

Ink Jet Recording Apparatus

The present invention relates to an ink jet printer. Moreover, the printer has a plurality of ink jet recording heads moving in the width direction of a recording sheet and ejects ink of a plurality of colors in accordance with printing data to print a color image. The ink jet recording apparatus also has the plurality of ink jet recording heads mounted on the same carriage so as to realize high density printing. More particularly, the present invention relates to a capping device which seals an ink jet recording head suitable for such a recording apparatus.

An on-demand ink jet recording apparatus ejects ink pressurized in a pressurizing chamber from a nozzle as ink drops to a recording sheet, to record printing data on the sheet. Such an apparatus has a problem in that a printing failure is caused by an increased viscosity due to evaporation of an ink solvent through nozzle openings, the drying of ink, adhesion of dust, introduction of air bubbles, etc. To comply with this, an ink jet recording apparatus is provided with a capping device which seals nozzle openings during a nonprinting period.

Such a capping device is proposed in, for example, Unexamined Japanese Patent Publication No. HEI 1-125239. In the proposed capping device, a slider is pushed

REPLACED SHEETS		NO
☒	Description : paged 1 to paged 28	28
☒	Figure(s) : paged 28 to paged 29	29
☒	Drawing(s) : paged 47 to paged 17/17	17/17
☒	Abstract : paged 70 to paged -	-
DATE OF RECEIPT		

This Sheet Has Been Replaced



by a carriage returning toward the home position, to be moved toward a nozzle face of a recording head along an inclined guide face which is formed on a frame, and a cap member disposed on the surface of the slider is made pressingly contact with the recording head, thereby sealing nozzles.

Since development of personal computers allows graphic processing to be executed in a relatively simple manner, a printer which can output a hard copy of a color image displayed on a screen is requested. In view of differences in ink consumption and recording density between colors, and also the prevention of discoloration during a quiescent time, an ink jet printer which can conduct such a color printing is so configured that two recording heads, i.e., a recording head for black and white printing and a recording head for color printing are mounted on a carriage.

Consequently, a capping device must be disposed for each of plural ink jet recording heads, and driving mechanisms for respectively moving the capping devices so as to make contact with and separate from the recording heads are required. This produces a problem in that the whole structure of the printer is complicated.

The invention has been conducted in view of these problems. It is an object of the invention to provide a novel _____

This Sheet Has Been Replaced



ink jet recording apparatus in which the operation of moving plural capping devices so as to make contact with and separate from recording heads can be realized by a simple mechanism.

In order to solve the problems, according to the invention, an ink jet recording apparatus comprises: a carriage on which first and second ink jet recording heads each having nozzle openings are mounted; and a slider having first and second cap members which seal the nozzle openings of the first and second ink jet recording heads, respectively, the slider being supported at a center portion in a longitudinal direction by a support member which is rotatable about a rotation shaft elongating in a direction perpendicular to a moving direction of the carriage and which is movable in the moving direction of the carriage, the support member being movable also in a direction opposing the recording heads in accordance with the movement of the slider.

When the carriage is moved under the state where it abuts against the slider, the slider swings about the shaft in a manner similar to a seesaw so that the slider butts against one of the recording heads and then the other recording head. Therefore, two cap members on the same slider can surely be attached to the respective recording heads. Furthermore, the two cap members are moved by moving the single slider in the manner interlocked with the movement of the carriage, and hence the attaching and detaching mechanism for the cap members can be simplified in structure.

This Sheet Has Been Replaced



Fig. 1 is a perspective view showing the structure of the vicinity of a printing mechanism of an ink jet recording apparatus to which the capping device of the invention is to be applied;

Fig. 2 is a plan view in which the capping device is shown at the center;

Fig. 3 is a plan view showing an embodiment of the capping device;

Fig. 4 is a front view showing the embodiment of the capping device in the state where the capping device butts against recording heads;

Fig. 5 is a diagram showing the state where a sheet feed and pump motor is coupled with a tube pump;

Fig. 6 is a diagram showing the structure of a longitudinal section of the tube pump;

Fig. 7 is a diagram showing the structure of a cross section of the tube pump;

