United States Patent [19]

Kato

[11] **3,801,057**

[45] **Apr. 2, 1974**

[54] **APPARATUS FOR THE PRODUCTION OF RECORDING ELECTRODES OF THE MULTIPLE NEEDLE TYPE**

[75] Inventor: **Tadashi Kato,** Yamato, Japan

[73] Assignee: **Ricoh Co., Ltd.,** Tokyo, Japan

[22] Filed: **Dec. 5, 1972**

[21] Appl. No.: **312,308**

[30] **Foreign Application Priority Data**

Dec. 10, 1971 Japan 46-100422
Oct. 12, 1972 Japan 47-102019

[52] **U.S. Cl.** **249/83,** 249/110, 249/160, 425/123

[51] **Int. Cl.** **B29c 27/30**

[58] **Field of Search** 249/83, 105, 110, 160; 425/123, 117; 164/332, 333

[56] **References Cited**

UNITED STATES PATENTS

1,372,673	3/1921	Cunningham	164/332 X
1,484,076	2/1924	Perry	249/105 X
3,132,196	5/1964	Veatch, Jr.	249/110 X

Primary Examiner—R. Spencer Annear
Attorney, Agent, or Firm—Cooper, Dunham, Clark, Griffin & Moran

[57] **ABSTRACT**

An apparatus comprising an upper mold in the form of a drum formed in its outer periphery with a thread of a very small pitch, 0.25 mm. for example, and having a wire wound in convolutions in the thread formation, and a lower metallic mold formed at its top with a plurality of upper mold support surfaces forming therebetween an upwardly diverging obtuse angle and each being formed therein with a rectangular recess for receiving a resin injected therein. The top of the lower metallic mold may be formed with an upwardly curving upper mold support surface in place of the obtuse angle forming surfaces. After the upper mold is placed on top of the lower mold with the major axis of the plurality of rectangular recesses in the latter being disposed axially of the former, an electrically insulating resin is injected in the recesses and allowed to solidify therein. After the resin has solidified, the lower mold is removed from the upper mold and the rectangular resin bars are removed from the outer periphery of the drum-shaped upper mold by severing the wire and laminated together to produce recording electrodes of the multiple needle type.

