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(71) Applicant:
**RISO KAGAKU CORPORATION
Tokyo (JP)**

(72) Inventors:
• **Nomura, Kunio,**
c/o Riso Kagaku Corp. R&D Center
Inashiki-gun, Ibaraki-ken (JP)
• **Takizawa, Shinichi,**
c/o Riso Kagaku Co. R&D Center
Inashiki-gun, Ibaraki-ken (JP)

• **Oike, Hikaru,**
c/o Riso Kagaku Corp. R&D Center
Inashiki-gun, Ibaraki-ken (JP)
• **Okada, Yoshiyuki,**
c/o Riso Kagaku Corp. R&D Center
Inashiki-gun, Ibaraki-ken (JP)
• **Irie, Yukio,**
c/o Riso Kagaku Corp. R&D Center
Inashiki-gun, Ibaraki-ken (JP)
• **Fujimoto, Yasuhiro,**
c/o Riso Kagaku Co. R&D Center
Inashiki-gun, Ibaraki-ken (JP)

(74) Representative:
Klunker . Schmitt-Nilson . Hirsch
Winzererstrasse 106
80797 München (DE)

(54) **Method of and apparatus for making heat-sensitive stencil master**

(57) A heat-sensitive stencil master is made by imagewise perforating a heat-sensitive stencil master material by use of a thermal head having a plurality of heater elements which are arranged in a main scanning direction and are respectively energized through discrete electrodes while the stencil master material is fed in a sub-scanning direction. A thermal head in which each of the heater elements is divided into at least two segments which are connected to a common discrete electrode to be energized simultaneously with each other is used and each picture element of the stencil master is formed by two or more small perforations formed by the segments of each heater element.

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Description

BACKGROUND OF THE INVENTION

5 Field of the Invention

[0001] This invention relates to a method of and an apparatus for making a stencil master by imagewise perforating a heat-sensitive stencil master material by use of a thermal head comprising a plurality of heater elements, and more particularly to such a method and an apparatus in which setoff and/or strike through can be suppressed.

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Description of the Related Art

[0002] There has been known a heat-sensitive stencil master making apparatus in which a thermal head having a plurality of resistance heaters is pressed against a thermoplastic resin film of a heat-sensitive stencil master material to thermally perforate the thermoplastic resin film. Further there has been known a stencil printer which makes print using a stencil master made by the stencil master making apparatus.

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[0003] Figure 8 shows an example of such a heat-sensitive stencil master making apparatus. In Figure 8, a heat-sensitive stencil master material 1 in a continuous length is conveyed in the direction of arrow A by a platen roller 3 driven by an electric motor (not shown) and passed between the platen roller 3 and a thermal head 4. The heat-sensitive stencil master material 1 has a thermoplastic resin film on one side thereof and resistance heater elements 40 of the thermal head 4 are pressed against the thermoplastic resin film of the material 1 when the material 1 is passed between the platen roller 3 and the thermal head 4.

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[0004] Figure 9 is an enlarged schematic plan view of the thermal head 4. As shown in Figure 9, the thermal head 4 comprises a plurality of rectangular resistance heater elements 40 arranged in a row in a main scanning direction (a direction perpendicular to a sub-scanning direction which is the direction in which the stencil master material 1 is conveyed relative to the thermal head 4). The size A of each of the resistance heater elements 40 in the main scanning direction and the pitches p in which the resistance heater elements 40 are arranged in the main scanning direction (will be referred to as "the heater element pitches p", hereinbelow) are determined according to a desired resolution of the stencil master making apparatus in the main scanning direction, and the size B of each of the resistance heater elements 40 in the sub-scanning direction is determined according to a desired resolution in the sub-scanning direction which is determined by feed pitches of the stencil master material 1 and/or the like.

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[0005] One ends (as seen in the sub-scanning direction) of the resistance heater elements 40 are connected to a common electrode 42 and the other ends of the resistance heater elements 40 are respectively connected to discrete electrodes 43 so that electric power can be supplied to the resistance heater elements 40 independently of each other.

[0006] The resistance heater elements 40 are selectively energized by a thermal head drive means (not shown) and the portions of the thermoplastic resin film in contact with the energized resistance heater elements 40 are thermally perforated. Each of the resistance heater elements 40 forms one picture element and a two-dimensional image is formed on the stencil master material 1 by moving the material 1 in the sub-scanning direction (the direction of arrow A) while selectively energizing the resistance heater elements 40.

[0007] A stencil master cut off the material 1 thus imagewise perforated is wound around a printing drum of a stencil printer (not shown) and ink is supplied to the stencil master 1 (reference numeral 1 will be sometimes used to denote the stencil master, hereinbelow), whereby ink is transferred to a printing paper through the perforations in the stencil master 1 and print is made.

[0008] When the distances between adjacent picture elements of the printed image are represented by p, and when the stencil master material 1 is conveyed in the sub-scanning direction so that the distances between adjacent picture elements of the printed image are p in both the main scanning direction and the sub-scanning direction, the resolution of the printed image is expressed as 1/p. The stencil master making apparatus which makes a stencil master in this manner is called a 1/p resolution stencil master making apparatus, and the stencil printer which makes print by use of a stencil master made in this manner is called a 1/p resolution stencil printer. The distance p between the picture elements corresponds to each of the heater element pitches, the perforation pitches (pitches in which the heat-sensitive stencil master material 1 is perforated) and the printing pitches in the main scanning direction.

[0009] For example, ink transferred to the printing paper through a perforation of the heat-sensitive stencil master 1 having a diameter of d1 spreads over an area which is d2 in diameter as shown in Figure 10. The dot formed by ink transferred to the printing paper through a perforation of the stencil master 1 (the area of a diameter d2) will be referred to as "a printing dot", hereinbelow.

[0010] When solid printing is to be made by a 1/p resolution stencil printer, a stencil master in which perforations are separated from each other by a predetermined gap as shown in Figure 11A. The gaps between the perforations are set so that ink spreading over the printing paper fills the gaps and printing dots form a continuous and uniform solid area

as shown in Figure 11B. When the gaps between the perforations of the stencil master are too large, gaps are formed between the printing dots and the printing dots cannot form a continuous and uniform solid area.

