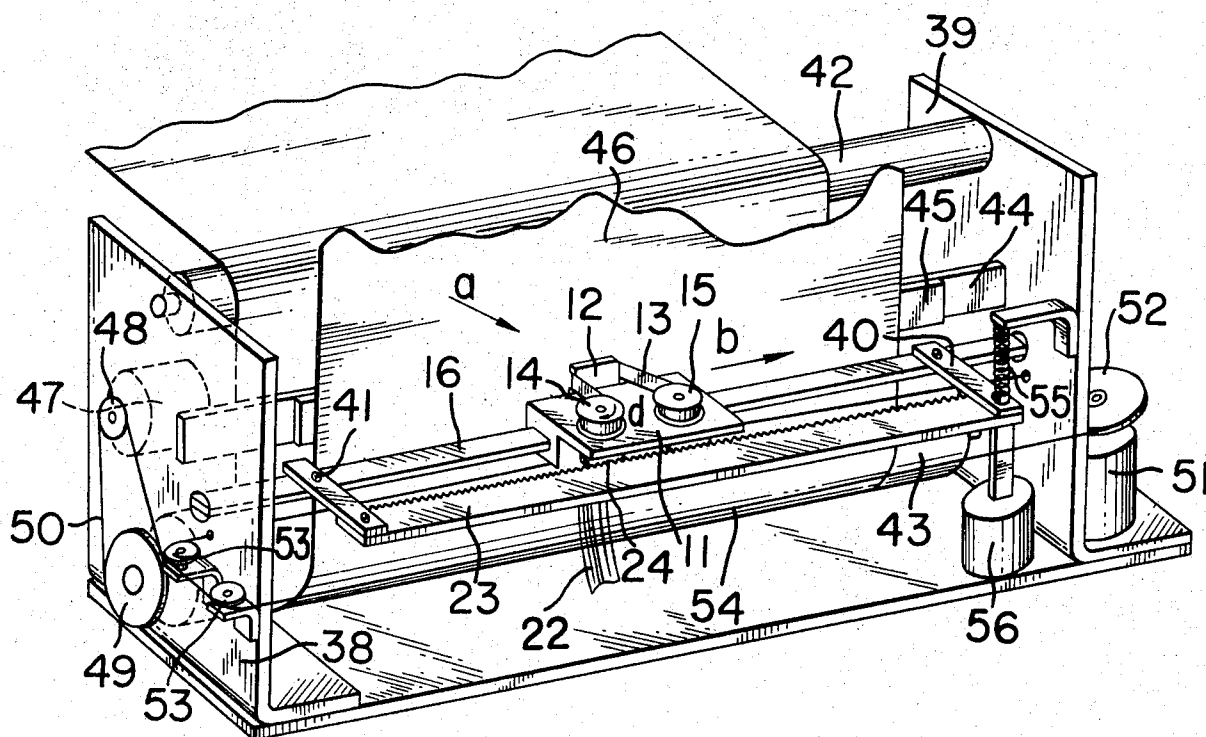


FIG. 2B

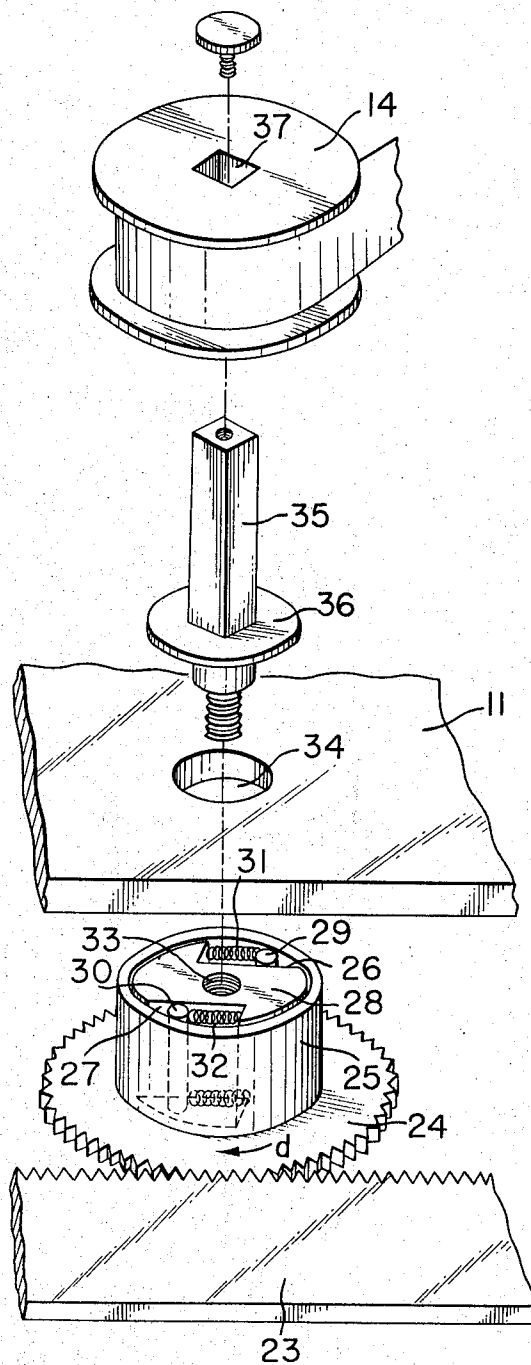


FIG. 4F

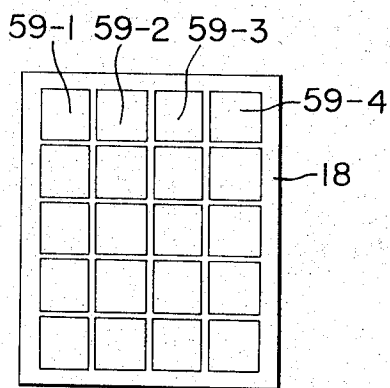


FIG. 4G

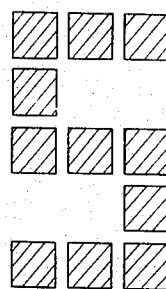


FIG. 5

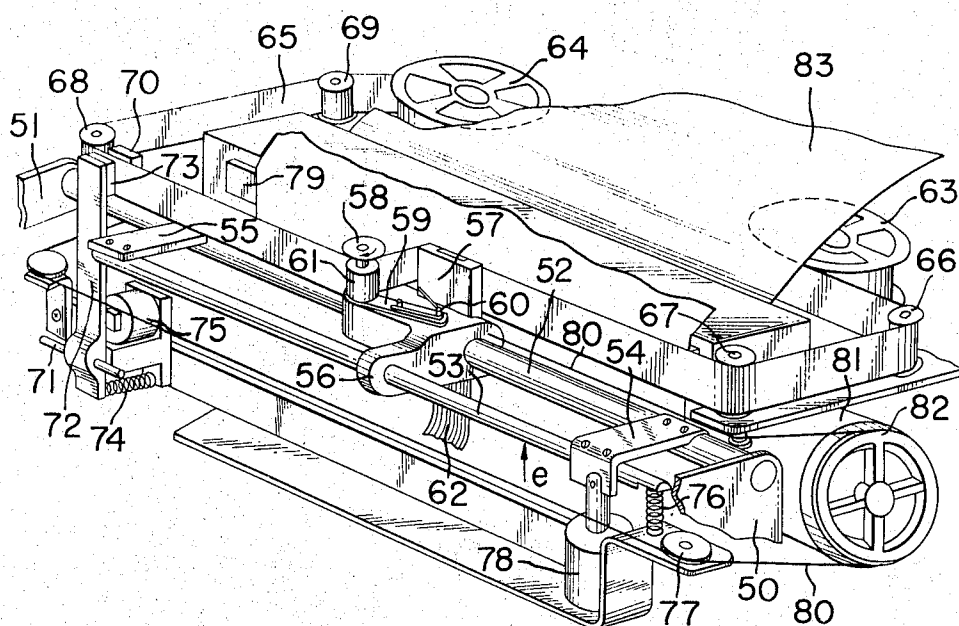


FIG. 6

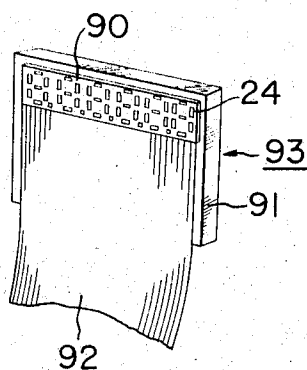
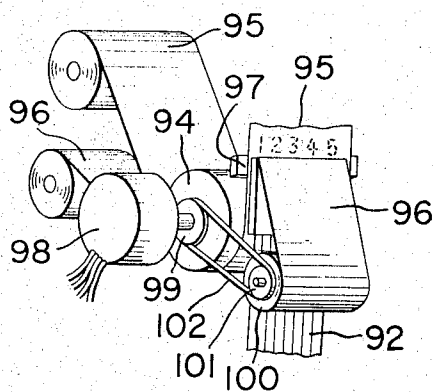


FIG. 7



RECORDING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a recording apparatus of the non-impact type which uses a thermal head and a print member to record information on a web of recording paper such as plane paper free of any thermosensitive material.

