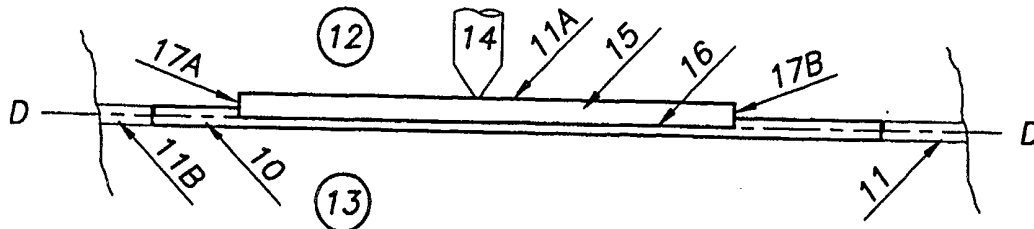




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(54) Title: METHOD AND TOOL FOR MANUFACTURING AN ANTENNA UNIT, AND AN ANTENNA UNIT

**(57) Abstract**

A method for manufacturing an antenna unit, including a resilient, metallic core (10), which is in the form of a wire, and an injected, insulating jacket at least partially enclosing the core, wherein use is made of an injection moulding tool, which is split in a parting plane (D), containing the longitudinal, central axis of the core. The insulating jacket is injection moulded in two steps. The core is in a first step provided with a first jacket portion (15), while the remaining part of the core is supported in a first mould cavity portion (11B), which is adapted to the shape of the core. At least a part of the injection moulding tool and the core with the injected first jacket portion are displaced in relation to each other. In a second step, the still bare part of the core is provided with a second jacket portion, supplementary to the first-mentioned jacket portion, while the core (10) with the injected first jacket portion (15) is supported inside a second mould cavity portion (19), which is adapted to the shape of the first jacket portion.

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**METHOD AND TOOL FOR MANUFACTURING AN ANTENNA UNIT, AND AN
ANTENNA UNIT**

The present invention relates to a method and a tool for
5 manufacturing an antenna unit, in particular an antenna unit
for mobile phones and similar. The invention also relates to an
antenna unit manufactured according to this method.

10 Antenna units for mobile phones normally have a central,
preferably resilient, metallic core, for example in the form of
a wire or tubular core, usually with a circular cross-section,
and a jacket enclosing the resilient core, consisting of a
suitable thermoplastic material, preferably of a kind being
15 particularly fluid, the jacket mainly serving to improve the
aesthetic impression of the antenna unit. The design of the
upper end of the antenna unit and its base may vary from one
manufacturer to another.

Hitherto, attempts have frequently been made to centre the
20 metallic core in the best possible way in a tubular jacket
material, which either is manufactured beforehand or is being
manufactured, for example by injection moulding, when the
resilient core is introduced into the jacket. These operations
are quite cumbersome and usually lead to considerable centering
25 difficulties. The metallic, resilient core may therefore occupy
exceedingly odd positions and bending shapes in the enclosing
jacket.

The purpose of the present invention is to create a method and
30 a tool to be used when manufacturing an antenna unit, which
method may be performed easily and rapidly, and which ensures
that the metallic core occupies a well defined and uniformly
centered position in the manufactured antenna unit. The method
concerns the manufacture of an antenna unit, including a

metallic core, which is tubular or in the form of a wire and which is preferably resilient, and a jacket which encloses the core partially or fully, and which is made of an injectable material. A tool is used for injection moulding, said tool
5 being split in a parting plane comprising the longitudinal, central axis through the core. The method is characterised essentially in that the isolating jacket is injected in at least two steps, wherein the core in a first step is provided with a first jacket portion substantially shaped like a tubular
10 semi-cylinder while the remaining part of the core is supported in a first mould cavity portion adapted to the shape of the core, whereupon at least a part of the injection moulding tool and the core with the injected first jacket portion are displaced in relation to each other, such that the core with
15 the injected first jacket portion is supported in a mould cavity portion shaped for this purpose. Thereafter, the still bare portion of the core, in a second step, is provided with a second jacket portion, being supplementary to the first-mentioned jacket portion and being shaped substantially like a
20 tubular semi-cylinder.