10 Claims, 4 Drawing Figures

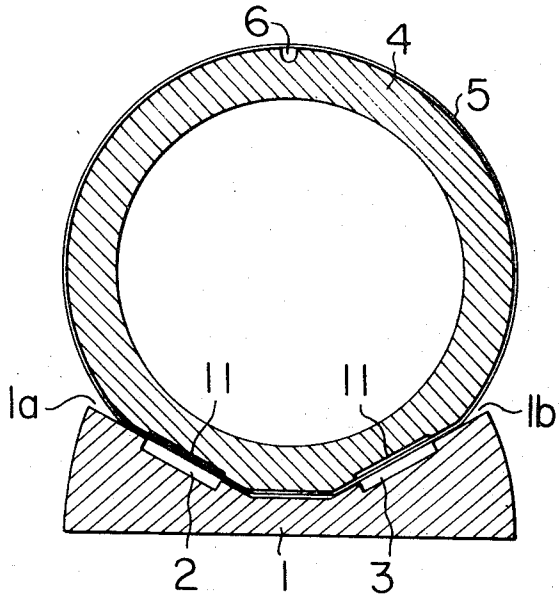


FIG. 1

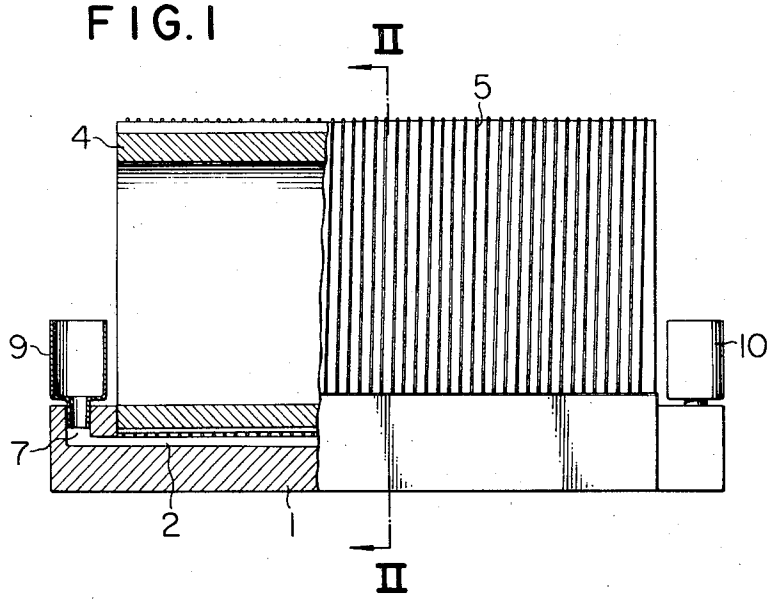


FIG. 2

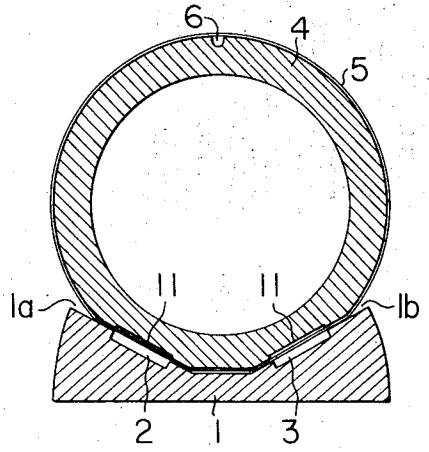


FIG. 3

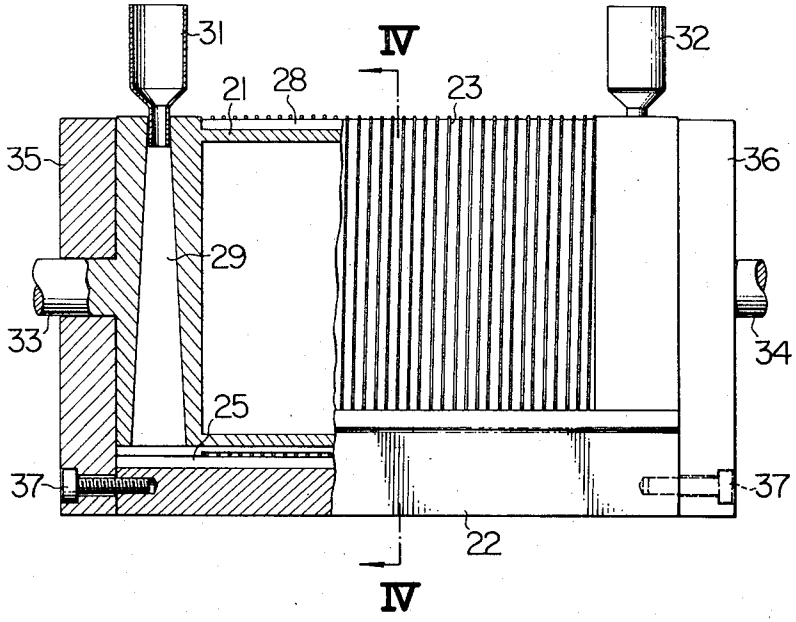
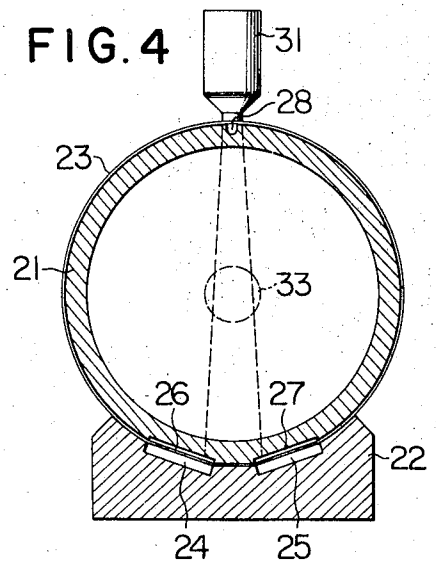

31
IV
32
21
28
23
35
36
29
33
34
25
37
37
22
IV

FIG. 4


31
28
23
21
33
26
27
22
24
25

APPARATUS FOR THE PRODUCTION OF RECORDING ELECTRODES OF THE MULTIPLE NEEDLE TYPE

BACKGROUND OF THE INVENTION

Nowadays, facsimile is used as means for scanning a graphic material so that the image is converted into electric signals which may be used either locally or remotely to produce a recorded likeness of the original. By using a facsimile transmitter, it is possible to break down letters, a picture, a painting or the like into picture elements and convert them into electric signals by scanning. The signals may be transmitted to a distant place and reproduced to obtain a recorded likeness of the original.