2. Description of the Prior Art

A known system for recording on a recording medium visual information such as alphanumeric characters or other symbols has involved the use of printing types in the form of information or pins or the like arranged so as to form information. These printing types or pins are pressed against a recording medium with a carbon tape or the like interposed therebetween to thereby impress the recording medium with the shapes of the printing types or the pins. Such system is commonly referred to as "impact printer" and has been widely used because of its numerous merits such as high definition of the resultant prints, availability of any desired shape of printed character, usability of ordinary paper for the recording medium, low running cost, and freedom of the recorded information from aging or similar variations which is attributable to the fact that the printing effected by such impact printer takes place through the transfer of pigments or like material to the recording paper. Nevertheless, this system involves considerably great noises produced by the impacts from the printing types during impression. On the other hand, non-impact printers as opposed to the impact printers, i.e., those printers having no impact means have also been widely in use. The non-impact printers are grouped into various types such as the ink jet system whereby drops of ink are moved through the air in a controlled direction so as to adhere to recording paper to thereby depict any desired information on the recording paper, the thermal print system whereby exothermic elements adjacent a sheet of thermosensitive paper are selectively caused to generate heat to thereby provide any desired pattern on the thermosensitive paper, and the discharge print system whereby a discharge wire scans over a sheet of discharge breakdown paper with a discharge signal being applied between the discharge paper and the discharge wire to thereby break down portions of the discharge paper which display the desired information. Among these, the thermal print system has been most popular inasmuch as it involves less of the mechanical drive portions and permits easier application of electrical controls.

Such a thermal printer uses print elements which may be formed of semiconductor material, as shown in U.S. Pat. No. 3,496,333. Such print element comprises a semiconductor substrate formed with a plurality of thermally independent islands, each of which is provided with a semiconductor heating section. Any one of these islands may be selected to represent the information to be printed and a heating current may be applied to the selected island to cause the associated heating section to heat in the pattern of the information to be printed.

The described thermal element may be disposed on a sheet of thermosensitive paper which may be discolored in the portions thereof subjected to heat, and then the thermal element may be energized so that the selected island therein may heat in a certain information

pattern. After one character has been printed, the thermal element may be moved to a position for printing the next information, thus accomplishing a series of desired prints on the thermosensitive paper.

In the thermal printer using thermosensitive paper as described, there is no impact means which would produce noises and the problem of noise production is much less serious than in the conventional impact system. However, thermosensitive paper is the only usable recording medium in this system and this means a much higher running cost as well as very much limited choice of available recording mediums. Moreover, the thermosensitive paper, even once printed, is ready to be discolored by any extraneous heat applied thereto, and this leads to a serious problem in keeping the printed paper.

SUMMARY OF THE INVENTION

The present invention is directed to the presentation of a recording apparatus of the non-impact type and using no thermosensitive paper for the recording medium and in which a print member comprising a heat-resistant substrate coated with heat-fusible adhesive resin material may be brought into intimate contact with a web of recording paper while the print member may be contacted by a thermal head provided with heating elements formed as islands in a common plane, and the recording paper and the thermal head may be moved relative to each other in such contact position to effect printing.

A recording apparatus using heat to transfer the information is known from U.S. Pat. No. 2,917,996, but this known apparatus may still be said to be of an impact type in that recording paper is impacted by heated pins with a carbon tape interposed therebetween, and this type is similar to the ordinary impact printers as far as the noise problem is concerned.

It is therefore an object of the present invention to prevent a recording apparatus of the non-impact type which does not employ any special recording medium but the commonly used plane paper for the recording paper.

It is another object of the present invention to present a recording apparatus of the non-impact type which can record information on recording paper free of any thermosensitive material by means of a thermal head.

It is still another object of the present invention to present a recording apparatus in which a thermal head having a plurality of islands formed generally in a common plane and selectively energizable for heating may be brought into intimate contact with a print member which in turn may be brought into intimate contact with a web of recording paper, and in such position said islands may be selectively energized to effect printing on the recording paper by means of the print member.

It is yet another object of the present invention to present a recording apparatus in which the thermal head may be moved along the recording paper as the former is urged against the latter with the print member interposed therebetween.

It is a further object of the present invention to present a recording apparatus in which a carriage carrying the thermal head thereon is slidable on a rail along the plane of the recording paper and during the movement of the thermal head on the rail in one direction the

print member opposed to the thermal head is in intimate contact with the recording paper but during the movement of the thermal head in the other direction the print member is out of engagement with the recording paper.

It is still a further object of the present invention to present a recording apparatus in which the print member is supported on the carriage carrying the thermal head and during the movement of the carriage in the one direction the print member is moved on the carriage while keeping an intimate contact with the recording paper.

It is yet a further object of the present invention to present a recording apparatus in which during the movement of the thermal head in one direction relative to the recording paper the print member is fixedly held with respect to the recording paper but during the movement of the thermal head in the other direction the print member is moved.

