

Description

The present invention relates to a wire dot printer adapted to use a plurality of differently coloured inks to effect multicolour printing.

Impact colour printers are known which employ a ribbon which has differently coloured areas arranged either longitudinally or transversely. This type of impact colour printer can print characters in one colour only while the print head is moving with respect to the paper in a single stroke. When it is necessary to print different colours on a single line, the print head is required to move along the same line in as many strokes as there are colours to be printed, resulting in a greatly reduced printing speed. Moreover, the service life of the ribbon employed is governed by that of the colour area thereof which is most frequently used. In such an impact colour printer, more colours than the colours available on the ribbon can be recorded by printing a number of colours on the same dot. However, the ink previously printed on the dot tends to be transferred to the other coloured areas on the ribbon, with the result that the inks of different colours will be mixed together on the ribbon as the latter becomes frequently used.

It is also known from IBM Technical Disclosure Bulletin No. 10, Volume 22, March 1980, pages 4363-4365 to provide an impact printer in which use is made of a colour wheel having a plurality of radial fingers which are respectively provided with pads which may be impregnated with differently coloured inks. The colour wheel may be rotated so as to bring a specific finger into a printing position, whereby to print a particular colour. Such a printer is, however, very slow because it is not possible to print more than one colour at a time.

In our co-pending European Patent Application EP-A-0042293 entitled "Wire dot printer", there is disclosed a wire dot printer having a matrix of wire ends for carrying fluid ink to effect printing. The wire dot printer is capable of supplying an appropriate amount of fluid ink to the wire ends for performing stable printing of high quality. However, this wire dot printer was not adapted to use a plurality of differently coloured inks.

The wire dot printer disclosed in the said co-pending application employs two tubes for supplying fluid ink to a print head and for collecting excess ink. To convert this wire dot printer into a colour printer which utilizes three differently coloured inks, a total of six ink supply and collection tubes is required which interconnect the print head with three ink tanks, one tank for each of the inks, the tubes being coupled to predetermined portions of the print head. Accordingly, such a colour printer would be cumbersome to assemble.

It is important in wire dot printers utilizing a plurality of differently coloured inks that provision be made for preventing the inks from being mixed with each other. To this end, the interior of the print head should have ink passages formed for

respective inks in a limited space without causing colour mixing. Therefore, the print head is liable to be complex in structure, cumbersome to put together, and less reliable in operation.

With the wire dot printer of the said co-pending application, a continued printing operation results in a deposit of paper dust from the recording paper and of ink spattered from the paper onto the end of the print head. As a result, the recording paper tends to get smeared by the deposit on the print head. The deposited paper dust finds its way into ink passage tubes so as to interfere with the proper supply and collection of ink. For colour printing with inks of different colours, the deposited paper dust would give rise to capillary attraction causing the inks to be mixed together. The printed characters would thus be of mixed colour, and no proper colour printing could be accomplished.

According, therefore, to the present invention, there is provided a wire dot printer comprising a print head which carries a plurality of printing wires, and fluid ink application means for applying fluid ink to printing end faces of the printing wires, characterised in that, for the purpose of using a plurality of differently coloured fluid inks to effect multicolour printing, the print head has a plurality of said fluid ink application means, the printing wires being arranged in a plurality of separate groups each group of which is housed in a respective fluid ink application means so as to be adapted to be supplied thereby with fluid ink of a colour which differs from that supplied to any other group.

Each of said groups of wires may be arranged in a row at the distal end of the print head.

The fluid inks may, for example, have the colours cyan, yellow and magenta, or may be constituted by those inks plus a black ink.

The printing wires may be selectively projected to control the density of printed dots in these colours, or to superimpose dots for printing various colours.

The printer may have a guide block having a plurality of separate compartments extending longitudinally of said printing wires and divided by partitions, said groups of wires being respectively disposed in said compartments.

Each fluid ink application means may be arranged to be supplied with fluid ink from a respective ink tube, the print head being mounted on a carriage on which there is slidably mounted a tube connector which is coupled to said ink tubes, each fluid ink application means comprising an ink supply guide which is connected to said tube connector and which is arranged to supply fluid ink to the printing end faces of the respective group of wires.

The wire dot printer may have a cleaning member which has projections engageable with the distal end of said print head, said projections alternating with recesses which are kept out of contact with said distal end of the print head, said cleaning member being rotatable for cleaning said distal end of the print head.

The cleaning member may be composed of as many cleaning portions as there are colours of inks, partitions being interposed between the cleaning portions.

The cleaning member may comprise separate cleaning member pieces which may be readily attached and removed.

The invention enables high-speed multicolour printing to be effected without colour mixing.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:-

Figure 1 is an exploded perspective view of one embodiment of a wire dot printer adapted to use a plurality of differently coloured inks according to the present invention,

Figure 2 is a cross-sectional view of a nose of a print head in the wire dot printer shown in Figure 1,

Figure 3 is a cross-sectional view of an ink applicator mechanism at the distal end of the print head in the wire dot printer of Figure 1,

Figure 4 is a perspective view of a guide block in the wire dot printer of Figure 1,

Figure 5 is a front elevational view of the ink applicator mechanism as seen from the printing ends of wires in the wire dot printer of Figure 1,

Figure 6 is a bottom view of the nose of the print head,

Figure 7 is a plan view of a carriage of the wire dot printer of Figure 1 with the print head and ink tanks thereof removed,

Figure 8 is a side elevational view of a pump forming part of the wire dot printer of Figure 1,

Figure 9 is a perspective view of an ink tank which may be used in a wire dot printer according to the present invention,

Figures 10(a) and 10(b) are plan and cross-sectional views respectively of a manually engageable grip which may be used on the ink tank illustrated in Figure 9,

Figure 11 is a cross-sectional view of the ink tank shown in Figure 9 with the said grip in position,

Figures 12(a) and 12(b) are perspective views of different embodiments of grips, said grips having different handle portions,

Figure 13 is a diagrammatic front elevational view showing a matrix of wire ends at the distal end of the print head,

Figure 14 is a diagram illustrative of printed dots,

Figure 15 is a fragmentary plan view of a wire dot printer according to the present invention which employs a cleaning device,

Figure 16 is a side elevational view of the wire dot printer shown in Figure 15,

Figure 17 is a side elevational view of another embodiment of a cleaning device,

Figure 18 is a cross-sectional view of the cleaning device of Figure 17 as mounted on a platen shaft,

Figure 19 is a fragmentary plan view of yet another embodiment of a cleaning device, and

Figure 20 is a timing chart illustrating the operation of the cleaning device.