When the transmitted electric signals are reproduced electrostatically to produce a recorded likeness of the original, the electrostatic recording head used comprises recording electrodes of the multiple needle type embedded, for example in a synthetic resin plate. Recording electrodes of the multiple needle type described above generally comprise two to several thousands of very fine needles disposed at predetermined spacing (0.125 mm. for example) and embedded, for example, in a thermosetting resin plate.

In producing recording electrodes of the multiple needle type, it has hitherto been customary to form in the outer periphery of a drum a peripheral thread for winding a wire in the thread formation and injected resin receiving rectangular recesses disposed with their major axis being parallel to the axis of the drum. After the wire is wound in the thread formation, a resin is injected in the rectangular recesses and allowed to solidify therein. After solidifying, the convolutions of wire are cut and the rectangular resin plates having a multitude of predetermined lengths of wire serving as needles arranged in predetermined spaced apart relationship and embedded in the resin plates are removed from the drum.

To produce recording electrodes of the multiple needle type, two of these rectangular resin plates are laminated with their needle bearing surfaces facing each other and the rows of needles of one resin plate being staggered with respect to the rows of needles of the other resin plate so that one row of needle of one resin plate is disposed intermediate between the two adjacent rows of needles of the other resin plate. Thus fixing of needles is carried out twice before a set of recording electrodes embedded in a single base is produced.

Conventional apparatus for carrying out production of recording electrodes of the multiple needle type have had disadvantages. In injecting a resin in the rectangular recesses formed in the outer periphery of the drum after a wire is wound in convolutions on the drum, there is the danger of the resin leaking between the injecting jigs and the edges of the recesses. Moreover, when a plurality of recesses are formed in the outer periphery of the drum, the recesses are inclined and make resin injection a tricky job.

SUMMARY OF THE INVENTION

This invention relates to an apparatus for the production of recording electrodes of the multiple needle type.

An object of the invention is to provide an apparatus of the type described comprising an upper mold in the form of a drum having a wire wound in convolutions in a spiral thread formed in the outer periphery of the mold, and a lower metallic mold formed at its top with a plurality of upper mold support surfaces forming therebetween and upwardly diverging obtuse angle and each being formed therein with a rectangular recess for receiving a resin injected therein. When the resin is injected in the recesses after the upper mold is placed on the lower mold, it is possible to produce in one operation a plurality of rectangular resin plates in which a multitude of predetermined lengths of wire serving as needles arranged in predetermined spaced apart relationship (0.25 mm. for example) and embedded in the resin plates.

Another object of the invention is to provide an apparatus of the type described comprising an upper mold in the form of a drum having a wire wound in convolutions in a spiral thread formed in the outer periphery of the mold, and a lower metallic mold formed at its top with an upwardly curving upper mold support surface formed therein with a plurality of rectangular recesses for receiving therein a resin injected therein.

Another object of the invention is to provide an apparatus of the type described which comprises a pair of support shafts arranged axially of the drum-shaped upper mold and projecting outwardly from opposite ends of the drum to support the mold when a wire is wound from a wire winder to facilitate winding of the wire in convolutions around the upper mold, and which permits the upper and lower molds to be positively fixed in place by using the shafts as stoppers for support plates for the upper and lower molds when a resin is injected in the rectangular recesses so that the resin can solidify in a stable manner.

According to the invention, there is provided an apparatus for the production of recording electrodes of the multiple needle type comprising an upper mold in the form of a drum formed in its outer periphery with a thread of a very small pitch, 0.25 mm. for example, and having a wire wound in convolutions in the thread formation, and a lower metallic mold formed therein with an upper mold support surface or surfaces and a plurality of resin receiving rectangular recesses, whereby a plurality of rectangular resin plates each having a multitude of predetermined lengths of wire serving as needles arranged in predetermined spaced apart relationship end embedded in the plates can be produced in a single operation.

