

# United States Patent

[19]

Matsuura

[11] 3,847,342

[45] Nov. 12, 1974

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

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[22] Filed: Dec. 7, 1972

[21] Appl. No.: 312,941

[30] Foreign Application Priority Data

Dec. 16, 1971 Japan..... 46-102174

[52] U.S. Cl..... 249/85, 249/95, 425/121, 425/123

[51] Int. Cl..... B29c 6/04

[58] Field of Search ..... 425/35, 111, 117, 121, 425/123, 129, 243, DIG. 38, DIG. 34; 249/85, 95, 83, 78; 264/261, 272, 279, 271, 275, 277

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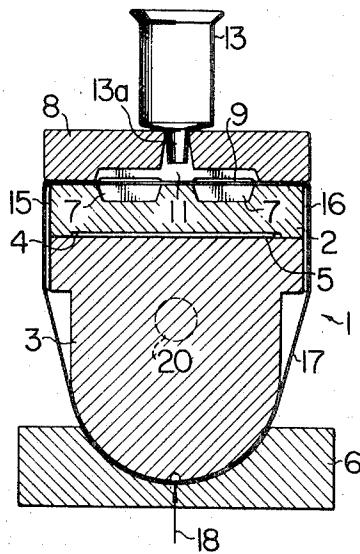
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[57] ABSTRACT

An apparatus comprising an upper mold formed at its top with a plurality of resin injecting gates and on its lower surface with a plurality of rectangular recesses, and a lower mold having a planar upper surface and a substantially convex lower surface and being formed on the planar upper surface with a plurality of rectangular resin receiving recesses disposed parallel to each other and along the longitudinal axis of the lower mold, the lower mold having a very fine wire wound thereon in convolutions in predetermined spaced apart relationship. After the upper mold is placed on the lower mold, a resin is injected through the resin injecting gates into a cavity formed by the rectangular recesses in the upper and lower molds and allowed to solidify therein so as to fix portions of the wire convolutions disposed in the resin receiving recesses. A printed board is applied to each side of the upper portion of the lower mold, and the wire is wound on the two printed boards as well as the lower mold. Then, the two printed boards are electrically connected to the wire before the latter is cut and removed from the lower mold on which it is wound.