Terms such as "left" and "right", as used in the description below, are to be understood to refer to directions as seen in the drawings.

Figure 1 shows in an exploded perspective view a carriage and surrounding parts in a wire dot printer adapted to use a plurality of differently coloured inks according to the present invention. A carriage 20 supports thereon ink tanks 50a, 50b, 50c for containing inks of three colours, that is, cyan, yellow and magenta. The carriage 20 also supports a tube pump 90, and a print head 1. The carriage 20 is movable transversely across a sheet of recording paper (not shown). The print head 1 comprises a nose 3 housing a total of twenty four printing wires 14 (Figure 2) and a driver 2 for selectively projecting the wires 14 toward the sheet of recording paper. The print head 1 is secured to the carriage 20 by screws 24.

The wires 14 are guided by and supplied with inks from a guide block 4. The guide block 4 has an ink supply and discharge guide 5 to which a tube connector 13 is coupled. To the tube connector 13, there are coupled a total of six ink supply and collection tubes 40 for the inks, the tubes 40 being connected in pairs through the pump 90 to the ink tanks 50a, 50b, 50c respectively.

Figure 2 is a cross-sectional view of the nose 3 showing the guide block 4 and the tube connector 13. The guide block 4 is in the form of a hollow prism extending longitudinally of the wires 14, and has two partitions 4a (Figure 1) extending in the longitudinal direction of the wires 14 to divide the guide block 4 into three compartments 4b (Figure 1). The ink supply and discharge guide 5 is mounted integrally on the front end of the guide block 4. As many guide plates 19a, 19b, 19c as are required for preventing the wires 14 from buckling are disposed in the guide block 4. The wires 14 are inserted from the left (Figure 2) where the driver 2 is located through guide holes 19d in the guide plates 19a, 19b, 19c and guide holes in the ink supply and discharge guide 5 until the wire ends reach the printing end at the right of Figure 2. Three ink application guides 7 and three wire guides 6 (Figure 1) are mounted on the guide block 4 for controlling the amount of ink applied and for arranging the wires 14 properly, as more fully described below.

The print head 1 according to the present embodiment has twenty four wires 14 divided into three groups of eight wires, each group being constituted by a vertical row or array of wires and being housed in a respective wire guide 6 and ink application guide 7 so as to be supplied with an ink of one particular colour which differs from that of the other groups. The groups of wires 14 are separated by the partitions 4a and are each arranged in a vertical array at the printing end, i.e. the distal end of the print head 1. Thus, the twenty four wires

14 are positioned at the nose end in three vertical arrays of wire ends or printing end faces 14a (see Figure 4) which are separated from each other. The inks are supplied through ink supply holes 8 in a lower portion of the ink supply and discharge guide 5, and circulate through the ink supply and discharge guide 5. Portions of the ink supply are fed to the wires 14 and are used up in the printing, and any excess ink is collected through ink collection holes 9 formed above the ink supply holes 8 in the lower portion of the ink supply and discharge guide 5. Since the wires 14 for each ink colour are vertically arrayed, three respective ink passages may be formed independently of each other in the respective ink application guides 7. During the printing operation, the inks are transferred back along the wires due to reciprocating movement thereof. However, there is no danger that these inks may get mixed together as the compartments 4b in the guide block 4 are separated by the partitions 4a.

Figure 3 shows in cross-section an ink applicator assembly at the distal end of the print head shown in Figure 1. The ink applicator assembly comprises the ink supply and discharge guide 5, the wire guides 6, and the ink application guides 7. The ink applicator assembly is composed of three ink applicator devices juxtaposed laterally, each ink applicator device being basically as disclosed in the co-pending European Patent Application Serial No. 81302692.9 entitled "Wire dot printer". Now, let the inks having the colours of yellow, magenta and cyan be represented by Y, M, C, respectively. The inks Y, M, C are passed through ink supply ports 8Y, 8M, 8C, respectively, and ink passages to ink collection ports 9Y, 9M, 9C, respectively. The ink passages are defined between the ink supply and discharge guide 5 and the wire guide 6. The wires 14 are arranged as wire arrays 14Y, 14M, 14C in the respective ink applicator devices 6, 7. The inks are stably applied to the wire arrays by the respective ink application guides 7. More specifically, each ink passage comprises a by-pass portion 15 having an increased depth and width for allowing ink to flow easily, and a capillary region 16 defined in a reduced gap between the ink supply guide 5 and the wire guide 6 for drawing ink due to capillary attraction. Thus, ink is drawn from the by-pass portion 15 into the capillary region 16 under capillary attraction. Each wire guide 6 and the respective wires 14 are spaced by clearances dimensioned to provide capillary attraction. The inks are thus fed toward the wire ends 14a and applied thereto under the capillary attraction of the capillary region 16 and pumping action when the wires 14 are driven longitudinally.

Figure 4 is a perspective view of the guide block 4 showing the wire ends 14a, with the ink application guides 7 and the wire guides 6 removed. As shown, the partitions 4a extend to the printing end of the guide block 4, for thereby preventing the coloured inks from being mixed together at the printing end beyond the ink

supply and discharge guide 5, so as to establish clear colour printing.

Figure 5 is a front elevational view of the guide block 4 illustrating the printing ends 14a of the wires 14. The respective ink application guide 7 is shown mounted on the right-hand wire array. The respective ink application guide 7 is not shown in the case of the central wire array. Neither the respective ink application guide 7 nor the respective wire guide 6 are shown in the case of the left-hand wire array so that the ink supply and discharge guide 5 can be clearly seen. The inks supplied from the ink supply ports 8 flow into the by-pass portions 15, then are drawn into the capillary regions 16, and are finally discharged through the ink collection ports 9.

