

[54] **METHOD OF CONSTRUCTING
RECORDING HEADS**

[75] Inventor: **Hans Bauerlen**, Gerlingen, Germany

[73] Assignee: **Robert Bosch GmbH**, Stuttgart,
Germany

[22] Filed: **May 25, 1972**

[21] Appl. No.: **256,976**

[30] **Foreign Application Priority Data**

May 26, 1971 Germany..... 2126043

[52] U.S. Cl. **29/592**, 156/174, 346/139 C

[51] Int. Cl. **G01d 15/16**

[58] Field of Search 29/592, 605; 346/1, 139 C;
336/232, 234; 156/173, 174, 175, 242

[56] **References Cited**

UNITED STATES PATENTS

3,206,832	9/1965	Strother.....	29/592
3,391,041	7/1968	Moore	156/174
3,693,185	9/1972	Lloyd.....	29/592
3,057,767	10/1962	Kaplan	29/156.8 B

1,422,451	7/1922	Krusemark.....	156/174
1,129,666	2/1915	Gray	156/173

Primary Examiner—Charles W. Lanham

Assistant Examiner—D. C. Crane

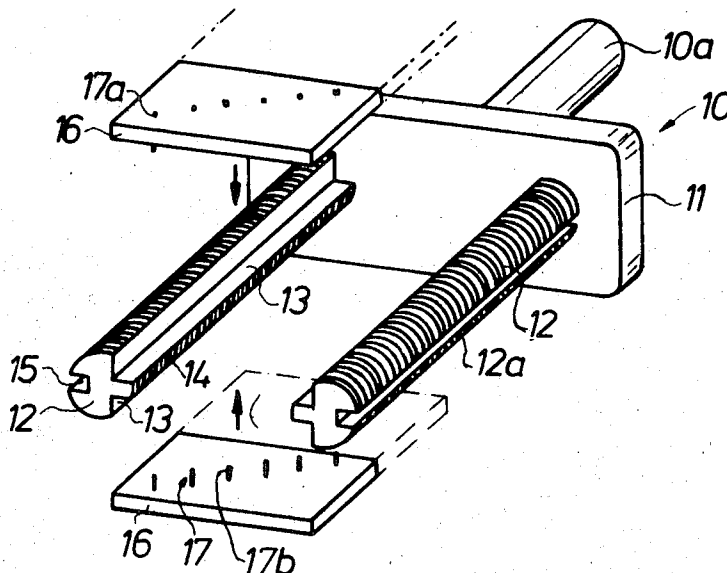
Attorney, Agent, or Firm—Michael S. Striker

[57]

ABSTRACT

The method of constructing recording heads includes the steps of positioning a plurality of contact pins between spaced parallel threaded rods and winding a wire uniformly and under tension around the latter, adjacent turns being placed into successive grooves of the threads. The contact pins are displaced from one another in the direction of the turns, and the parallel turns are each connected to one of the contact pins. The portions of the turns between the rods are embedded in an insulating material. Each rod has a longitudinal groove over which the turns pass and the latter are cut along each groove to produce free ends which are ground and sharpened to provide suitable writing electrodes, and recording heads produced in accordance with this method.

12 Claims, 5 Drawing Figures



METHOD OF CONSTRUCTING RECORDING HEADS

BACKGROUND OF THE INVENTION

This invention relates to a method for constructing writing heads with a plurality of insulated writing electrodes which are placed adjacent to one another for use with an apparatus to record information on a recording medium. The invention also relates to the writing head which is produced in accordance with the method.

In connection with high speed printers, as well as perforated or punched tape writing apparatus and the like, it is necessary to utilize a plurality of writing electrodes which are uniformly spaced adjacent to one another, so that characters or letters and numerals can be recorded. In such apparatus, the letters and numbers are produced by the formation of a plurality of markings which when viewed as a whole make up the letter or numeral. More particularly, the known apparatus record the information by producing a raster or a mosaic, wherein the simultaneous production over the width of the record carrier of dots or short lines, when recorded selectively by the plurality of recording electrodes, and while the recording medium is moving, can produce or generate the outlines of the letters and numerals which are, however, normally in a quantized state. It is already known, in connection with writing heads of this type, to place a plurality of writing electrodes adjacent to one another and to separate these through the use of isolating plates, the plates acting as spacers therebetween, and then to package the entire assembly to produce a writing head. Such a construction is disclosed in U.S. Pat. No. 1,524,340. However, this type of construction of writing heads is not economical and the required tolerances of the isolating plates forming the electrode spacers add to the cost, so that not only is the construction expensive, but the recording head has a large width. To construct writing heads wherein the writing electrodes are spaced very close to one another, the tolerances in accordance with the known method must be extremely tight and therefore, this further adds to the cost of the construction.

