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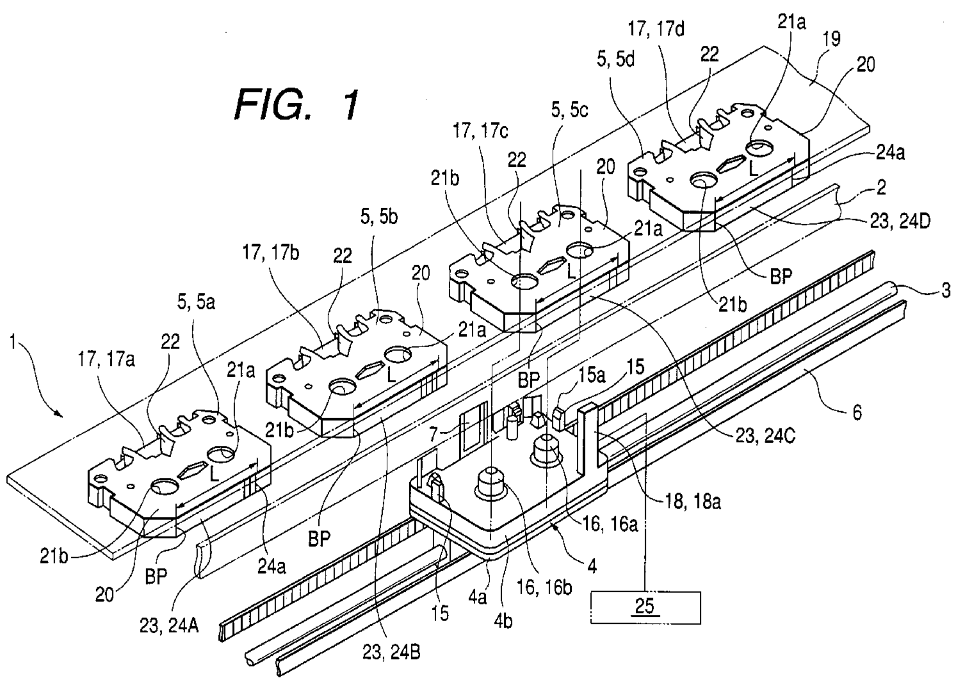
(54) Thermal transfer printer

(57) It is the object of the present invention to provide a thermal transfer printer which can realize a correct transfer even on the portion where the ink is overlaid on the already transferred ink or slightly transferred with the use of durable resin-based ink and a vivid multi-gradation recording.

To achieve this object, the thermal transfer printer according to the present invention is provided with an ink ribbon (17) comprising a base substance (26), a separating layer (27) laminated on the base substance (26), and a resin-based ink layer (28) laminated on the separating layer (27), and a heat insulation layer (31) formed on a recording paper (29), and a control unit (25) for controlling a time of carrying a current to the thermal head (7) in a plurality of steps according to the gradation of an image to be recorded.

FIG. 1



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Description

[0001] The present invention relates to a thermal transfer printer, and in particular, to a thermal transfer printer suitable for realizing a dot-diameter gradation printing on a recording paper with the use of a resin-based ink as the heat-fusible ink of an ink ribbon.

[0002] When a multi-gradation printing is made with the use of a heat-fusible ink, a dither method or a heat concentration method of using a special thermal head with small heating elements have been so far employed. Further in recent years, as a requirement for a color image of higher resolution has been increased, a thermal transfer printer has been proposed in which the multi-gradation recording is made by controlling the energy of current to be carried to the heating elements of the thermal head.

[0003] The thermal transfer printer of this kind employs an ink ribbon made by laminating a wax-based ink layer on a base substance and a specifically designed porous paper called micro-porous paper as recording paper. The ink ribbon and the micro porous paper are sandwiched between a platen and the thermal head and the energy of a current carried to each heating elements of the thermal head is controlled to control the thermal energy applied to the wax-based ink, whereby the ink fusion area is controlled according to image information.

[0004] The wax-based ink to which the thermal energy is applied is fused at the temperatures of 70 to 80 °C and permeates into the surface of the micro porous paper and pores of about 1 to 10 μm in diameter to form a recording image.

[0005] Further, there has been proposed another retransfer method in which the multi-gradation recording is made on a specifically designed image-receiving sheet with the use of the ink ribbon having a single resin-based ink layer of 0.2 to 1.0 μm thick and then the recorded image is transferred again to a permanent support substance.

[0006] In the conventional thermal transfer printer, however, in the case of making a recording with the use of the wax-based ink described above, there exists a problem in that since the ink itself is soft, when the recorded image is rubbed, the recorded image is made dirty and degraded.

[0007] Furthermore, in the case of using the micro porous paper, there exists a problem in that the ink permeates into the porous layer and can not produce a vivid image by the effect of the surface characteristic of the micro porous paper.

[0008] On the other hand, in the case of recording an image with the use of the ink ribbon having a resin-based single ink layer, the above-mentioned problem caused by rubbing is solved and hence a durable and vivid image can be produced. However, there exists a problem that since the resin-based ink is inferior in transfer sensitivity to the wax-based ink, in particular, it can not produce a sufficient sensitivity in the multi-gradation recording and produces a sense of roughness caused by a degraded transfer.