It is a further object of the present invention to present a recording apparatus in which the print member is disposed in intimate contact with a plurality of thermal heads fixedly arranged in a row and the recording paper is disposed in intimate contact with the print member, the recording paper being movable in a direction at right angles to the row of thermal heads.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will become more fully apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view of an embodiment of the recording apparatus according to the present invention in which the carriage carries thereon the thermal head and the print member;

FIG. 2A is a perspective view as viewed along arrow *a* in FIG. 1 and particularly showing the thermal head and the adjacent portions;

FIG. 2B is an exploded perspective view particularly showing a reel appearing in FIG. 1;

FIGS. 3C to 3E are cross-sectional views illustrating the sequence in which recording is effected by the thermal head, FIG. 3C showing the stage ready for recording, FIG. 3D showing the stage at which recording is taking place, and FIG. 3E showing the stage at which the print member is being disengaged from the recording paper;

FIG. 4F is a front view as viewed along arrow *d* in FIG. 2A and particularly showing the thermal head;

FIG. 4G illustrates an example of the pattern representing the information provided by the thermal head of FIG. 4F;

FIG. 5 shows, in perspective view, another embodiment of the recording apparatus according to the present invention in which the print member remains fixed in front of the recording paper until one line print is completed by the thermal head;

FIG. 6 is a perspective view showing another form of the thermal head assembly; and

FIG. 7 is a perspective view of a further arrangement of the recording apparatus incorporating the thermal head of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, there is shown an embodiment of the recording apparatus according to the present in-

vention, which includes a carriage 11 carrying thereon a thermal head holder member 12 and a pair of reels 14, 15 with a length of print ribbon or member 13 wound thereon. The carriage 11 is reciprocally movable along a rail 16.

The carriage 11 is more particularly shown in FIG. 2A which is a perspective view of the carriage as viewed in the direction of arrow *a* in FIG. 1. The holder member 12 is formed of a thermally and electrically good conductive material such as aluminum or the like and provided with a groove 17 formed in a portion thereof. A base member 19 of ceramics or similar material carrying thereon a thermal head 18 is received in and secured to the groove 17 as by bonding. The holder member 12 is secured to the carriage 11 as by screws 20, 21. A cord 22 for applying electrical signals therethrough to the thermal head 18 extends downwardly along the groove 17.

The thermal head 18 may be of any type which comprises exothermic elements arrayed in a matrix form on a common plane and selectively energizable. For example, as described in U.S. Pat. No. 3,496,333, it may comprise thermally independent semiconductor islands arrayed in a matrix form on a substrate, and semiconductor resistors disposed in said islands and adapted to be selectively energized. In the holder member 12 at the opposite sides of the thermal head 18, there are provided guide grooves 23 and 24 which may be formed by bevelling the holder member 12 at portions thereof so as to ensure the print ribbon 13 to move over the thermal head 18 without deviating therefrom.

In the manner as shown in FIG. 1, the print ribbon 13 is disposed on the carriage 11 with the portion thereof between the reels 14 and 15 passing round the grooves 23, 24. One of the reels 15 which is rotatable to supply the ribbon 13 therefrom is securely mounted on the carriage 11, while the other reel 14 serving as the take-up reel is constructed with a gear 24 secured to the rotatable spindle of the reel 14 by means of a one-way clutch (to be described) and meshing with a rack plate 23 so that the reel 14 is rotated in the direction of arrow *d* for taking up the ribbon 13 during the rightward stroke (the direction of arrow *b*) of the carriage 11 along the rail 16 and that the reel 14 stops its take-up function when the carriage 11 reverts to its leftward stroke (the direction opposite to that of arrow *b*).

FIG. 2B is an exploded perspective view which more particularly shows the take-up reel 14 with respect to the print ribbon take-up portion thereof. As shown there, the gear 24 meshing with the rack plate 23 has a hollow cylindrical drum 25 securely mounted thereon, and a rotatable member 28 having a diameter slightly smaller than that of the drum 25 and provided with two wedge-shaped cut-away portions 26 and 27 is rotatably mounted within the drum 25.

Cylindrical retainer members 29 and 30 are inserted into the cut-away portions 26 and 27 of the rotatable member 28, and adapted to be biased by springs 31 and 32 into pressure contact with the walls of the wedge-shaped portions. Thus, the drum 25, the rotatable member 28, the retainer members 29, 30 and the springs 31, 32 together constitute a one-way clutch so that rotation of the drum in the direction of arrow *d* causes the retainer members 29 and 30 to be urged more against the wedge-shaped portions to thereby rotate the rotatable member 28 with the drum 25. Conversely, when the drum 25 is rotated in the direction

opposite to that of arrow *d*, the retainer members 29 and 30 will be driven in the direction to retract from the wedge-shaped portions so that the rotatable member 28 can not follow the rotation of the drum 25, thereby maintaining itself in a stationary position. In other words, the one-way clutch is so designed that rotation of the gear 24 in the direction of arrow *d* causes rotation of the rotatable member 28 but rotation of the gear 24 in the opposite direction results in stoppage of the rotatable member 28.