According to the invention, it is suitable that the antenna unit, preferably through combined radial and axial injection, such that a certain rotation and turbulence occurs in the
25 injected material, is provided with a knob, situated in a separate mould cavity around the upper end of the core and in intimate contact with at least the first injected jacket portion. It should also be possible, after minor modification of the tool, to manufacture so called dual-antenna units, i.e.
30 antenna units containing two parallel antenna cores, situated side by side at some distance from each other in said parting plane of the tool. Preferably one is somewhat shorter than the other so as to be adapted to the prevailing frequency intervals.

It should also be possible, after corresponding modifications of the tool, to manufacture also so called telescopic aerials in a similar manner.

5 Further suitable features are stated in claims 2 through 17.

The invention will be described further below with reference to the appended drawings illustrating two embodiments of a tool for manufacturing an antenna unit according to the invention.

10

Figures 1-3 illustrate a first, a second and a third step, respectively, during the manufacturing of an antenna unit according to a first embodiment.

15 Figures 4-6 illustrate a second embodiment wherein a tool is used with a fixed and a rotary part.

For a full understanding of the first embodiment according to figures 1-3, these figures should be placed side by side, from
20 left to right on the drawing, with the parts of the antenna core aligned with each other.

According to figure 1, a core wire 10 of a suitable, preferably resilient material, for example a nickel-titanium alloy, and
25 with an outer diameter of, e.g., 0,9 mm, is introduced into a first mould cavity, generally referred to as 11, between two tool halves 12 and 13. This first mould cavity 11 is designed in such a way that one can provide the core wire 10, through injection of a suitable plastic material, into a first portion
30 11a of the tool part 12 through channels 14, with a first jacket portion 15 shaped like a tubular semi-cylinder with a substantially uniform wall thickness, lateral surfaces 16 parallel with the parting plane D of the tool, and end wall surfaces 17A, 17B transverse to the axis of the core wire 10.

Now, the core wire rests with one half thereof in a groove 11B in the lower tool half 13.

5 In accordance with figure 2, the core wire is thereafter moved axially a distance corresponding to at least the length of the first jacket portion 15, whereupon the core wire, through injection of a plastic material, is provided with a second jacket portion 18, whereas the first jacket portion 15 with the enclosed core wire is resting in a mould cavity 19, adapted to 10 the first jacket portion 15 in the upper mould half 12. One realises that the core portions 15 and 19 are substantially identical in shape. However, it may be preferable that, as illustrated in figure 2, the second injected jacket portion, through corresponding shaping of the mould cavity intended for 15 this jacket portion, is given a shorter axial length than the first injected jacket portion.

In the first injection step, the position of the unit is controlled in that one half of the core wire is guided in its 20 groove, and during the second injection step, the position of the unit is controlled in that the first jacket portion with enclosed core wire is guided in a groove designed for this purpose in the upper tool part 12.

25 If desired one may, as indicated in figure 3, as a last step, provide the antenna unit with a properly shaped protective knob, preferably during injection of the plastic in a combined axial and radial direction, such that one achieves, for the best possible injection, a favourable rotational movement and 30 turbulence of the plastic material.

A person skilled in the art realises that, at a suitable instant, preferably after the completion of the second step of the core injection, in connection with the closing of the tool

for injection of the illustrated knob, the core wire is cut off, for example in the plane K illustrated in figure 3.

