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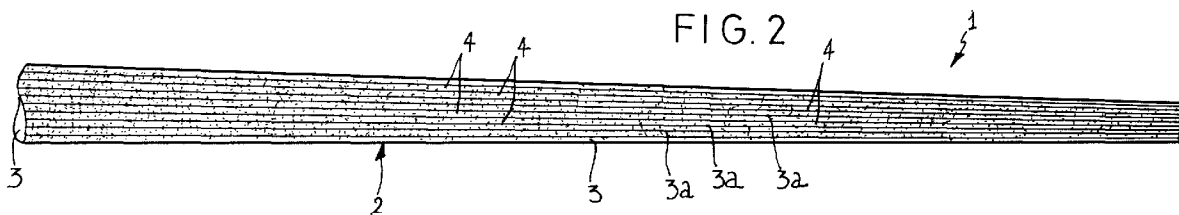
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(54) **A whip antenna**

(57) A whip antenna (1) comprises a main body (2) of a plastic resin (3) incorporating reinforcing fibres (3a) as well as homogeneously distributed particles (4) of an

electrically conductive material adapted to give the whole main body (2) good characteristics in terms of electric conductivity and capability of transmitting-receiving radio signals.



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## Description

The present invention relates to a whip antenna to be used in particular on motor-vehicles for both receiving and transmitting radio signals.

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

In particular, the last-mentioned type of antenna has been recently very successful on the market due to the good features in terms of lightness in weight, mechanical flexibility and reduced production costs that said antennas are capable of ensuring.

It is however to point out that in order to be able to conveniently transmit and receive radio signals, antennas made of reinforced plastic material must necessarily have a thread-like element inside them, which element is made of an electrically conductive material, copper for example, and extends along the longitudinal axis of the antenna itself.

The presence of said conductive element to be buried into the plastic matrix gives rise to some complications from a manufacturing point of view and surely to some important disadvantages in terms of production costs.

It is in fact to note, with reference to the antenna manufacturing process, that the element of electrically conductive material must be put in place perfectly in register with the longitudinal antenna axis in order to ensure a perfectly uniform behaviour in the finished antenna both from an electromagnetic and from a mechanical point of view.

In addition, since during a second step the element of electrically conductive material is to be electrically connected with the whip antenna stand and therefore the wireless apparatus with which the antenna is associated, in the finished antenna a stripping operation needs to be carried out on an end portion thereof, in order to bare at least one predetermined portion of the inner conductive element.

Obviously, this additional and on the other hand unavoidable final operation greatly affects the overall costs of the finished product in terms of percentage.

Not to forget is the fact that, since a conductive element is to be provided within the plastic matrix, constant checkings in order to ascertain the electrical continuity and structural integrity of said conductive element are necessarily required.

The above checkings obviously make the production line more complicated and in any case do not eliminate the risk that the finished product may just the same exhibit failures in the electrically conductive element, of such an extent that final discarding of the product becomes necessary, which will bring about obvious drawbacks from an economic point of view.

Under this situation, it is a fundamental aim of the

present invention to devise a whip antenna and a method of production of same that are capable of substantially overcoming all the above mentioned drawbacks.

In particular, it is an object of the present invention to provide a whip antenna made of a reinforced plastic resin in which the need of a thread-like element of electrically conductive material, usually present in antennas of the traditional type as the element for receiving and radiating signals, is obviated.

In this connection it is to note that elimination of this element has always been considered as substantially impossible, due to the necessity to make antennas provided with an as regular as possible transmitting-receiving pattern (or directivity function), in particular with reference to whip antennas adapted for motor-vehicles.

Notwithstanding this obvious technical prejudice, the Applicant has surprisingly succeeded in overcoming all mentioned drawbacks and making a whip antenna devoid of the central thread-like element of metal material, of a type as claimed in the appended claims.

Further features and advantages will become more apparent from the detailed description of some preferred embodiments of a whip antenna in accordance with the present invention, taken hereinafter with reference to the accompanying drawings given by way of non-limiting example, in which:

- Fig. 1 diagrammatically shows a production line for antennas in accordance with the present invention;
- Fig. 2 is a fragmentary longitudinal sectional view to an enlarged scale of a first embodiment of a whip antenna in accordance with the present invention;
- fig. 3 is a fragmentary longitudinal sectional view to an enlarged scale of a second embodiment of a whip antenna in accordance with the invention.

With reference to the drawings, a whip antenna in accordance with the present invention has been generally identified by reference numeral 1.

