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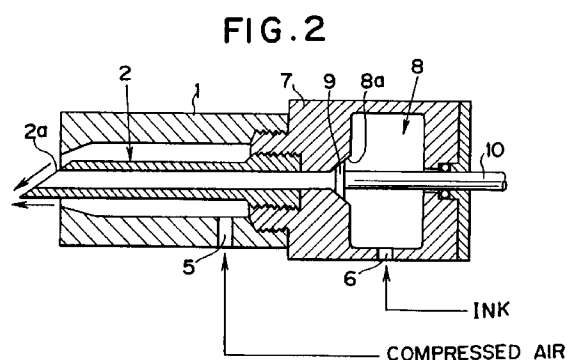
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(54) **Painting air brush.**

(57) A painting air brush draws and sprays ink from an ink jet tube member (1) in the presence of a negative pressure produced when air is ejected from an annular air jet outlet encircling an ink jet outlet (2a, 2b, 2c) of said ink jet tube member. A valve mechanism (8a, 9) provided at a rear end of the ink jet tube member controls the amount of ink released to the ink jet tube member. No needle member at the forward end of the ink tube member is used for controlling the ink supply amount, which prolongs the life of the air brush and ensures high-speed, stable ink jet for a long time.



This invention relates to an improvement of an air brush to be used in an automatic painting apparatus.

In an automatic painting apparatus, developed as a full color image printing system for printing an extra-large screen with a number of micro pixels, an air brush is used as an ink jet type pen. Such an air brush is designed to draw and spray ink from a jet outlet of an ink jet tube in the presence of a negative pressure caused by an air jet.

An air brush shown in Figure 6 has been proposed in EP-0317219 for use in the above-indicated automatic painting apparatus. This air brush has a double-tube structure including an outer air jet tube member 1 and an inner ink jet tube member 2. In the ink jet tube member 2 is provided a needle member 3 for controlling the amount of ink to be released. A solenoid type drive mechanism is coupled to the rear end of the needle member 3. In an operation for drawing and spraying ink from the jet outlet of the ink jet tube member 2 in the presence of a negative pressure caused by an air jet, the needle member controls the ink jet outlet. In the same drawing, numeral 5 denotes a compressed air flow inlet, and 6 designates an ink flow inlet.

The air brush in the above-indicated automatic painting apparatus is superior to an air brush of a type configured to control the released amount of ink by adjusting the supplied air pressure in that it performs more precise control of the released amount of ink for forming pixels.

However, since the needle member is moved at a speed as high as several thousands times of reciprocation per second, its frictional contact with the ink jet tube member is violent during its reciprocal movements. Therefore, the ink jet outlet wears or peels off in a short time, and the life of the air brush is short. Further, the needle member requires significant energy for reciprocal movements, which prevents speed-up of the reciprocal movements. That is, the frequency for on/off action of the needle member is low, and high-speed painting is not possible.

It is therefore an object of the invention to provide a painting air brush that can provide an adequate released amount of ink without the use of a needle member. A further object of the invention is to provide a painting air brush that can provide uniform release of jet ink without being affected by ejected air.

In order to attain the object, the invention is based on a painting air brush for drawing and spraying ink from an ink jet outlet of an ink jet tube member in the presence of a negative pressure produced when air is ejected from an annular air jet outlet encircling the ink jet outlet, and it is characterized in that a valve mechanism for controlling the released amount of ink to the ink jet tube member is provided at a rear portion of the ink jet tube member. The ink jet outlet of the ink jet tube member may be formed by cutting the tube aslant from one side or opposite sides.

According to the construction, it is possible to control the amount of ink supplied to the ink jet tube member by operating the valve mechanism, without using a needle member.

In addition, since the ink jet outlet has the aforementioned unique configuration, air found in front of the ink jet outlet forms a laminar flow. As a result, no vortex flow occurs, and the site of the ink jet outlet through which the ink flows does not vary but is maintained constant.

Figure 1 is a side elevation of a painting air brush embodying the invention.

Figure 2 is a cross-sectional view of the air brush.

Figure 3 is a perspective view of an ink jet tube member.

Figure 4 is a cross-sectional view of a painting air brush taken as a further embodiment of the invention.

Figure 5 is a perspective view of an ink jet tube member.

Figure 6 is a cross-sectional view of an existing painting air brush.

Figure 7 is a cross-sectional view of an ink jet tube member having a different shape of ink jet outlet, for use in the foregoing embodiments.

Figure 8 is a cross-sectional view of the ink jet tube member of Figure 7 for showing an ink flow status in the tube member.

Figures 1 to 3 show an embodiment of the invention.

In these drawings, reference numeral 1 refers to an air jet tube member, 2 to an ink jet tube member, and 7 to a supporting member that supports both tube members at their rear ends.