[0009] Further, there exists a fault in this method that after the image is recorded on the specifically designed image-receiving sheet, another process of transferring the image again is required and makes handling troublesome.

[0010] Furthermore, in the case of using the resin-based ink in the conventional thermal transfer printer, as shown in FIG. 8 and FIG. 9, there exists a problem that the thermal energy generated by the heating of the heating elements (not shown) of the thermal head 32 is passed from the ink ribbon 33 to the back surface side of the recording paper 34 to increase the amount of heat radiation, whereby the transfer sensitivity is further reduced.

[0011] In addition, in the case of recording a full-color image with the use of at least three color inks of yellow, cyan, and magenta, there exists a problem that when an ink is transferred and then the next ink is overlaid thereon, the transfer sensitivity of the ink overlaid on the already transferred ink is reduced further compared with the lowest ink transferred directly to the specifically designed image-receiving sheet, whereby a defective color-overlaying is produced.

[0012] Therefore, the conventional thermal transfer printer presents a significant challenge of realizing a correct transfer even on the portion where the ink is overlaid on the already transferred ink or slightly transferred with the use of the resin-based ink and a vivid multi-gradation recording.

[0013] It is the object of the present invention to provide a thermal transfer printer which can realize a correct transfer even on the portion where ink is overlaid on the already transferred ink or slightly transferred with the use of the durable resin-based ink and a vivid multi-gradation recording.

[0014] To achieve the above-mentioned object, a thermal transfer printer according to the present invention has an ink ribbon formed of a base substance, a separating layer laminated on the base substance, and a resin-based ink layer laminated on the separating layer, a heat insulation layer formed on recording paper, and a control unit for controlling a time of carrying a current to a thermal head in a plurality of steps according to the gradation of an image to be recorded. This constitution can sufficiently increase the temperature of the resin-based ink and hence easily transfer the resin-based ink to the recording paper and correctly record even the highlight of the image, which can realize a multi-gradation recording with high definition.

[0015] Preferably, the recording paper is coated with the heat insulation layer in which inorganic pigment particles of 0.5 to 5 μm in diameter and polymer-based microcapsules of 1 to 3 μm in diameter are dispersed. This constitution can apply the more amount of heat of the thermal head to the resin-based ink and stably transfer the resin-based ink to the recording paper.

[0016] Preferably, the heat insulation layer of the recording paper has a plurality of pores of 10 to 30 μm in diameter on the surface thereof. This constitution can realize a multi-gradation recording using the resin-based ink in high quality.

[0017] Preferably, each of a plurality of color resin-based ink layers has different fusion viscosity and is fused and transferred to the recording paper in the order of decreasing fusing viscosity. When the resin-based ink is overlaid on the recording paper to which the resin-based ink is already transferred, this constitution can transfer the resin-based ink surely.

[0018] Preferably, the plurality of color resin-based ink layers comprise at least cyan, magenta, and yellow and the fusion viscosity of the resin-based ink layers are decreased in the order of cyan, magenta and yellow. A recording image of higher resolution, less sense of roughness and high quality can be obtained by overlaying the resin-based inks in the order of decreasing visual sensitivity.

[0019] Embodiments of the invention will now be described, by way of example only, with reference to the accompaying drawings, in which;

[0020] FIG. 1 is a perspective view showing a main part of a preferred embodiment of a thermal transfer printer according to the present invention.

[0021] FIG. 2 is a schematic side view of a carriage of the thermal transfer printer in FIG. 1.

[0022] FIG. 3 is a side view showing a parallel crank mechanism of the carriage of the thermal transfer printer in FIG. 2.

[0023] FIG. 4 is a side cross-sectional view showing an ink ribbon in the preferred embodiment.

[0024] FIG. 5 is a schematic side view of a thermal head showing the effect of heat insulation of an ink ribbon in the preferred embodiment.

[0025] FIG. 6 is a graphical representation showing the relationship between a thermal head temperature, a resin base ink temperature and a lapse of time after carrying current to the thermal head in the preferred embodiment.

[0026] FIG. 7 is a graphical representation showing a control of carrying a current to the thermal head by a control unit in the preferred embodiment.

[0027] FIG. 8 is a schematic side view of a thermal head showing the effect of heat insulation of an ink ribbon in a conventional thermal transfer printer

[0028] FIG. 9 is a graphical representation showing the relationship between a thermal head temperature, a resin base ink temperature and a lapse of time after carrying a current to the thermal head in a conventional thermal transfer printer.

[0029] A thermal transfer printer 1 of the present preferred embodiment is provided with a plate-shaped platen 2 disposed at a predetermined position of a frame (not shown) with a recording surface thereof 2A nearly vertical and a guide shaft 3 disposed under the platen 2 toward the front of the platen 2 in parallel to the platen 2. A horizontally divided carriage 4 is mounted on the guide shaft 3 at a suitable position; a lower carriage 4a is mounted on the guide shaft 3 and an upper carriage 4b is provided with a ribbon cassette 5 described below and is mounted on the lower carriage 4a such that it can be separated from the lower carriage 4a in the up-and-down direction.

[0030] The carriage 4 can be reciprocated along the guide shaft 3 by driving a suitable drive belt 6 looped around a pair of pulleys (not shown) driven by drive means (not shown) such as stepping motor, etc.