A threaded bore 33 is formed centrally through the rotatable member 28 and a rotary spindle 35 is threadably inserted into the threaded bore 33 through an aperture formed through the carriage 11. The rotary spindle 35 has a flange 36 secured to an intermediate portion thereof, and the upper portion of the spindle above the flange 36 is formed as a square rod for securely receiving thereon the reel 14 formed with a complementary square aperture 37.

The carriage 11 thus carrying thereon the thermal head and print ribbon is slidably mounted on the rail 16 which has the opposite ends thereof rotatably supported by side plates 38 and 39. The rack plate 23 is disposed parallel to the rail 16 and these two members are secured together by fixing plates 40 and 41 in such a manner that the rack plate is always in mesh engagement with the gear 23.

Extending between and rotatably journaled to the side plates 38 and 39 is a roller 42 for deflecting the recording paper, and a transport roller 43 extends below the roller 42 and is also rotatably journaled to the side plates 38 and 39. A holder member 44 extends along the path of travel of the thermal head and has the opposite ends thereof secured to the side plates. The holder member 44 has a resilient member 45 of rubber, felt or like material attached to one side thereof which faces the thermal head. A web of recording paper 46, on which recording is to be done by the thermal head, may be passed downwardly and then upwardly over the paper transport roller 43 and further between the resilient member 45 and the thermal head. A paper transport motor 47 is provided to drive the paper transport roller 43 via a belt 50 connecting a pulley 48 on the shaft of the motor 47 to a pulley 49 on the paper transport roller 43, thereby driving the recording paper in one direction.

A pulse motor 51 is provided to move the carriage and has a pulley 52 secured to the rotary shaft thereof. Another pulley 53 is rotatably mounted to a portion of the side plate 38. A length of wire 54 connects the two pulleys 52 and 53 and one end of the wire 54 is secured to the carriage 11, so that rotation of the pulse motor 51 will cause movement of the carriage 11 along the rail 16.

A spring 55 is provided between and secured to one end of the rack plate 23 and an arm extending inwardly from the side plate 39 so as to bias the rack plate 23 upwardly. Secured to said one end of the rack plate is a plunger 56 which, when energized, may attract the rack plate 23 downwardly against the force of the spring 55. It will thus be seen that, when the plunger 56 is not in energized condition, the rail 16 is biased into counterclockwise rotation by the spring action to maintain the thermal head in pressure contact with the printing paper with the print ribbon interposed therebetween.

The print ribbon 13 will be described in greater detail. The print ribbon or member 13 comprises a heat-

resistant back-up layer coated with a thin film of adhesive resin of low melting point fusible by a heat applied thereto, the thickness of the film being in the range of several microns to several tens of microns. The term "adhesive resin" used herein means a thermoplastic resin having no tackiness in itself at room temperature but fusible at low temperatures (say, from about 80°C to about 100°C) to present an adhesive property, such as resin materials of low melting point among phenol resin, maleic acid resin, rosin, epoxy resin, etc., and it is commercially available under the tradename such as "Steabelite" (manufactured by Herculespowder Co.) or "EPICOAT 1004" (manufactured by Shell Oil Co.)

In the present invention, the print ribbon was prepared by uniformly mixing 5 grams of Steabelite, 1 gram of H.B.B. dye (tradename, by Orient Kasei Co.) and 50 milliliters of methyl ethyl ketone and by applying a thin layer of such mixture over a film of Myler (tradename for polyethylene terephthalate) having a thickness of 6 to 9 microns. Such print ribbon can intimately contact with the recording paper and nothing can be recorded thereon simply under pressure but the recording thereon is possible only when the ribbon is heated under pressure.