6 Claims, 3 Drawing Figures



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FIG. 1

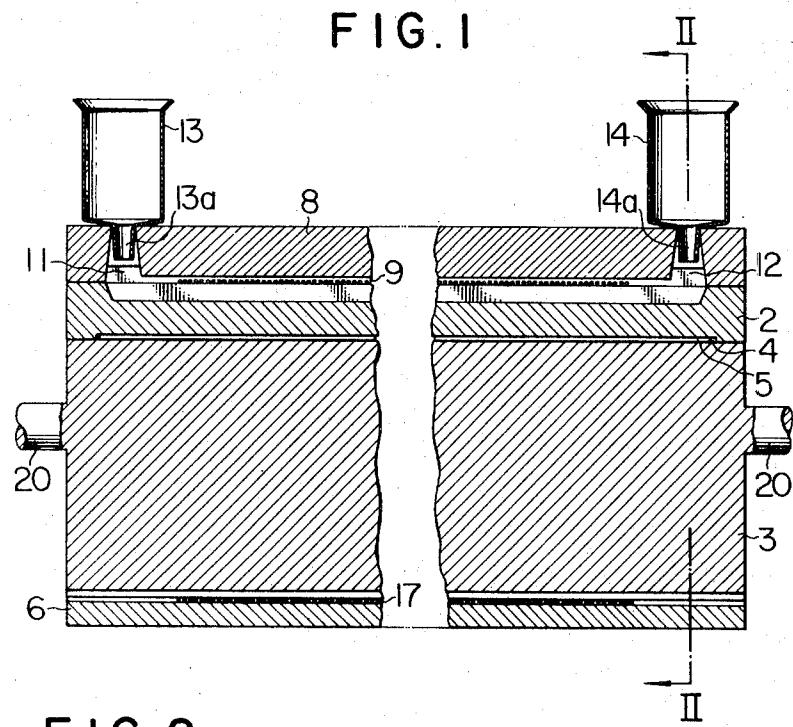


FIG. 2

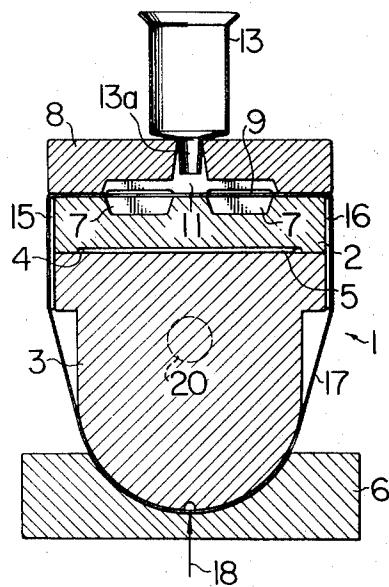
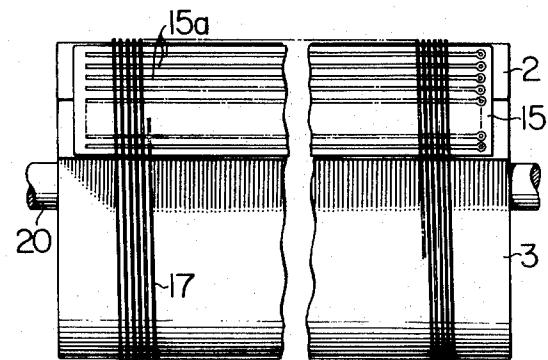


FIG. 3



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

**BACKGROUND OF THE INVENTION**

By using a facsimile system, any fixed graphic material including letters, pictures and photographs can be scanned and broken down into picture elements which are converted into electric signals and used either locally or remotely to produce a recorded likeness of the original. To produce quickly a recorded likeness of the original in clear and perfect image, it is required to use a scanning mechanism and a scanning means of high accuracy and precision for regulating the position of the image. When an electrostatic recording means is employed for reproducing and recording the image transmitted to a remote place by a facsimile system, it has been customary to use a set of recording electrodes of the multiple needle type as an electrostatic recording head. A set of recording electrodes of the multiple needle type generally comprise two to several thousands of very fine needles arranged parallel to one another in predetermined spaced apart relationship and fixed by a thermosetting resin. The needles are generally obtained by severing required lengths of a wire wound spirally in convolution at a predetermined pitch.

In one method of arranging a wire spirally in convolutions at a predetermined pitch which is generally used for the production of recording electrodes of the multiple needle type, at least one resin receiving recess is formed on one portion of the periphery of a drum and disposed parallel to the longitudinal axis of the drum, and a thermosetting resin is injected in the recess and allowed to solidify after a wire is wound peripherally on the drum at a predetermined pitch, so that portions of the wire convolutions disposed in the recess can be fixed in the resin and a needle supporting resin plate can be obtained. In injecting the resin into the recess, it is necessary to bring the lower end of an injecting means into alignment with the recess. Difficulty has hitherto been faced with in injecting the resin into the recess because the resin has tended to leak through the connection between the recess and injecting jigs due to misalignment.

A set of recording electrodes of the multiple needle type generally comprises a multitude of needles arranged in two levels, the needles of each level being disposed parallel to each other in predetermined spaced apart relationship as aforementioned and the needles of the two levels being staggered so that one needle of one level is disposed between the two adjacent needles of the other level. Thus, it has hitherto been customary simultaneously to produce a plurality of needle supporting resin plates and to laminate such resin plates to produce a set of recording electrodes of the multiple needle type. Simultaneous production of a plurality of needle supporting resin plates has hitherto posed a problem which is hard to obviate but which should be obviated to produce recording electrodes of the multiple needle type of high quality. The problem is that, when two rectangular recesses are formed on the periphery of a drum, the recesses are inclined in opposite directions and difficulty is experienced in injecting a resin thereinto without leakage. Moreover, difficulty is experienced in electrically connecting the needles arranged in predetermined spaced apart relationship and fixed in the resin to the printed boards.