[0031] The carriage 4 is provided with a thermal head 7 which is opposed to the platen 2 and can be freely brought into contact with or separated from the platen 2 by a well-known head-moving mechanism (not shown) moved by a drive motor (mot shown) and records on a recording paper 29 (described below) carried on the platen 2 in the state of contact (head-down state) in which the thermal head 7 is in contact with the platen 2. The thermal head 7 is provided with a plurality of heating elements (not shown) which are arranged in a line and heated selectively on the basis of desired recording information inputted by a suitable input unit (not shown) such as keyboard, etc.

[0032] Further, the energy of current to be carried to the thermal head 7, that is, the time during which a current is carried to the heating elements of the thermal head 7, can be controlled in 15 steps with the use of a controlling unit 25 described below.

[0033] Describing the carriage 4 further in detail, the plate-shaped upper carriage 4b nearly parallel to the upper surface of the lower carriage 4a is joined to the lower carriage 4a such that the upper carriage 4b is moved near to or away from the lower carriage 4a in parallel to each other by a parallel crank mechanism 8. The parallel crank mechanism 8, as shown in FIG. 3, is provided in pairs on both sides of the carriage 4 and each of them has a pair of links 9a and 9b which are crossed in a shape of X and are rotatably joined at a crossing position with a pin 10a. And the ends of the links 9a and 9b are slidably retained by pin a 10b, 10c, 10d, and 10e to the elongated holes (not shown) made in the top ends of the right and left sides of the lower carriage 4a and the upper carriage 4b.

[0034] Further, the lower carriage 4a is provided with a rotary crank mechanism 11 and the rotary crank mechanism 11 produces a parallel motion of the upper carriage 4b. The rotary crank mechanism 11 comprises a rotary plate 12 supported by the lower carriage 4a such that it can be rotated and a connecting link 14 rotatably joined to the rotary plate 12 by a pin 13a at an eccentric position and the top end of the connecting link 14 is rotatably joined to the upper carriage 4b by a pin 13b. The rotary plate 12 is rotated by suitable drive means (not shown) such as motor, etc.

[0035] Returning to FIG. 1, on both the right and left sides of the upper carriage 4b, plate-shaped arms 15 which form engaging parts 15a are erected at an interval nearly equal to the width of a ribbon cassette 5, each of which is slightly curved inward at the top thereof and has projections at the upper and lower ends thereof. At the center of the upper carriage 4b, a pair of rotary bobbins 16 are arranged at a predetermined interval such that they protrude upward and an ink ribbon 17 can be moved in a predetermined direction by the bobbins 16. One of the pair of bobbins 16 is a sending bobbin 16a for sending the ink ribbon 17 and the other of them is s reeling bobbin 16b for reeling the ink ribbon 17.

[0036] Further, on the end of the carriage 4 which is the remote side of the platen 2, an optical sensor 18a is mounted as a sensor 18 for detecting the kind of the ink ribbon 17 received in the ribbon cassette 5. In the present embodiment, a reflection-type sensor is used as the optical sensor 18a. The optical sensor 18a is connected to the control unit 25 disposed at a desired position of the thermal transfer printer 1 and for controlling the recording operation of the thermal transfer printer 1.

[0037] As shown in FIG. 1 and FIG. 2, a nearly plate-shaped canopy 19 is provided above the carriage 4 at a suitable gap and is supported by a frame (not shown) such that it can be opened or closed, as shown by both arrows A in FIG. 2. The canopy 19 functions as a paper-pressing member at the exit of a paper-feeding mechanism (not shown) in a closed state and is opposed to the carriage 4 and has a length nearly equal to the moving range of the carriage 4.

[0038] The canopy 19 is provided with a plurality of cassette holders (not shown) for holding the ribbon cassette 5 at a predetermined position on the bottom thereof which is opposed parallel to the carriage 4, and the cassette holders arrange in a line a plurality of ribbon cassettes 5 each of which receives the ink ribbon 17 (17a, 17b, 17c, 17d) to which each resin-based ink 28 of cyan, magenta, yellow, or black is applied in the present preferred embodiment.

[0039] As shown by both arrows B in FIG. 2, each ribbon cassette 5 is passed selectively between the canopy 19 and the upper carriage 4b by the motion of the parallel crank mechanism 8 operated with the rotary crank mechanism 11.

[0040] Each ribbon cassette 5 in the present preferred embodiment is formed in the same shape and in the same size, irrespective of the kind of ink ribbon 17, and has a pair of rotatably supported reels (not shown), a pair of rotatably supported ribbon-feeding rollers, and a plurality of guide rollers which can rotatably supported and face a ribbon passage in a case body 20 which can be divided in two upper and lower parts and is nearly square in a plan view.

[0041] The ink ribbon 17 is looped around a pair of reels and the middle portion of the ink ribbon 17 is guided outside. When the ribbon cassette 5 is mounted on the upper carriage 4b, one of the pair of reels is used as a reeling reel for reeling the ink ribbon 17 used for recording and the other is used as a feeding reel for feeding the ink ribbon 17. A plurality of key ways are splined on the inner peripheral surface of each reel at an interval in the peripheral direction and the inner peripheral surface of the reeling reel is made a reeling hole 21b for retaining the reeling bobbin 16b and the inner peripheral surface of the feeding reel is made a feeding hole 21a for retaining the feeding bobbin 16a.