5 In the embodiment according to figures 4-6, a wire blank is inserted in a fixed tool part (fig. 4) and is cut off by means of a device 21. Half of the wire blank is covered by injection of plastic material, preferably while retaining supporting tabs. Thereupon, a movable tool part (figure 5) is rotated half a turn around an axis 21, whereupon the other half of the cut
10 wire blank is covered by injection material until a complete product is achieved. Concurrently, newly inserted wire blanks are half covered by injection material. After each injection, fully manufactured antenna units are output from the tool.

15 As illustrated in figure 4, each time four wires are inserted into the fixed part of the tool, whereupon the tool is closed and the wires are cut off. Thereafter, half the surface of the wire and a part of the core knob are covered by injection material.

20

The tool is now opened with its movable part, whereupon the semi-finished details are lifted. Thereafter, the movable tool part is rotated and brings with it its semi-finished details to the opposite part (the left part of figure 4) of the fixed tool
25 part, and concurrently new wire is inserted into the fixed tool part (the right part of figure 4). Thereafter, the tool is closed and the semi-finished parts are kept in their mould cavities which now constitute mould cavities for a safe fixation of the jacket portions with accompanying cores.

30

Thereafter, the second jacket portion and the remaining part of the knob are covered by injection material, as illustrated in figure 6.

CLAIMS

1. A method for manufacturing antenna units including a metallic core, which is tubular or in the form of a wire, and a jacket composed of an injectable, insulating material, at least partially enclosing the core, wherein use is made of an injection moulding tool, which is split in a parting plane containing the longitudinal, central axis of the core

characterised in

10

- that the insulating jacket is injection moulded in at least two steps,

15

- wherein the core, in a first step, is provided with a first jacket portion substantially shaped as half a tubular cylinder, while the remaining parts of the core are supported inside a first mould cavity portion, adapted to the shape of the core,

20

- whereupon at least a part of the injection moulding tool and the core with the injected first jacket portion are displaced in relation to the other, such that the core with the injected first jacket portion is supported inside a second mould cavity portion, which is adapted to this

25

purpose,

30

- whereupon the still bare part of the core, in a second step, is provided with a second jacket portion, supplementary to the first-mentioned jacket portion and being shaped substantially as half a tubular cylinder.

2. Method according to claim 1, **characterised in**

- 5 - that, after said first step, the core (10) with the injected first jacket portion (15), is fed forward axially a distance corresponding at least to the length of the first jacket portion.

3. The method according to claim 1 or 2, **characterised by**

- 10 - that said first jacket portion is given a substantially even wall thickness, with lateral sides (16) situated in said parting plane and end walls (17A, 17B) positioned counter to the jacket axis and,
- 15 - that said second jacket portion is given a substantially even wall thickness, lateral sides situated in said parting plane, and end walls positioned counter to the jacket axis.

4. The method according to any one of claims 1 to 3,

20 **characterised in**

- that the second injected jacket portion (18), by a corresponding design of the mould cavity intended for this jacket portion, is given a smaller axial length than the
- 25 jacket portion injected first.

5. The method according to any one of claims 1 to 4,

characterised in

- 30 - that the antenna unit, during a third injection step, is provided with a knob (20), situated in a mould cavity around the upper end of the core and in intimate contact with at least the end of the core and the first injected jacket portion.

6. The method according to claim 5, **characterised in**

- 5 - that the injection during the third step is performed through combined radial and axial injection into said mould cavity, in such a way that a certain turbulence and rotation of the injected material occurs.

7. The method according to any one of claims 1 to 4,

10 **characterised in**

- that the antenna unit during the first and/or the second injection steps is provided with a knob (20).

15 8. The method according to claim 1, **characterised in**

- that, after said first step, a movable part of the tool is rotated a half turn in relation to a fixed part of the tool,
- 20 - wherein the core with its injected first jacket portion is brought from said first mould cavity, situated in the first tool part, to a mould cavity corresponding to said second jacket portion, also situated in the fixed tool part, and
- 25 - wherein the mould cavity, which is used for injection of the first jacket portion, is situated in the movable tool part and constitutes during said second step, said second mould cavity.

