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(71) Applicant: **Top Glass S.p.A.**
20096 Pioltello, Milano (IT)

(72) Inventor: **Branca, Alfonso**
20145 Milano (IT)

(74) Representative: **Sutto, Luca**
Bugnion S.p.A.,
Via Carlo Farini 81
20159 Milano (IT)

(54) Method of making whip antennas and whip antenna made thereby

(57) The invention relates to a method of making whip antennas comprising the steps of manufacturing an elongated body (2) capable of receiving and transmitting radio signals and producing, by material removal, a surface working defined by a recess of helical shape (16) distributed over an outer surface (2a) of the elongated body. It is also described an antenna made by said method.

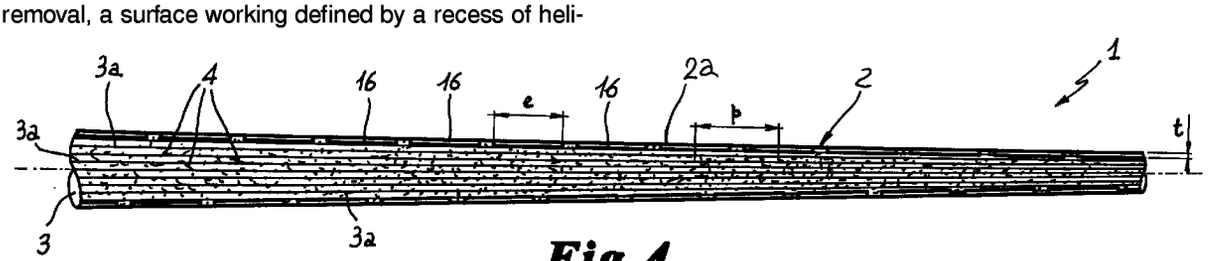

Fig.4

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Description

The present invention relates to a method of making whip antennas and to a whip antenna made thereby.

In particular, a preferential reference is made to whip antennas to be used on motor-vehicles for both receiving and transmitting radio signals.

It is known that whip antennas for motor-vehicles substantially have a greatly elongated cylindrical or cone-shaped conformation and are usually made either of a metal material or of a plastic material reinforced with fibres of different kinds.

In use, all antennas of the above typologies have a drawback in that they are very noisy (giving rise to annoying whistles and buzzes) if they are impinged on by an air flow at a sufficiently high speed relative to the antenna itself.

This is due to the strong turbolence and drag effects caused by the circular-section conformation of this type of antennas.

In order to overcome the above mentioned drawback, it has been recently widely promoted the use of whip antennas in which an outer spiral element made of steel, copper or other material is associated with the true antenna body so that on the whole an uneven surface is defined that, when impinged on by an air flow, better succeeds in breaking current lines, thereby greatly reducing those noise phenomena that are typical of antennas with a smooth surface.

It is however to note that the use of the outer spiral element makes the antenna manufacturing process much more complicated due also to the fact that, in order to ensure an appropriate engagement between the spiral element and the antenna body, a final step is required for application of an outer sheath of plastic material, of the heat-shrinkable type for example, in order to cause a stable engagement of the spiral element.

In conclusion, the additional manufacturing steps to which in this case an antenna needs to be submitted greatly increase the production costs of same, due both to the use of further components to be added to those strictly required for a correct electromagnetic operation of the antenna itself, and to the considerable reduction in the production rates.

It is to note that there is a particular demand for reducing the antenna manufacturing time to a minimum above all when antennas made of reinforced resin are concerned. Actually, due to their own nature, these antennas can be obtained at high production rates by continuous processes.

Under this situation, it is a fundamental aim of the present invention to devise a method of making whip antennas and a new antenna made by adopting said method, which are capable of substantially overcoming all the above mentioned drawbacks.

In particular, it is an object of the present invention to provide a method enabling production of whip antennas capable of operating in a correct manner, that is without producing undesired noise or whistles, even under the hardest aerodynamic conditions, without on the other hand requiring the use of additional components or additional working steps susceptible of impairing the production rates of said antennas.