[0011] It is preferred that the diameters of the printing dots and the perforations satisfy the relation, diameter of printing dot = $\sqrt{2} \times$ perforation pitches. Further since the heater element pitches of the thermal head 4 is fixed by the stencil master making apparatus and cannot be selected freely, it is necessary to properly set the diameters of the perforations in order to properly set the gaps between the perforations. That is, in the heat-sensitive stencil master making apparatus, it is necessary to set the diameters of the perforations so that the gaps between the perforations become proper for ink to spread over the gaps and form a continuous and uniform solid area.

[0012] When uniform solid printing is to be made, it is said that use of a 300dpi stencil printer, which is lower than a 600dpi stencil printer in resolution, gives rise to problems of deterioration in printing quality and the occurrence of set-off, strike through and/or rubbing off due to a larger amount of ink transferred to the printing paper. That is, in a stencil printer of low resolution, it is difficult to minimize the amount of ink to be transferred to the printing paper so that setoff, strike through and/or rubbing off do not occur while ensuring sufficient image quality and uniformity of the solid printing.

[0013] This problem may be overcome by increasing the resolution of the stencil master making apparatus by use of a thermal head in which the heater element pitches are small and one picture element is formed by, for instance, a pair of heater elements. However this approach is disadvantageous in that the scanner and/or the image processing system must be modified to accommodate the increased resolution, which adds to the cost.

SUMMARY OF THE INVENTION

[0014] In view of the foregoing observations and description, the primary object of the present invention is to provide a method of and an apparatus for making a stencil master which allow to make stencil printing so that setoff, strike through and/or rubbing off do not occur while ensuring sufficient image quality and uniformity of the solid printing without substantially increasing the cost or complicating the system even if stencil printing is made at low resolution by use of a low resolution stencil printer.

[0015] As will be described in more detail later, we have discovered that when each printing dot corresponding to one picture element of an image is formed by a plurality of small printing dots, setoff, strike through and rubbing off can be suppressed to an extent equivalent to high resolution printing and at the same time uniformity of the solid printing can be ensured. This invention has been made on the basis of this discovery. That is, in accordance with one aspect of the present invention, there is provided a method of making a heat-sensitive stencil master in which the stencil master is made by imagewise perforating a heat-sensitive stencil master material by use of a thermal head having a plurality of heater elements which are arranged in a main scanning direction and are respectively energized through discrete electrodes while the stencil master material is fed in a sub-scanning direction, wherein the improvement comprises the steps of

perforating the heat-sensitive stencil master material by use of a thermal head in which each of the heater elements is divided into at least two segments which are connected to a common discrete electrode to be energized simultaneously with each other, and forming each picture element of the stencil master by two or more small perforations formed by the segments of each heater element.

[0016] The two or more small perforations forming each picture element may be formed either in one sub-scanning position or in a plurality of adjacent sub-scanning positions. For example, when each picture element of the stencil master is to be formed by two small perforations arranged in the sub-scanning direction, the two small perforations may be formed in one sub-scanning position by use of a thermal head in which each heater element is divided into two heater element segments arranged in the sub-scanning direction, or may be formed in two adjacent sub-scanning positions, each in one sub-scanning position, by use of a thermal head in which each heater element is not divided in the sub-scanning direction. Further, the two or more small perforations forming each picture element may partly overlap with each other.

[0017] It is preferred in order to perforate the heat-sensitive stencil master material in a desirable manner in both the main scanning direction and the sub-scanning direction that the perforation of the stencil master material be performed in a manner such that the proportion of open area Q which is defined by the following formula for an area which is a/n in length in the main scanning direction and b/m in length in the sub-scanning direction becomes not smaller than 20% and not larger than 70%,

$$Q(\%) = [S / \{(a/n) \times (b/m)\}] \times 100$$

wherein $\underline{a}$ represents the length of one picture element in the main scanning direction, $\underline{b}$ represents the length of one

picture element in the sub-scanning direction, S represents the area of the small perforation formed by each of the segments of each heater element, $\underline{n}$ represents the number of the small perforations forming each picture element as numbered in the main scanning direction and $\underline{m}$ represents the number of the small perforations forming each picture element as numbered in the sub-scanning direction, $\underline{n}$ being an integer not smaller than 2 and $\underline{m}$ being an integer not smaller than 1.

[0018] In accordance with another aspect of the present invention, there is provided an apparatus for carrying out the method of the present invention. That is, there is provided an apparatus for making a heat-sensitive stencil master by imagewise perforating a heat-sensitive stencil master material by use of a thermal head having a plurality of heater elements which are arranged in a main scanning direction and are respectively energized through discrete electrodes while the stencil master material is fed in a sub-scanning direction, wherein the improvement comprises that

each of the heater elements of the thermal head is divided into at least two segments which are connected to a common discrete electrode to be energized simultaneously with each other.

[0019] It is preferred that the apparatus of the present invention be provided with a control means which controls the perforation of the stencil master material to be performed in a manner such that the proportion of open area Q which is defined by the following formula for an area which is a/n in length in the main scanning direction and b/m in length in the sub-scanning direction becomes not smaller than 20% and not larger than 70%,

$$Q(\%) = [S / \{(a/n) \times (b/m)\}] \times 100$$

wherein $\underline{a}$ represents the length of one picture element in the main scanning direction, $\underline{b}$ represents the length of one picture element in the sub-scanning direction, S represents the area of the perforation formed by each of the segments of each resistance heater element, $\underline{n}$ represents the number of the small perforations forming each picture element as numbered in the main scanning direction and $\underline{m}$ represents the number of the small perforations forming each picture element as numbered in the sub-scanning direction, $\underline{n}$ being an integer not smaller than 2 and $\underline{m}$ being an integer not smaller than 1.

[0020] It is preferred that the control means controls the perforation of the stencil master material by controlling the power supplied to the segments of the heater elements of the thermal head as well as the feed rate of the stencil master material in a sub-scanning direction.