30 9. The method according to claim 8, **characterised in**

- that said first and second steps are performed concurrently in two opposite parts of the tool.

10. The method according to claim 8 or claim 9, **characterised in**

- 5 - that several antenna units are manufactured concurrently in said both opposite parts of the tool.

11. The method according to any one of claims 8 to 10, **characterised in**

- 10 - that, after each turn of the moveable tool part and expulsion of a respective ready-made antenna unit, one or several wire blanks, intended to constitute said core or cores, are inserted into the fixed tool part.

15 12. Tool for manufacturing an antenna unit in accordance with the method defined in claim 1, wherein the antenna unit contains a metallic core, which is tubular or in the form of a wire, and a jacket composed of an injectable, insulating material, at least partially covering the core, wherein use is
20 made of an injection moulding tool, which is split in a parting plane containing the longitudinal, central axis of the core, **characterised in**

- 25 - that the tool is provided with two separate mould cavities, namely a first mould cavity (11A), in which the core during a first step is provided through injection with a first jacket portion (15) shaped as half a tubular cylinder, while the remaining part of the core is supported in a mould cavity portion (11B) adapted to the shape of the core, and a
30 second mould cavity, situated at a distance from the first mould cavity, in which the still bare part of the core, correspondingly, in a second step is supplied with a second jacket portion, supplementary to the first mentioned jacket portion (18), shaped as half a tubular cylinder, while the

core with the injected, first jacket portion is supported in a second mould cavity portion (19), shaped for this purpose.

13. Tool according to claim 12, **characterised in**

5

- that the tool has a separate mould cavity for receiving one end of the core for forming a knob (20) onto the core.

14. Tool according to claim 13, **characterised in**

10

- that said separate mould cavity during a third injection step is in intimate contact with at least the outer end of the core and said jacket portion.

15. Tool according to claim 12, **characterised in**

15

- that a separate mould cavity, for forming of at least a part of a knob on one end of the core, is connected to said first mould cavity.

20

16. Tool according to any one of claims 12-15, **characterised in**

- that the tool has at least one more mould cavity, extending in parallel to the other mould cavities, at some distance from these and in the same mould parting plane, for injection of a jacket onto an additional core, extending in parallel to the first mentioned core, for forming a so called dual antenna.