In the present invention, the provision of a plurality of support shafts disposed axially of the drum-shaped upper mold and projecting outwardly from opposite ends thereof to be connected to the wire winder facilitates winding of the wire in convolutions on the periphery of the upper mold. The use of the shafts as stoppers for connecting support plates for the upper and lower molds permits the resin injected in the recesses to solidify in a stable manner.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of the apparatus for the production of recording electrodes of the multiple needle type comprising one embodiment of the invention;

FIG. 2 is a sectional view taken along the line II—II of FIG. 1;

FIG. 3 is a front view of the apparatus for the production of recording electrodes of the multiple needle type comprising another embodiment of the invention; and

FIG. 4 is a sectional view taken along the line IV—IV of FIG. 3.

DESCRIPTION OF PREFERRED EMBODIMENTS

In FIG. 2, a lower mold 1 includes two top surfaces 1a and 1b forming an obtuse angle therebetween and diverging upwardly in the form of a letter V. Surfaces 1*a* and 1*b* are formed therein with rectangular recesses 2 and 3 respectively for receiving a resin injected therein.

Disposed above lower mold 1 as shown in FIG. 2 is drum-shaped upper mold 4 having formed in its outer periphery a spiral thread of a very small pitch (0.25 mm. for example) for arranging a wire in convolutions in predetermined spaced apart relationship. A wire 5 is wound in the thread formation on upper mold 4 which is formed on its outer periphery with a plurality of contact surfaces adapted to engage the support surfaces 1a and 1b respectively of lower mold 1. Upper mold 4 is also formed in its outer periphery with a narrow axially extending groove 6 for cutting the wire 5.

Formed at opposite ends of each rectangular recess 2 or 3 are pouring gates 7 for injecting a resin therethrough into the recess which have injecting jigs 9 and 10 mounted therein.

A thermosetting resin is injected in rectangular recesses 2 and 3 after the drum-shaped upper mold 4 having wire 5 wound in convolutions thereon is placed on lower mold 1 with resin receiving rectangular recesses 2 and 3 being disposed with their major axis being parallel to the axis of the drum-shaped upper mold. When the resin solidifies, portions of convolutions of wire 5 disposed on the contact surfaces of drum-shaped upper mold 4 are fixed in the solidified resin in recesses 2 and 3. A portion of the resin may flow toward portions of the convolutions of the wire disposed between rectangular recesses 2 and 3 when it is injected in the recesses. This causes no trouble at all because the wire pieces between recesses 2 and 3 are cut and removed after the resin solidifies.

By removing rectangular resin plates from recesses 2 and 3 after the resin has solidified, it is possible to obtain a pair of rectangular resin plates having a multitude of predetermined lengths of wire serving as needles arranged at predetermined spaced apart relationship and embedded in the resin plates. By laminating the two rectangular plates at surfaces 11 thereof in electrically insulated condition, it is possible to produce a set of recording electrodes of the multiple needle type in which tips of needles are arranged in two rows as seen from one end of the electrode toward the other end lengthwise thereof.

By providing two support shafts arranged axially of the drum-shaped upper mold and projecting outwardly from opposite ends thereof for supporting the drum-shaped upper mold when it is connected to a wire winder, it is possible to facilitate winding of a wire in convolutions around the drum-shaped upper mold. The upper mold having such shafts are described with reference to FIG. 3 and FIG. 4.

An upper drum 21 is placed on a lower mold 22 and maintained in intimate contact therewith, the lower mold being formed at its top with a curved surface of the same curvature as the outer periphery of the upper mold. Upper mold 21 is formed in its outer periphery with a spiral groove of a very fine pitch (0.25 mm. for example) and has a wire 23 wound in convolutions in the thread formation as is the case with the embodiment shown in FIG. 1 and 2.

Lower mold 22 is formed therein with a plurality of rectangular recesses 24 and 25 for receiving a resin injected therein, and upper mold 21 is formed in its lower portion with a plurality of rectangular recesses 26 and 27 of relatively small depth disposed in positions corresponding to those of rectangular recesses 24 and 25 respectively and arranged axially of the upper mold. Upper mold 21 is also formed in its upper portion with a narrow groove 28 arranged axially of the mold for cutting the wire.

A plurality of resin injecting gates 29 (only one is shown) are formed near opposite ends of drum-shaped upper mold 21 for injecting a resin therethrough. Resin injecting gates 29 are maintained at their lower ends in communication with a plurality of cavities formed by rectangular recesses 24, 25, 26 and 27. Injecting jigs 31 and 32 are mounted in injecting gates 29 respectively.