[0042] Further, the surface of the ribbon cassette 5 opposite to the platen 2 in the state in which the ribbon cassette 5 is mounted on the carriage 4 is depressed to form a depression 22 to which the thermal head 7 faces and the middle portion of the ink ribbon 17 is guided in the depression 22.

[0043] Still further, an identification mark 23 for identifying the kind of ink ribbon 17 received in the ribbon cassette 5 is provided on the rear surface of the ribbon cassette 5 which extends in parallel to the surface having the depression 22. The identification mark 23 of the present preferred embodiment is formed by a reflection seal 24 with a non-reflection part 24a having a different number of stripes depending on the kind of ink ribbon 17.

[0044] The identification mark 23 is detected by the optical sensor 18a provided on the carriage 4 and the detection signal is outputted to the control unit 25 of the thermal transfer printer 1, and the control unit 25 counts the number of the identification mark 23 of each ribbon cassette 5 and identifies the kind of ink ribbon 17a, 17b, 17c, and 17d received in the ribbon cassette 5.

[0045] In other words, the ribbon cassette 5a shown at the most left-hand side in FIG. 1 has the reflection seal 24A with the non-reflection part 24a having three stripes as the identification mark 23. The left end of the rear surface shown toward the front of the ribbon cassette 5 in FIG. 1 is made a base position BP for detecting the identification mark 23, and a distance L between the base position BP and the right end of the non-reflection part 24a of the identification mark 23 positioned at the right end in FIG. 1 is made the same for all the idemnification marks 23 and the desired non-reflection part 24a for identifying the kind of ink ribbon 17a is formed within the distance L. The carriage 4 can be stopped in the state in which the optical sensor 18a detects the identification mark 23 to be used and the ribbon cassette 5 received in the cassette holder is passed to the upper carriage 4b in the state in which the carriage 4 is stopped.

[0046] Further, the ink ribbon 17 in the present preferred embodiment, as shown in FIG. 4, is made by laminating a wax-based separating layer 27 on a base plastic film 26 and laminating a resin-based ink layer 28 on the wax-based separating layer 27.

[0047] It is preferable in terms of peeling effect of the resin-based ink layer 28 to form the wax-based separating layer 27 in a thickness of 0. 1 to 5 µm. Further, from the viewpoint of heating temperature of the thermal head, it is recommended that the softening point of the wax be 50 to 130 °C and therefore the kind of wax be selected from paraffin wax, silicon wax, montan wax, polyethylene wax, Japan wax, bees wax, candelilla wax, rice wax, and the like.

[0048] Further, it is preferable in terms of good transfer to the recording paper 29 and easy gradation representation that the resin-based ink layer 28 has a fusion viscosity of 100,000 to 2,000,000 cP at 100 °C, and resin having a more preferable fusion viscosity of 650,000 cP is used in the present preferred embodiment. Then, from the viewpoint of good transfer to the recording paper 29 and easy procurement, it is recommended that the kind of wax be selected from vinyl polymer, polyester-based resin, polyethylene-based resin and polyamide-based resin, such as polyethylene, polyvinyl chloride, vinyl chloride, polyvinyl acetate, vinyl chloride-vinyl acetate copolymer resin, polyacrylic ester, etc.

[0049] Furthermore, the resin-based ink layer 28 is formed such that its fusion viscosity is made gradually smaller by each color according to the order of recording. In the present preferred embodiment, the fusion viscosity of the resin-based ink layer 28 is made smaller in the order of cyan, magenta, yellow and black and the resin-based ink 28 is fused and transferred to the recording paper 29 in the decreasing order of fusion viscosity. Since the resin-based ink 28 is fused and transferred under the conditions like this, the resin-based ink 28 is transferred well even to the portion where each resin-based ink 28 is overlaid on the already transferred ink, whereby a beautiful recording image can be realized.

[0050] In this respect, in the present preferred embodiment, it is not necessarily required that the black ribbon cassette 5 is disposed as the ribbon cassette 5 for receiving the ink ribbon 17 to which the resin-based ink 28 is applied and it is acceptable that at least the ribbon cassettes 5 for receiving the cyan, magenta, and yellow ink ribbons 17 are disposed.

[0051] Still further, the recording paper 29 used in the present preferred embodiment comprises base paper 30 (recording side surface) and a heat insulation layer 31 formed on the base paper 30. The heat insulation layer 31, as shown in FIG. 5, prevents the heat of the heating element of the thermal head 7 from being radiated to the back side of the recording paper 29 through the ink ribbon 17 and the recording paper 29, and the quantity of heat given to the resin-based ink 28 of the ink ribbon 17 is increased by the effect of heat insulation of the heat insulation layer 31. In the present preferred embodiment, as shown in FIG. 6, the temperature of the resin-based ink layer 28 of the ink ribbon 17 is increased by about 60 percent compared with the case in which the recording paper 29 is not provided with the heat insulation layer 31.

[0052] As one example of the recording paper 29, there is the recording paper comprising the base paper 30 coated with the heat insulation layer 31 in which inorganic pigment particles 31A and polymer-based microcapsules 31B are dispersed. It is preferable in terms of improving the effect of heat insulation to use the heat insulation layer 31 having inorganic pigment particles 31A of 0. 5 to 5 μm, more preferably, 2 to 3 μm in diameter. Further, as examples of the inorganic pigment particles, there are talc, kaolin, calcium carbonate, aluminum hydroxide, barium sulfate, alumina, and various kinds of titanium oxides.