Figs. 8 (a) and (b) are diagrams showing the shape of slots formed in a driving wheel constituting a tube pump which is a first tube pump;

Fig. 9 is a diagram showing the state where a carriage is moved to a position where recording heads oppose respective cap members;

This Sheet Has Been Replaced



Fig. 10 is a diagram showing the state where the carriage is moved to a position where one of the recording heads butts against one of the cap members;

Fig. 11 is a diagram showing the state where the carriage is moved to a position where the two recording heads butt against the two cap members;

Fig. 12 is a diagram showing the state where the carriage is moved to a suction enabled position;

Figs. 13(a) and 13(b) are diagrams respectively showing the states of first and second tube pumps in the case where the sheet feed and pump motor is reversely rotated;

Figs. 14(a) and 14(b) are diagrams respectively showing the states of second and first tube pumps in the case where the sheet feed and pump motor is forward rotated;

Figs. 15(a) and 15(b) are diagrams respectively showing the states of second and first tube pumps in the case where the sheet feed and pump motor is stopped;

Fig. 16 is a section view showing another embodiment of the tube pump;

Figs. 17 (a) and (b) are diagrams illustrating the operation of the tube pump of Fig. 16;

Fig. 18 is a chart illustrating the process in a low suction mode;

Fig. 19 is a chart illustrating the rotation directions of a pulse motor and a pump motor in a low suction mode.

This Sheet Has Been Replaced



The invention will be described in detail in conjunction with illustrated embodiments.

Fig. 1 shows diagrammatically the vicinity of a printing mechanism of an ink jet recording apparatus to which the capping device of the invention is to be applied. In the figure, the reference numeral 1 designates a carriage which is supported by a guide member 2 and coupled with a pulse motor 23 through a timing belt 3 so as to be reciprocally movable in a direction parallel to a platen 5.

A first recording head 7 for black and white printing, and a second recording head 8 for color printing (Fig. 4) are mounted on the carriage 1 in such a manner that nozzle openings are directed to a recording sheet 6. A black ink cartridge 9, and a color ink cartridge 10 are detachably mounted in the upper portions of the recording heads 7 and 8, respectively.

When the recording heads in this configuration receive a drive signal from a head driving circuit (not shown) through a flexible cable 11, ink flows out the ink cartridges 9 and 10 to enter into the recording heads 7 and 8 so that black and colored dots are formed on the recording sheet 6.

Fig. 2 is a diagram showing an upper face in the vicinity of the capping device. In the figure, the reference numeral 20 designates a sheet feed roller. The sheet feed roller 20 is coupled with a sheet feed and pump motor 24 by a gear 22 which is fixed to one end of a rotation shaft 21, to

This Sheet Has Been Replaced



feed the recording sheet 6 in synchronization with the printing process.

In the figure, the reference numeral 12 designates the above-mentioned capping device which is disposed in the moving path of the carriage 1 outside the printing region. First and second cap members 31 and 32 which are made of an elastic material and have a cup-like shape are disposed on a slider 30. The slider 30 is located in the manner interlocked with the movement of the carriage, at either of two positions, i.e., a capping position where the capping device covers the faces of the two recording heads 7 and 8 on which nozzles are opened (hereinafter, such a face is referred to as "nozzle opening face"), and a noncapping position where the capping device is separated from the nozzle opening faces. In the cap members 31 and 32, the opening area is selected in accordance with the sizes of the respective first and second recording heads 7 and 8.

The first and second cap members 31 and 32 respectively have suction ports 31a and 32a which are connected to ends of tubes 33 and 34 constituting parts of first and second tube pumps 37 and 38 which will be described later, so as to be subjected to suction forces produced by the tube pumps 37 and 38. The first and second tube pumps 37 and 38 are selectively driven by the sheet feed and pump motor 24 through a wheel train 40 to conduct a suction operation. More specifically, when the motor 24 is forward rotated, only the first tube pump

This Sheet Has Been Replaced



37 conducts a suction operation, and, when the motor 24 is reversely rotated, only the second tube pump 38 conducts a suction operation.