Each ink application guide 7 has a plurality of slots 7b leading to wire guide holes 7a for guiding the respective wires 14, and a slot 7c connecting the wire guide holes 7a together for allowing smooth application of ink to the respective wires 14. While each ink applicator device has been described as being composed of separate components, that is the wire guide 6, and the ink application guide 7, the wire guide 6 and the ink application guide 7 may be integrally formed.

Figure 6 is a bottom view of the nose 3 of the print head 1, the view showing the guide block 4 for guiding the wires 14 and supplying the inks to the wires 14. The ink supply and discharge guide 5 constitutes part of the guide block 4, and the tube connector 13 is coupled to the ink supply and discharge guide 5. A total of six tubes 40 which are respectively referenced 40a to 40f, for supplying and discharging the inks of the respective colours are connected to the tube connector 13 and to the ink tanks 50a, 50b, 50c through the pump 90.

The manner in which the ink supply and collection tubes are connected to the ink supply and discharge guide 5 will be described with reference to Figures 1 and 2. The ends of the six tubes 40 extending from the ink tanks 50a-50c are first mounted on projections 11a, 11b (Figure 2) for example, of the tube connector 13 so that the tubes 40 are connected to the projections 11a, 11b. When the head 1 is to be fixed to the carriage 20, the tube connector 13 is slidably set in place between carriage members 20a, 20b, and the head 1 or the tube connector 13 or both are slidably positioned relative to each other to permit six projections 5a of the ink supply and discharge guide 5, which projections 5a are provided with the holes 8, 9, to be connected in a corresponding six holes, such as 10a, 10b of the tube connector 13, for setting the print head 1 in position. Thereafter, the head 1 is fastened to the carriage 20 by the screws 24. Accordingly, the head 1 can be quite easily secured to the carriage 20 with the tubes 40 connected to the head 1.

In the embodiment of Figure 2 which shows the nose in vertical cross-section, the holes 10a, 10b in the tube connector 13 are coupled to the projections 5a of the ink supply and discharge

guide 5. The tube connector 13 has grooves receiving O-rings 12 therein for preventing ink leakage and allowing more reliable tub connection. The O-rings 12 may alternatively be received in the projection 5a of the ink supply and discharge guide 5 for the same reason.

The ink tanks and the pump for supplying and discharging the inks will now be described with reference to Figure 1. The ink tanks 50a, 50b, 50c are removably mounted in a tank guide 51 fixed to the carriage 20. Hollow needles 52 are disposed in and affixed to the tank guide 51 for passing the inks from the tanks 50a, 50b, 50c and for introducing the inks into the tanks 50a, 50b, 50c. In the illustrated embodiment, the ink tanks 50a, 50b, 50c with the inks of three colours, that is, cyan, yellow, and magenta are mounted in the tank guide 51 for effecting multi-colour printing. The tank guide 51 has partitions 51d extending to the bottom thereof and defining independent tank insertion compartments 51a, 51b, 51c respectively for the ink tanks 50a, 50b, 50c. The hollow needles 52 are provided in pairs, each said pair corresponding to one colour only. With the three colours in this embodiment, a total of six hollow needles are secured to the bottom of the tank guide 51. The ink tanks 50a, 50b, 50c are inserted respectively in the tank insertion compartments 51a, 51b, 51c. When the ink tanks are fully inserted, the hollow needles 52 penetrate resilient diaphragms (not shown) attached to the bottoms of the ink tanks for supplying the inks contained in the ink tanks.

Since the tank compartments 51a, 51b, 51c are divided independently by the partitions 51d extending to the bottom of the ink tank 51, there is no risk that the inks of the different colours may become mixed together even when there is ink leakage upon attachment or removal of the ink tanks. Therefore, proper multicolour printing can be achieved at all times.

The pump 90 for supplying the inks is in the form of a tube pump driven by a pump motor 30 through a motor gear 31, intermediate gears 32, 33, and a pump gear 34. The pump motor 30 is secured to a projection 20f of the carriage 20 by screws 39 (only one shown). An intermediate gear shaft 35 is screwed to or mounted by insert moulding on a carriage projection 20e. Likewise, an intermediate gear shaft 37 and a pump gear shaft 36 are screwed to or mounted by insert moulding on carriage projections 20c, 20d. The tubes 40, which are made of an elastomeric material such as silicone rubber, extend from the hollow needles 52, which project into the ink tanks 50a, 50b, 50c and extend through the tube pump 90 to the tube connector 13 and thus to the ink supply and discharge guide 5 which is integral with the print head 1. Therefore, ink paths are formed which extend from the ink tanks 50a, 50b, 50c to the tube pump 90 and 50 to the print head 1, and then back to the tube pump 90 and to the ink tanks 50a, 50b, 50c.

The pump 90 will next be described in greater detail with reference to Figures 7 and 8.

The pump 90 is a peristaltic pump having tube presser rollers 44 (Figure 8) for application to the tubes 40, the tube presser rollers 44 being mounted respectively on roller shafts 43. The pump 90 is supported on the pump gear shaft 36 which is provided with the pump gear 34, the pump gear shaft 36 being journaled in a bearing plate 41. The tubes 40 extend through holes in a pump housing 38, the said holes being slightly smaller in diameter than the tubes 40. The tubes 40 are fixed in these holes against withdrawal under frictional forces. The housing 38 is composed of a pair of housing members 38a, 38b pivotably mounted on the intermediate gear shaft 37 and urged by a spring 42 extending therebetween to press the tubes 40. The principles of operation of the tube pump 90 are known and hence will not be described in detail. When the pump motor 30 is energized, the pump gear 34 is driven to cause the tube presser rollers 44 arranged in a circle concentric with the pump gear 34 to rotate about the roller shafts 43 and also to revolve around the pump gear shaft 36. The tube presser rollers 44 as they roll along press the tubes 40 against the housing members 38a, 38b to effect peristaltic pumping of the fluids or inks in the tubes.