[0053] Further, the polymer-based microcapsule 31B is formed in a hollow ball with a diameter of 1 to 3 μm and has an air layer therein and hence can increase the effect of heat insulation.

[0054] Still further, as another example of the recording paper 29, there is micro-porous paper having a plurality of pores of 10 to 30 μm in diameter on the surface thereof and the micro-porous paper produces the effect of heat insulation by the air in the pores on the surface thereof.

[0055] Furthermore, the thermal transfer printer 1 in the present preferred embodiment is provided with the control unit 25 for controlling the moving speed of the thermal head 7, a contact pressure of the thermal head 7 against the platen 2 and the time of carrying a current to each heating element of the thermal head 7.

[0056] The control unit 25 comprises a memory, a CPU (both not shown) and the like, and to peel the resin-based ink 28 in the half-fusion state, the moving speed of the thermal head 7 is controlled such that the relative speed of the thermal head 7 to the recording paper 29 is 2 to 30 in/ sec, more preferably, 5 in/ sec.

[0057] Still further, the control unit 25 controls the contact pressure of the thermal head 7 against the platen 2 to not less than 0. 3 kg/cm, whereby the resin-based ink 28 is surely transferred onto the recording paper 29 and is stably transferred onto the portion where each resin-based ink 28 is overlaid.

[0058] In addition, the control unit 25 controls the energy of current to be carried by controlling the time of carrying the current to each heating element of the thermal head 7 in 15 steps, so that a dot-diameter gradation recording to the recording paper 29 is realized. That is, as shown in FIG. 7, the control unit 25 can control the dot diameter in 15 levels, from level 1 to level 15 (16 steps including the case where the current is not carried) by controlling the time of carrying the current to one heating element with the cycle of a pulse of current kept constant, so that an image can be represented as the dot-diameter gradation on the basis of a matrix constituted by each heating element. For example, the matrix is constituted by 9 dots of 3 dots wide by 3 dots high.

[0059] Next, the function of the preferred embodiments of the present invention will be described below.

[0060] In the thermal transfer printer 1 according to the present invention, when recording information subjected to an image processing by a host computer or the like is sent to the control unit 25, the carriage 4 at the home position is moved by the direction of the control unit 25 and the optical sensor 18a mounted on the carriage 4 detects the identification mark 23 of the ribbon cassette 5. The optical sensor 18a sends a detection signal inherent in each identification mark 23 comprising the arrangement and pitch of the stripes of the non-refection part 24a to the control unit 25. The control unit 25 determines whether the detection signal corresponds to the identification 23 of the direction, and if the detection signal corresponds to the identification 23 of the direction, the control unit 25 stops the movement of the carriage 4.

[0061] In the present preferred embodiment, the fusion viscosity of the ink ribbon 17 is decreased in the order of cyan, magenta, yellow and black and hence, first, the ribbon cassette 5 for receiving the cyan ink ribbon 17 is identified.

[0062] Then, as shown by both arrows B in FIG. 2, the ribbon cassette 5 for receiving the selected desired ink ribbon 17 therein is selectively passed between the canopy 19 and the upper carriage 4b by the parallel crank mechanism 8 and the rotary crank mechanism 11 and is mounted on the carriage 4, which is the end of the selection operation of the ribbon cassette 5.

[0063] Next, the recording paper 29 with the heat insulation layer 31 laminated thereon is set manually or by a paper feeding unit (not shown) between the platen 2 and the thermal head 7 and a recording operation is started. The thermal head 7 is moved down and pressed onto the platen 2 at a line pressure of 0. 3 kg/cm by the direction from the control unit 25 via the ink ribbon 17 to which the resin-based ink 28 is applied and the recording paper 29, and the carriage 4 is moved such that the relative speed of the thermal head 7 to the recording paper 29 is 2 to 30 in/ sec. When each heating element of the thermal head 7 is heated by controlling the time of carrying the current to each heating element according to the desired gradation of the recording image while the thermal head 7 is being moved with respect to the recording paper 29 in this manner, the resin-based ink 28 of the ink ribbon 17 is peeled off by a suitable quantity from the wax-based separating layer 27 and is transferred to the recording paper 29.

[0064] Therefore, according to the preferred embodiment of the present invention, the resin-based ink 28 of the ink ribbon 17 is laminated on the base film via the wax-based separating layer 27 and hence the resin-based ink 28 is easily transferred to the recording paper 29 and can represent the highlight portion of the image correctly with high definition.

[0065] Further, since the heat insulation layer 31 is formed on the recording paper 29, the heating temperature of the thermal head 7 can be easily held and sufficiently soften the resin-based ink 28 of the ink ribbon 17, so that even the resin-based ink 28 can easily make a dot-diameter gradation recording with high resolution.

[0066] Still further, since the moving speed of the carriage 4 is controlled such that the relative speed of the thermal head 7 to the recording paper 29 is 2 to 30 in/ sec, the resin-based ink 28 can be peeled off by a suitable quantity and can be surely transferred to the recording paper 29.

[0067] In this connection, the present invention is not limited to the present invention described above and may be further modified if necessary.