It is additionally known to construct a recording head by imbedding a plurality of writing electrode wires in electrically insulating material. This construction of writing heads is however difficult, especially when the writing electrodes are to be placed very close to one another, since a slight shifting in the positions of the writing electrodes during the embedding process of the isolating material may cause the electrode wires to short and thereby make the writing head useless.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method of constructing recording heads which does not possess the disadvantages which exist in the known methods.

It is another object of the present invention to provide a method as described above which is simple and economical to carry out and which provides reliable writing heads.

It is another object of the present invention to provide a method of the type under discussion which can be utilized to produce both rigid as well as flexible writing heads.

It is a further object of the present invention to provide a method as above described which consistently produces writing heads wherein the adjacent wires are uniformly spaced from one another and which can be constructed in minimal amount of time.

In order to achieve the above objects, the method in accordance with the present invention comprises the steps of uniformly winding a wire under tension around at least two spaced rods so that adjacent turns are substantially parallel to one another. The adjacent portions of the turns located between the two spaced rods are then imbedded in insulating material to permanently fix the parallel relationship of the adjacent portions. The turns are then severed in the region of the spaced rods to form free ends respectively for the imbedded portions located between the two spaced rods.

In accordance with a presently preferred embodiment, said rods are each provided with a screw thread, and the step of winding comprises engaging each turn in a successive groove of the respective screw thread. Also, adjacent portions of the turns located between the spaced rods and on opposite sides thereof define two substantially parallel planes. One of the isolating plate carrying connector contact pins is positioned adjacent to each plane between the spaced rods prior to winding. After the winding step, the adjacent portion of the turns lying in one plane are connected to the respective pins carried on the respective adjacent isolating plate.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of the winding apparatus to wind the electrode wires, showing two isolating plates positioned prior to placing the same into the winding apparatus;

FIG. 2 is a transverse cross-section, of a part of the winding apparatus shown in FIG. 1, showing the electrode wires being cut to produce the free writing ends;

FIG. 3 shows a perspective of a writing head produced in accordance with the method illustrated in FIGS. 1 and 2;

FIG. 4 is a perspective view of a portion of the winding apparatus shown in FIG. 1, illustrating another embodiment of the present invention; and

FIG. 5 is a perspective view of a writing head produced in accordance with the method illustrated in FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein the same reference numerals have been utilized for identical parts throughout, and first referring to FIG. 1, this illustrates a winding apparatus generally designated by the reference numeral 10. The winding apparatus 10 has a flange or supporting cross member 11. The flange 11 is supported by a shaft 10a whose direction is substantially perpendicular to the plane of the flange 11. The

flange 11 carries two threaded rods 12 which extend in directions substantially parallel to that of the shaft 10a.

The threaded rods 12 are spaced a predetermined distance from each other and are substantially parallel to one another. Each rod 12 is provided with an upper and a lower elongated cut out portion 13 on its circumferential portion which faces the opposite rod. The provision of the upper and lower elongated cut out portions 13 results in a narrow bar 14 therebetween which acts as a supporting surface to be described. Elongated slots 15 are provided on the circumferential portions of the rods 12 which are diametrically opposite to the narrow bars 14. Thus, the elongated slot 15 in each rod 12 is arranged to open in a direction which faces away from the adjacent rod. Each of the rods 12 is provided with a helical screw thread 12a which act as spacer means for the wire to be wound, as to be described. However, the use of a helical screw thread, while desirable, is not limiting the type of spacer arrangements which may be utilized.

In accordance with one presently preferred embodiment, a plurality of isolating plates 16 are placed above and below the rods 12, as shown in FIG. 1, the width of the isolating plates 16 being selected to be equal to the distance between the facing surfaces of the elongated cutout portions 13. Each isolating plate 16 has embedded therein connecting wires or contact pins 17. The connecting wires 17 are imbedded in the isolating plates 16 in directions which are normally perpendicular to the planes defining the isolating plates 16.