Figs. 3 and 4 show an embodiment of the above-described capping unit. In the figures, the reference numeral 30 designates the slider which is disposed in such a manner that the first and second cap members 31 and 32 are swingable about shafts 31c and 32c in agreement with the distance between the two recording heads 7 and 8 mounted on the carriage 1. In the figures, the reference numerals 41 and 42 designate first and second guide pieces each of which consists of two subpieces that are disposed in the both sides of the first and second recording heads 7 and 8 mounted on the carriage 1, so as to correspond to the widths of the heads. The first and second guide pieces are separated from each other by a distance so that, when the carriage 1 is set at a predetermined position, they oppose the recording heads 7 and 8, respectively. At one end portion of the slider 30 (the right end portion in the figure), formed is a flagpiece 45 which butts against a projection 44 protruding from the lower end of the carriage 1 when the carriage 1 is located at the position where the first and second cap members 31 and 32 exactly oppose the respective first and second recording heads 7 and 8. An engaging piece 46 is disposed at a position which is closer to the tip end than the flagpiece 45, so as to make contact with and separate from a guide member 47 fixed to a base.



The guide member 47 comprises a projection 47a which prevents the slider 30 from being slipped off, and a slant face 47b elongating between two positions. Usually, the slider 1 is located at one of the positions so as to be separated from the lower ends of the recording heads 7 and 8 by a given distance. In a capping period, the slider 1 is located at the other position where the cap members 31 and 32 are made resiliently contact with the recording heads 7 and 8.

A shaft 50 elongating in a direction perpendicular to the moving direction of the carriage 1 is disposed at the center of the lower portion of the slider 30. The both ends of the shaft 50 are loosely fitted into a lever 52. The lower end of the lever is swingably attached to a shaft 54 of the base 53 through a slot 52a. An upper end of a coil spring 56 which is slightly buckling toward the nonprinting region is attached to the slider 30. The lower end of the coil spring 56 is fixed to the base 53, and inclined toward the printing region.

According to this configuration, during a noncapping period, the slider 30 is urged toward the printing region by the coil spring 56 while one end of the slider is restricted by the lowest end of the slant face 47b of the guide member 47, and the center portion by the lever 52, so as to be horizontally positioned at a height where a gap g is formed in a degree sufficient for separating the recording heads 7 and 8 from the respective cap members 31 and 32.



The slider 30 has a valve unit 60 disposed at a position in the side of a case 61. The valve unit 60 is communicated with air release ports 31b and 32b formed in the respective cap members 31 and 32. An operation rod 62 protrudes from the valve unit 60. When the slider 30 is moved to the capping position and the operation rod 62 butts against the case 61, the operation rod 62 is pressed toward the printing region so that the air release ports 31b and 32b are closed by the valve unit 60.

Figs. 5, 6 and 7 shows an embodiment of the above-mentioned pump units. A driving wheel 72 of the one pump 37 can be coupled with the sheet feed and pump motor 24 through a wheel train 70. The pump tubes 33 and 34 through which the cap members 31 and 32 are communicated with a waste ink tank 14 are covered by cover cases 73 and 74, respectively, so that the outer side of each tube is formed into a substantially circular shape. Each of the pump tubes 33 and 34 can be resiliently pressed by two rollers 85 and 85 or 86 and 86 which are movably loosely fitted into slots formed in a train of driving wheels 72, 81, 82 and 83 which are fixed to the both ends of rotation shafts 77 and 78. The rotation shaft 77 and 78 are coupled with each other through a connecting member 76. The slots will be described later in detail.

Figs. 8(a) and 8(b) show an embodiment of the above-mentioned guide slots 90 which are formed in the driving wheels supporting the rollers 85 and 86. The guide slots 90



are formed as slots each of which elongates in such a manner that the distance between the slot and the center of the respective driving wheel is gradually changed. When the sheet feed and pump motor 24 is reversely rotated (arrow A), the shafts 85a of the rollers 85 are moved along the respective slots 90 toward the outer periphery. This causes the rollers 85 to be rotated while making pressingly contact with the tube 33, thereby generating a suction force. When the motor 24 is forward rotated (arrow B), the shafts 85a of are moved toward the center and the rollers 85 are separated from the tube 33 so that the pump operation is extinguished.