**SUMMARY OF THE INVENTION**

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

One object of the invention is to provide an apparatus for the production of recording electrodes of the multiple needle type comprising a lower mold having a planar upper surface and a substantially convex lower surface which facilitates the production of recording electrodes of the multiple needle type.

Another object is to provide an apparatus for the production of recording electrodes of the multiple needle type comprising a lower mold having a planar upper surface, a substantially convex lower surface and planar upper side surfaces which facilitates the provision of electric connections between printed boards and the recording electrodes of the multiple needle type.

According to the invention, there is provided an apparatus for the production of recording electrodes of the multiple needle type comprising a lower mold having a planar upper surface and a substantially convex lower surface, said planar upper surface being formed thereon with a plurality of resin receiving rectangular recesses disposed parallel to each other and along the longitudinal axis of the mold, such lower mold being adapted to have a wire wound spirally in convolutions on its periphery in predetermined spaced apart relationship, and an upper mold formed on its lower surface with a plurality of shallow rectangular recesses in positions corresponding to those of the recesses formed in the lower mold and in its upper portion with at least one resin injecting gate for injecting therethrough a resin into a cavity formed by the rectangular recesses in the upper and lower molds.

In the present invention, a multitude of minuscule grooves of a predetermined dimension spaced apart from one another a predetermined distance may be formed peripherally in the substantially convex lower surface of the lower mold and a wire is wound on the lower mold so that the wire convolutions may be fitted in the grooves, thereby permitting the wire to be wound at a predetermined pitch and disposed in an orderly manner on the planar upper surface of the lower mold to produce resin plates supporting a multitude of needles arranged in predetermined spaced apart relationship.

The upper side surfaces of the lower mold may be formed in planar form, so that printed circuit boards may be each applied to one of the planar upper side surfaces before the wire is wound spirally on the lower mold. This facilitates the provision of electric connections between the needles of the resin plates to the printed circuit boards.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a vertical sectional view taken through the longitudinal axis 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; and

FIG. 3 is a side view of the lower mold showing the manner in which a wire is wound spirally in convolutions on its periphery.

## DESCRIPTION OF A PREFERRED EMBODIMENT

A lower mold 1 shown in FIGS. 1 and 2 comprises a mold proper 2 and a support 3 which define therebetween a space 4 having a heater 5 mounted therein for heating mold proper 2 to a suitable temperature between 50° and 80° C.

The support 3 of lower mold 1 includes a substantially convex lower surface which is received in a complementary groove formed in a bed 6. The mold proper 2 of lower mold 1 includes a planar upper surface in which a plurality of relatively deep rectangular recesses 7 are formed and disposed parallel to the longitudinal axis of lower mold 1.

An upper mold 8 is formed on its lower surface with a plurality of relatively shallow rectangular recesses 9 in positions corresponding to those of the rectangular recesses 7 formed in lower mold 1 to define therebetween a cavity. Resin injecting gates 11 and 12 are formed near opposite ends of the major axis of upper mold 8, as shown in FIG. 2, and have tubular ends 13a and 14a of resin injecting jigs 13 and 14 inserted therein respectively. Lower mold 1 has planar opposite side surfaces as shown in FIG. 2, and printed circuit boards 15 and 16 are each applied to one side surface of lower mold 1.

After printed circuit boards 15 and 16 are applied to the opposite side surfaces of lower mold 1, a wire 17 is peripherally wound spirally in convolutions on lower mold 1 at a predetermined pitch or 0.25 mm., for example. In order to wind wire 17 spirally in convolutions in predetermined spaced apart relationship with high accuracy and precision, the substantially convex lower surface of lower mold 1 may be formed therein with a multitude of minuscule grooves of predetermined dimension spaced apart from one another a predetermined distance or 0.25 mm., for example. A plurality of shafts 20 are each connected to one of opposite ends of lower mold 1 to facilitate winding of wire 17 from a wire winder on lower mold by mounting lower mold on the wire winder through shafts 20.