The foregoing and further objects that will become more apparent in the progress of the present description are substantially achieved by a method of making whip antennas and an antenna made by said method, in accordance with the description of the appended claims.

Further features and advantages will best be understood from the detailed description of a preferred and non-exclusive embodiment of a method and an antenna in accordance with the invention. This description will be taken hereinafter with reference to the accompanying drawings given for purposes of illustration only and therefore not intended to be limiting, in which:

- Figs. 1 to 6 are fragmentary views in longitudinal section of different embodiments of an antenna in accordance with the invention; and
- Fig. 7 diagrammatically shows a production line for the concerned antennas, by way of example only.

With reference to the accompanying drawings, a whip antenna in accordance with the present invention (only partly shown in the drawings) has been generally identified by numeral 1 in Fig. 1.

The whip antenna 1 comprises an elongated main body 2 that in this case preferably has a greatly elongated cone-shaped conformation. Obviously the main body 2 may also be of cylindrical conformation, the shape being not of importance to the invention.

The main body 2 may be made of a plastic resin 3, a polyester resin for example. As the case may be, the polyester resin may either be of an insulating type (see Figs. 1 and 2) or incorporate particles, microgranules or microfibres in a preset amount for example, of an electrically conductive material such distributed as to give the whole elongated body 2 good electric and electromagnetic features and consequently a good capability to receive and transmit radio signals (see Figs. 3, 4, 5 and 6). For more details in this connection, please refer to the European Patent Application No. 96830529 in the name of the same Applicant and herein incorporated by reference.

In the case in which the plastic resin is on the contrary insulating, an electrically conductive thread-like element 5 is coaxially disposed inside it and it extends along the whole longitudinal axis of the elongated body. This thread-like element may be made either of a metal material, such as copper, aluminium or other metals, or another material such as a carbon material which combines excellent electrical-conductivity characteristics with good mechanical characteristics.

It is to note that, in order to improve features of

antennas already provided with a conductive elongated body, introduction thereinto of said electrically conductive thread-like element too may be in any case convenient (see Figs. 5 and 6).

In an original manner, the elongated body 2 at one outer surface 2a thereof shows a surface working defined by at least one or, optionally, more recesses 16 distributed along at least one longitudinal portion of the elongated body and such arranged that, when the antenna is in use, they reduce the turbolence effects and the resulting drag effects caused by air flows impinging on the antenna itself when it is installed on a moving vehicle. In other words, the recesses are such formed that, section by section, they define shapes capable of conveniently directing the air flow in a manner adapted to minimize the turbolence and slipstream effects so that the antenna noise is consequently reduced.

Preferably a single recess 16 is provided which is defined by a continuous cavity of helical shape along the longitudinal portion of the elongated body. This continuous cavity of helical shape has its axis corresponding with the elongated body axis and a predetermined pitch (p). It is to note that generally the longitudinal portion concerned with the surface working may correspond with part or all of the extension of the elongated body 2 outer surface. It is also to note that the pitch (p) of the continuous cavity of helical shape may be constant or variable along the antenna axis. In any case, whether the cavity is of a constant or a variable pitch, it has an extension (e) measured in the longitudinal direction which is included between a minimum value (Figs. 1, 3, 5) in which this extension is greatly lower than the cavity pitch (p), and a maximum value (Figs. 2, 4, 6) in which the extension (e) is substantially of same value as said pitch. It will be recognized that by varying pitch (p) or the longitudinal length of extension (e), a very wide range of surface workings and, as a result, aerodynamic effects, can be achieved. Another parameter of the cavity is given by the cavity depth (t) measured in a radial direction.