25

17. Antenna unit manufactured according to a method as defined in any one of claims 1-11.

30

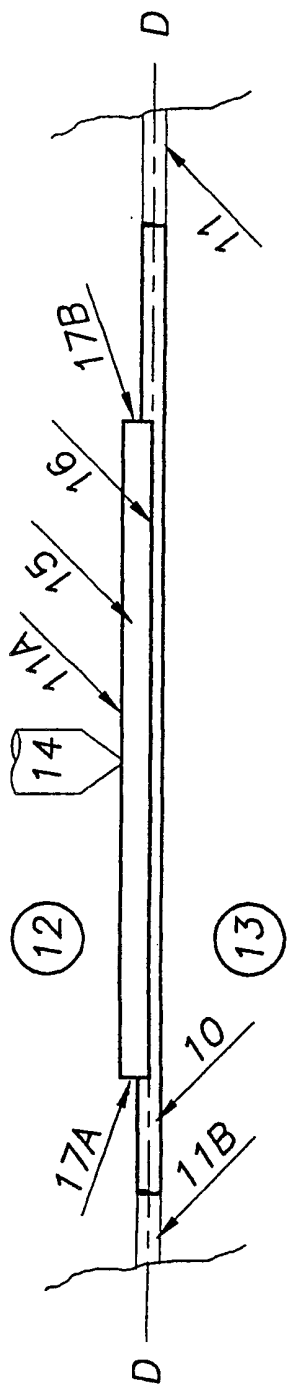


FIG. 1