Support shafts 33 and 34 connected at their bases to opposite ends of drum-shaped upper mold 21 and aligned with the center axis of drum-shaped upper mold 21 are fitted in openings formed in support plates 35 and 36 respectively which are detachably connected at their bases to lower mold 22 by belts threads 37.

After wire 23 is wound in convolutions around upper mold 21, upper mold 21 is placed on lower mold 22 and a thermosetting resin is injected in cavities formed by rectangular recesses 24, 25, 26 and 27. When the resin solidifies in the cavities, wire pieces disposed in the carities are fixed and embedded in position in the resin at predetermined spaced apart relationship. After the resin has solidified, the wire convolutions portions disposed between recesses 24 and 25 are cut and removed and the wire 23 convolutions in groove 28 are also cut, so as to provide a plurality of rectangular resin plates having predetermined lengths of wire serving as needles arranged in predetermined spaced apart relationship and embedded in the resin plates. By laminating the two rectangular resin plates at surfaces thereof corresponding to recesses 26 and 27 respectively, it is possible to provide a set of recording electrodes of the multiple needle type embedded in a resin plate, in which tips of needles are arranged in two rows as seen from one end of the electrode toward the other end lengthwise thereof.

What is claimed is:

1. An apparatus for the production of recording electrodes of the multiple needle type comprising a drum-shaped upper mold formed in its outer periphery with a spiral thread for winding a fine wire in convolutions of a small pitch on the spiral thread, a lower mold formed at its top with at least one support surface adapted to come into intimate contact with a lower portion of the outer periphery of the upper mold in a molding position, said at least one support surface being formed therein with a plurality of resin receiving rectangular recesses arranged parallel to the axis of the drum-shaped upper mold when the molds are in the molding position, and a plurality of resin injecting gates

for injecting a resin in said resin receiving rectangular recesses.

2. An apparatus as in claim 1 wherein said at least one support surface comprises two upwardly diverging surfaces forming therebetween an obtuse angle, and the drum-shaped upper mold is formed in its lower portion with a plurality of contact surfaces adapted to come into face-to-face contact with the upwardly diverging support surfaces formed in the lower mold.

3. An apparatus as in claim 1 wherein said at least one support surface is an upwardly facing concave surface curved to conform to the curvature of the lower portion of the periphery of the drum-shaped upper mold, so that the upper mold and the lower mold are maintained in face-to-face contact with each other when they are placed one over the other in said molding position.

4. An apparatus as in claim 1 including a plurality of support shafts connected at their bases to opposite ends of the drum-shaped upper mold and aligned with the center axis of the upper mold.

5. An apparatus as in claim 4 wherein said lower mold includes a plurality of support plates supporting said plurality of support shafts respectively.

6. An apparatus as in claim 1 wherein said resin injecting gates are provided in one of said upper mold and lower mold.

7. An apparatus for producing recording electrodes of the multiple needle type comprising a drum-shaped first mold having around its circumference means defining a spiral thread for winding a wire in convolutions characterized by small pitch, said first mold including means defining a pair of recesses in its outer circumferential surface which are parallel to each other and extend axially, a second mold having a concave surface conforming in curvature to the curvature of the drum-shaped mold and adapted to mate with the drum-shaped mold in a molding position in which a portion of the drum-shaped mold is in intimate contact with at least a portion of the concave surface of the second mold, said second mold having on said concave surface means defining a pair of recesses aligned with the recesses of the drum-shaped mold when the molds are in the molding position, the aligned recesses forming a pair of cavities, at least one of said molds including resin injecting gates for injecting a resin into said cavities.

8. An apparatus as in claim 7 wherein said drum-shaped mold includes a pair of support shafts extending outwardly of its axially spaced ends, said shaft extending along the same centrally located axis of the drum-shaped member.

9. An apparatus as in claim 7 wherein the drum-shaped mold is disposed over the second mold and the concave surface of the second mold faces upwardly when the molds are in their molding position.

10. An apparatus as in claim 9 wherein the resin injecting gate is in the drum-shaped mold, and wherein said cavities are rectangularly shaped cavities extending axially and parallel to each other.

* * * * *