In the illustrated embodiment, two tubes 40 are provided for supplying and discharging an ink of a single colour, and hence a total of six tubes 40a to 40f are provided for printing in three colours. The tubes are disposed in three adjacent pairs between the housing members 38a, 38b. The pump 90 can thus be of a small size for feeding and discharging the inks of the three colours. While the illustrated embodiment employs a tube pump, pumps of other types such as a gear pump or a plunger pump may be employed in place of the tube pump.

The ink tanks will now be described in more detail.

Figure 9 is a diagrammatic perspective view of an ink tank 50 which may be used in a wire dot printer according to an embodiment of the present invention, the ink tank 50 having a manually engageable grip 54 affixed thereto by means of a grip fastening pin 53.

Figure 10 shows the grip 54 in plan at (a) and in cross section at (b). The grip 54 should preferably be of a flexibly resilient material such as rubber. The grip 54 shown in Figure 10 is basically comprised of a grip portion 54a to be gripped by hand and an engagement portion 54c to be held in engagement with the ink tank 50. The engagement portion 54c includes a bulb-shaped body 54d having a central hole 54b extending there-through and including a conical taper portion 54e at a lower end thereof.

Figure 11 illustrates in cross-section the grip 54 as attached to the ink tank 50. The ink tank 50 is made of a plastics material such as polyacetal or nylon, and has a hole 50d in its upper wall 50e for insertion therein of the engagement portion 54c of the grip 54. The ink tank 50 also has in its lower wall 50f a hole 50g in which there is inserted a

resilient diaphragm 55. An ink supply needle 52a for supplying ink from the tank 50 to the tubes 40, and an ink return needle 52b, for returning excess ink to the tank 50, extend through the resilient diaphragm 55 and into the tank 50. The ink supply needle 52a and the ink return needle 52b are mounted on the tank guide (not shown in Figure 11) and have pointed distal ends. When the ink tank 50 is set in the tank guide, the needles 52a, 52b can penetrate the resilient diaphragm 55 on the bottom of the ink tank 50 so that ink can be supplied from the ink tank or returned to the ink tank. The resilient diaphragm 55 may be formed of rubber, for example, to provide sealing against ink leakage.

The engagement portion 54c of the grip 54 is pushed into the hole 50d in the upper wall 50e of the ink tank 50, and the grip fastening pin 56 is then inserted into the hole in the engagement portion 54c. Since the hole 54b in the engagement portion 54c is tapered as shown in Figure 10(b) prior to the engagement portion 54c being pushed into the hole 50d, the bulb-shaped body 54d of the engagement portion 54c is spread outwardly by pushing a pin 56 of a substantially uniform cross section into the hole 54b. Therefore, the engagement portion 54c is secured to the ink tank 50 to prevent it from being pulled off when the plate-shaped grip 54a is gripped and pulled up in order to remove the ink tank 50 from the tank guide. The grip fastening pin 56 has a vertical through aperture 56a effective in allowing air to escape out of the ink tank 50. With wire dot printers utilizing ink, the pump 90 has a greater ability to collect ink from the head than to supply ink to the head for stabilizing the printing quality. For this reason, ink and excess air are introduced into the ink tank 50. If the ink tank 50 were sealed off, the pressure within the ink tank 50 would be increased to the point where some damage could occur. The aperture 56a in the pin 56 for allowing air escape is thus required for preventing this shortcoming. The grip may have a ring shaped handle portion 57 as shown in Figure 12(a), a rod shaped handle portion 58 as shown in Figure 12(b), or any other simple configuration which provides an easy grip.

With the grip 54 mounted on the ink tank 50, the ink tank 50 can easily be removed simply by gripping and pulling up the grip 54 when desired. There is no need to change the dimensions of the contour of the ink tank 50 for such removal. The ink tank 50 can be removed with no space available around the ink tank. Where a plurality of such ink tanks are disposed in juxtaposed relation as illustrated in Figure 1, it would be quite difficult to hold the ink tanks themselves by hand, but they can readily be detached by gripping the grips described above. Since a plurality of inks having varying colours are utilized in multicolour printers, it is necessary that the colours of the inks in the ink tanks be identified when the ink tanks are to be inserted or replaced. To meet this requirement, the grips 54a, 54b, 54c are differently coloured in hues corresponding respectively

to the inks. By thus colouring the grips in the same colours as those of the inks, the colours used can be identified with the utmost ease. If the grips are made of rubber, they may be given any desired colour by mixing one or more pigments with the rubber. Accordingly, ink tank identification can be accomplished simply and inexpensively. Another advantage with the present invention is that it is easy to introduce ink into an ink tank. Before the grip 54 is mounted on the ink tank 50, the relatively large hole 50d remains open in the upper wall 50e of the ink tank 50, and the ink can be introduced into the ink tank through this hole 50d. After the tank 50 has been filled with ink, the grip 54 is attached and the grip fastening pin 56 is pushed in. Before the grip fastening pin 56 is pushed into the grip 54, the bulb-shaped body 54d of the engagement portion 54c of the grip 54 is easily deformable, so that the engagement portion 54c can easily be fitted into the ink tank 50 with no danger that any of the ink therein will be ejected from the ink tank.

In the wire dot printer described above, the inks Y, M, C are supplied from the independent ink tanks 54a, 54b, 54c through the respective tubes 40 to the ink supply and discharge guide 5 on the distal end of the print head 1. Excess inks are returned to the respective ink tanks. The print head of the said wire dot printer has a respective wire array for each of the different colours, the wire arrays constituting, in effect, independent print heads. Therefore, the fundamental colours Y, M, C can be simultaneously printed when the print head moves over a sheet of recording paper in a single stroke.

Figure 13 shows an arrangement of wire ends 14a at the distal end of the print head 1. The wire arrays 14Y, 14M, 14C have the same number of wires positioned at the same height. When the print head 1 is moved through a distance equal to a distance L between adjacent wire arrays, the print head 1 is controlled to print dots on the next wire array. This mode of operation allows any of the colours Y, M, C to be printed on any single point on the recording paper. By superimposing the colours Y and M, a dot can be printed in red. Similarly, dots can be printed in blue and green by superimposing the colours M and C, and Y and C, respectively. Further, a black dot can be printed by superimposing the colours Y, M, C. Accordingly, seven colours can be obtained simply by moving the print head over the recording paper in a single stroke.