[0021] In accordance with the method and the apparatus of the present invention, since each picture element of the stencil master is formed by a plurality of small perforations, each printing dot corresponding to one picture element of an image to be printed is formed by a plurality of small printing dots formed by ink transferred to the printing paper through the small perforations which are formed by the segments of the heater element, and accordingly setoff, strike through and rubbing off can be suppressed and at the same time uniformity of the solid printing can be ensured.

[0022] Further since the segments of each heater element is connected to the same discrete electrode, the scanner and/or the image processing system need not be modified to accommodate increased resolution, and accordingly the cost is not increased.

[0023] When perforation of the heat-sensitive stencil master material is controlled so that the proportion of open area Q is in the range identified above, the heat-sensitive stencil master material can be perforated in a desirable manner in both the main scanning direction, whereby the sub-scanning direction and the shape of each printing dot is stabilized, the occurrence of thin spots in the solid image can be prevented, and excellent printing can be performed with the perforations kept independent.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

Figure 1 is a view showing the relation between the printing resolution and the amount of ink transferred, Figures 2A and 2B are views for illustrating an example of forming one printing dot by a plurality of small printing dots, Figure 3 is a schematic view showing a heat-sensitive stencil master making apparatus in accordance with an embodiment of the present invention, Figure 4 is an enlarged fragmentary view showing a part of the thermal head employed in the heat-sensitive stencil master making apparatus of the embodiment, Figure 5A is a view showing the relation between the printing dots and the perforations of the stencil master, Figure 5B is a view showing the relation between the small printing dots forming each of the printing dots shown in Figure 5A and the small perforations of the stencil master for the small printing dots,

Figure 6 is a view for illustrating the proportion of open area Q,

Figure 7 is an enlarged fragmentary view showing a part of another example of a thermal head which can be employed in the heat-sensitive stencil master making apparatus shown in Figure 3,

Figure 8 is a schematic view showing a conventional heat-sensitive stencil master making apparatus,

Figure 9 is an enlarged fragmentary view showing a part of a thermal head which is employed in the conventional heat-sensitive stencil master making apparatus,

Figure 10 is a view for illustrating the relation between the diameter of the perforation and the diameter of the printing dot, and

Figures 11A and 11B are views for illustrating the relation between the perforations of the stencil master and the printing dots on the printing paper when solid printing is made.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0025] A preferred embodiment of the present invention will be described in detail with reference to the drawings, hereinbelow.

[0026] As described above, this invention has been made on the basis of the discovery that when each printing dot corresponding to one picture element of an image is formed by a plurality of small printing dots, setoff, strike through and rubbing off can be suppressed to an extent equivalent to high resolution printing and at the same time uniformity of the solid printing can be ensured. This point will be described first.

[0027] In each of stencil printers whose resolution were 200dpi, 300dpi, 400dpi and 600dpi, respectively, the diameters of perforations of stencil masters were set so that uniform solid printing was realized (that is, so that the diameter of printing dots became $\sqrt{2}$ times the perforation pitches and the portion which was not covered with any one of the printing dots was minimized while the portion simultaneously covered with four printing dots was nullified as shown in Figure 5A), and the amount of ink transferred to the printing paper was measured for each of the printers. Figure 1 shows the result of the measurement.

[0028] As can be understood from Figure 1, as the resolution of the printer lowers, the amount of ink transferred to the printing paper increases and it becomes more difficult to suppress setoff, strike through and rubbing off while ensuring uniformity of the solid printing. In other words, for a given uniformity of the solid printing, as the resolution of the printer increases, occurrence of setoff, strike through and rubbing off becomes less.

[0029] Printing was made by replacing each printing dot shown in Figure 2A with four small printing dots so that the area covered by the four small printing dots (e.g., the area shown by the thick line in Figure 2B) became substantially equal to the area of each printing dot shown in Figure 2A (e.g., the area shown by the thick line in Figure 2A) and the same printing resolution was held. As a result, the printing performance against setoff, strike through and rubbing off was improved to as high as printing at a higher resolution while uniformity of solid printing was maintained. Further it has been empirically found that excellent printing can be obtained when said proportion of open area Q is not smaller than 20% and not larger than 70%.

[0030] Figure 3 shows a heat-sensitive stencil master making apparatus 10 in accordance with an embodiment of the present invention.

[0031] In Figure 3, a heat-sensitive stencil master material 1 in a continuous length is conveyed in the direction of arrow A by a conveyor means 9 comprising a platen roller 3 driven by an electric motor (not shown) and passed between the platen roller 3 and a thermal head 5. The electric motor for driving the platen roller 3 is driven by a motor drive means 8.

[0032] Figure 4 is an enlarged fragmentary view showing a part of the thermal head 5. The thermal head 5 comprises a plurality of resistance heater elements 50 arranged in a row in the main scanning direction (a direction perpendicular to the sub-scanning direction in which the heat-sensitive stencil master material 1 is conveyed relative to the thermal head 5). The sizes and the pitches of the resistance heater elements 50 in the main scanning direction are determined according to the resolution of the apparatus 10 in the main scanning direction, and the sizes of the resistance heater elements 50 in the sub-scanning direction are determined according to the resolution of the apparatus 10 in the sub-scanning direction which is determined by feed pitches of the stencil master material 1 in the sub-scanning direction.

[0033] Each of the resistance heater elements 50 are divided in the main scanning direction into a pair of rectangular heater element segments 50a and 50b.

[0034] Each pair of heater element segments 50a and 50b are connected to each other through an intermediate conductor 54 and are connected in series between a common electrode 52, which is common to all the resistance heater elements 50, and a discrete electrode 53 which is connected to a driver IC 55. That is, the pair of heater element segments 50a and 50b of each resistance heater element 50 are simultaneously energized by the driver IC 55 to thermally perforate the parts of the heat-sensitive stencil master material 1 in contact therewith.

[0035] The motor drive means 8 and each driver IC of the thermal head 5 are connected to a controller 7. The con-

troller 7 supplies power to the heater element segments 50a and 50b of the respective resistance heater elements 50 and controls the feed rate of the heat-sensitive stencil master material 1 so that the proportion of open area Q is in a predetermined range, whereby uniformity of solid printing is maintained without occurrence of setoff and the like and excellent printing can be performed with the perforations kept independent.