Claims

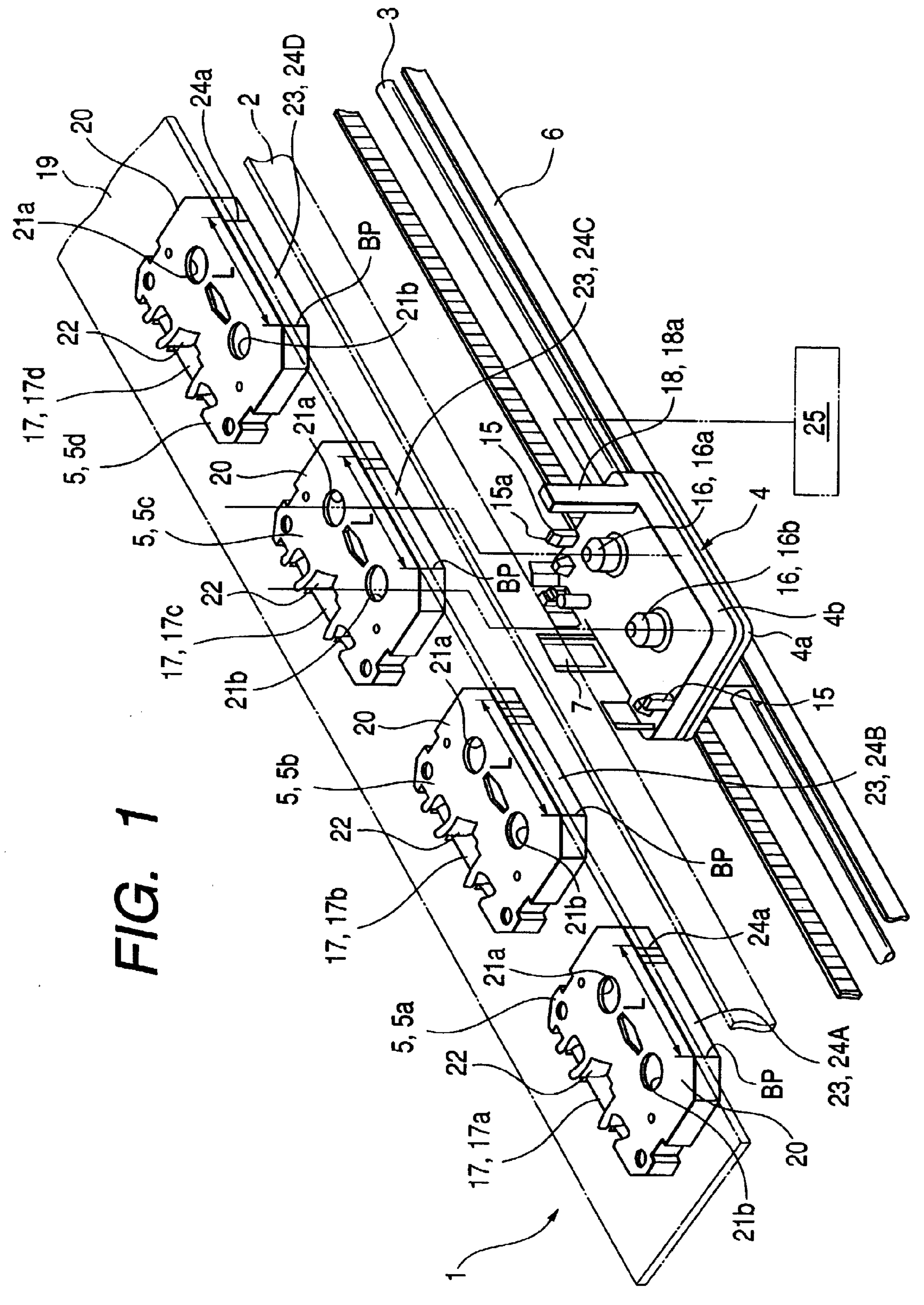
1. A thermal transfer printer for making a recording on recording paper by moving a thermal head while pressing the thermal head against a platen via an ink ribbon and the recording paper and by selectively fusing and transferring the heat-fusible ink of the ink ribbon, wherein the ink ribbon comprises a base substance, a separating layer laminated on the base substance, and a resin-based ink layer laminated on the separating layer, wherein the recording paper has a heat insulation layer formed thereon, and wherein said thermal transfer printer includes a control unit for controlling a time of carrying a current to said thermal head in a plurality of steps according to the gradation of an image to be recorded.

2. A thermal transfer printer according to claim 1, wherein the recording paper is coated with the heat insulation layer in which inorganic pigment particles of 0.5 to 5 μm in diameter and polymer-based microcapsules of 1 to 3 μm in diameter are dispersed.

3. A thermal transfer printer according to claim 1 or 2 wherein the heat insulation layer of the recording paper has a plurality of pores of 10 to 30 μm in diameter on the surface thereof.

4. A thermal transfer printer according to claim 1,2 or 3 wherein a color recording with the use of a plurality of color resin-based ink layers is performed, and wherein each of the plurality of resin-based ink layers has a different fusion viscosity and is fused and transferred to the recording paper in the order of decreasing fusing viscosity.