Figure 14 shows another embodiment of a multicolour printing operation in which dots 17Y, 17M, 17C in the colours Y, M, C, respectively, are printed so as not to be superimposed, and three adjacent dots in the colours Y, M, C are regarded as a single picture element or pixel (18). With this arrangement, seven colours can be printed by suitably combining the dots in Y, M, C in the pixels. It is important for clear hue expression with this multicolour printing system that wires of small diameters be used for printing small dots to reduce the diameter of the pixels.

Where ink ribbons are employed, the small diameter wires tend to pierce through interstices in the ribbon fabric, resulting in damage to the ink ribbon. However, there is no such trouble experienced with a wire dot printer utilizing ink. The smaller wire diameter which can be used contributes to improved printing quality and is capable of easy hue expression with dot matrices.

Multicolour printers using ink ribbons are disadvantageous in that the ink density on the ribbon varies due to the differences between the frequency of use of the different colour areas on the ribbon, resulting in the printing of unbalanced colours. With wire dot printers utilizing inks, however, liquid inks are directly applied to the wire ends so that no change occurs in the colour density and hence the printed colours are balanced even after printing has been carried out for a long period of time.

A cleaning device for removing paper dust and ink deposited on the distal end of the print head will now be described.

As shown in Figure 13, the print head for multicolour printing has wire arrays 14Y, 14M, 14C containing equal numbers of wires and spaced at equal distances L. Figure 15 fragmentarily shows a printer having a cleaning device, and Figure 16 is a side elevational view of the printer shown in Figure 15. The print head 1 is reciprocated in the directions of the arrows by a drive mechanism (not shown) for printing on a sheet of recording paper (not shown) on a platen 23. A cleaning member 71 comprises an integral body having a stepped configuration as illustrated in Figure 15 and including cleaning portions 71a, 71b, 71c having centres spaced at a distance L equal to the distance L at which the wire arrays are spaced apart. The cleaning member 71 is rotatably mounted on a platen shaft 70 which is coaxial with the platen 23. The cleaning member 71 is made of a porous, water-absorbent, resilient spongy material such as a foamed polyvinyl formal resin. The density of minute holes in the cleaning member 71 is rendered progressively higher from the outer periphery toward the centre of the cleaning member 71 so that the water absorption capability becomes stronger toward the centre of the cleaning member 71. This enables inks to flow more easily toward the centre of the cleaning member 71 and tends to prevent inks from mixing at the outer periphery of the latter. The cleaning member 71 is of an integral construction and can be rotated independently of the motion of the platen 23 by a drive mechanism (not shown) which may comprise a motor, a solenoid, or the like.

As shown in Figure 16, the outer peripheral configuration of the cleaning member 71 comprises projections 72 which can be held in contact with a distal end 1a of the print head 1 and alternate recesses 73 which are at all times held out of engagement with the distal end 1a of the print head 1. The cleaning member 71 has a radius R at the projections 72, the radius R being slightly larger than the distance between the centre of the platen 23 and the distal end 1a of the print head 1 by

a distance which may range from 0.1 to 0.2 mm, for example. Thus, the distal end 1a of the print head 1 can be brought into complete contact with the cleaning member 71 at the projections 72. The cleaning member 71 is, however, always kept out of contact with the print head end 1a at the recesses 73.

The operation of the cleaning device thus constructed will now be described. After the print head 1 has printed desired characters and symbols while reciprocating in the directions of the arrows of Figure 15, the print head 1 returns to and stops in its home position in which the cleaning portions 71a, 71b, 71c face the wire arrays 14Y, 14M, 14C, respectively. At this time, the cleaning member 71 is stopped with one of the recesses 73 facing the distal end 1a of the print head 1 as illustrated in Figure 16. Then the cleaning member 71 is rotated by its drive mechanism (not shown) to cause one of the projections 72 to wipe the print head end 1a so as to remove paper dust, ink and other foreign matter. When the next recess 73 faces the print head end 1a, the rotation of the cleaning member 71 is brought to an end, and the print head 1 is actuated for a next cycle of the printing operation.

By thus wiping the print head end 1a with the rotating cleaning member 71 while the cleaning portions 71a, 71b, 71c face the wire arrays 14Y, 14M, 14C, respectively, the portions of the print head end 1a respectively for the different inks can be cleaned independently, so that no ink mixture will take place on the print head.

Figure 17 is a side elevational view of another embodiment of a cleaning member which may be used in the wire dot printer of the present invention, and Figure 18 is a cross-sectional view of the cleaning member of Figure 17 as mounted on a platen shaft. In the embodiment of Figures 17 and 18, a cleaning member 74 includes three cleaning portions 74a, 74b, 74c corresponding to the three ink colours used. The outer peripheral shape of the cleaning member 74 is the same as that of the cleaning member 71 illustrated in Figure 16. However, as shown in Figure 17, the cleaning member 74 is divided into two cleaning member pieces 74-1, 74-2 having attachment holes 75. As shown in Figure 18, the cleaning member 74 is rotatably mounted coaxially on the platen shaft 70. For this purpose, the cleaning member 74 is secured to an attachment plate 78 by attachment pins 76 which pass through the attachment holes 75, the attachment plate 78 being rotatably mounted on the platen shaft 70. The cleaning portions 74a, 74b, 74c are divided by partitions 77 so as to prevent ink mixture between the cleaning portions. Since the cleaning member 74 is divided into the cleaning member pieces 74-1, 74-2, it can easily be attached to and detached from the attachment plate 78 for replacement when the cleaning member 74 is smeared with ink or is damaged or worn out. The use of the partitions 77 helps to prevent inks from being mixed together between the cleaning portions.

Figure 19 illustrates yet another embodiment of a cleaning member which may be used in a wire

dot printer according to the present invention. Although the cleaning member 79 shown in Figure 19 has the same outer peripheral shape as those of the cleaning members of the previous embodiments, it is mounted on a frame 80 out of axial alignment with the platen 70 and independently thereof so that its axial position may be adjusted. The cleaning member 79 is rotatable in the directions of the arrows. With this arrangement, the distance between the cleaning member 79, and the distal end 1a of the print head 1 can easily be adjusted, and the cleaning member 79 can be removed from or attached to the printer more simply for easy replacement without requiring the removal or attachment of other parts.