The whip antenna 1 comprises a main body 2 of elongated conformation which in this case preferably is in the form of a cone. The main body 2 is made of a plastic resin 3, a polyester resin for example, into which a predetermined reinforcing fibre 3a, preferably consisting of a conventional glass fibre, is incorporated.

In an original manner, the plastic resin 3 also incorporates particles 4, micrograins or microfibrils for example, of an electrically conductive material in a preset amount, such distributed as to give the whole main body 2 good electric and electromagnetic features and, as a result, a good capability to receive and transmit radio signals. Preferably, particles 4 of an electrically conductive material are homogeneously distributed in the plastic resin 3 in such a manner as to give the main body 2 a symmetric behaviour from an electromagnetic point of view.

From a manufacturing point of view, it has been found that the electrically conductive material can con-

sist of any material capable of being brought to a very reduced particle size, having good conductivity features and, at the same time, adapted to conveniently bond to a plastic matrix. In particular, powders of acetylene black, graphite, carbon black or still other materials can be employed as the electrically conductive material.

From the standpoint of the mass amount of the electrically conductive material 4, it has been found that, in order to ensure a sufficiently good operation of the finished antenna, this material must be provided in a mass rate at least higher than 2% with respect to the overall mass of the main body. Preferably this mass rate should be included between 5 and 10% in order to impart good electric and electromagnetic features to the antenna.

In accordance with a preferential solution shown in Fig. 3, it is provided for the main body 2 to further comprise an electrically conductive thread-like element 5 extending along the whole longitudinal axis of the main body itself. This thread-like element can be made of either a metal material, such as copper, aluminium or other, or another material, carbon material for example, which combines excellent electrical conductivity characteristics with excellent mechanical characteristics.

From a production point of view, the whip antenna 1 can be made both continuously, as shown in Fig. 1, and with the use of conventional moulding techniques (not shown).

Upon a more detailed examination of the plant shown in Fig. 1, one can see that the reinforcing fibre 3a is continuously unwound from a supply station 6 and moves towards one or more guide grids 7 until it reaches a soaking station 8 consisting for example of one or more tanks inside which the fibre 3a suitably guided is immersed in a resin 3 in a liquid state to be then sent, after one or more optional wringing steps, to the preforming and forming stations 9 of the piece being worked. At or immediately downstream of the forming station, polymerizer means 10 operates which consists for example of heating elements, lamps or other devices causing cross-linking of the piece that in this way achieves a rigid structure. Also provided downstream of the polymerization station 10 is one or more driving units 11 carrying out movement of the piece which is ultimately sent to a transverse-cutting station 12 in order to produce elements of a discrete length that, after undergoing optional surface-grinding, painting and other operations, will form the finished whip antenna 1.

It is to point out that, alternatively to the above described process, the whip antenna 1 can obviously be obtained by extrusion (using thermoplastic resins, for example) or by moulding, as described in claim 13.

The invention achieves important advantages.

It will be in fact recognized that, due to the presence of particles 4 of electrically conductive material within the plastic resin 3, the use of the conventional metal conductor could be avoided and, as a result, all drawbacks associated therewith could be solved. In particular, the antenna in accordance with the invention can be made

at more reduced costs than in the past, since careful centering operations of the thread-like element with respect to the antenna body are no longer necessary, neither do inspections on the electrical continuity of the thread-like element need to be carried out.

Furthermore, it is clearly useless to perform a stripping operation on the finished antenna, at the end portion thereof, because the whole main body of the antenna in accordance with the invention is electrically conductive and therefore can be directly connected to the wireless apparatus associated with the vehicle. It is also to note that elimination of the thread-like conductive element makes the antenna in reference very reliable in time, since the occurrence of phenomena involving breaking of the electrical continuity is no longer possible.

Also the embodiment shown in Fig. 3 has some advantages over the known art, in that, in this case too, it is no longer necessary to carry out stripping of the end portion of the antenna itself due to the fact that, as already said, the whole main body 2 has a good electrical conductivity.