The isolating plates 16 are then placed within the elongated cutout portions 13 by bringing these in contact with the narrow bars 14. This step is generally illustrated by the arrows in FIG. 1. Also suggested in FIG. 1 by the dashed lines is that the isolating plates 16 can be arranged in two rows adjacent to one another. Additionally, a plurality of plates which have a smaller width can be placed between the bars as described above to produce several writing heads which have, however, less writing electrodes.

The shaft 10a of the winding apparatus is held in a suitable motor driven means (not shown) so that the flange 11 may be rotated about the axis of the shaft 10a. A wire, to be discussed in connection with FIG. 2, is wound about the rods 12 by rotating the shaft 10a while shifting wire in the direction of the threaded screws or grooves 12a at a rate which corresponds to the pitch of the thread. Accordingly, the wire is wound about the threaded rods under tension and engages the grooves 12a of the rods 12, so that the electrode wire distances between the different turns which form the helix shaped configuration is fixed and maintained constant between successive turns.

The connecting wires 17 are imbedded, as described above, into the isolating plates 16. These wires extend through the isolating plates so as to provide outwardly directed ends 17a as well as inwardly projecting ends 17b. The outwardly directed ends 17a project beyond the surface of the isolating plate 16 only a short distance for connection to the writing electrodes, as will hereafter be described. On the other hand, the inwardly projecting ends 17b project beyond the surface of the isolating plates 16 a somewhat greater distance, these ends being in the form of plug connecting pins which may be utilized in conjunction with a connector having

female portions which are adapted to receive the projecting ends 17b.

Referring now to FIG. 2, this shows a cross section of the winding apparatus 10 once the isolating plates 16 have been brought to bear against the narrow bars 14. It will be noted, that the inwardly projecting ends 17b from the upper and lower isolating plates may be displaced relative to one another between the rods 12 so as not to engage or interfere with one another. However, should the projecting ends 17b be made somewhat shorter, then, of course, this may not be necessary. With reference to FIG. 2, it is viewed here after the conductor or wire 18 has been wound under tension about the two threaded rods 12. After the winding step has been completed, the ends of the wire are fixed in a conventional manner so as to prevent unwinding upon release. It will be noted, that the outwardly directed ends 17a project towards the wire portions 18a between the rods 12 and terminate in the region thereof. The connecting wires 17 are so spaced from one another in the longitudinal directions of the rods 12, that each successive connecting wire 17 lies adjacent and under a successive turn or wire portion 18. At this time, the portions of the turns located between the two spaced rods are connected to the outwardly directed ends 17a, e.g., by spot welding, resistance welding, laser beam welding, soldering or electron beam welding. In this manner, the electrode wires 18 become connected electrically to the staggered or laterally displaced connecting wires 17. These contacts are designated in the Figure by reference numeral 24. As described above, the inwardly projecting ends 17b are made in the form of a male connector so that they may be mated with a corresponding female connector. The adjacent parallel portions of the turns located between the two spaced rods are generally designated by the reference numerals 18a. These portions generally designate those parts of the turns which are not directly in contact with the rods 12. After the connections have been made between the connecting wires 17 and the electrode wire 18, the spaced parallel relationship of the adjacent portions are fixed by pouring a casting resin 19 onto the conductor portions 18a, which upon hardening, together with the isolating plates 16, form an isolating body 20.

After hardening of the casting resin, in which the wires are now fixedly imbedded, the individual turns of the electrode wire 18 are severed in the regions of the elongated slots 15. According to the presently preferred embodiment, the severing step comprises cutting the turns in the region where they pass over the slots 15 with a grinding wheel or disk 21, which has been schematically shown in FIG. 2. It will be appreciated, that upon cutting of the turns in this manner, each adjacent parallel portion 18a is provided with two opposite ends, each wire now being electrically insulated from its adjacent wires. Typically, the wire is selected to have some resiliency so that upon cutting the same, it will spring to its original configuration prior to winding about the rods 12. After the cutting step, the isolating bodies 20, each comprising of an isolating plate 16 together with its imbedded connecting wires, a plurality of electrode wires or adjacent portions 18a as well as the hardened imbedding material, can be lifted off of the narrow bars 14. Each isolating body 20 now incorporates the advantageous features of the present invention.