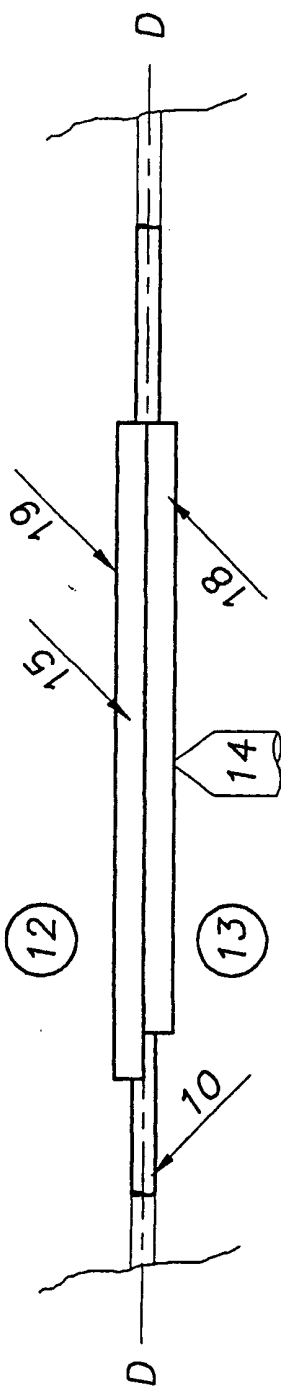


FIG. 2

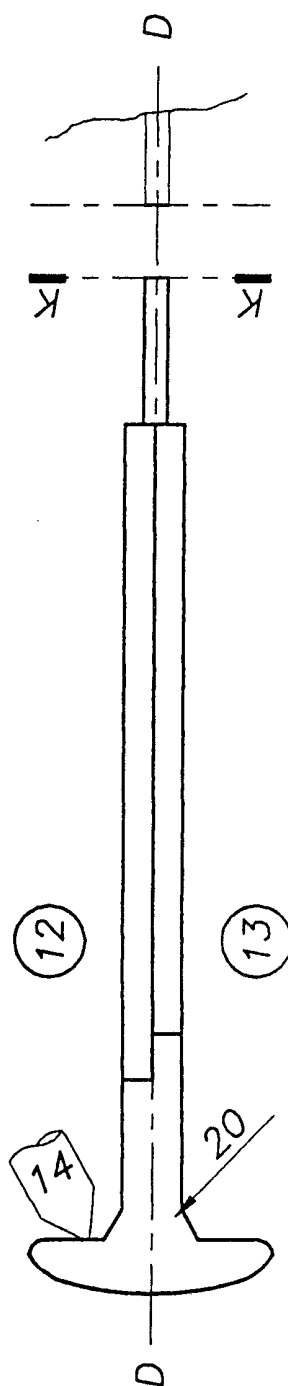


FIG. 3

FIG. 4

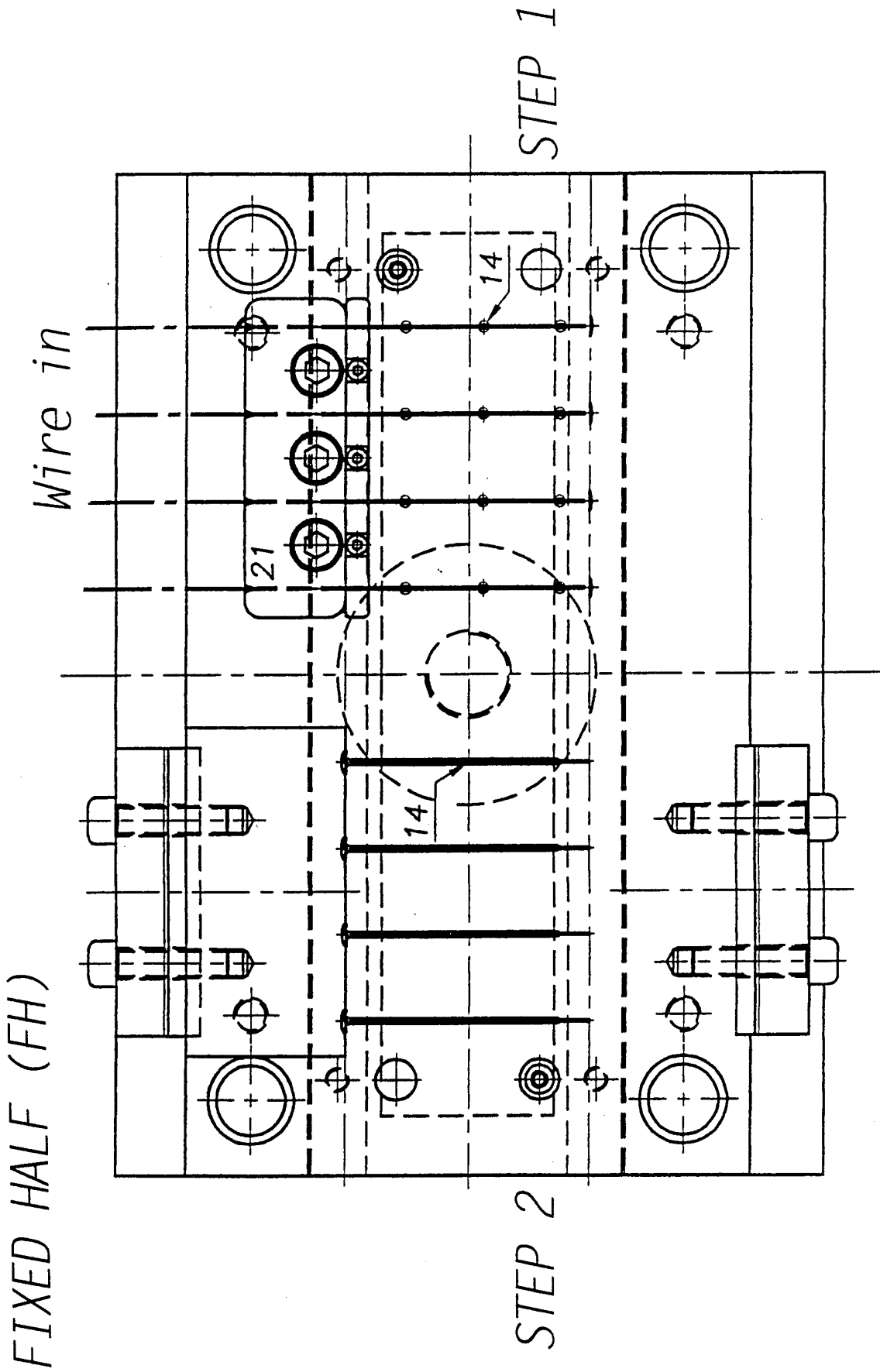


FIG. 5

MOVEABLE HALF (MH)