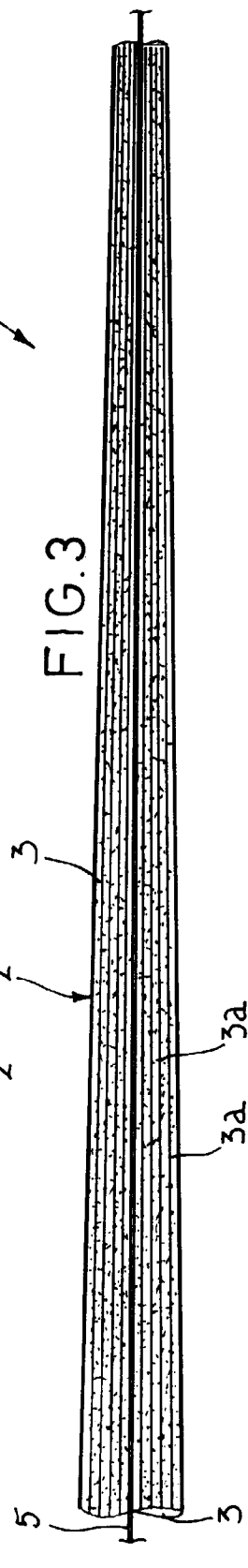
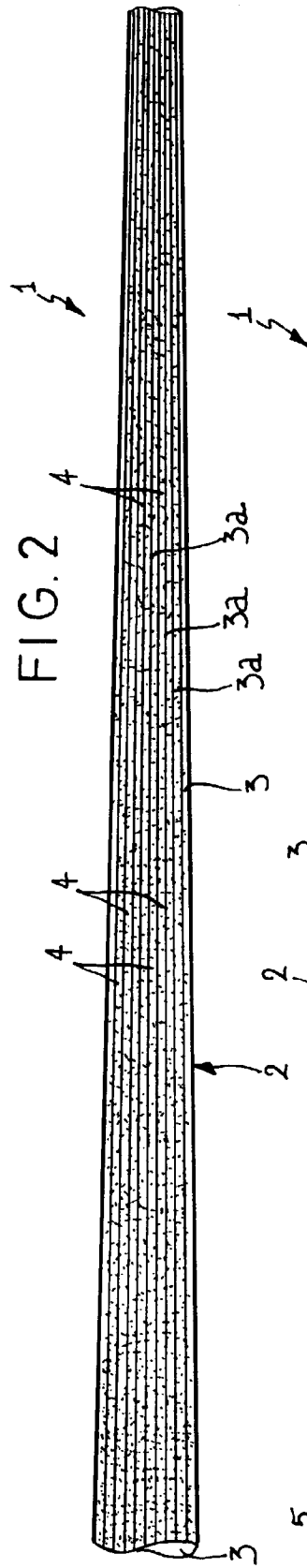
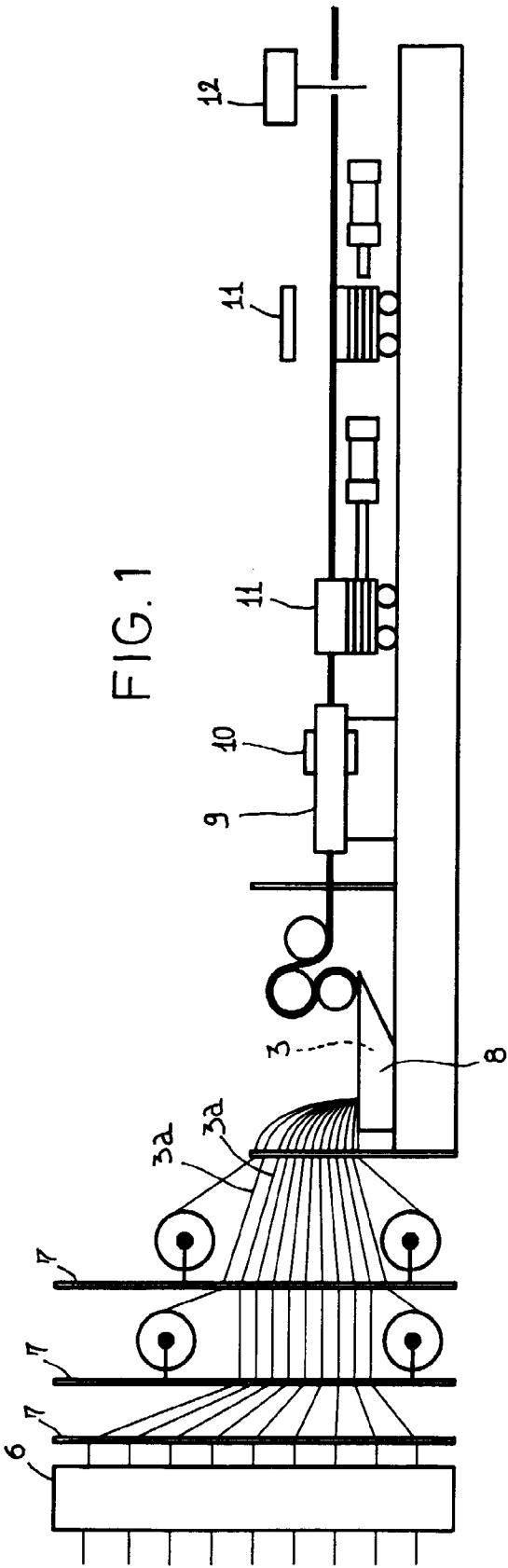
In conclusion, the whip antenna in accordance with the invention achieves important advantages in terms of productivity and considerable improvements in terms of easy installation and also in terms of performance as regards both transmission-reception of signals and mechanical behaviour.