The second tube pump 38 is configured so as to operate in a manner opposite to the first tube pump 37. Specifically, when the motor 24 is reversely rotated, the rollers 86 are moved toward the center so that the pump operation is extinguished, and, when the motor 24 is forward rotated, the rollers 86 are moved toward the outer periphery so as to be rotated while making pressingly contact with the tube 34, thereby generating a suction force.

In this way, the pump which is to generate a suction force can be selected by switching the rotation direction of the motor 24. In the figure, the reference numeral 92 designates a roller pressing piece which is made of an elastic material such as rubber. When the driving wheel 72 is rotated, the roller pressing piece 92 resiliently presses the rollers 85 so that the rollers 85 are forcedly moved along the respective



slots 90 to the position corresponding to the rotation direction of the motor. The roller pressing piece 92 has an advantage for absorbing a snap sound when the roller is separated from the tube.

Figs. 16 and 17 show another embodiment of the above-mentioned pump units 13. In the figures, only the pump unit which communicates with one of the cap members is shown. As shown in the figures, a part of a tube 67 is bent with a large radius of curvature so as to be formed into an α -like shape. The loop portion is inserted into a cover case 111 while the crossing portions are passed through a tube insertion hole 110, in such a manner that the resilience of the tube causes the loop portion to make one turn while running along an inner wall face 111a of a pump chamber 120. The tube 67 is resiliently pressed by a roller 116 which is movably loosely fitted into a guide slot 115 of a driving wheel train 114 fixed to a rotation shaft 113. A fixing bush 117 is provided at the crossing portions so that the tube 67 is prevented from slipping off the tube insertion hole 110.

Figs. 17(a) and 17(b) are diagrams illustrating the pump unit shown in Fig. 16 in which portions unnecessary in the description are not shown. The guide slot 115 is formed in the driving wheel train 114 as a slot which elongates in such a manner that the distance between the slot and the center is gradually changed.

This Sheet Has Been Replaced



When a power exerted by a driving motor which is not shown is transmitted to the tube pump through the driving wheel train 114 so that the tube pump is moved in the direction of an arrow in Fig. 17(a), this movement causes the shaft 116a of the roller 116 to be moved along the guide slot 115 toward the outer periphery, whereby the roller 116 is rotated while making pressingly contact with the tube 67 to generate a suction force. When the pump is rotated in the direction of an arrow shown in Fig. 17(b), the shaft 116a is moved toward the center and the roller 116 is separated from the tube 67 so that the pump function is extinguished. In the tube pump, the tube pump has the configuration in which the roller 116 makes pressingly contact also with portions 67a and 67b of the tube 67 in the crossing portions, and therefore a continuous pumping operation can be conducted by the sole roller. In this embodiment, the snap sound which is made when the roller is separated from the tube can be reduced in level by a noise reduction effect achieved by the tube arranged along the inner wall face 111a of the pump chamber 120. Since a part of a tube is looped so as to form an α -like shape with a small curvature, a tube can be routed without requiring a large curvature even in the case of a small-sized tube pump. This enables a tube of a relatively large diameter to be used, and both suction and discharge tubes to be linearly elongated. A friction force generated at the crossing portions can surely prevent the tube from being fed out by tube pressing means.



The tube pump in the embodiment is coupled with a tube pump which is configured so as to symmetrically operate in the same manner as the foregoing embodiment, at 113a of the rotation shaft 113 through a connecting member which is not shown. This enables the single driving source to selectively drive capping means to conduct suction.

Next, the operation of the apparatus configured as described above will be described.

As shown in Fig. 2, when the carriage 1 on which the two recording heads 7 and 8 are mounted is moved in a direction indicated by an arrow C in Fig. 9, a lever 102 which can be rotated in the direction of an arrow 101 about a shaft 100 disposed at the lower portion of the carriage 1 is made contact with a slant face 103 to be rotated. This rotation causes a slide gear 104 to be moved against the resilience of a spring 105 so that the power exerted by the sheet feed and pump motor 24 is transmitted to the pump units 13. The carriage 1 then reaches the slider 30 located outside the printing region, and then the first recording head 7 engages with the second guide 42 disposed on the slider 30. When the carriage 1 is further moved under this state, the first recording head 7 engages with the first guide 41, and the second recording head 8 with the second guide 42, whereby the slider 30 is aligned so as to take a posture corresponding to the carriage 1. When the carriage 1 is further moved under this state, the projection piece 44 disposed at the front end of the carriage 1 butts against the



flagpiece 45 of the slider 30, resulting in that the first and second cap members 31 and 32 of the slider 30 oppose the respective first and second recording heads 7 and 8 of the carriage 1 with being separated therefrom by the fixed gap g, and at positions where the cap members can accommodate the respective recording heads 7 and 8.