[0036] In this particular embodiment, one picture element of the stencil master is formed by four small perforations two of which are formed by the respective heater element segments 50a and 50b of each resistance heater element 50 on one main scanning line (in one sub-scanning position) and the other two of which are formed by the respective heater element segments 50a and 50b of the same resistance heater element 50 on the adjacent main scanning line (in the adjacent sub-scanning position). Ink transferred to the printing paper through the four small perforations forms one printing dot. As a result, a stencil master can be made at high resolution.

[0037] The four small perforations for one printing dot may be formed by the same data and the scanner and the image processing system may be of the same resolution as represented by the number of the discrete electrodes 53. That is, unlike when the resolution of the stencil master making apparatus is simply increased, it is unnecessary to modify the scanner and/or the image processing system to accommodate increased resolution, and accordingly the cost is not increased.

[0038] For example, for printing pitches at 300dpi, the heater element segments 50a and 50b are arranged at perforation pitches of 600dpi and the feed pitch of the stencil master material 1 in the sub-scanning direction is set at 600dpi. At this time, a scanner and an image processing system for 300dpi are used. In this state, by driving the thermal head 5 on the basis of the same line data for two adjacent main scanning lines (each pair of heater element segments 50a and 50b are driven by the same data for the corresponding picture element), each printing dot for 300dpi can be formed by four small perforations for 600dpi.

[0039] Figure 5A shows the relation between the printing dots and the perforations when each printing dot at 300dpi is formed by one perforation at 300dpi in making uniform solid printing, whereas Figure 5B shows the relation between the printing dots and the perforations when each printing dot at 300dpi is formed by four small perforations at 600dpi in making uniform solid printing. In Figures 5A and 5B, the smaller circles indicated at Y are the perforations and the larger circles indicated at Z are the printing dots. In the case of the perforation at 300dpi, the proportion of open area Q is 40% and in the case of the perforation at 600dpi, the proportion of open area Q is 30%.

[0040] When each printing dot at 300dpi shown in Figure 5A is formed by a plurality of small printing dots at 600dpi shown in Figure 5B in making solid printing, the amount of ink transferred to the printing paper is reduced as compared with when each printing dot is formed by a single printing dot as can be understood from Figure 1, whereby the printing performance against setoff, strike through and rubbing off is improved and at the same time uniformity of solid printing is maintained.

[0041] Though the present invention has been described above in conjunction with the case where the small perforations are formed in the same pitches in the main scanning direction and the sub-scanning direction, the present invention may be applied to the case where the small perforations are formed in different pitches in the main scanning direction and the sub-scanning direction. For example, each picture element of the stencil master may be formed by 2×1 small perforations (two small perforations arranged in a row in the main scanning direction) or 3×3 small perforations. This can be realized by so setting the number of the heater element segments of each resistance heater element and/or the feed pitches of the printing paper. Further it is possible to form each printing dot at 200dpi by a plurality of small printing dots at 400dpi. The printing resolution can be of any value.

[0042] Though, in the embodiment described, the proportion of open area Q is 40% in the case of the perforation at 300dpi, and 30% in the case of the perforation at 600dpi, the proportion of open area Q need not be limited to those values. It has been found that when the proportion of open area Q is not smaller than 20% and not larger than 70%, the amount of ink transferred to the printing paper is reduced, whereby the printing performance against setoff, strike through and rubbing off is improved and at the same time uniformity of solid printing is maintained. When the length of one picture element in the main scanning direction is represented by a , the length of one picture element in the sub-scanning direction is represented by b , the area of the small perforation formed by each of the segments of each heater element is represented by S , the number of the small perforations forming each picture element as numbered in the main scanning direction is represented by n (n being an integer not smaller than 2) and the number of the small perforations forming each picture element as numbered in the sub-scanning direction is represented by m (m being an integer not smaller than 1) as shown in Figure 6, the proportion of open area Q is defined by the following formula for an area which is a/n in length in the main scanning direction and b/m in length in the sub-scanning direction.

$$Q(\%) = [S / \{(a/n) \times (b/m)\}] \times 100$$

[0043] Figure 7 is an enlarged fragmentary view showing a part of a thermal head 6 which can be also employed in the heat-sensitive stencil master making apparatus 10. The thermal head 6 comprises a plurality of resistance heater elements 60 arranged in a row in the main scanning direction (a direction perpendicular to the sub-scanning direction

in which the heat-sensitive stencil master material 1 is conveyed relative to the thermal head 6). The sizes and the pitches of the resistance heater elements 60 in the main scanning direction are determined according to the resolution of the apparatus 10 in the main scanning direction, and the sizes of the resistance heater elements 60 in the sub-scanning direction are determined according to the resolution of the apparatus 10 in the sub-scanning direction which is determined by feed pitches of the stencil master material 1 in the sub-scanning direction.

[0044] Each of the resistance heater elements 60 are divided in the main scanning direction into a pair of rectangular heater element segments 60a and 60b. The heater element segments 60a and 60b are of slit type, and are connected in parallel between a common electrode 62, which is common to all the resistance heater elements 60, and a discrete electrode 63 which is connected to a driver IC 65. That is, the pair of heater element segments 60a and 60b of each resistance heater element 60 are simultaneously energized by the driver IC 65 to thermally perforate the parts of the heat-sensitive stencil master material 1 in contact therewith.

[0045] As in the case where the aforesaid thermal head 5 is employed, one picture element of the stencil master may be formed by four small perforations two of which are formed by the respective heater element segments 60a and 60b of each resistance heater element 60 on one main scanning line (in one sub-scanning position) and the other two of which are formed by the respective heater element segments 60a and 60b of the same resistance heater element 60 on the adjacent main scanning line (in the adjacent sub-scanning position). Ink transferred to the printing paper through the four small perforations forms one printing dot. For example, one printing dot at 300dpi can be formed by four small printing dots at 600dpi.

[0046] As in the case where the aforesaid thermal head 5 is employed, when each printing dot at 300dpi is formed by four small printing dots at 600dpi by use of the thermal head 6, the amount of ink transferred to the printing paper is reduced as compared with when each printing dot at 300dpi is formed by a single printing dot, whereby the printing performance against setoff, strike through and rubbing off is improved and at the same time uniformity of solid printing is maintained.