5. A thermal transfer printer according to claim 4, wherein the resin-based ink layers comprise at least cyan, magenta, and yellow and the fusion viscosity of the resin-based ink layer is decreased in the order of cyan, magenta, and yellow.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17, 17c
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18, 18a
19
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23, 24C
23, 24D
24a
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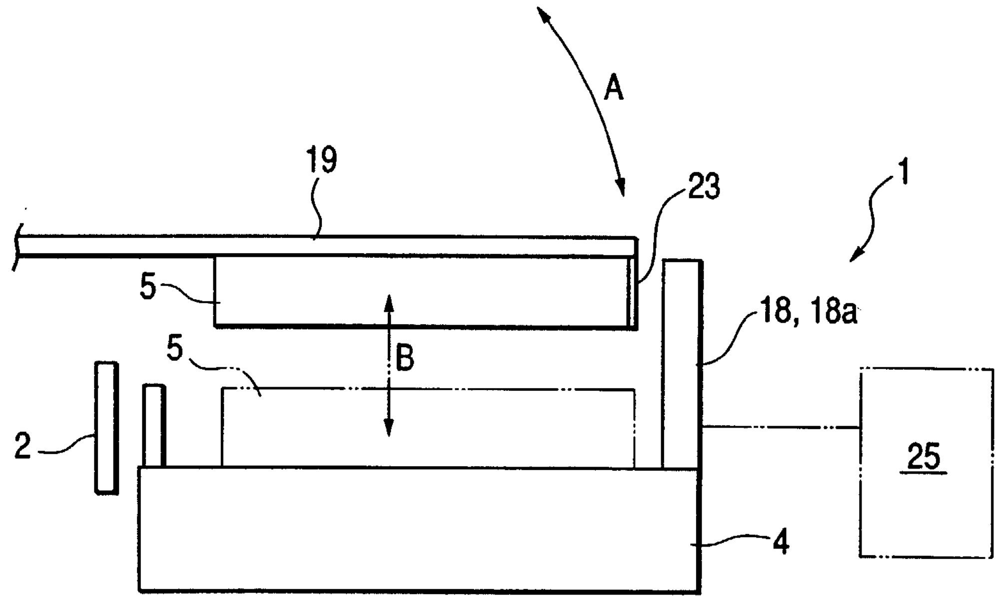
BP
L

FIG. 1

FIG. 2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5
B
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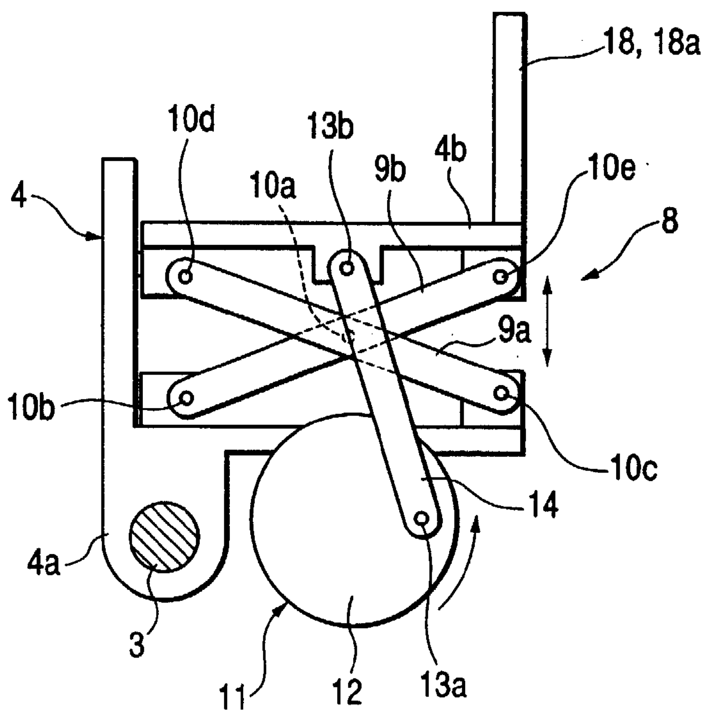
25
4