When the carriage 1 is further moved under this state, the carriage 1 applies a force to the flagpiece 45 of the slider 30 via the projection 44 of the carriage 1, and the lever 52 which is subjected to the urging force of the coil spring 56 that is slightly buckling at its upper portion in the moving direction of the carriage 1 applies a resistance force to the slider 30. Therefore, the slider 30 inclines forward so that a force is exerted to lift up the rear end of the slider 30 as indicted by an arrow D in Fig. 10.

As a result, the rear portion of the slider 30 is lifted up while the shaft 50 functions as the rotation fulcrum, so that the second cap member 32 which is located at a more rearward position than the shaft 50 (in the side of the printing region) first butts against the second recording head 8. At this time, since the cap member 32 is attached to the slider 30 in a slightly swingable manner and the slider 30 is swingably attached to the base 53 through the lever 52, the cap member 32 is lifted up while being guided by the second recording head 8 and then butts against the second recording

This Sheet Has Been Replaced



head 8 at a position where the cap member can seal the head (Fig. 10).

When the carriage 1 is further moved toward the case 61, the coil spring 56 becomes impossible to resist the force exerted by the carriage 1, and begins to buckle so that the slider 30 is lifted up (as indicated by an arrow E in Fig. 11). This causes the portion of the slider 30 in the side of the case to be lifted up as it is while maintaining the state where the second cap member 32 is fitted into the second recording head 8, with the result that the first cap member 31 is fitted into the first recording head 7. Since the slider 30 swings with respect to the base 53 and the first and second cap members 31 and 32 are somewhat swingable with respect to the slider 30 and configured by an elastic member, naturally, the cap members 31 and 32 are guided by the edges of the recording heads 7 and 8 and then fitted into the recording heads 7 and 8, respectively (Fig. 11).

When the carriage 1 is further moved in this way, the slider 30 is horizontally moved toward the case 61 while the upper face of the slider is restricted by the recording heads 7 and 8. Then, the operation rod 62 protruding from the front end of the slider 30 butts against the case 61 to be pressed in the direction of an arrow K in Fig. 12 so as to isolate the air release ports 31b and 32b of the cap members 31 and 32 from the air.

This Sheet Has Been Replaced



Under this state, since the coil spring 56 largely buckles, the slider 30 is lifted up by the resilient force of the coil spring 56. Consequently, the cap members 31 and 32 make resiliently contact with the recording heads 7 and 8 to surely seal them (Fig. 12).

Under the state where the cap members 31 and 32 make resiliently contact with the recording heads 7 and 8 as described above, the sheet feed and pump motor 24 is coupled with the driving wheel 72 of the tube pump 37 by the lever 102. When the motor 24 is reversely rotated, therefore, the first tube pump 37, and the second tube pump 38 connected thereto through the connecting member 76 are rotated. The rotation of the driving wheel 72 in the direction indicated by an arrow F in Fig. 13 causes the rollers 85 to be guided by the slots 90 and moved toward the outer periphery so as to make resiliently contact with the tube 33, and hence the first tube pump 37 starts the suction operation (Fig. 13(a)).

On the other hand, in the second tube pump 38, the rollers 86 are moved toward the center by the rotation of the driving wheel in the direction indicated by an arrow G, and rotated in a substantially idling manner at positions where the rollers do not resiliently press the tube 34 (Fig. 13(b)). Therefore, only the first cap member 31 is subjected to a suction force so that the first recording head 7 sucks ink. Ink ejected from the first recording head 7 into the cap member

This Sheet Has Been Replaced



31 is discharged through the tube 33 into the waste ink tank 14.

