July 29, 1969 E. ASCOLI 3,458,761

WRITING HEAD PRODUCING A JET OF INK

Filed July 6, 1967 2 Sheets-Sheet 1

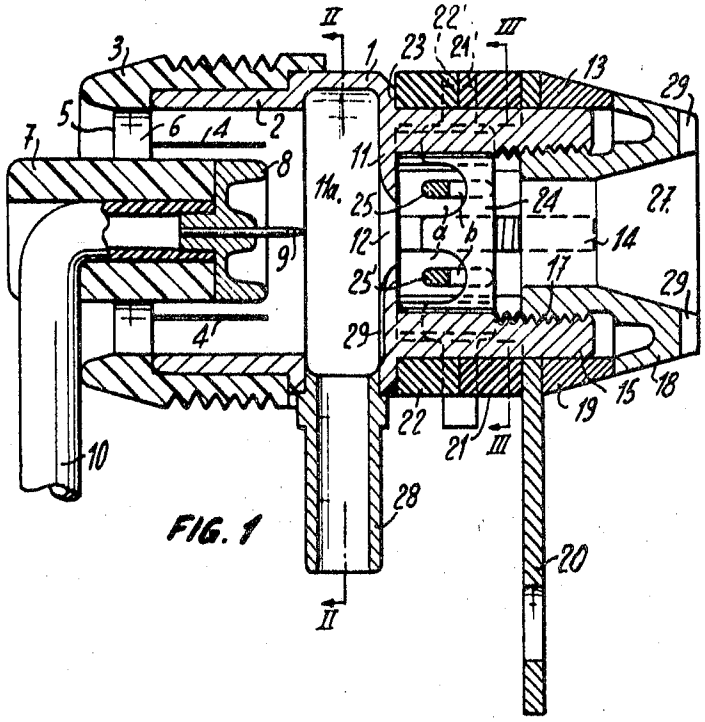

FIG. 1

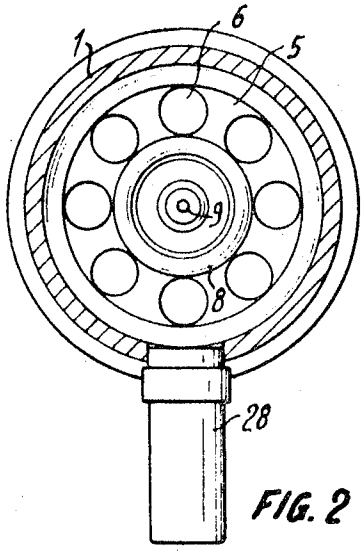

FIG. 2

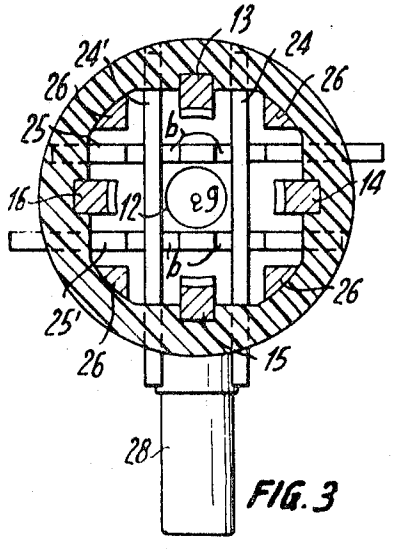

FIG. 3

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July 29, 1969 E. ASCOLI 3,458,761

WRITING HEAD PRODUCING A JET OF INK

Filed July 6, 1967 2 Sheets-Sheet 2

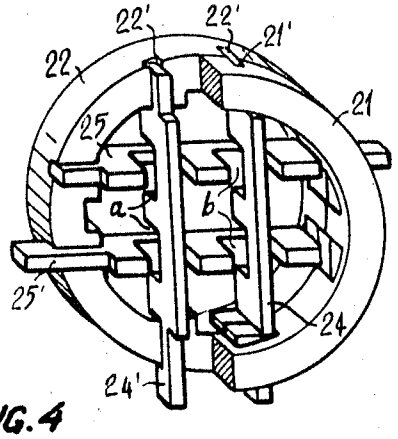

FIG. 4

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WRITING HEAD PRODUCING A JET OF INK

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U.S. Cl. 317—3 3 Claims

ABSTRACT OF THE DISCLOSURE

An electrically controlled writing head, wherein the same longitudinal fraction of the jet of ink is subjected simultaneously to the action of a pair of horizontal deflecting electrodes and of a pair of vertical deflecting electrodes. Said electrodes are constituted by plates arranged in pairs interengaging each other as provided by the notching of their cooperating edges perpendicular to each other and to the axis of the jet.

Background of the invention

Writing heads producing a jet of ink are already known which include a body carrying a tube forming a nozzle for the jet of ink and jet-deflecting electrodes located to either side of the axis of said tube.