The cleaning member 79 may be of an integral construction with grooves between adjacent cleaning portions as shown in Figure 15, or may have as many cleaning portions as there are colours to be printed with partitions interposed therebetween.

Figure 20 is a timing chart showing operation of the cleaning device. With reference to the embodiment of Figure 15, the sheet of recording paper is fed along by each paper feed signal, and the print head 1 is moved in one direction of reciprocation at each carriage feed signal. After the print head 1 has returned to the home position, the cleaning member is rotated by a cleaning signal to clean the distal end 1a of the print head 1.

It is not necessary to clean the distal end 1a of the print head 1 each time a line is printed on the recording paper. A single cleaning operation suffices each time a single page of recording paper has been printed. Assuming that a single page contains n lines, a single cleaning signal is issued for cleaning the print head for n-time productions of a paper feed signal and of a carriage feed signal issued subsequently to the paper feed signal. The cleaning member 71 can thus have a longer service life than would otherwise be possible, and stable printing operation for a prolonged period of time is ensured.

The cleaning signal can also be generated by manual operation. As long as the print head 1 is stopped in the home position with the cleaning portions 71a, 71b, 71c facing the wire arrays 14Y, 14M, 14c, respectively, a cleaning signal can be issued as desired to rotate the cleaning member 71 for cleaning the distal end 1a of the print head 1.

While in the foregoing embodiments the wire arrays on the print head are held opposite to the cleaning portions when the print head is in the home position, the home position may not necessarily be aligned with the cleaning member. Instead, the print head may be moved to bring its wire arrays opposite to the cleaning portions of the cleaning member in response to a cleaning signal, and after the print head has come to a stop, the cleaning member may be rotated for the cleaning operation.

Although certain preferred embodiments have been shown and described, it should be under-

stood that many changes and modifications may be made therein without departing from the scope of the appended claims.

Claims

1. A wire dot printer comprising a print head (1) which carries a plurality of printing wires (14) and fluid ink application means (5-7) for applying fluid ink to printing end faces (14a) of the printing wires (14), characterised in that, for the purpose of using a plurality of differently coloured fluid inks to effect multicolour printing, the print head has a plurality of said fluid ink application means (5-7), the printing wires (14) being arranged in a plurality of separate groups (14C, 14M, 14Y) each group of which is housed in a respective fluid ink application means (5-7) so as to be adapted to be supplied thereby with fluid ink of a colour which differs from that supplied to any other group.

2. A wire dot printer according to claim 1 characterised in that each of said groups of wires (14C, 14M, 14Y) is arranged in a row at the distal end of the print head (1).

3. A wire dot printer according to claim 1 or 2 characterised by a guide block (4) having a plurality of separate compartments (4b) extending longitudinally of said printing wires (14) and divided by partitions (4a), said groups of wires (14C, 14M, 14Y) being respectively disposed in said compartments (4b).

4. A wire dot printer according to any preceding claim characterised in that each fluid ink application means (5-7) is arranged to be supplied with fluid ink from a respective ink tube (40), the print head (1) being mounted on a carriage (20) on which there is slidably mounted a tube connector (13) which is coupled to said ink tubes (40), each fluid ink application means comprising an ink supply guide (5) which is connected to said tube connector (13) and which is arranged to supply fluid ink to the printing end faces (14a) of the respective group of wires.

5. A wire dot printer according to claim 4 characterised in that said tube connector (13) is connected to said print head (1) through O-rings (12).

6. A wire dot printer according to any preceding claim characterised by a cleaning member (71) which has projections (71a, 71b, 71c) engageable with the distal end of said print head (1), said projections (71a, 71b, 71c) alternating with recesses which are kept out of contact with said distal end of the print head (1), said cleaning member (71) being rotatable for cleaning said distal end of the print head (1).

7. A wire dot printer according to claim 6 characterised in that said cleaning member (74) is composed of as many cleaning portions (74a, 74b, 74c) as there are colours of inks, partitions (77) being interposed between said cleaning portions (74a, 74b, 74c).

8. A wire dot printer according to claim 6 or 7 characterised in that said cleaning member (74) comprises separate cleaning member pieces (74-

dot printer according to the present invention. Although the cleaning member 79 shown in Figure 19 has the same outer peripheral shape as those of the cleaning members of the previous embodiments, it is mounted on a frame 80 out of axial alignment with the platen 70 and independently thereof so that its axial position may be adjusted. The cleaning member 79 is rotatable in the directions of the arrows. With this arrangement, the distance between the cleaning member 79, and the distal end 1a of the print head 1 can easily be adjusted, and the cleaning member 79 can be removed from or attached to the printer more simply for easy replacement without requiring the removal or attachment of other parts.

The cleaning member 79 may be of an integral construction with grooves between adjacent cleaning portions as shown in Figure 15, or may have as many cleaning portions as there are colours to be printed with partitions interposed therebetween.

Figure 20 is a timing chart showing operation of the cleaning device. With reference to the embodiment of Figure 15, the sheet of recording paper is fed along by each paper feed signal, and the print head 1 is moved in one direction of reciprocation at each carriage feed signal. After the print head 1 has returned to the home position, the cleaning member is rotated by a cleaning signal to clean the distal end 1a of the print head 1.

It is not necessary to clean the distal end 1a of the print head 1 each time a line is printed on the recording paper. A single cleaning operation suffices each time a single page of recording paper has been printed. Assuming that a single page contains n lines, a single cleaning signal is issued for cleaning the print head for n-time productions of a paper feed signal and of a carriage feed signal issued subsequently to the paper feed signal. The cleaning member 71 can thus have a longer service life than would otherwise be possible, and stable printing operation for a prolonged period of time is ensured.

The cleaning signal can also be generated by manual operation. As long as the print head 1 is stopped in the home position with the cleaning portions 71a, 71b, 71c facing the wire arrays 14Y, 14M, 14c, respectively, a cleaning signal can be issued as desired to rotate the cleaning member 71 for cleaning the distal end 1a of the print head 1.