When the print ribbon so provided is brought into a position as shown in FIG. 3C, where the adhesive resin layer 57 is in intimate contact with the recording medium 46 while the back-up layer 58 is in intimate contact with the thermal head 18, and if an electric current is applied for 10 to 20 milliseconds to any selected one of the islands 59₁, 59₂, 59₃ and so on, then the thermal head in the selected island will reach a surface temperature of about 200°C and this heat will act through the back-up layer 58 to melt the region of the adhesive resin 57 which corresponds to the selected island, so that the adhesive resin in such region will adhere to the recording paper 46. The temperature of the thermal head will lower below the resin melting point 4 to 10 milliseconds after the application of the current has been discontinued, and concurrently therewith the portion of the adhesive resin which now lies on the recording paper 46 will also solidify to complete the printing of one character or symbol. Thereafter, the thermal head 18 may be moved in the direction of arrow in FIG. 3E by the pulse motor while the back-up layer 58 of the print ribbon may be progressively separated from the recording paper. In this way, only a portion of the adhesive resin which has melted may be solidified to remain on the recording paper 46 in the manner as shown in FIG. 3E. When the recording apparatus of FIG. 1 is in its print cycle during which the plunger 56 is in its de-energized condition or the carriage 11 is moving in the direction of arrow *b*, the rail 16 is biased counterclockwise by the spring 55 so that the thermal head 18 is in pressure contact with the recording paper 46 with the print ribbon 13 interposed therebetween.

In such position, a signal for selectively energizing the islands of the thermal head may be applied through the cord 22 for a predetermined length of time, whereafter the pulse motor 52 may be energized to move the carriage 11 in the direction of arrow *b* by an amount corresponding to one printed character, whereby the gear 24 meshing with the rack plate 23 may be rotated in the direction of arrow *d*. Since the one-way clutch secured to the gear 24 transmits the rotation in the direction of arrow *d* to the rotatable member 28 as noted

previously, the rotary spindle 35 is rotated to turn the take-up reel 14 in the direction of arrow *d* to thereby take up the print ribbon 13 in accordance with the amount of movement of the carriage 11.

When one line print is completed by repeating the above-described process, the plunger 56 may be energized to rotate the rail 16 clockwise against the force of the spring 55, so that the carriage 11 in turn is rotated clockwise about the rail 16 to bring the thermal head out of engagement with the recording paper while keeping an intimate contact with the print member.

A drive signal may then be applied to the pulse motor 51 to move the carriage 11 in the direction opposite to that of arrow *b* while the motor 47 may be energized to feed the recording paper by an amount corresponding to one print line.

When the carriage 11 is thus moved to its leftmost end position as viewed in FIG. 1, the pulse motor 51 and the plunger 56 may both be deenergized to permit the thermal head to be again urged against the recording paper with the print member therebetween, in preparation for the next print cycle. The gear 24 keeps mesh engagement with the rack plate 23 even during the described leftward stroke of the carriage 11, but the rotary spindle is prevented from rotating by the action of the one-way clutch during such stroke.

FIG. 5 illustrates another embodiment of the recording apparatus according to the present invention. A rail 52 extends between and is rotatably supported by side plates 50 and 51, and another rail 53 extends generally parallel to the rail 52. These two rails 52 and 53 are secured together in a predetermined spaced relationship by fixing plates 54 and 55. A carriage 56 is slidably mounted on these rails and securely carries thereon a holder member 57 having a thermal head secured thereto, and a one-way roller 58 consisting of a one-way rotatable drum covered with a resilient material such as rubber or the like. A lever 59 is pivotally mounted on the carriage 11 by means of a pin 60. A pinch roller 61 is rotatably mounted on a portion of the lever 60 and biased into engagement with the one-way roller 58 by a spring (not shown).

The thermal head is mounted on the holder member 57 just in the same way as described with respect to FIG. 2A, and may be supplied with an electrical signal through a cord 62. The thermal head is provided with print ribbon guide grooves similar to those described with respect to the previous embodiment.

A pair of supply reel 63 and take-up reel 64 is provided for a length of print ribbon 65. The print ribbon 65 may be supplied from the supply reel 63 to pass over guide rollers 66, 67 and then over the thermal head and between the one-way roller 58 and the pinch roller 61, whereafter the ribbon may pass over guide rollers 68, 69 and onto the take-up reel 64. Means for holding the print ribbon therebetween are provided adjacent the guide roller 68. Such means may comprise a frictional member 70 of rubber or like material secured to an unshown fixed member such as chassis or the like, and a second frictional member 73 provided on a pivotable lever 72 in opposed relationship with the frictional member 70 so as to permit the print ribbon to intervene therebetween. The lever 72 is pivotable about a pin 71. A spring 74 is secured to one end of the lever 72 so as to bias this lever for counterclockwise rotation about the pin 71, i.e., for rotation in such a direction that the frictional member 73 is moved away from the other

frictional member 70. Electromagnetic means 75 is provided in opposed relationship with another portion of the lever 72 so that the electromagnetic means, when energized, may actuate the lever 72 into clockwise rotation to thereby cause the two frictional members 70 and 73 to hold the print ribbon fixedly therebetween.