### Claims

1. A whip antenna comprising a main body (2) of elongated conformation, made of a plastic resin (3) incorporating a predetermined reinforcing fibre (3a), characterized in that said plastic resin (3) further incorporates particles (4) of an electrically conductive material in a preset amount, in order to give the whole main body (2) a capability of receiving and transmitting radio signals.
2. An antenna according to claim 1, characterized in that said particles (4) of electrically conductive material are homogeneously distributed in said plastic resin (3).
3. An antenna according to claims 1 or 2, characterized in that said particles (4) of electrically conductive material are powders.
4. An antenna according to anyone of the preceding claims, characterized in that said electrically conductive material comprises acetylene black.
5. An antenna according to anyone of claims 1 to 3, characterized in that said electrically conductive material comprises graphite.

6. An antenna according to anyone of claims 1 to 3, characterized in that said electrically conductive material comprises carbon black.
7. An antenna according to anyone of the preceding claims, characterized in that said electrically conductive material is provided in a mass rate at least higher than 2%, with respect to the overall mass of the main body (2). 5  
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8. An antenna according to claim 7, characterized in that said electrically conductive material is provided in a mass rate preferably included between 5% and 10%, with respect to the overall mass of the main body (2). 15
9. An antenna according to anyone of the preceding claims, characterized in that said main body (2) comprises an electrically conductive thread-like element (5) extending along the main body itself. 20
10. An antenna according to claim 9, characterized in that said thread-like element (5) is made of a metal material. 25
11. An antenna according to claim 9, characterized in that said thread-like element (5) is made of a carbon material.
12. A method of making whip antennas, in particular of the type as claimed in anyone of the preceding claims, comprising the following steps: 30
- soaking a predetermined reinforcing fibre (3) into a plastic resin; 35
  - sending said soaked reinforcing fibre (3) to a forming station (9) to obtain a continuous semifinished product;
  - solidifying said continuous semifinished product; 40
  - transversely cutting the continuous semifinished product to obtain a plurality of elements of predetermined length intended for forming said whip antennas, characterized in that before said soaking step, a mixing step of the plastic resin (3) in a liquid state with particles of an electrically conductive material is provided. 45
13. A method of making whip antennas, in particular of the type as claimed in anyone of claims 1 to 11, comprising the following steps: 50
- soaking a predetermined reinforcing fibre (3) into a plastic resin;
  - positioning said soaked reinforcing fibre (3) in a forming station; 55
  - moulding said soaked fibre to obtain said whip antenna (1), characterized in that before said

soaking step a mixing step of the plastic resin (3) in a liquid state with particles of an electrically conductive material is provided.





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EUROPEAN SEARCH REPORT

Application Number  
EP 96 83 0529

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)
Y	FR-A-2 660 116 (FACON) 27 September 1991 * page 2, line 21 - page 4, line 12; claims 1-10; figures 2,3 * ---	1,2,5-13	H01Q9/30
Y	EP-A-0 040 674 (KATHREIN WERKE KG) 2 December 1981 * page 4, line 16 - page 5, line 27; claims 1-6; figures 1-4 * ---	1,2,5-13	
A	FR-A-2 312 864 (ETUD RECH CHIMIQUE LAB) 24 December 1976 * page 3, line 11 - page 4, line 8; figures 1-3 * ---	1-13	
A	US-A-4 134 120 (DELOACH THOMAS R ET AL) 9 January 1979 * column 2, line 28 - column 4, line 10; figures 3-5 * ---	1-13	
A	EP-A-0 336 738 (BICC) 11 October 1989 * column 6, line 47 - column 8, line 60; figures 4,5 * ---	12,13	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	PATENT ABSTRACTS OF JAPAN vol. 11, no. 257 (E-534), 20 August 1987 & JP-A-62 065501 (DX ANTENNA), 24 March 1987, * abstract * -----	12,13	H01Q
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 16 January 1997	Examiner Angrabeit, F
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

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