While in the foregoing embodiments the wire arrays on the print head are held opposite to the cleaning portions when the print head is in the home position, the home position may not necessarily be aligned with the cleaning member. Instead, the print head may be moved to bring its wire arrays opposite to the cleaning portions of the cleaning member in response to a cleaning signal, and after the print head has come to a stop, the cleaning member may be rotated for the cleaning operation.

Although certain preferred embodiments have been shown and described, it should be under-

stood that many changes and modifications may be made therein without departing from the scope of the appended claims.

5 Claims

1. A wire dot printer comprising a print head (1) which carries a plurality of printing wires (14) and fluid ink application means (5-7) for applying fluid ink to printing end faces (14a) of the printing wires (14), characterised in that, for the purpose of using a plurality of differently coloured fluid inks to effect multicolour printing, the print head has a plurality of said fluid ink application means (5-7), the printing wires (14) being arranged in a plurality of separate groups (14C, 14M, 14Y) each group of which is housed in a respective fluid ink application means (5-7) so as to be adapted to be supplied thereby with fluid ink of a colour which differs from that supplied to any other group.

2. A wire dot printer according to claim 1 characterised in that each of said groups of wires (14C, 14M, 14Y) is arranged in a row at the distal end of the print head (1).

3. A wire dot printer according to claim 1 or 2 characterised by a guide block (4) having a plurality of separate compartments (4b) extending longitudinally of said printing wires (14) and divided by partitions (4a), said groups of wires (14C, 14M, 14Y) being respectively disposed in said compartments (4b).

4. A wire dot printer according to any preceding claim characterised in that each fluid ink application means (5-7) is arranged to be supplied with fluid ink from a respective ink tube (40), the print head (1) being mounted on a carriage (20) on which there is slidably mounted a tube connector (13) which is coupled to said ink tubes (40), each fluid ink application means comprising an ink supply guide (5) which is connected to said tube connector (13) and which is arranged to supply fluid ink to the printing end faces (14a) of the respective group of wires.

5. A wire dot printer according to claim 4 characterised in that said tube connector (13) is connected to said print head (1) through O-rings (12).

6. A wire dot printer according to any preceding claim characterised by a cleaning member (71) which has projections (71a, 71b, 71c) engageable with the distal end of said print head (1), said projections (71a, 71b, 71c) alternating with recesses which are kept out of contact with said distal end of the print head (1), said cleaning member (71) being rotatable for cleaning said distal end of the print head (1).

7. A wire dot printer according to claim 6 characterised in that said cleaning member (74) is composed of as many cleaning portions (74a, 74b, 74c) as there are colours of inks, partitions (77) being interposed between said cleaning portions (74a, 74b, 74c).

8. A wire dot printer according to claim 6 or 7 characterised in that said cleaning member (74) comprises separate cleaning member pieces (74-



1, 74-2) which may be readily attached and removed.

9. A wire dot printer according to any of claims 6 to 8 characterised by a platen (23) having a platen shaft (70) and disposed opposite to said print head (1), said cleaning member (71) being mounted coaxially on said platen shaft (70).

10. A wire dot printer according to any of claims 6 to 8 characterised by a platen (23) having a platen shaft (70) and disposed opposite to said print head (1), said cleaning member (79) being mounted out of coaxial relationship with and independently of said platen shaft (70).

Patentansprüche

1. Nadeldrucker mit einem Druckkopf (1), der eine Vielzahl von Drucknadeln (14) trägt, und einer Flüssigdruckfarbenaufbringungseinrichtung (5-7) zum Aufbringen von Flüssigdruckfarbe auf die Druckstirflächen (14a) der Drucknadeln (14), dadurch gekennzeichnet, daß der Druckkopf zum Zweck der Verwendung einer Vielzahl von verschiedenfarbigen Flüssigdruckfarben, um ein Mehrfarbenducken zu bewirken, eine Vielzahl von besagten Flüssigdruckfarbenaufbringungseinrichtungen (5-7) aufweist, wobei die Drucknadeln (14) in einer Vielzahl von getrennten Gruppen (14C, 14M, 14Y) angeordnet sind, von denen jede in einer jeweiligen Flüssigdruckfarbenaufbringungseinrichtung (5-7) untergebracht ist, so daß sie dadurch mit einer Flüssigdruckfarbe versorgt werden kann, deren Farbe sich von derjenigen Druckfarbe unterscheidet, die einer anderen Gruppe geliefert wird.

2. Nadeldrucker nach Anspruch 1, dadurch gekennzeichnet, daß jede der Gruppen von Nadeln (14C, 14M, 14Y) in einer Reihe am äußeren Ende des Druckkopfes (1) angeordnet ist.

3. Nadeldrucker nach Anspruch 1 oder 2 gekennzeichnet durch einen Führungsblock (4) mit einer Vielzahl von getrennten Abteilen (4b), die längs der Drucknadeln (14) verlaufen und durch Trennwände (4a) unterteilt sind, wobei die Gruppen von Nadeln (14C, 14M, 14Y) jeweils in den Abteilen (4b) angeordnet sind.

4. Nadeldrucker nach einem der vorhergehenden Ansprüche dadurch gekennzeichnet, daß jede Fluidruckfarbenaufbringungseinrichtung (5-7) so angeordnet ist, daß sie mit Flüssigdruckfarbe von einem jeweiligen Druckfarbenrohr (40) versorgt werden kann, der Druckkopf (1) an einem Schlitten (20) angebracht ist, an dem gleitend verschiebbar ein Rohrverbindungsstück (13) angebracht ist, das mit den Druckfarbenrohren (40) gekoppelt ist, jede Flüssigdruckfarbenaufbringungseinrichtung eine Druckfarbenversorgungsführung (5) umfaßt, die mit dem Rohrverbindungsstück (13) verbunden und so angeordnet ist, daß sie Flüssigdruckfarbe den Druckstirflächen (14a) der jeweiligen Gruppe von Nadeln liefert.

5. Nadeldrucker nach Anspruch 4, dadurch gekennzeichnet, daß das Rohrverbindungsstück (13) über O-Ringe (12) mit dem Druckkopf (1) verbunden ist.