The resulting writing head described in connection with FIG. 2, is illustrated in FIG. 3. The isolating body 20 is depicted here to be of transparent casting resin in order to more clearly illustrate the writing head. In this writing head 22, there are illustrated six writing electrodes or adjacent parallel portions 23 which are densely arranged adjacent to one another and imbedded in the resin material. The connecting wires 17 are within the isolating body 20 and are laterally displaced relative to one another at the points where they make contact 24 with the writing electrodes. The connecting wires 17 are shown to project substantially perpendicularly to the direction of the writing electrodes 23 and are suitable to be mated with a corresponding connector (not shown) outside of the isolating body 20.

To finish the ends of the writing electrodes and make them suitable for use for this purpose, the present invention also contemplates imbedding the ends of the writing electrodes in a binding material, e.g., glue or other resinous material, to facilitate the removal of burrs or ridges at the ends formed by the cutting disk 21 and evenly sharpening the same. By aligning the ends of the writing electrodes to lie on a straight line, and uniformly finishing the same, the writing heads are now ready for use. After the finishing steps, the binding material may be removed in any suitable manner well known in the art.

With the writing heads in accordance with the present invention, the writing electrode 23 have ends on both sides of the isolating body 20, these projecting from both ends thereof. Thus, the writing head 22 may be utilized on one side, the other or both sides simultaneously. Thus, by providing the recording material to both sides of the isolating body 20, and applying suitable electrical signals to the connecting wires 17, a record may be imprinted on both of the recording surfaces simultaneously. As explained above, the recording material normally moves in a direction which is normal to the directions of the writing heads.

A second embodiment of the method disclosed in connection with FIGS. 1-3, is illustrated in FIGS. 4 and 5. Here, the threaded rods 12 are shown, while the flange 11 and the shaft 10a have been left out. In this embodiment, the electrode wire 31 is shown already wound about the rods 12. As in the first embodiment, the winding of the wire about the rods 12 produces two sets of adjacent parallel portions 31a which are positioned between the rods 12 and which generally define a plane in which all of the portions on the same side of the rods lie in. In accordance with this method, the isolating plates 16 discussed in connection with FIGS. 1-3 are normally not utilized. Here, a pair of substantially rigid plates 30 are brought into contact with the elongated cutout portions 13, as were the isolating plates in the first embodiment. The supporting plates 30 extend substantially along the entire length of the rods 12 and act as supporting surfaces therebetween, as to be described. A substantially flexible plastic type foil 32 is then placed over the supporting plates 30 prior to winding the electrode wire 31. The plastic foil 32 is supported by the supporting plate 30 to thereby maintain the same in a substantially flat configuration. At this time, the electrode wire 31 is wound about the rods 12, as described in connection with FIG. 1, the electrode wire at least partially covering, the plastic foil 32. After the entire electrode wire 31 has been wound to enclose the entire plastic foil 32, a plastic foil 33 is brought into

contact with the wire sections 31a to effectively cover the same. The two plastic foils 32 and 33, while the winding portions 31a are still under tension, and therefore uniformly spaced, are integrally connected to one another, e.g., by welding or by applying heat to both of the plastic foils to thereby melt the same. The purpose of this step is to fix the relative positions of the winding portions 31a relative to one another as in the first embodiment, this now being accomplished by fixing the position of each winding portion in the fused or intimately connected plastic foils 32 and 33 which prevents the movement of the wire portions 31a.

At this time, the windings of the electrode wire 31 may again be cut along the elongated slots 15 of the threaded rods 12, as described above, and again resulting writing heads are produced. Although not absolutely essential, the plastic foils 32 and 33 are flexible within limits so that they may be deformed, while, of course, the parallel relationships of the winding portions 31a are always maintained parallel within the plastic foils relative to one another.

The resulting writing head 34 which is made in accordance with the method discussed in connection with FIG. 4 is illustrated in FIG. 5. This writing head is suitable for apparatus for picture transmission as well as for so-called numerical writers, in which the entire width of the writing head is utilized. It may be disadvantageous and sometimes impossible, to connect to the writing electrode ends 35 while they are parallel and in the same planes as the writing ends 35a. For such instances, the writing heads in accordance with the present invention, and particularly with the method described in connection with FIG. 4, can be utilized since the resulting writing heads are in the form of flat cables which may be bent around intervening components 36 which may form part of the writing apparatus. The projecting electrode ends 35 project from the now fused plastic foils 32, 33 and lie in a straight line, the ends thereof making contact with a record carrier 37 which may be metallized or covered with a metal lining or deposit which is capable of being oxidized or burned by application of a voltage thereto by the ends 35a. The record carrier 37 travels in the direction shown by the arrow. In this manner, by selectively applying voltages to the ends 35a, while the record carrier 37 is moving, letters, numerals, as well as picture recordings can be made.