[0047] As in the case where the aforesaid thermal head 5 is employed, each picture element of the stencil master may be formed by 2×1 small perforations (two small perforations arranged in a row in the main scanning direction) or 3×3 small perforations. This can be realized by so setting the number of the heater element segments of each resistance heater element and/or the feed pitches of the printing paper. Further it is possible to form each printing dot at 200dpi by a plurality of small printing dots at 400dpi. The printing resolution can be of any value.

Claims

1. A method of making a heat-sensitive stencil master in which the stencil master is made by imagewise perforating a heat-sensitive stencil master material by use of a thermal head having a plurality of heater elements which are arranged in a main scanning direction and are respectively energized through discrete electrodes while the stencil master material is fed in a sub-scanning direction, wherein the improvement comprises the steps of

perforating the heat-sensitive stencil master material by use of a thermal head in which each of the heater elements is divided into at least two segments which are connected to a common discrete electrode to be energized simultaneously with each other, and

forming each picture element of the stencil master by two or more small perforations formed by the segments of each heater element.

2. A method as defined in Claim 1 in which the perforation of the stencil master material is performed in a manner such that the proportion of open area Q which is defined by the following formula for an area which is a/n in length in the main scanning direction and b/m in length in the sub-scanning direction becomes not smaller than 20% and not larger than 70%,

$$Q(\%) = [S / \{(a/n) \times (b/m)\}] \times 100$$

wherein a represents the length of one picture element in the main scanning direction, b represents the length of one picture element in the sub-scanning direction, S represents the area of the small perforation formed by each of the segments of each heater element, n represents the number of the small perforations forming each picture element as numbered in the main scanning direction and m represents the number of the small perforations forming each picture element as numbered in the sub-scanning direction, n being an integer not smaller than 2 and m being an integer not smaller than 1.

3. An apparatus for making a heat-sensitive stencil master by imagewise perforating a heat-sensitive stencil master material by use of a thermal head having a plurality of heater elements which are arranged in a main scanning

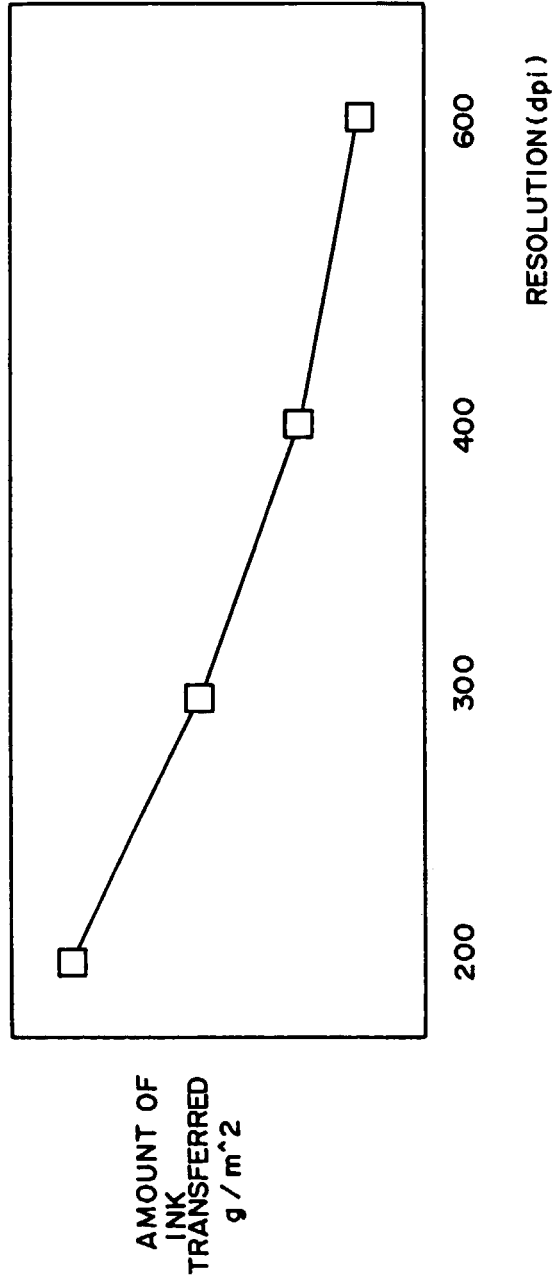
direction and are respectively energized through discrete electrodes while the stencil master material is fed in a sub-scanning direction, wherein the improvement comprises that

each of the heater elements of the thermal head is divided into at least two segments which are connected to a common discrete electrode to be energized simultaneously with each other.

4. An apparatus as defined in Claim 3 further comprising a control means which controls the perforation of the stencil master material to be performed in a manner such that the proportion of open area Q which is defined by the following formula for an area which is a/n in length in the main scanning direction and b/m in length in the sub-scanning direction becomes not smaller than 20% and not larger than 70%,

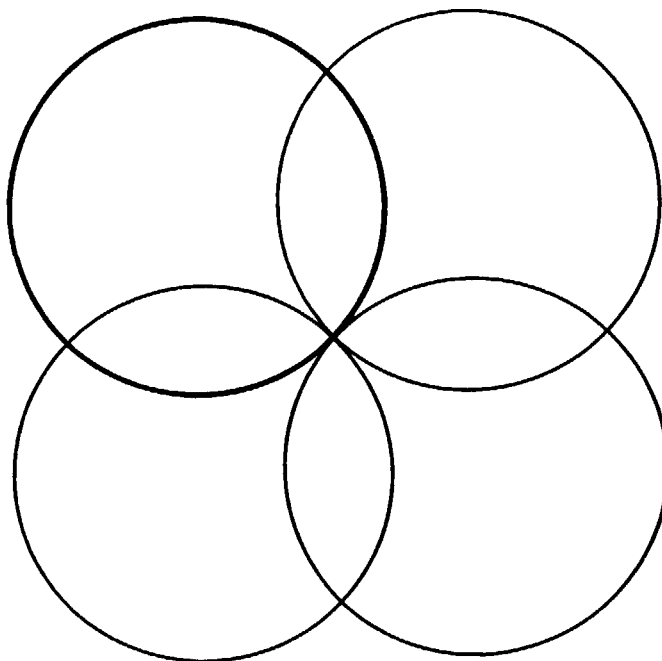
$$Q(\%) = [S / \{(a/n) \times (b/m)\}] \times 100$$

wherein a represents the length of one picture element in the main scanning direction, b represents the length of one picture element in the sub-scanning direction, S represents the area of the perforation formed by each of the segments of each resistance heater element, n represents the number of the small perforations forming each picture element as numbered in the main scanning direction and m represents the number of the small perforations forming each picture element as numbered in the sub-scanning direction, n being an integer not smaller than 2 and m being an integer not smaller than 1.