6. Nadeldrucker nach einem der vorhergehenden Ansprüche gekennzeichnet durch ein Reinigungselement (71), das Vorsprünge (71a, 71b, 71c) aufweist, die mit dem äußeren Ende des Druckkopfes (1) in Eingriff kommen können, wobei sich die Vorsprünge (71a, 71b, 71c) mit Aussparungen abwechseln, die außer Kontakt mit dem äußeren Ende des Druckkopfes (1) gehalten werden, und das Reinigungselement (71) zum Reinigen des äußeren Endes des Druckkopfes (1) drehbar ist.

7. Nadeldrucker nach Anspruch 6, dadurch gekennzeichnet, daß das Reinigungselement (74) aus der gleichen Anzahl von Reinigungsteilen (74a, 74b, 74c) besteht, wie verschiedenfarbige Druckfarben vorgesehen sind, wobei zwischen den Reinigungsteilen (74a, 74b, 74c) Trennwände angeordnet sind.

8. Nadeldrucker nach Anspruch 6 oder 7, dadurch gekennzeichnet, daß das Reinigungselement (74) getrennte Reinigungselementteile (74-1, 74-2) umfaßt, die leicht angebracht und abgenommen werden können.

9. Nadeldrucker nach einem der Ansprüche 6 bis 8, gekennzeichnet durch eine Druckwalze (23) mit einer Walzenachse (70), die dem Druckkopf (1) gegenüber angeordnet ist, wobei das Reinigungselement (71) koaxial auf der Walzenachse (70) angebracht ist.

10. Nadeldrucker nach einem der Ansprüche 6 bis 8, gekennzeichnet durch eine Druckwalze (23) mit einer Walzenachse (70), die dem Druckkopf (1) gegenüber angeordnet ist, wobei das Reinigungselement (79) nicht koaxial zur Walzenachse (70) und unabhängig von der Walzenachse (70) angebracht ist.

Revendications

1. Imprimante par points à aiguilles comprenant une tête d'impression (1) qui porte plusieurs aiguilles (14) d'impression et un dispositif (5-7) d'application d'une encre fluide destiné à appliquer une encre fluide à des faces (14a) d'extrémité d'impression des aiguilles d'impression (14), caractérisée en ce que, pour l'utilisation de plusieurs encres fluides de couleurs différentes destinées à assurer une impression en plusieurs couleurs, la tête d'impression a plusieurs dispositifs (5-7) d'application d'encre fluide, les aiguilles d'impression (14) étant disposées en plusieurs groupes séparés (14C, 14M, 14Y), chaque groupe d'aiguilles étant logé dans un dispositif respectif (5-7) d'application d'une encre fluide afin qu'il soit adapté à recevoir ainsi une encre fluide d'une couleur qui est différente de celle des encres transmises à un autre groupe.

2. Imprimante par points à aiguilles selon la revendication 1, caractérisée en ce que chacun des groupes d'aiguilles (14C, 14M, 14Y) est disposé en ligne à l'extrémité externe de la tête d'impression (1).

3. Imprimante par points à aiguilles selon l'une des revendications 1 et 2, caractérisée par un bloc (4) de guidage ayant plusieurs compartiments séparés (4b) disposés suivant la longueur des



aiguilles d'impression (14) et séparés par des cloisons (4a), les groupes d'aiguilles (14C, 14M, 14Y) étant disposés respectivement dans les compartiments (4b).

4. Imprimante par points à aiguilles selon l'une quelconque des revendications précédentes, caractérisée en ce que chaque dispositif (5-7) d'application d'une encre fluide est disposé de manière qu'il reçoive une encre fluide d'un tube respectif (40) d'encre, la tête d'impression (1) étant montée sur un chariot (20) sur lequel un connecteur (13) de tubes est monté afin qu'il puisse coulisser, le connecteur étant couplé aux tubes (40) d'encres, chaque dispositif d'application d'une encre fluide comprenant un guide (5) d'alimentation en encre qui est raccordé au connecteur (13) de tubes et qui est destiné à transmettre une encre fluide aux faces (14a) d'extrémité d'impression des groupes respectifs d'aiguilles.

5. Imprimante par points à aiguilles selon la revendication 4, caractérisée en ce que le connecteur (13) de tubes est connecté à la tête d'impression (1) par des joints toriques (12).

6. Imprimante par points à aiguilles selon l'une quelconque des revendications précédentes, caractérisée par un organe de nettoyage (71) qui a des saillies (71a, 71b, 71c) qui peuvent venir au contact de l'extrémité externe de la tête d'impression (1), les saillies (71a, 71b, 71c) étant placées en alternance avec des cavités qui sont mainte-

nues à distance de l'extrémité externe de la tête d'impression (1), l'organe de nettoyage (71) pouvant tourner afin qu'il nettoie l'extrémité externe de la tête d'impression (1).

7. Imprimante par points à aiguilles selon la revendication 6, caractérisée en ce que l'organe d'impression (74) est composé d'autant de parties de nettoyage (74a, 74b, 74c) qu'il y a de couleurs d'encres, des cloisons (77) étant placées entre les parties de nettoyage (74a, 74b, 74c).

8. Imprimante par points à aiguilles selon l'une des revendications 6 et 7, caractérisée en ce que l'organe de nettoyage (74) comporte des morceaux séparés (74-1, 74-2) d'organe de nettoyage qui peuvent être facilement mis en place et retirés.

9. Imprimante par points à aiguilles selon l'une quelconque des revendications 6 à 8, caractérisée par un support d'impression (23) sous forme d'un rouleau ayant un arbre (70), disposé en face de la tête d'impression (1), l'organe de nettoyage (71) étant monté coaxialement sur l'arbre (70) du support d'impression.

10. Imprimante par points à aiguilles selon l'une quelconque des revendications 6 à 8, caractérisée par un support d'impression (23) sous forme d'un rouleau ayant un arbre (70) disposé en face de la tête d'impression (1), l'organe de nettoyage (79) étant monté sans être coaxial à l'arbre (70) et étant monté indépendamment de cet arbre.

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