A spring 76 is secured at one end to a portion of the rail 53 and at the other end to a chassis 76 so as to bias the rail 53 in the direction of arrow *e*, i.e., so as to bias the rail 52 for clockwise rotation. A further plunger 78 is secured to a portion of the fixing plate 54 so that the plunger, when energized, may actuate the rail 53 in the direction opposite to that of arrow *e*, i.e., so as to rotate the rail 52 in counterclockwise direction.

A resilient member 79 of rubber, felt or like material is provided at a location where the thermal head on the holder member 57 bears against when the carriage 56 is moved along the rails 52 and 53. A wire 80 having one end secured to the carriage 56 is wrapped around a pulley 82 on a pulse motor 81 so that the carriage 56 may be moved along the rails 52, 53 by the drive from the pulse motor 81. Designated by numeral 83 is a web of recording paper which may be the commonly used plane paper instead of the special paper such as thermosensitive paper.

In the recording apparatus of the described construction, during the recording cycle, the electromagnetic means 75 is energized to cause the frictional members 70 and 73 to hold the print ribbon 78 therebetween while the plunger 78 is in unenergized condition. Thus, the carriage 56 is biased for counterclockwise rotation about the rail 52 to thereby urge the unshown thermal head against the recording paper 83 with the print ribbon 65 intervening therebetween.

When a signal is applied through the cord 62 to a selected one of the islands in the thermal head, there occurs entirely the same operation as described above with respect to FIG. 3, whereby the adhesive resin on the print ribbon 65 in the selected island melts and adheres to the recording paper. After the signal application has been continued for a predetermined length of time, the pulse motor 81 is energized to move the carriage 56 rightwardly by a predetermined amount (as viewed in FIG. 5), but the print ribbon 65 remains immovably arrested between the frictional members 70 and 73 and the one-way roller 58 and pinch roller 61 are rotated in the direction of arrow to separate the used section of the print ribbon from the recording paper. The apparatus is now ready for printing the next character or symbol. When a drive signal is again applied through the cord 62 to another selected island in the thermal head, the same process as that described above takes place to effect a printing operation. In this way, successive characters are printed until one line print is completed, whereupon the plunger 78 is energized to disengage the thermal head from the recording paper while the electromagnetic means 75 is deenergized to release the print ribbon from the hold between the frictional members 70 and 73.

In this position, the pulse motor 81 is energized to drive the carriage 56 leftwardly. Since the roller 58 is rotatable only in one direction and unrotatable in the other direction, this roller 58 cooperates with the roller 61 to hold the print ribbon 65 therebetween. Thus, the leftward movement of the carriage 56 causes the print ribbon to be transported from the reel 63. Since the

other reel 64 is biased by an unshown mechanism in the direction for taking up the print ribbon, the successive portions of the print ribbon transported with the leftward movement of the carriage 56 may be taken up on the reel 64.

During such leftward stroke of the carriage 56, the recording paper is advanced upwardly by an amount corresponding to one print line, by an unshown means.

When the carriage 56 comes to its leftmost end position, the electromagnetic means 75 is again energized to cause the frictional members 70 and 73 to hold the print ribbon 65 therebetween while the plunger 78 is deenergized to permit the thermal head to be urged against the recording paper with the print ribbon interposed therebetween. It is now possible to start a new line printing by applying a drive signal from the cord 62 to the thermal head.

FIGS. 6 and 7 illustrate still another embodiment of the recording apparatus according to the present invention in which printing can be provided on the recording paper only with the feed movement of the paper and of the print member.

In this embodiment, as shown in FIG. 6, a plurality of thermal heads 90 corresponding in number to the characters or symbols to be printed in one line is disposed on a single holder member 91 to provide an exothermic unit. More specifically, the thermal head assembly as shown in FIG. 6 is exclusively for use in numerical printing and comprises a row of 8-shaped elements, each of which comprises separately energizable, independent islands formed in a common plane and corresponds to one character. Such thermal heads 90 each comprising 8-shaped elements are secured to the holder member 91 which may be formed of aluminum or other thermally and electrically good conductor, and a cord 92 is provided for the application of electrical signals to the thermal head. Thus, an exothermic unit is constituted as generally designated by 93.

According to the present embodiment, such exothermic unit 93 is secured to an unshown chassis or the like and a resilient member 97 is fixedly disposed in opposed relationship with the thermal head of the heating unit. A web of recording paper 95 free of any thermosensitive material and a print member 96 similar to the above-described one are supplied in overlapped relationship to a paper transport roller 94, so that the recording paper and the print member are sandwiched between the thermal head 90 and the resilient member 96, with the print member being contacted by the thermal head and with the recording paper being contacted by the print member. The paper transport roller 94 is directly connected to a pulse motor 98 and has a pulley 99 mounted on a portion thereof. The pulley 99 is connected to a pulley 101 on a print member take-up roller 100 by a belt 102 so that energization of the pulse motor 98 causes the recording paper and the print member to be fed into between the thermal head assembly 90 and the resilient member 97 and that the print member having passed the thermal head assembly is taken up on the take-up roller 100.