The ink jet tube member 2 may have the jet outlet 2c shown in Figure 7, but it may have an angled jet outlet 2a made by cutting the tube aslant from one side, as will be explained later, in order to reduce uneven release of ink. The cutting angle of the jet outlet 2a is selected from the range of 30 to 35 degrees.

The supporting member 7 defines therein an ink valve chamber 8 communicating with the interior of the ink jet tube member 2. The outlet from the ink valve chamber 8 is shaped into a conical valve seat 8a. A valve member 9 secured on an operating rod 10 engages with or disengages from the valve seat 8a to shut or open the communication. The operating rod 10 has an extension extending to the exterior beyond the supporting member 7 and coupled to a solenoid type actuating mechanism 11. Numeral 12 denotes a support base.

In the above-indicated construction, the released amount of ink can be adjusted, without using a needle member, by controlling the opening amount of the valve member 9 through the operating rod 10 moved by the solenoid type actuating mechanism 11 while maintaining the supplied air pressure constant.

In case that the ink jet outlet is formed as 2c in Figure 7, uneven release of ink may occur, which

makes it impossible to provide a density gradation in precise correspondence to the ink jet amount, in particular, when control is made to reduce the released amount of ink.

It is considered that such uneven release of ink derives from affection by a vortex flow R generated in front of the ink jet outlet 2c by air jet. That is, when the released amount of ink is small, the ink jet is readily affected by the vortex flow and, as shown in Figure 7, unevenness occurs in released amount of ink jet. Additionally, since the site at the ink jet outlet 2c, through which ink runs, is not maintained constant in the site shown in Figure 8 but varies otherwise, the ink jet direction also varies.

However, by employing the angled jet outlet 2a made by cutting the ink jet outlet from one side, jet air forms a laminar flow running along the angled surface of the jet outlet 2a as shown by arrows in Figure 2, and a vortex flow hardly occurs. Further, the ink flow site in the ink jet outlet does not vary but is maintained constant. For example, when the jet outlet is a downward slope as illustrated, the ink flows toward the sharp end of the jet outlet, and the jet direction is determined by the flow position.

As an experiment, ink was sprayed by using an air brush in which the ink jet tube member 2 has an inner diameter of 0.2mm and an outer diameter of 0.4mm, an air jet tube member 1 has an inner diameter of 0.9mm, and the ink jet outlet is cut by an angle of 30 degrees from one side thereof, by maintaining the air pressure constant, under a constant air pressure, by controlling the opening amount of the valve member 9 so as to provide a small amount of ink by the solenoid type actuating mechanism 11 via the operating rod 10. As a result, an image with a density gradation corresponding to the released amount of ink was obtained.

Figures 4 and 5 show another embodiment of the invention.

This invention uses the jet outlet 2b formed by cutting the ink jet tube member 2 aslant from opposite sides. In this construction, jet air forms a laminar flow running along the angled surfaces of the jet outlet 2b as shown by arrows in Figure 4, and a vortex flow hardly occurs. In addition, the laminar-flow effect is more excellent than that of the foregoing embodiment. This was confirmed by an image painting experiment.

As described above, according to the invention, since the valve mechanism is provided at the back of the ink jet tube member, released amount of ink can be controlled precisely in the same manner as is done by an air brush using a needle member, while maintaining the supplied air pressure constant. Further, since no needle is used, the ink jet tube member does not wear by friction, and has a long life.

In addition, by shaping the jet outlet of the ink jet tube member into an angled configuration, occur-

rence of a vortex flow in front of the jet outlet is prevented, thereby ensuring even release of ink, which leads to a remarkable effect, in particular, for a picture in a light color with a small amount of ink.

Claims

1. A painting air brush for drawing and spraying ink from an ink jet tube member (1) in the presence of a negative pressure produced when air is ejected from an annular air jet outlet encircling an ink jet outlet (2a, 2b, 2c) of said ink jet tube member located at a front end thereof, characterised by comprising a valve mechanism (8a, 9) provided at a rear end of said ink jet tube member for controlling release of ink to said ink jet tube member.
2. A painting air brush according to claim 1 wherein said jet outlet (2a) of said ink jet tube member is angled by cutting said tube aslant from one side thereof.
3. A painting air brush according to claim 1 wherein said jet outlet (2b) of said ink jet tube member is angled by cutting said tube aslant from opposite sides thereof.
4. A painting air brush as claimed in any of claims 2 and 3 wherein the ink jet tube member is angled at an angle of between 30 and 35 degrees relative to the axial extent of the ink jet tube member.