From a production point of view, the whip antenna 1 may be made either continuously, as shown in Fig. 7, or by the use of moulding techniques (not shown). Upon a more detailed examination of the plant shown in Fig. 7, one can see that first of all the elongated body must be submitted to a manufacturing process to enable it to receive and transmit radio signals. For this reason, the manufacturing process is comprised of a first step in which a plastic resin in a liquid or fluid state is mixed with particles of an electrically conductive material. (This step is not shown in the figure). Subsequently, a reinforcing fibre 3a is continuously unwound from a supply station 6 and moves on towards one or more guide grids 7 until it reaches a soaking station 8, for example consisting of one or more tanks inside which the fibre 3a suitably guided is immersed in the plastic resin mixed with electrically conductive material. Subsequently the soaked fibres, after one or more wringing steps, are sent to the workpiece preforming and forming stations 9. At the forming station or immediately downstream, polymerizer means 10 operates which for example consists of heating elements, lamps or still other devices that cause cross-linking of the workpiece which in this way takes a rigid structure. Also provided downstream of the polymerization station is one or more driving units 11 carrying out movement of the workpiece which is ultimately sent to a transverse-cutting station 12 in order to produce elements of a discrete length (i.e. elongated bodies) that will subsequently undergo surface-grinding, painting and still further operations. Preferably, during said surface-grinding operation carried out on said elements of discrete length or elongated bodies a surface-working step is also performed which causes formation of one or more of said recesses in at least one longitudinal portion of the elongated body. Preferably it is to note that said surface working is obtained by material removal and defines, as shown in the drawings, a single continuous recess extending over the outer surface of the longitudinal portion and identified by a cavity of substantially helical shape, as already said in detail in the preceding description concerning the structure of the whip antenna in accordance with the invention, to which reference is made.

If the antenna manufacture takes place by moulding, obviously the surface working can be directly achieved during this step, by conveniently shaping the inner surfaces of the moulds.

The invention achieves important advantages.

Actually, it is to note that by virtue of the method of the invention, a whip antenna can be manufactured that, although involving a surface working adapted to reduce the noise produced by same under operating conditions, it does not imply important additional costs due to production complexities or to the necessity of employing further structural elements in addition to those strictly required from the electromagnetic point of view.

The method of the invention is quite adapted to be combined with continuous working processes such as those for producing antennas in a plastic matrix with a reinforcing fibre.

In addition, due to the particular nature of the method and the product in question, antennas having different aerodynamic characteristics may be obtained by merely varying either the pitch (p) or the extension (e) or the depth (t).

Since the surface working is directly obtained on the elongated body, it is apparent that by utilizing usual automatic systems for material removal said parameters can be modified very easily and without involving additional costs.

Claims

1. A method of making whip antennas comprising the step of:

- manufacturing an elongated body (2) capable of receiving and transmitting radio signals, characterized in that it further comprises the step of:
- carrying out a surface working at least at one outer surface (2a) of a predetermined longitudinal portion of the elongated body (2), which surface working is defined by at least one or more recesses (16) distributed over said outer surface (2a).

2. A method as claimed in claim 1, characterized in that said surface working is obtained by material removal.

3. A method as claimed in claim 1, characterized in that said at least one recess (16) is continuous and extends along the outer surface of the longitudinal portion.

4. A method as claimed in claim 1, characterized in that said recess (16) is a cavity of substantially helical shape, the axis of which is coincident with a longitudinal axis of the elongated body and which has a predetermined pitch (p).

5. A method as claimed in claim 4, characterized in that said cavity has an extension (e), measured in the longitudinal direction, which is included between a minimum value, in which said extension (e) is greatly lower than pitch (p) in the cavity of helical shape, and a maximum value in which said extension (e) is substantially of same value as said pitch (p).

6. A method as claimed in claim 1, characterized in that said manufacturing step comprises the following sub-steps:

- mixing a plastic resin (3) in the liquid state with particles of an electrically conductive material (4);
- soaking a predetermined reinforcing fibre (3a) in said plastic resin;
- addressing said soaked reinforcing fibre (3a) to a forming station (9) to obtain a continuous semi-finished product;
- solidifying said continuous semi-finished product;
- transversely cutting the continuous semifinished product to obtain a plurality of elements of predetermined length each intended for defining said individual elongated bodies (2).

7. A method as claimed in claim 6, characterized in that said surface-working step is carried out simultaneously with a grinding step on the surface of the elongated body (2).

8. A whip antenna comprising an elongated body (2) capable of receiving and transmitting radio signals, characterized in that, at an outer surface (2a) thereof it is provided with a surface-working defined by at least one or more recesses (16) distributed along at least one longitudinal portion of said elongated body (2) and arranged to reduce, under the antenna use conditions, turbolence effects caused by air flows impinging on the antenna itself.