FIG. 3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13a

FIG. 4

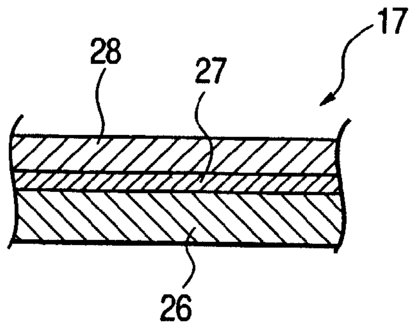

FIG. 5

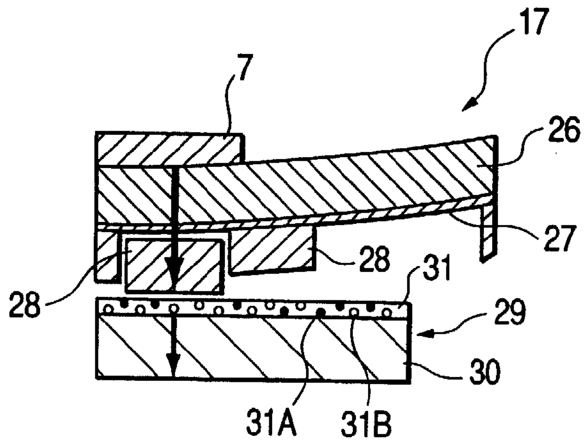

FIG. 6

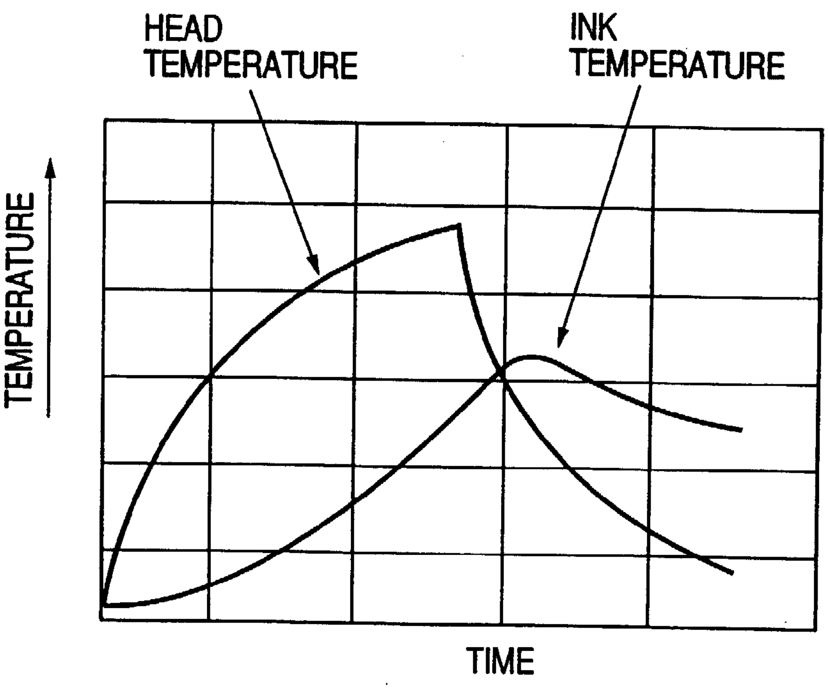

FIG. 7

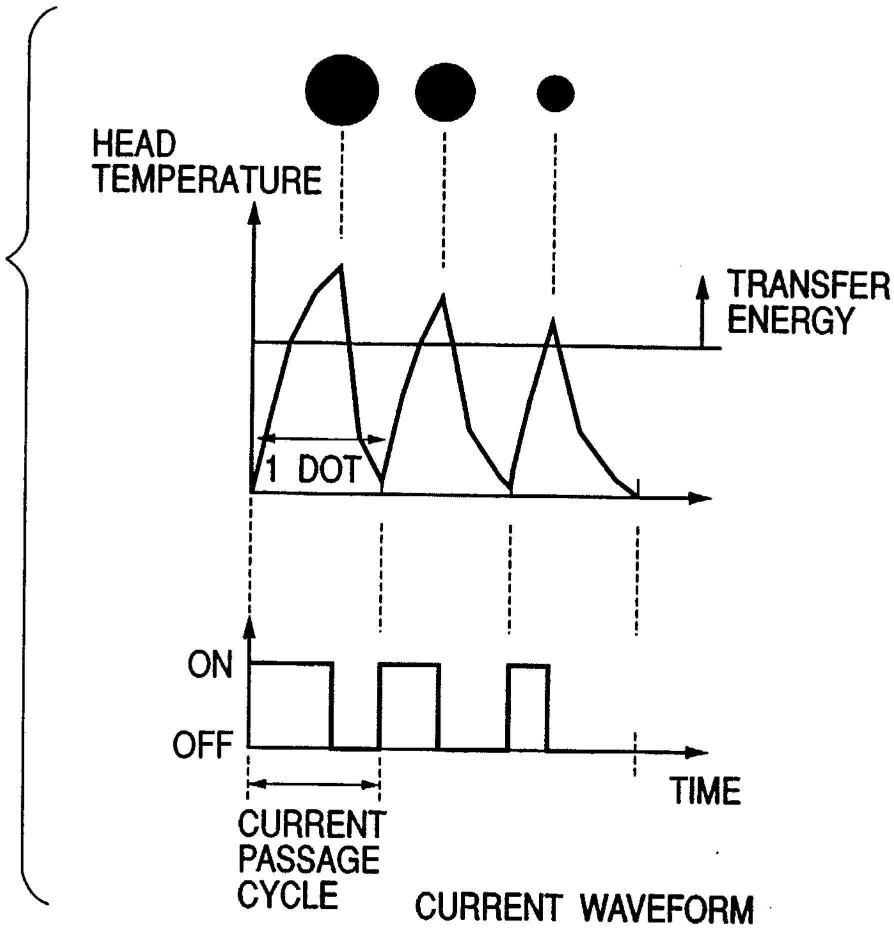

FIG. 8
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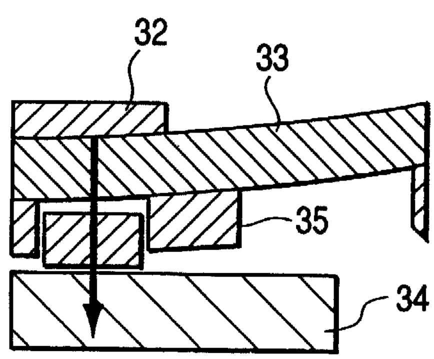

FIG. 9
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