In such writing heads, it is of interest to reduce its bulk as much as possible and to draw faithfully the character of which the outline is defined by the voltages applied to the deflecting electrodes.

Summary of the invention

The present invention has for its object means reducing substantially the length of the writing head and chiefly cutting out any deformation of the character to be drawn, which deformation is ascribable to the duration of progression of the jet of ink as it passes between the first pair of electrodes and then between the second pair, in the case where said two pairs of electrodes are located in sequence along the path of the jet of ink.

As a matter of fact, during the progression of the jet from one pair of electrodes to the next, the deflecting voltage applied to the second pair can be modified and consequently the phase relationship between the horizontal and vertical deflecting voltages would no longer remain unaltered.

The present invention has for its object a reading head projecting a jet of ink, of the type including a body carrying a tube forming a nozzle for the jet of ink and jet deflecting electrodes arranged pairwise to either side of the tube axis. This invention consists in that the electrodes are constituted by similar plates provided each with two notches along one edge so that the notched sections of the two plates serving for vertical deflection engage without any direct contact therewith, the notched sections of the two plates serving for horizontal deflection. Thus, all deflecting electrodes extend in registry with the same portion of the jet of ink.

Brief description of the drawings

The accompanying drawing illustrate diagrammatically and by way of example a preferred embodiment of the invention. In said drawings:

FIG. 1 is a longitudinal sectional view of said embodiment.

FIGS. 2 and 3 are transverse cross-sections through lines II—II and III—III of FIG. 1.

FIG. 4 is a perspective view of the electrode system.

Description of the preferred embodiment

The reading head illustrated includes a metal body **1** of which the cylindrical section **2** serves as a support for a coaxial bell-shaped member **3** of insulating material. Said bell-shaped member is merely slid over said cylindrical section **2** which is provided with longitudinal slots **4** adapted to increase its elasticity. The bell-shaped member **3** may be obtained through molding and it includes a transverse partition **5** provided with an annular series of openings **6** and rigid with a sleeve-shaped coaxial member **7**. Said sleeve-shaped member **7** forms a unit with the bell-shaped member **3** and may be cast for instance therewith out of a synthetic material such as that sold under the registered trade name nylon. The sleeve **7** serves as a support for a metal annulus **8** inside which is set a tube **9** forming a nozzle projecting the jet of ink. The ink is fed to the tube **9** through a yielding pipe **10**.

The body **1** carries in its medial section a transverse annular partition or wall **11** provided in its middle and in registry with the tube **9** with an opening **12** the edges of which are sharp.

The end of the body **1** opposed to its cylindrical section **2** forms four longitudinal projections **13, 14, 15, 16** of which the inwardly facing surfaces are tapered at **17**. Said tappings **17** allow screwing inside the body **1**, an outwardly projecting terminal metal member **18** adapted to clamp in position outside the body **1** a metal ring **19**, a securing plug **20** and two rings of insulating material **21** and **22** in contacting relationship with a peripheral shoulder **23** provided on the outer surface of the body **1**.

The two rings **21** and **22** serve as carriers for four plates **24, 24', 25, 25'** forming the electrodes deflecting the jet of ink projected out of the tube **9** through the opening **12** in the annular partition **11**. The surfaces facing each other on the rings **21** and **22** are provided with grooves **21'** and **22'** respectively, which serve as guides for the electrode plates. As illustrated in FIGS. 1 and 3, the plates **24** and **24'** are provided each with two notches *a*, whereas the plates **25** and **25'** show each two notches *b*. The plates **24, 24', 25, 25'** are furthermore given substantially the same shape and are arranged pairwise at right angles and in opposite relationship. Said arrangement allows interengaging said plates without any electric contact between them, the plates **24, 24'** lying in two vertical parallel planes and the plates **25, 25'** in two horizontal planes. Said interengaging plates occupy thus a minimum space in a direction parallel with the axis of the tube **9**. Thus, the particles of ink pass simultaneously between the horizontal deflecting plates and the vertical deflecting plates. This leads to an important advantage since, if the pairs of deflecting plates were arranged in sequence along the path of the jet of ink, this would lead to a deformation of the character drawn by it as a consequence of the time required for the progression of the particles from one pair of plates to the next. The structure disclosed thus cuts out completely said drawback.

It should be mentioned that no part of insulated material is apparent to view from any point of observation located at the end of the nozzle tube **9**. As a matter of fact, said end of the tube **9** cannot possibly "see" the bell-shaped member **3** made of insulating material, which member is concealed by the inner annulus **8** and the outer cylindrical section **2**. Similarly, the two insulating rings **21** and **22** are concealed by the annular portition **11**. Thus, the electric field extending between the tube **9** and partition **11** is not subjected to the action of the electric loads which may be carried by the parts of insulating material as provided for instance by a capacitory influence.