The connections to the writing electrodes 35 can either be made at the ends 35b or connecting wires, as described in connection with FIG. 1, may also be included or utilized in the second embodiment. In this case, the connecting wires (not shown) may be imbedded in the inner plastic foil 32 which would, however, normally be made somewhat less flexible to properly hold the connecting wires than it could be if no such connecting wires are utilized. Also, an isolating plate may be utilized in conjunction with the method described in connection with FIG. 4. In this case, however, if the flexibility of the writing head is to be maintained to some extent, the isolating plate which carries the connecting wires may be of narrower width so that the isolating plate itself does not lie on the narrow bars 14, but rather lie on the supporting plates 30. With the width of the isolating plates narrower than that of the writing head between its free ends, the writing head may still be flexed as illustrated in FIG. 5. Also, connecting wires similar to those used in FIG. 1 may be

connected to the free ends of the writing heads so that these are connected to the writing electrode 35. In this case it is advantageous to cover these free ends with casting resin or some other imbedding material to prevent movement of these ends relative to one another to thereby prevent shorts therebetween.

It is also possible, that the free ends of the writing heads 34 be rolled up into circular configurations whose planes lie normal to the plane of the writing head, to thereby form a collector or set of pressure contacts, which may be used in conjunction with a connector having suitable mating surfaces, so that by contact of these respective ends and surfaces the electrode wires 35 may be controlled or have electrical signals applied thereto.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of recording assemblies differing from the types described above.

While the invention has been illustrated and described as embodied in recording heads, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can be applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. Method of constructing recording heads comprising the steps of positioning a plurality of connector electrodes mounted on at least one isolating plate between at least two spaced rods; uniformly winding a wire under tension around said at least two spaced rods so that adjacent turns are substantially parallel to one another; connecting each turn to another of said connector electrodes; embedding adjacent portions of the turns located between the two spaced rods in insulating material to permanently fix the parallel relationship of the adjacent portions; and severing the turns in the region of the spaced rods to form free ends respectively for the embedded portions located between the spaced rods.

2. Method as defined in claim 1, wherein the step of

severing comprises the step of cutting.

3. Method as defined in claim 1, wherein said rods are each provided with a screw thread, and wherein the step of winding comprises engaging each turn in a successive groove of the respective screw thread.

4. Method as defined in claim 1, wherein the adjacent portions of the turns located between the spaced rods and on opposite sides thereof define two substantially parallel planes, and wherein one isolating plate carrying connector electrodes is positioned adjacent to each plane between the spaced rods prior to the winding step; and wherein the step of connecting comprises connecting the adjacent portions lying in one plane to the respective electrodes carried on the corresponding adjacent isolating plate.

5. Method as defined in claim 1, wherein said connecting step comprises soldering.

6. Method as defined in claim 1, wherein said connecting step comprises welding.

7. Method as defined in claim 1, wherein said imbedding step is carried out subsequently to said connecting step to thereby also imbed the connecting points between the turns and the connector electrodes.

8. Method as defined in claim 1, wherein each spaced rod is provided with a longitudinal slot open in a direction which faces away from the other respective rod, the turns passing over said slots when wound under tension, and wherein the severing step comprises cutting the turns along the slots.

9. Method of constructing recording heads comprising the steps of uniformly winding a wire under tension around said at least two spaced rods so that adjacent turns are substantially parallel to one another; imbedding adjacent portions of the turns located between the two spaced rods in insulating material to permanently fix the parallel relationship of the adjacent portions; severing the turns in the region of the spaced rods to form free ends respectively for the imbedded portions located between the spaced rods; fixing the free ends in a binding material; trimming the free ends to make them all lie along a straight line; and finishing the free ends to provide pointed ends suitable for recording heads.

10. Method as defined in claim 9, wherein the step of finishing comprises grinding.

11. Method as defined in claim 9, wherein the step of trimming comprises removing burrs.

12. Method as defined in claim 9, further comprising the steps of removing the binding material after said trimming and said finishing steps.

* * * * *