FIG.1

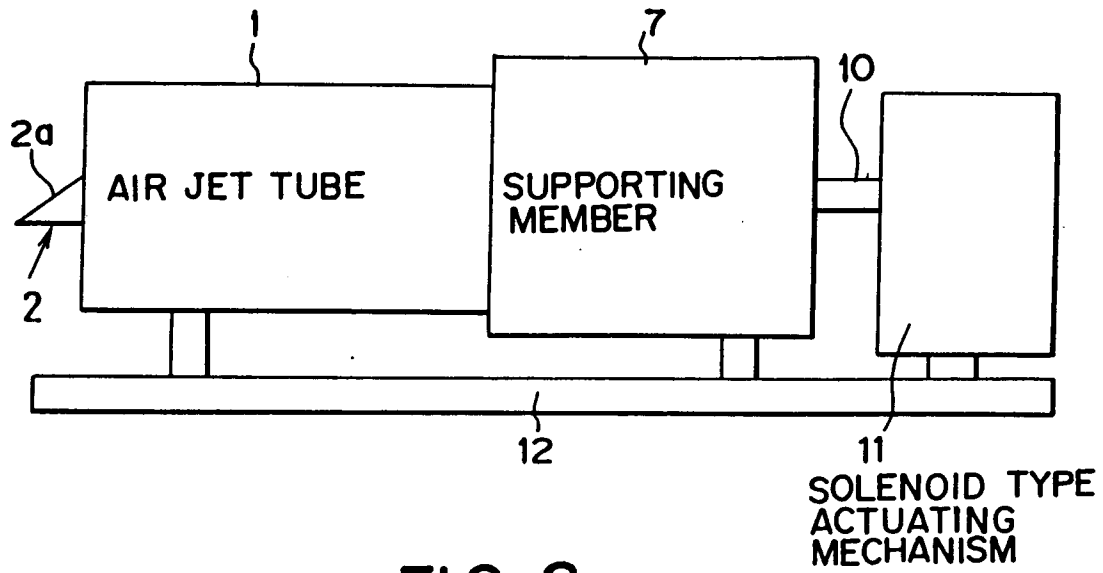


FIG. 2

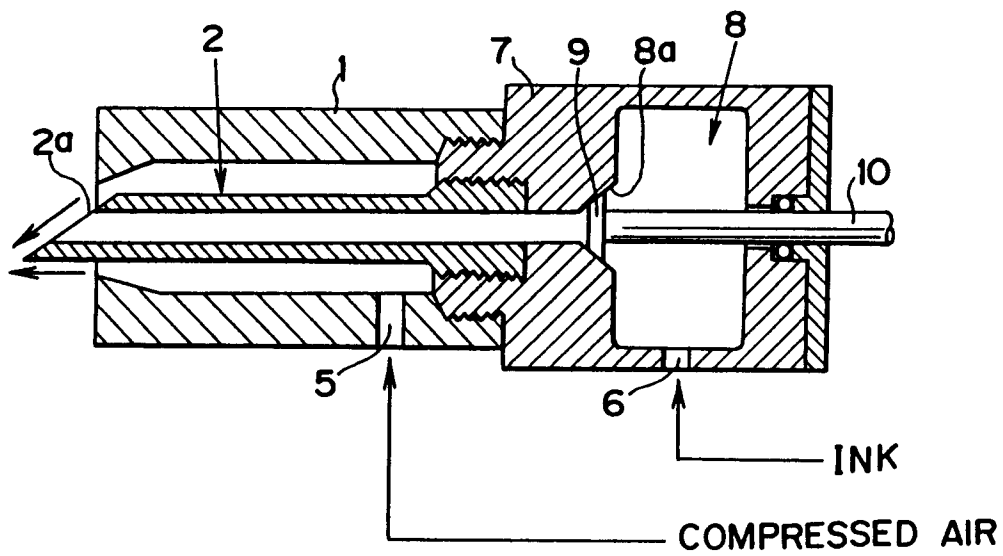


FIG. 3

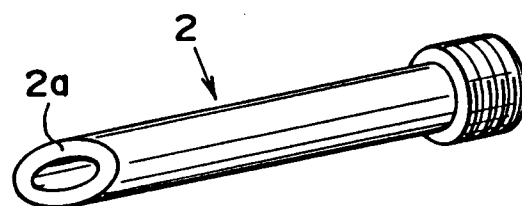


FIG. 4

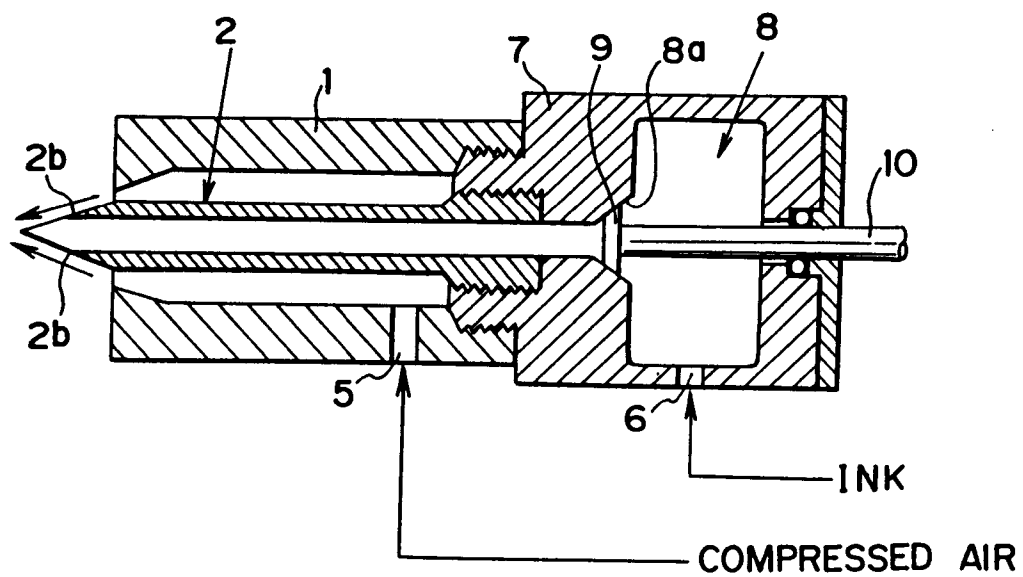


FIG. 5

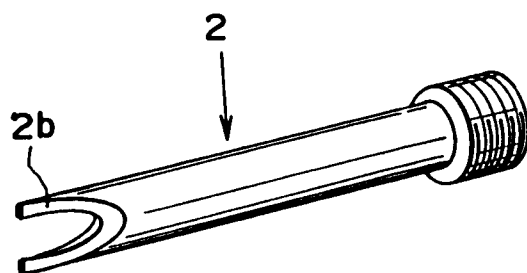


FIG. 6

PRIOR ART

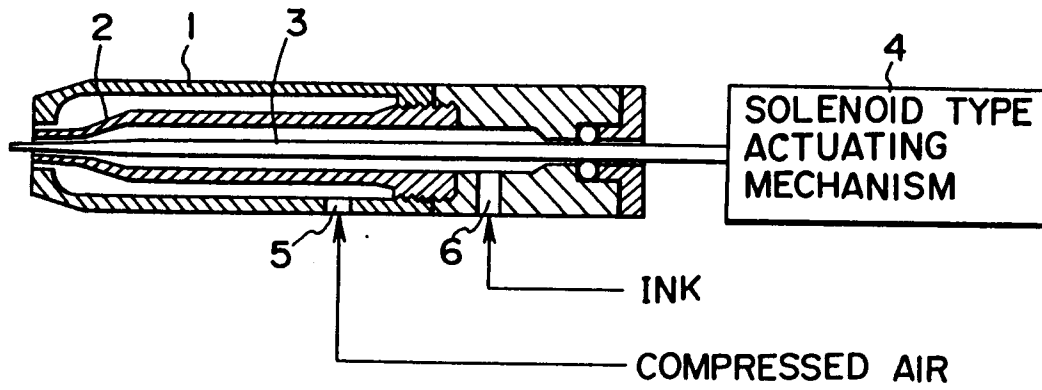


FIG. 7

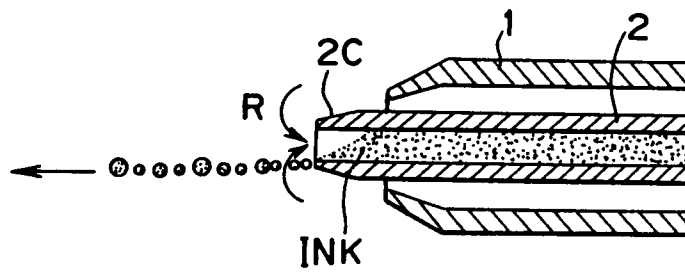
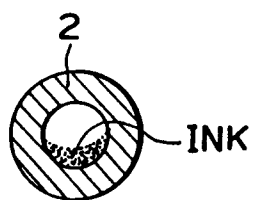


FIG. 8





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 30 6076

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	PATENT ABSTRACTS OF JAPAN vol. 014, no. 211 (C-0715)2 May 1990 & JP-A-20 48 057 (MARKTEC CORP.) 16 February 1990 * abstract *	1	B05B7/06 B05B1/30 B05B7/12
A	--- PATENT ABSTRACTS OF JAPAN vol. 015, no. 035 (M-1074)28 January 1991 & JP-A-22 74 560 (KOMORI) 8 November 1990 * abstract *	1	
A	--- WO-A-8 911 916 (KODAK LIMITED) * page 3, line 10 - line 13 *	2	

			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B05B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 19 OCTOBER 1992	Examiner JUGUET J.M.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			