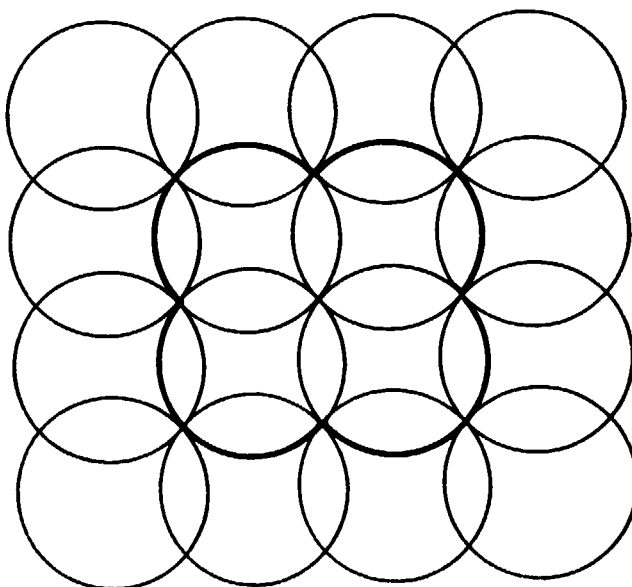


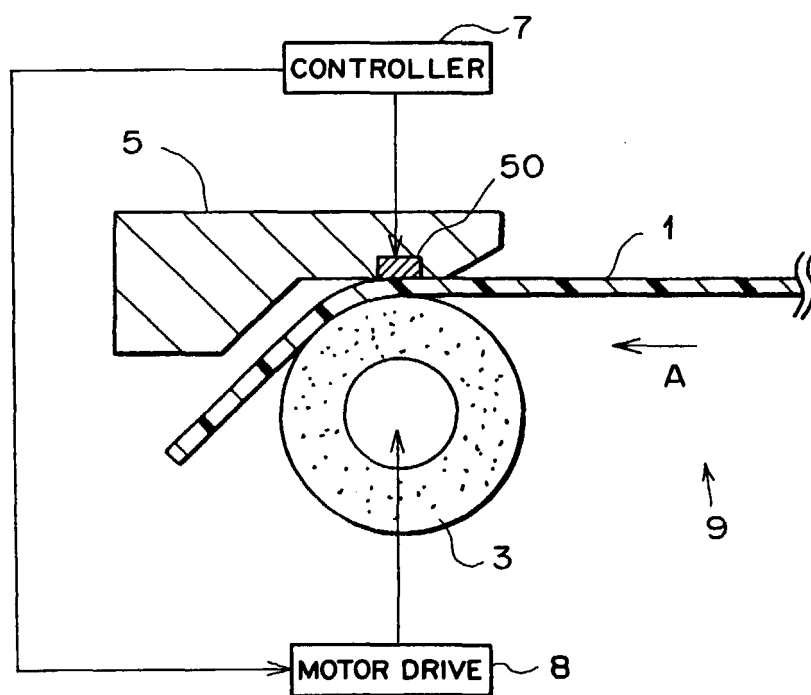
F I G . 1

F I G . 2 A



F I G . 2 B





F I G . 3

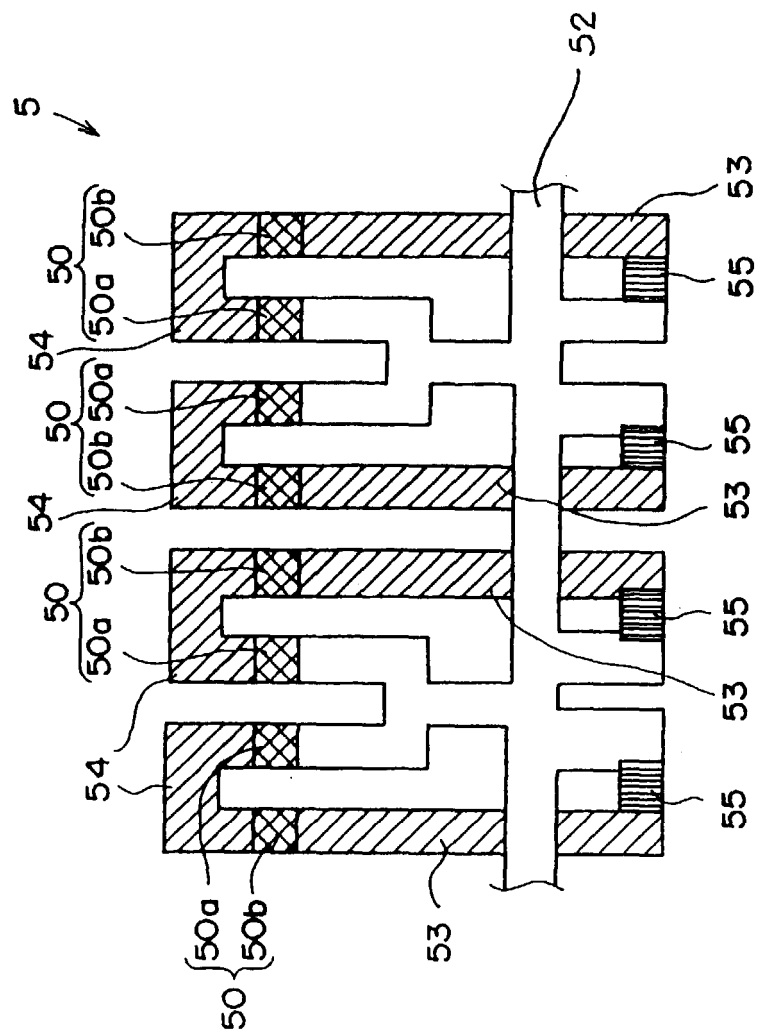
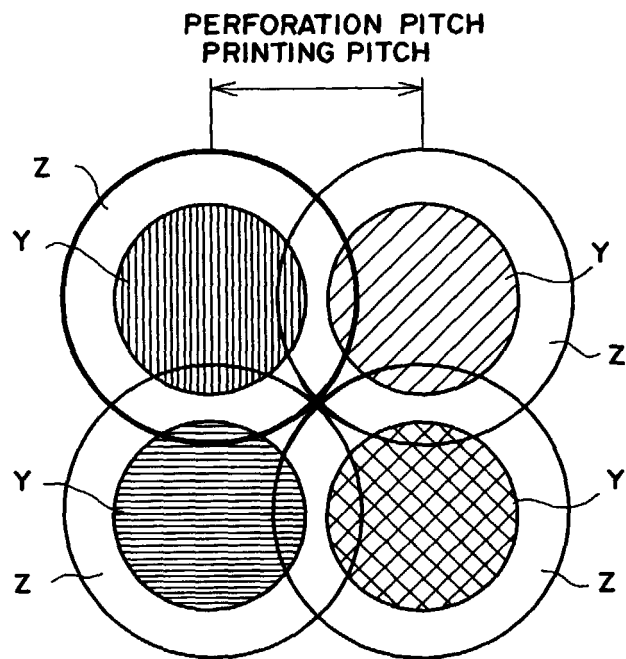
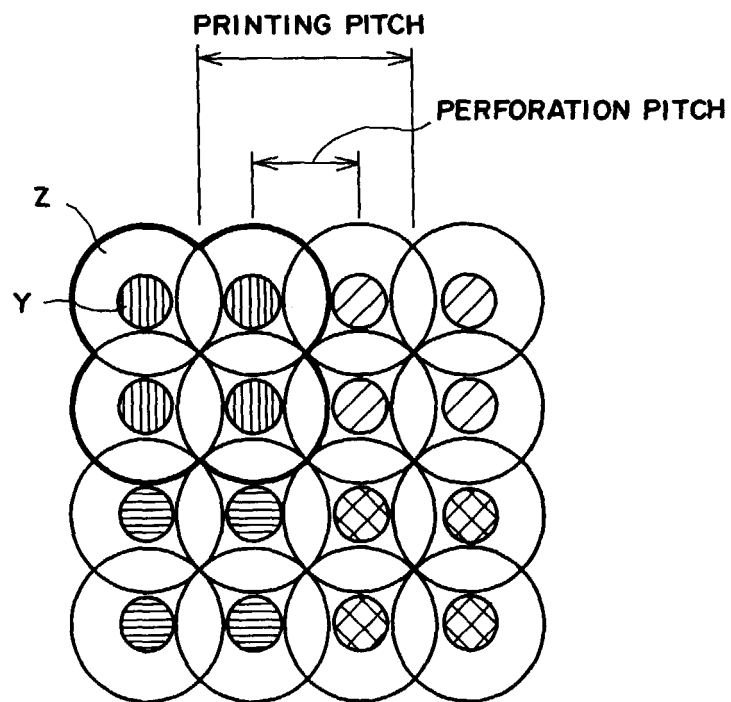