When the ink suction of the first recording head 7 conducted as described above is completed, the motor 24 is forward rotated so that, in the second tube pump 38, the driving wheel for the pump is rotated in the direction indicated by an arrow H, whereby the rollers 86 are moved toward the outer side to make resiliently contact with the tube 34 (Fig. 14(a)). In the first tube pump 37, the driving wheel is rotated in the direction indicated by an arrow J in Fig. 14(b) and the rollers 85 are moved toward the center so as to be located at positions where they do not resiliently press the tube 33 (Fig. 14(b)). This causes the second cap member 32 to suck ink from the recording head 8. Ink ejected into the second cap member 32 is discharged through the tube 34 into the waste ink tank 14.

Only one of the recording heads 7 and 8 from which one ink is to be sucked can be subjected to ink suction by selecting the rotation direction of the sheet feed and pump motor 24. Therefore, the other recording head from which ink is not to be sucked is prevented from being subjected to ink suction. Moreover, it is possible to use a motor of a small rating producing a torque which is scarcely sufficient for driving only one pump.

When the suction operation is completed, the driving wheels 72 and 83 are rotated by about 60 to 150 deg. in a

This Sheet Has Been Replaced



direction which is opposite to the suction force generating direction of the pump that is finally operated (in the embodiment, the second tube pump 38). By the tube 33 and the roller pressing piece 92, irrespective of the positions of the rollers 85 of the first pump 37 when the rotation angle is 150 deg. or less, the rollers 85 are prevented from moving over a roller pressing piece 92 to resiliently press the tube 33. When the rotation angle is 60 deg. or more, the shape of the slots 90 causes the rollers 86 which has resiliently pressed the tube 34 of the second pump 38, to be moved to positions where they do not resiliently press the tube 34. As a result, the first and second tube pumps 37 and 38 enter the stop state at positions where the rollers 85 and 86 do not resiliently press the respective tubes 34 and 35 (Figs. 15(a) and 15(b)). This enables the first and second cap member 31 and 32 to be communicated with the air through the respective tubes 34 and 35 which constitute the pumps, so that a printing failure of the recording heads which may be caused by variation in atmospheric pressure due to change in temperature is prevented from occurring. Furthermore, the tubes are prevented from being crushed for a long time by the rollers 85 and 86.

When a series of operations is completed and no further data to be printed exists, the apparatus is transferred to an inactive state and this state is maintained. In contrast, when the printing is to be continued, the carriage 1 is moved in the direction of the arrow K in Fig. 12. Since the first and



second cap members 31 and 32 are fitted into the recording heads 7 and 8, the slider 30 follows the movement of the carriage 1 to be moved in the direction of the arrow K. When the slider 30 is moved as described above and the projection 46 of the slider 30 reaches the lowest area of the slant face 47b of the guide member 47 (Fig. 9), the slider 30 is urged by the soil spring 56 to be lowered, and becomes horizontal. This produces the gap g between the recording heads 7 and 8 and the slider 30 so that the carriage can freely be moved in the main scanning direction. Consequently, the recording heads are moved as they are to the printing region and then execute the printing operation in accordance with printing data. Under this state, the engaging piece 46 of the slider 30 engages with the projection 47a of the guide member 47, and hence the slider can stand still at a predetermined position.

A suction operation other than the above-described suction operation will be described.

This suction operation is very effective method of precisely controlling an amount of the ink to be sucked (low suction mode). This operation will be described in detail with reference to Figs. 18 and 19. Although the following description is directed only to the operation conducted on the first recording head, the operation on the second recording head can be conducted in the same manner.

A controller which is not shown controls the pulse motor so that it forward rotates, whereby the recording head 7



is moved to the capping position for the capping device 12 which is located in the nonprinting region. The pulse motor is reversely rotated at time a so that the recording head 7 is moved a wiping position and the face of the recording head is wiped by a wiper which is not shown (step a). The wiper is arranged to the printing region vicinity of the capping device.