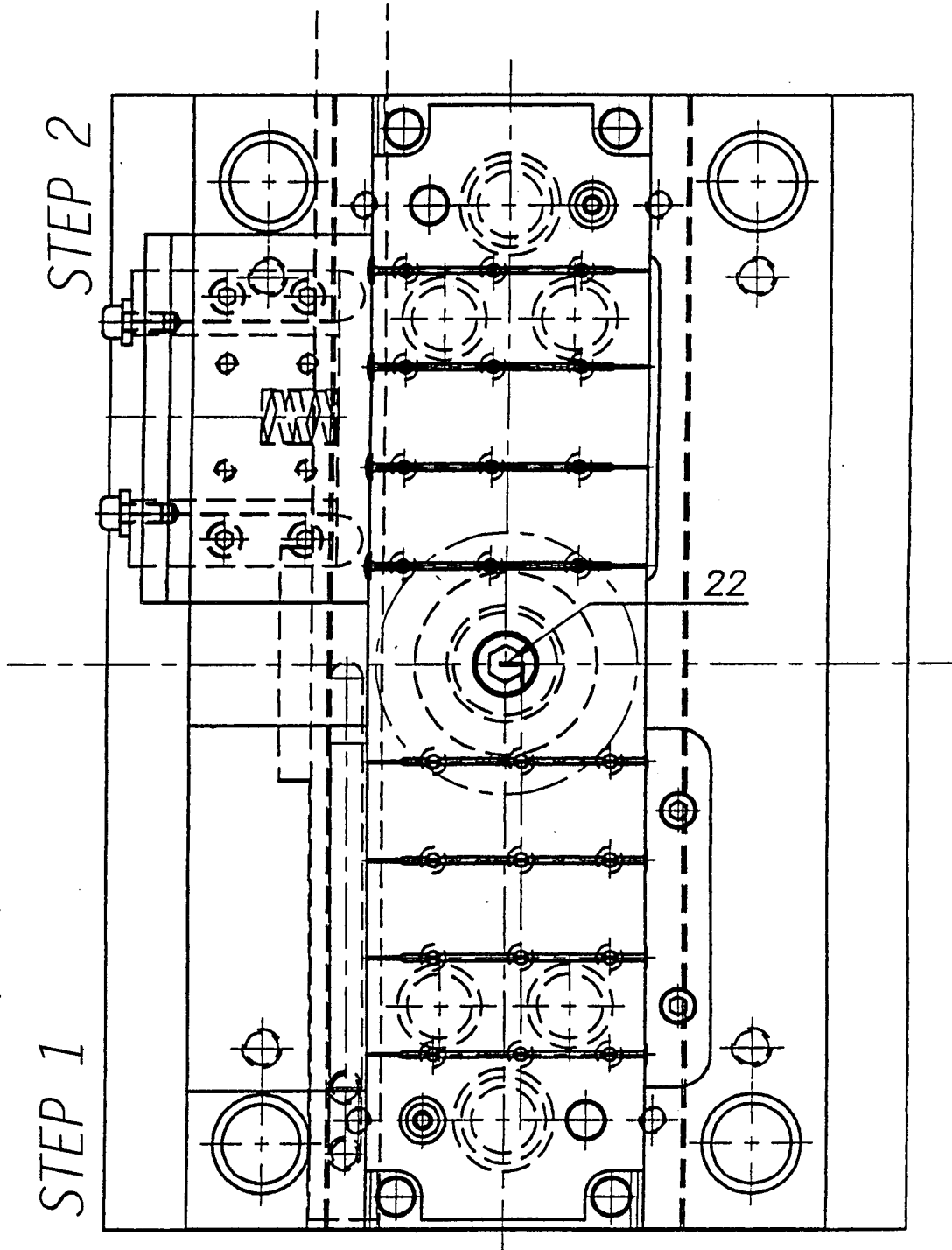
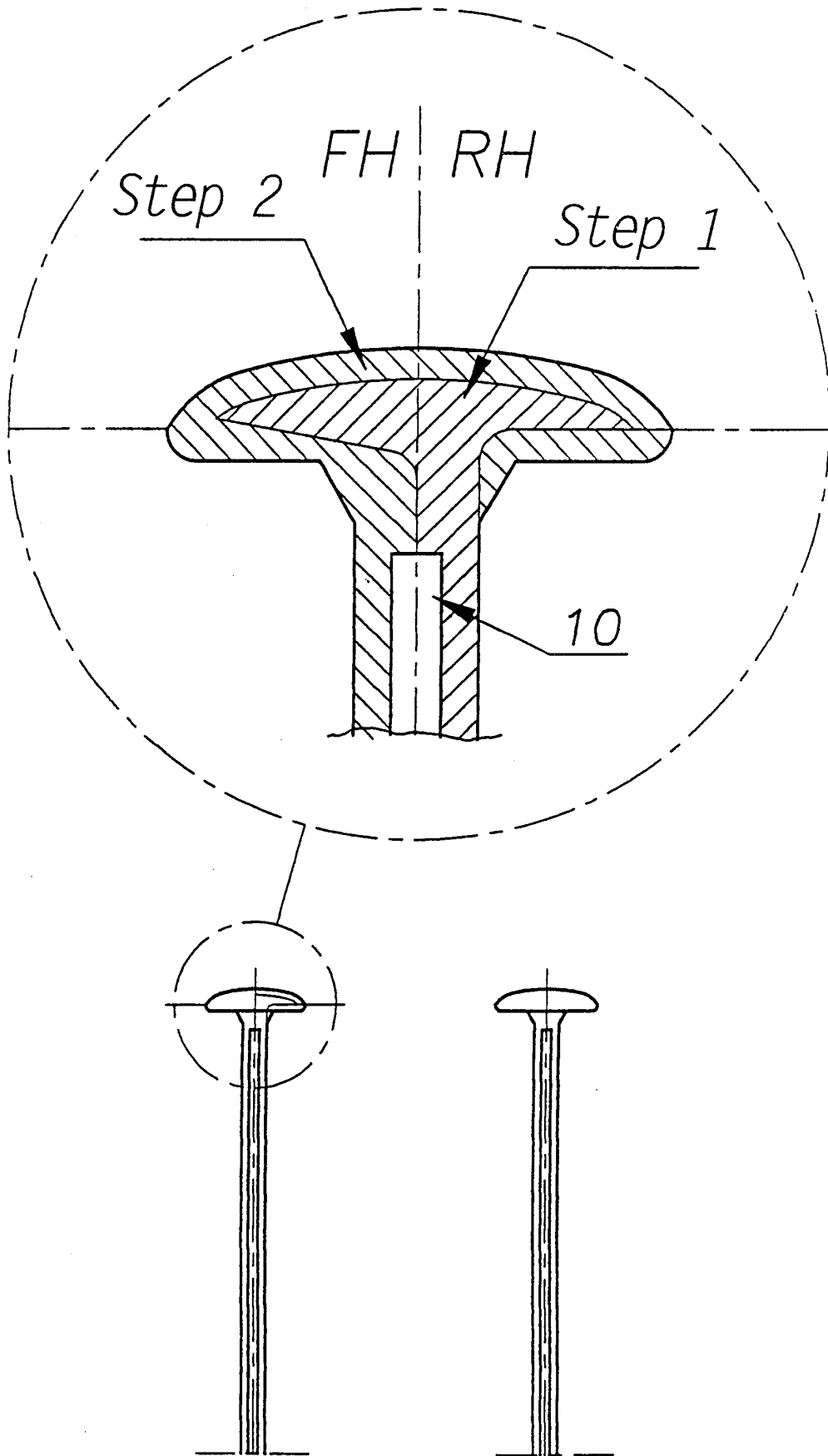


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 99/00379
A. CLASSIFICATION OF SUBJECT MATTER
IPC6: H01Q 9/30, H01Q 1/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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WPI, EPODOC
C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5341149 A (VELI-MATTI VALIMAA ET AL), 23 August 1994 (23.08.94), claim 1 --	1-17
A	US 4725395 A (BERNARD V. GASPARAITIS ET AL), 16 February 1988 (16.02.88), claim 1, abstract --	1-17
A	GB 2305298 A (ANDREW JESMAN ET AL), 2 April 1997 (02.04.97), abstract --	1-17
A	Patent Abstracts of Japan, abstract of JP 9-174596 A (MURATA MFG CO LTD), 8 July 1997 (08.07.97) --	1-17



Further documents are listed in the continuation of Box C.



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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	US 5836072 A (JONATHAN LEE SULLIVAN ET AL), 17 November 1998 (17.11.98), claim 1, abstract ----- -----	1-17

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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US 5836072 A	17/11/98	NONE	