In order to reduce as much as possible any parasitic action as a consequence of the static loads carried by the insulating parts, the two rings **21** and **22** are spaced with reference to the path followed by the jet of ink by the projections **13** to **16** on the support **2** and also by the

intermediate projections **26** (FIG. 3) inserted between the former projections. Thus, the jet of ink is protected to a maximum extent against any parasitic action ascribable to the static loads possibly carried by the insulating parts. Furthermore, the sole parts of the jet of ink which might be subjected to some slight action of the static loads carried by the rings **20** and **22** extend between the opening **12** and the entrance of the jet into the passage defined by the electrodes and also between the output of said passage and entrance of the openings **27** defined by the terminal metal member **18**.

It should be remarked that the plates **24**, **24'**, **25**, **25'** project beyond the outer periphery of the rings **21** and **22** so that it is possible to weld thereto conducting wires adapted to give said plates the desired instantaneous voltage.

The voltage applied to the tube **9** is transmitted either by the conductive ink or else by a metal lead which may, as a matter of fact, be inserted inside the yielding pipe **10**.

As soon as the difference in voltage between the partition **11** which is generally grounded and the tube **9** is sufficiently high, the ink escaping out of said tube forms a jet constituted by a succession of droplets. Said jet passing between the deflecting electrodes is shifted under the action of the voltages applied to said deflecting electrodes.

Preferably, the carrier parts made of metal, that is the parts **2**, **20** and **18** are subjected to the same voltage as the support carrying the surface to be written over. Consequently, the electric field between the opening **27** in the terminal member **18** and said surface showing the point of impact for the jet of ink is equal to zero and the path of the jet of ink can therefore no longer be modified between the output of the writing head and said point of impact onto the writing surface.

The extremely small ink droplets forming the secondary jet escape within a cone the apical angle of which is large and are arrested by the partition **11**. The latter is polished and the edge of the opening **12** therein is very sharp so that the droplets forming the secondary jet cannot collect on such a sharp cutting edge by reason of the surface pressure of the ink droplets. Furthermore, the sharp edge of the opening **12** merges into the surface of the partition **11** facing the tube **9** along a convex annular surface **11***a* which is also polished so as to further the coalescence of the extremely small ink droplets which may settle on said annular surface. Said droplets form thus a continuous annular sheet of ink which flows steadily towards an output port opening into the depending tube **28** as furthered by a vertical groove **29** extending between the convex surface **11***a* and said output port.

The above-described writing head shows numerous advantages over those proposed hitherto. As a matter of fact, said head is of a simple structure and shows a high rigidity. Furthermore, it forms a closed unit and the weak sections of said head are protected against shocks and the like objectionable actions.

By reason of the shield formed by the metal parts carrying the head, the electric fields inside said head remain always uniform and their values are well-defined. Said fields can be deformed neither by outer parasitic fields, nor under the action of the static loads which may collect on the insulating parts.

The openings **6** formed in the partition **5** allow air to enter the writing head so as to replace the air escaping through the opening **27** and which is carried along by the moving jet of ink. Thus, the air pressure inside the head remains substantially constant which is essential with a view to obtaining a clean writing.

The system of carrier parts is rigid with the securing lug **20** as provided by the mere screwing of the terminal member **18** inside the threads **17** cut in the longitudinal projections **13** to **16**. To this end, the terminal member **18** is provided along its outer edge with a slot **29'** adapted to be engaged by a screw-driver. Furthermore, the insulating bell-shaped member **3** rigid with the annulus **8** and tube **9** may be removed through a mere sliding over the cylindrical section **2** of the body **1** which allows inspecting and cleaning easily said tube **9**.

I claim:

1. In a writing head comprising a nozzle through which a jet of ink is projected, the provision of a first pair of deflecting electrode plates provided along one edge with two notches spaced by the same amount and extending in transverse registry with the location of a predetermined section of the jet projected out of the nozzle and a second pair of deflecting electrodes extending perpendicularly to the electrodes of the first pair in transverse registry with the same location and one edge of which engages the corresponding notches in the electrode plates without any contact between the plates of the two pairs.

2. A writing head as claimed in claim **1**, wherein the electrode plates of the second pair are also provided along their said one edges with two notches spaced by the same amount, the notched sections of the plates of said second pair engaging the notches in the plates of the first pair.

3. A writing head as claimed in claim **1**, comprising two annular rings surrounding the location of said predetermined section of the jet and provided in their cooperating adjacent surfaces with two spaced grooves in one direction and with two further spaced grooves perpendicular to the first-mentioned spaced grooves for engagement respectively by the edge of the corresponding electrode plates perpendicular to the said one edges, in the plates of the first pair.

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239—15; 346—75