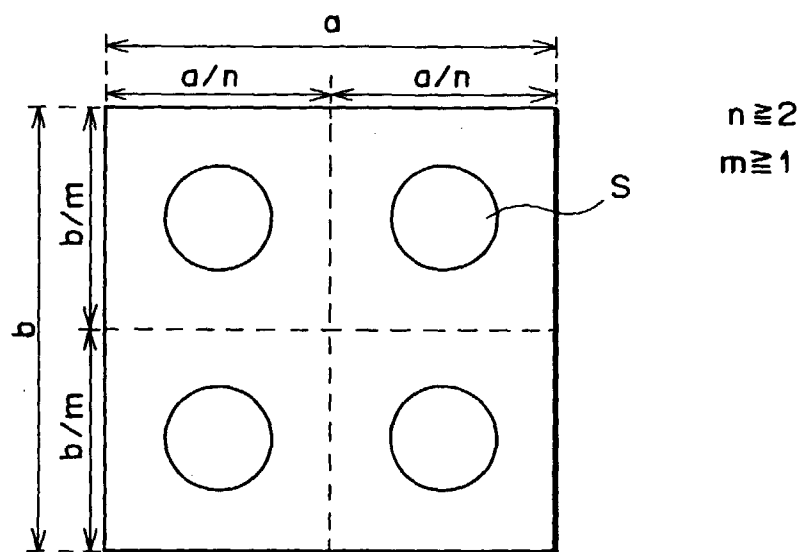
FIG. 4

F I G . 5 A



F I G . 5 B





F I G . 6

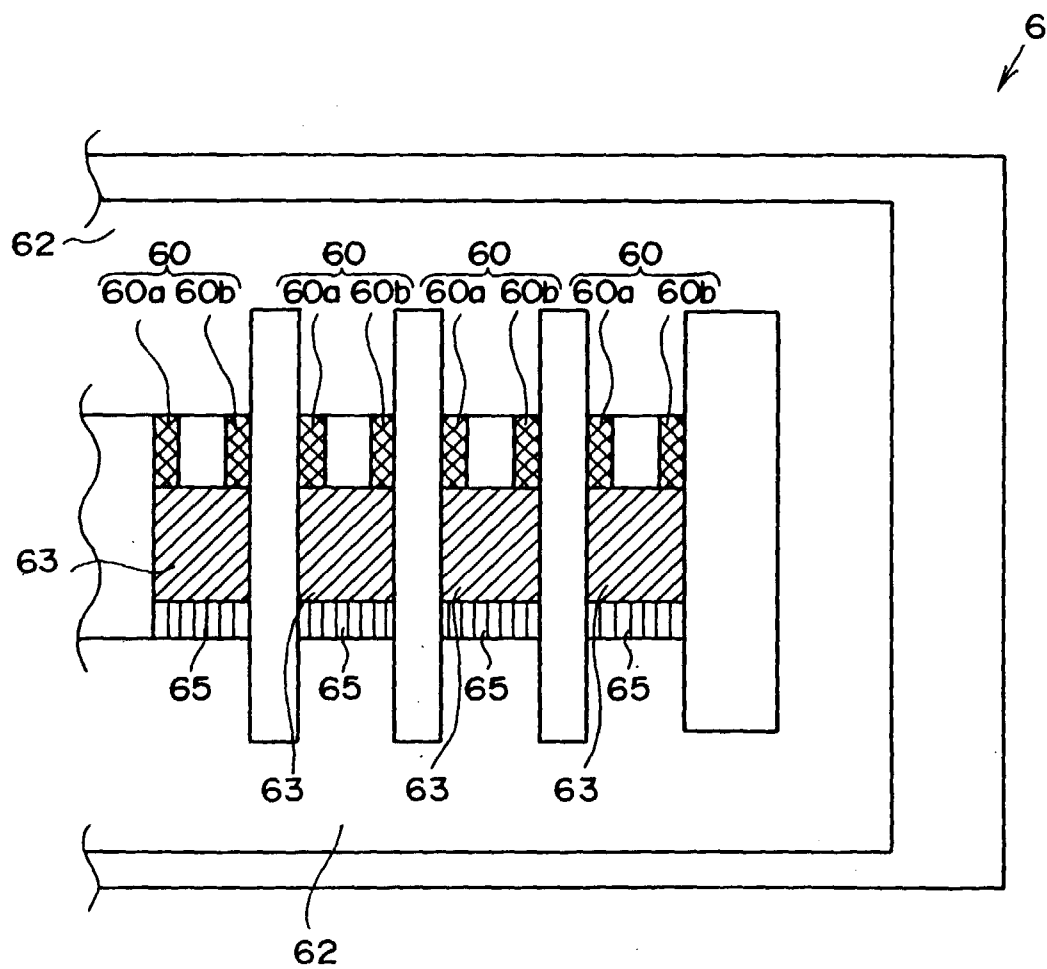
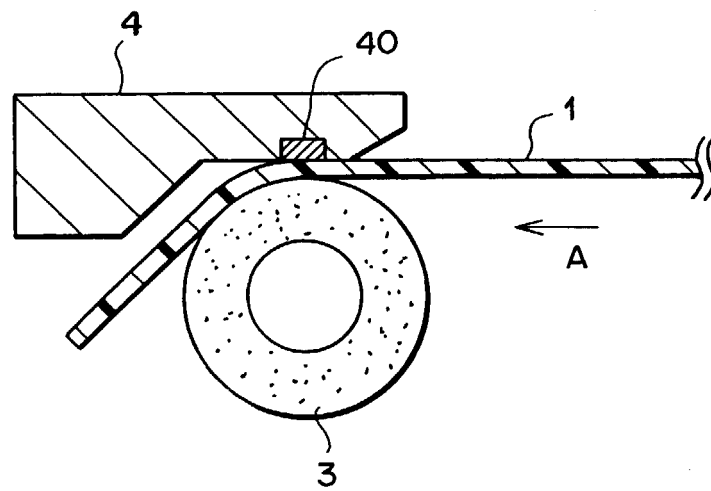