Therefore, if such a design is made that drive signals for one whole line are simultaneously applied through the cord 92 and thereafter the pulse motor 97 is energized to advance the recording paper by an amount corresponding to one print line, then the printed one line can be displaced upwardly with the next unprinted

or blank line coming to confront the thermal head assembly and with the used portion of the print member taken up on the roller 100, thus making the apparatus ready for printing a new line. In this way, one line print can be accomplished at a time by simultaneous application of multiple printing signals to the entire thermal head through the cord 92.

In the recording apparatus described just above, the print cycle continues throughout the operating time with the thermal head assembly continuously urged against the recording paper with the print member interposed therebetween.

We claim:

1. A recording apparatus comprising:

a thermal head having a plurality of islands generally disposed in a common plane, said islands being thermally independent of one another and capable of heating separately and selectively by electrical signals;

a print member, disposed opposite to said islands, comprising a heat-resistant back-up layer and a thin film formed of an adhesive resin of low melting point disposed over said back-up layer;

recording paper disposed to face the thin film of said print member and being free of any material which is thermosensitive for coloring;

means for urging said thermal head against said print member for bringing all of said plurality of islands into intimate contact with said heat-resistant back-up layer and said film into intimate contact with said recording paper; and

means for producing said electrical signals to selectively heat said plurality of islands so as to melt the corresponding part of said adhesive resin to transfer it onto said recording paper.

2. A recording apparatus according to claim 1, further comprising means for reciprocating said thermal head along said recording paper.

3. A recording apparatus comprising:

a thermal head having a plurality of islands generally disposed in a common plane, said islands being thermally independent of one another and capable of heating separately and selectively by electrical signals;

a carriage carrying said thermal head thereon;

a rail supporting said carriage for sliding movement thereon and for defining the path of movement of said carriage;

a print member disposed opposite to said islands, comprising a heat-resistant backup layer and a thin film formed of an adhesive resin of low melting point disposed over said back-up layer;

recording paper disposed to face the thin film of said print member and being free of any material which is thermosensitive for coloring;

means for reciprocatingly moving said thermal head along said rail;

means for urging said thermal head against said print member during a first stroke in which said carriage moves along said rail in one direction for bringing all of said plurality of islands into intimate contact with said heat-resistant back-up layer and said thin film into intimate contact with said recording paper;

means for producing said electrical signals to selectively heat said plurality of islands during said stroke so as to melt the corresponding part of said

adhesive resin to transfer it onto said recording paper; and

means for releasing said urging means to separate said print member from said recording paper during a second stroke in which said carriage moves along said rail in the other direction.

4. A recording apparatus according to claim 3, further comprising a toothed member provided along said rail, and a reel provided on said carriage for taking up said print member, said reel being connected via a one-way clutch to a gear meshing with said toothed member so that said reel is rotatable only when said carriage is moved in said first stroke.

5. A recording apparatus according to claim 3, further comprising:

means for extending said print member along said recording paper;

means for bringing a portion of said print member to be traversed by said thermal head into contact with said recording paper; and

means for disengaging a portion of said print member already traversed by said thermal head from said recording paper.

6. A recording apparatus according to claim 5, further comprising means for fixing said print member extended along said recording paper against movement in said one direction when said carriage is moved in said

one direction.

7. A recording apparatus according to claim 6, further comprising means provided on said carriage for holding said print member in a sandwiched fashion during the movement of said carriage in said other direction.

8. A recording apparatus according to claim 3, further comprising:

means for extending said print member along said recording paper;

a pair of opposed nip members for fixedly holding said print member;

means for controlling the hold of said nip members; and

rollers including a one-way rotatable roller disposed on said carriage so as to hold said print member therebetween.

9. A recording apparatus according to claim 1, wherein a plurality of thermal heads is arrayed in a row so as to define a print line and disposed at a fixed position.

10. A recording apparatus according to claim 3, further comprising means for moving said print member relatively to said thermal head during said first stroke in which said carriage moves in said one direction.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,855,448 Dated December 17, 1974

Inventor(s) TAKAYOSHI HANAGATA, ET AL.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 39, "prevent" should read -- present --;

Column 4, line 42, "righteard" should read --rightward--;

Column 6, line 18, "millilitters" should read --milliliters--;

Column 8, line 21, "pully" should read --pulley--;

Column 8, line 58, "menas" should read --means--.

Signed and Sealed this
twenty-fourth Day of February 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

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