After the wiping process, the pulse motor is forward rotated slightly at time b so that the recording head 7 is moved to the noncapping position which is located between the capping and wiping positions, and the cap member is set to be a noncapping state (step c). Under this state, the pump motor 24 is reversely rotated and the driving wheel 72 is rotated in the direction indicated by an arrow F in Fig. 13. The rollers 85 are transferred from the tube nonpressurizing state to the tube pressurizing state, and the state where ink suction is enabled is established (step d).

Thereafter, the pulse motor 23 is again forward rotated at time c, and the recording head 7 is moved to the capping position (step e). Under this state, the pump motor 24 is rotated in a predetermined number of turns so that the driving wheel 72 makes turns required for introducing fresh ink into the nozzles, with using the ink suction enabled state as the reference. A negative pressure is generated in the tube so that fresh ink is introduced into the nozzles, thereby removing clogging ink (step f).

This Sheet Has Been Replaced



After this ink suction operation, the pulse motor 23 is reversely rotated at time d, and the recording head 7 is returned to the noncapping position (step g). Under this state, the pump motor 24 is reversely rotated so that ink and air in the tube 14 are discharged into the waste ink tank (step h).

Then, the pump motor 24 is slightly rotated at time e, and the rollers are transferred from the tube pressurizing state to the tube nonpressurizing state, or returned to a pump release state (step i). Thereafter, the recording head 7 is then moved at time f to the printing region (step j).

As a result of the steps described above, the regeneration of the first recording head 7 is completed. When the second recording head is then to be regenerated, the regeneration can be conducted in the same manner with rotating the pump motor 24 in an opposite direction. In the steps of regenerating the first or second recording head, naturally, the suction step is not conducted on a head which is not required to be regenerated.

When the suction process is conducted in the steps described above, it is possible to manage the ink suction amount in the process of regenerating a head, so that ink consumption is reduced to a level as low as possible.

In the embodiments described above, the capping position designates a state where a recording head and a cap are in close contact with each other. The noncapping position



designates a state where the recording head and the cap are separated from each other.

In the embodiment, a cap is provided with a valve mechanism through which the cap can selectively be communicated or not communicated with the air. The same states as the capping and noncapping positions of the above-mentioned embodiments can be attained by the valve mechanism. The same operations as those of the above-mentioned embodiments can be realized under a state where the cap butts against the recording head. In this case, the capping position is attained by interrupting with the air and the non-capping position is attained by communicating with the air.

In the above, the embodiments in which nozzle openings of recording heads are directed downward have been described. It is a matter of course that, even in the case where nozzle openings of recording heads are directed upward or horizontally, the same effects can be attained by disposing caps so as to correspond to the arrangement of the recording heads or take a posture wherein the caps oppose the nozzle opening faces.

Although the embodiments in which the invention is applied to a color printer have been described, it is a matter of course that the same effects can be attained even when the invention is applied to a printer in which two ink jet recording heads ejecting drops of ink of the same color are mounted on one carriage so as to improve the recording density.



As described above, according to the invention, the apparatus includes a carriage on which first and second ink jet recording heads having nozzle openings are mounted, and a slider having first and second cap members which seal the nozzle openings of the first and second ink jet recording heads, respectively. The slider is supported at the center portion in a longitudinal direction by a support member which is rotatable about a rotation shaft elongating in a direction perpendicular to the moving direction of the carriage and which is movable in the moving direction of the carriage. The support member is movable also in a direction opposing the recording heads in accordance with the movement of the slider. When the carriage is moved under the state where the carriage butts against the slider, therefore, the slider swings about the shaft in a manner similar to a seesaw to butt against one of the recording heads, and then butts against the other recording head. Therefore, the two cap members on the single slider can surely be attached to the respective recording heads. Furthermore, the two cap members are moved by moving the single slider in the manner interlocked with the movement of the carriage, and hence the attaching and detaching mechanism for the cap members can be simplified in structure.

The foregoing description has been given by way of example only and it will be appreciated by a person skilled in the art that modifications can be made without departing from the scope of the present invention.

This Sheet Has Been Replaced





CLAIMS

1. An ink jet recording apparatus comprising:

a carriage on which first and second ink jet recording heads each having nozzle openings are mounted; and

a slider having first and second cap members which seal the nozzle openings of the first and second ink jet recording heads, respectively, the slider being supported at a center portion in a longitudinal direction by a support member which is rotatable about a rotation shaft elongating in a direction perpendicular to a moving direction of the carriage and which is movable in the moving direction of the carriage, the support member being movable also in a direction opposing the recording heads in accordance with the movement of the slider.