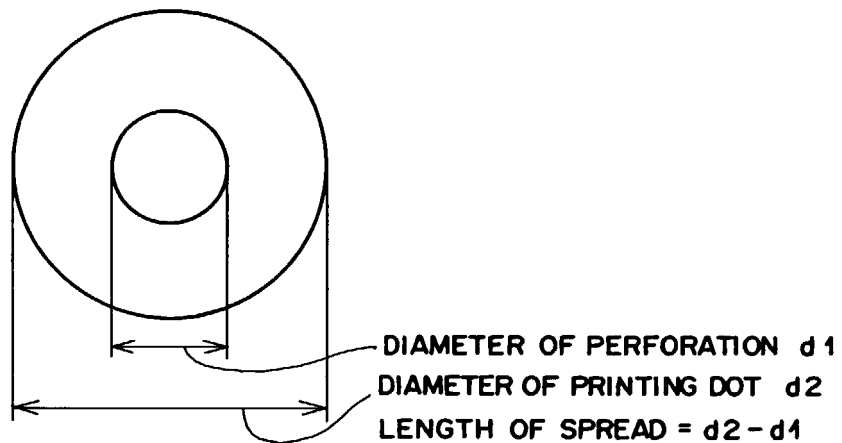
FIG. 7

F I G . 8

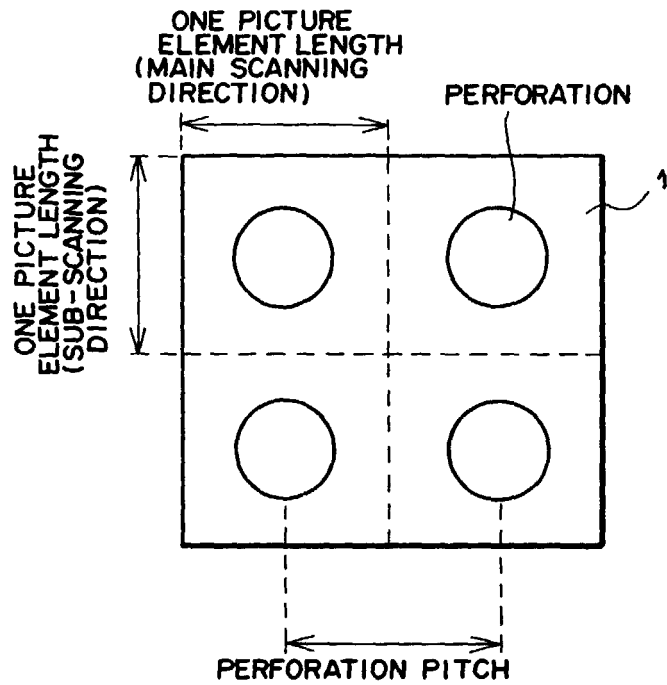


PRIOR ART

F I G . 10



F I G . 11A



F I G . 11B