After wire 17 is wound, a thermosetting resin is injected into injecting jigs 13 and 14 and poured through gates 11 and 12 into the cavity defined by rectangular recesses 7 and 9 where it is allowed to set, so that portions of the wire convolutions disposed in the rectangular recesses can be fixed in position in the solid resin. Since lower mold 1 is constantly heated by the heater 5 mounted in mold proper 2, the detrimental effect of rapid cooling of the resin injected in the recesses 7 and 9 can be prevented.

Following solidification of the resin injected in the recesses 7 and 9, very fine strips 15a on printed circuit boards 15 and 16 are electrically connected to the wire 17 as by soldering. Upon completion of the provision of electric connections, the wire 17 wound on lower mold 1 is cut in a direction of an arrow 18 in a position disposed on the substantially convex lower surface of mold 1, and the portions of the wire convolutions disposed between the two recesses 7 are cut and removed, thereby producing a plurality of resin plates each supporting a multitude of lengths of wire serving as needles arranged parallel to one another in predetermined spaced apart relationship. By laminating the two resin plates at their needle bearing surfaces, it is possible to produce a set of recording electrodes of the multiple

needle type comprising a multitude of needle electrodes arranged in two levels, the needle electrodes of the two levels being staggered so that each needle of one level is disposed between the two adjacent needles of the other level and ends of the needles are arranged in two straight lines as seen lengthwise from one of the laminate toward the other end.

What is claimed is:

1. An apparatus for the production of recording electrodes of the multiple needle type comprising a lower

10 mold having a planar upper surface and a substantially convex lower surface, said planar upper surface being formed thereon with a plurality of resin receiving rectangular recesses disposed parallel to each other and along the longitudinal axis of the lower mold, said lower mold being adapted to have a wire wound spirally in convolutions on its periphery in predetermined spaced apart relationship, and an upper mold formed on its lower surface with a plurality of shallow rectangular recesses in positions corresponding to those of the resin receiving recesses formed in the lower mold and in its upper portion with at least one resin injecting gate for injecting therethrough a resin into a cavity formed by the rectangular recesses in the upper and lower molds, to thereby embed in resin a plurality of parallel lengths of wire, each length being that part of a convolution of wire wound over the lower mold which is within said cavity, while the remainder of the wire length of the convolution is not embedded in resin.

2. An apparatus as set forth in claim 1 wherein a mul-

30 titude of minuscule grooves of a predetermined pitch are formed and disposed parallel to one another on the substantially convex lower surface of said lower mold.

3. An apparatus as set forth in claim 1 wherein said lower mold is formed with planar upper opposite side surfaces to facilitate applying of a printed circuit board to each of said planar side surfaces.

4. An apparatus as set forth in claim 1 wherein said lower mold includes a built-in heater to heat the mold to a temperature in the range between 50° and 80° C.

5. An apparatus as set forth in claim 1 wherein said lower mold comprises a mold proper and a supporter disposed one over the other, and a heater mounted between said mold proper and said supporter.

6. An apparatus for producing recording electrodes of the multiple needle type, comprising: a lower mold having a planar upper surface and a substantially convex lower surface, said planar upper surface having means defining a plurality of resin receiving recesses each extending along the longitudinal axis of the lower mold, said lower mold having means for receiving a wire wound spirally in convolutions around the outer periphery of the lower mold and over said recesses therein in predetermined spaced apart relationship, and an upper mold formed on its lower surface with a plurality of shallow recesses disposed in positions corresponding to those of the resin receiving recesses in the lower mold and formed in its upper portion with at least one resin injecting gate for injecting therethrough a resin into a cavity formed by the facing recesses in the upper and lower molds, whereby a plurality of convolutions of wire can be wound around the outer periphery of the lower mold, said convolution being in predetermined spaced-apart relationship, and the wire portions which extend through said cavity can be embedded in resin injected therein through said gate while the remainder of the convolution portions are not embedded in resin.

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