2. An ink jet recording apparatus according to claim 1, wherein the support member includes:

a coil spring which buckles when the slider is moved to a capping position and generates a resilient force in the direction opposing the recording heads; and

a lever having an end which is swingably attached to a shaft of a base through a slot, the rotation shaft being rotatably supported by the other end of the lever.

3. An ink jet recording apparatus according to claim 1, wherein the slider includes engaging means for butting against the carriage to receive a driving force from the carriage.





4. An ink jet recording apparatus according to claim 1, wherein each of the first and second cap members includes a suction port, and an air release port which is communicated with the air through valve means, and the suction ports of the first and second cap members are connected to first and second suction pumps, respectively.

5. An ink jet recording apparatus according to claim 1, wherein a valve unit which closes when the slider reaches a capping position is mounted on the slider, and an air release ports of the cap members are communicated with the air through the valve unit.

6. An ink jet recording apparatus according to claim 1, further comprising:

suction means for sucking the ink, the section means selectively driven in accordance with a rotation direction of the rotation drive source, suction ports of the cap members connected to suction means.

7. An ink jet recording apparatus according to claim 6, wherein the suction means includes a tube pump having:

rollers coupled with a rotation drive source and selectively driven in accordance with a rotation direction of the rotation drive source, to pressing a tube; and





a roller pressing piece brought into contact with the rollers to forcedly move the rollers toward one of a center and an outer side in accordance with the rotation direction.

8. An ink jet recording apparatus according to claim 6, wherein the suction means includes a tube pump having:

a pump chamber a part of which is opened so as to function as an insertion port for a tube; and

a driving wheel train having a single roller cooperating with an inner wall face of the pump chamber to press the tube, the driving wheel train being rotated about a shaft portion of the pump chamber,

wherein the tube has a loop portion, the loop portion is formed by crossing portions of the tube inserted into an α -like shape each other, and the loop portion is inserted into the pump chamber to elongate along the inner wall face of the pump chamber.

9. An ink jet recording apparatus according to claim 8, wherein a guide slot is formed in the driving wheel train, and the roller is transferred by the guide slot from a tube pressurizing state to a tube nonpressurizing state or from the tube nonpressuring state to the tube pressurizing state in accordance with the rotation direction.





10. An ink jet recording apparatus comprising:

means for keeping the recording head in a nonsuction state, for transferring the recording head to a suction state after the pump is forward rotated to set an ink suction enabled state, and for rotating the pump by an amount required for regenerating the recording head, with using the ink suction enabled state as the reference, to suck ink in the recording head.

11. A tube pump for an ink jet recording apparatus comprising:

rollers coupled with a rotation drive source and selectively driven in accordance with a rotation direction of the rotation drive source, to pressing a tube; and

a roller pressing piece brought into contact with the rollers to forcedly move the rollers toward one of a center and an outer side in accordance with the rotation direction.

12. A tube pump according to claim 11, wherein the suction means includes a tube pump having:

a pump chamber a part of which is opened so as to function as an insertion port for a tube; and

a driving wheel train having a single roller cooperating with an inner wall face of the pump chamber to press the tube, the driving wheel train being rotated about a shaft portion of the pump chamber,



wherein the tube has a loop portion, the loop portion is formed by crossing portions of the tube inserted into an α -like shape each other, and the loop portion is inserted into the pump chamber to elongate along the inner wall face of the pump chamber.

13. A tube pump according to claim 12, wherein a guide slot is formed in the driving wheel train, and the roller is transferred by the guide slot from a tube pressurizing state to a tube nonpressurizing state or from the tube nonpressurizing state to the tube pressurizing state in accordance with the rotation direction.

14. An ink jet recording apparatus substantially as hereinbefore described with reference to any one of the accompanying Figures.

15. A tube pump substantially as hereinbefore described with reference to any one of Figures 6 to 8 or 13 to 17.

This Sheet Has Been Replaced