9. An antenna as claimed in claim 8, characterized in that said at least one recess (16) comprises a continuous cavity of helical shape extending along said longitudinal portion, the axis of which is coincident with the longitudinal axis of the elongated body and which has a predetermined pitch (p).

10. An antenna according to claim 9, characterized in that said cavity has an extension (e), measured in a longitudinal direction, which is included between a minimum value in which said extension (e) is greatly lower than pitch (p) of the helically-shaped cavity, and a maximum value in which said extension (e) is substantially of same value as said pitch (p).

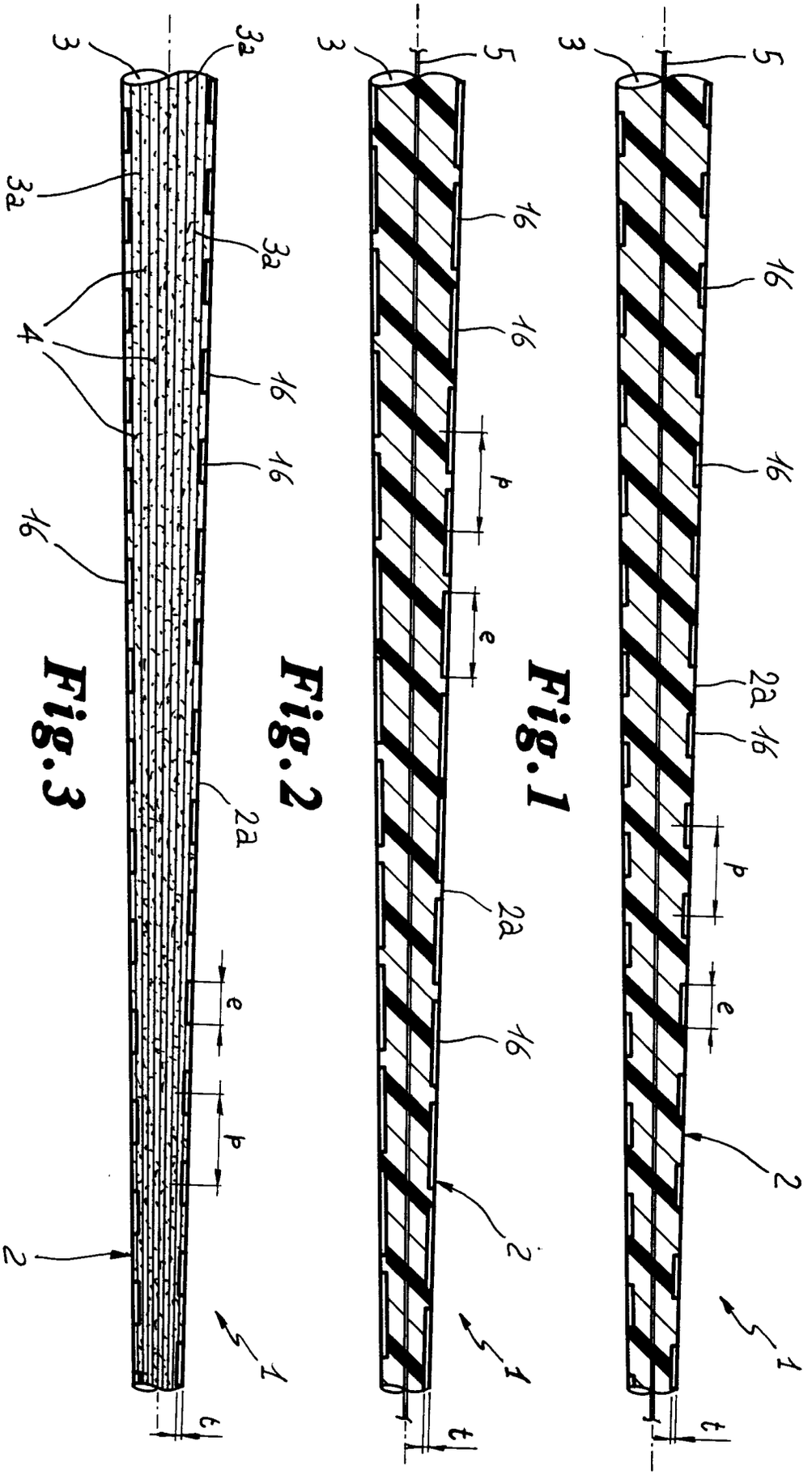

Fig.1

Fig.2

Fig.3

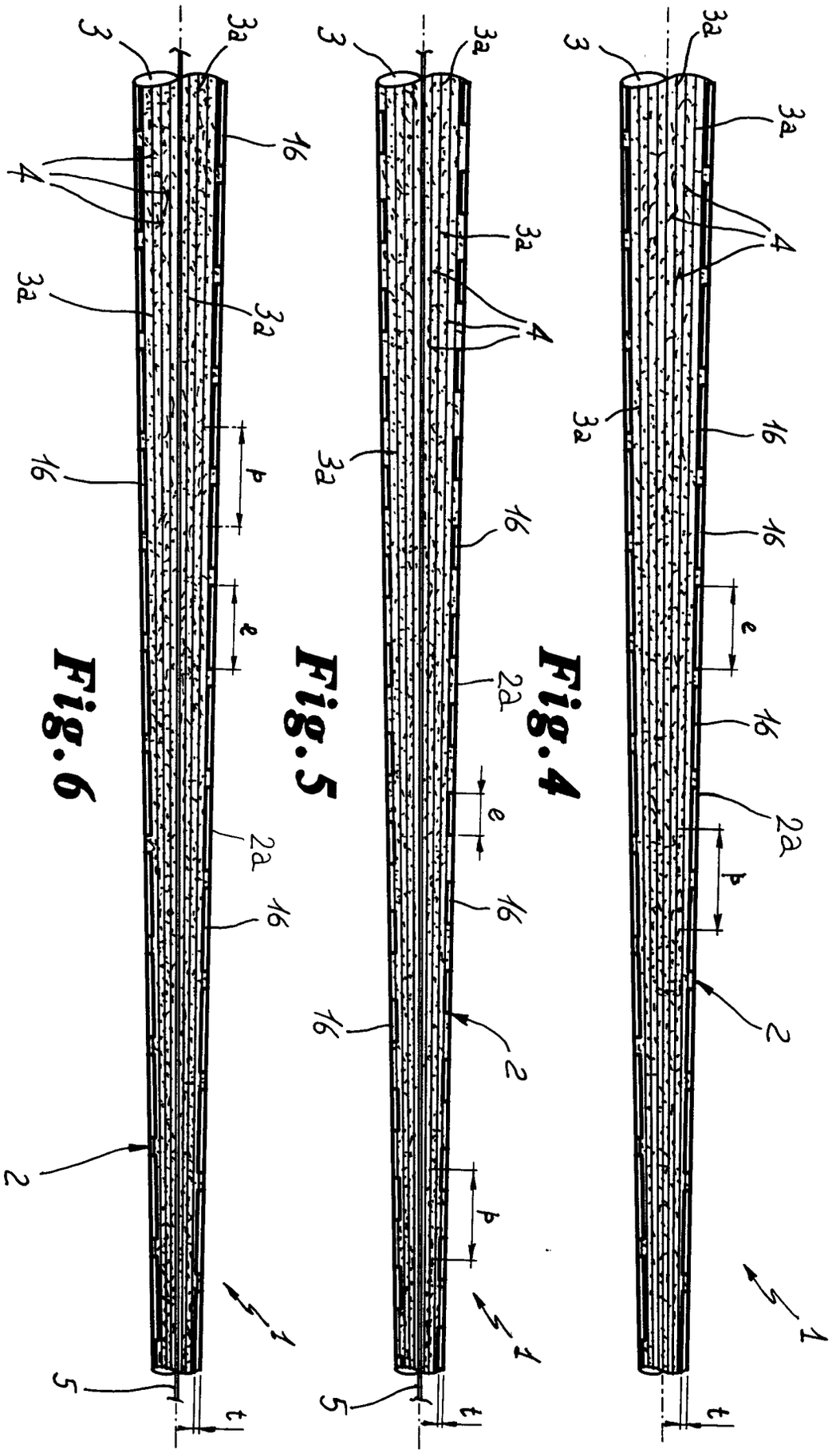

Fig.4

Fig.5

Fig.6

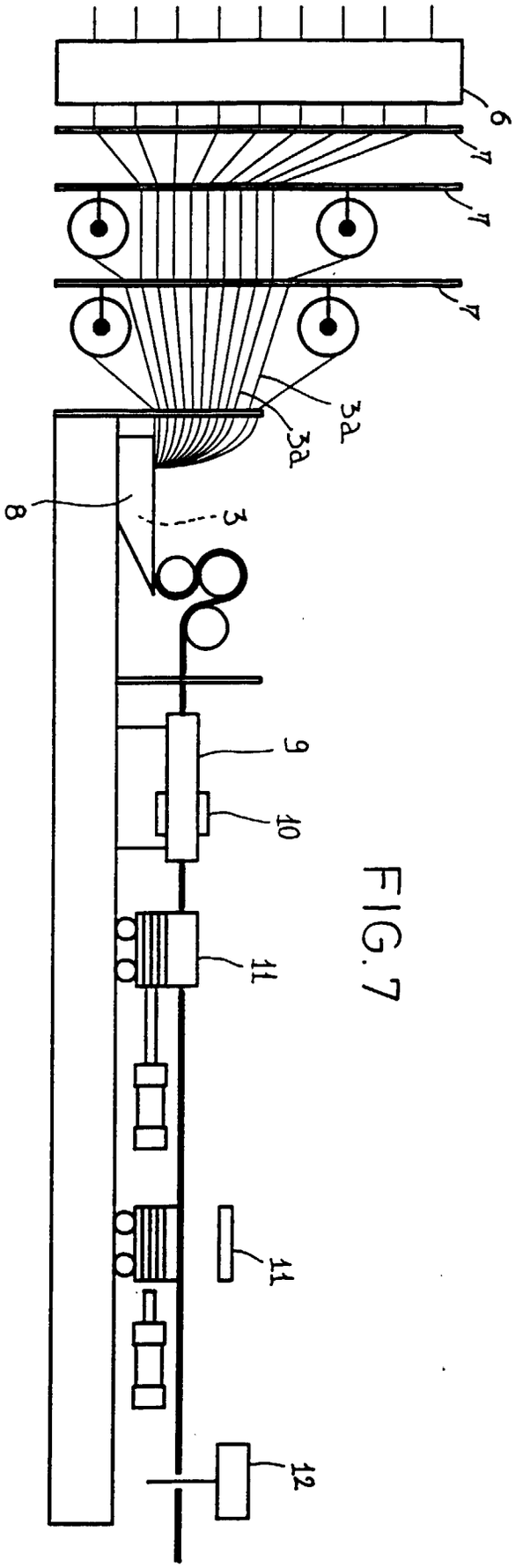

FIG.7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 83 0087

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	DE 195 16 889 A (BOSCH GMBH ROBERT) 14 November 1996 * the whole document *	1-10	H01Q9/30 H01Q1/32
X	EP 0 627 782 A (MECANIPLAST) 7 December 1994 * column 3, line 5-53; figures 1-5 *	1-5,8-10	
A		6,7	
X	DE 28 46 344 A (DAIMLER BENZ AG) 8 May 1980 * the whole document *	1-5,8-10	
A		6,7	
X	DE 38 22 664 A (KATHREIN WERKE KG) 16 February 1989 * column 4, line 51 - column 6, line 23; figures 1-3 *	1,3-5, 8-10	
X	EP 0 420 567 A (HARADA IND CO LTD) 3 April 1991 * column 4, line 13 - column 5, line 33; figures 5,7 *	1,3-5, 8-10	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H01Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 July 1997	Van Dooren, G

CATEGORY OF CITED DOCUMENTS

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