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(54) **IMPROVED METHOD AND TOOL FOR PRODUCING CONVOLUTED TUBES APPLICABLE TO STEERING COLUMNS AND UNIVERSAL JOINTS**

(57) The invention refers to the manufacturing procedure for a convoluted tube (26) using a tube (28) which has previously been fitted with recesses (18) obtained by turning (14) and applying a tool (25) formed by a holder (10) equipped with discs (22) at regular distances, an inner surface (22a), operating in combination with a support (21) which is fitted inside the tube (14) to be then subjected to a compression force on the end from the head (27) of the support (21).

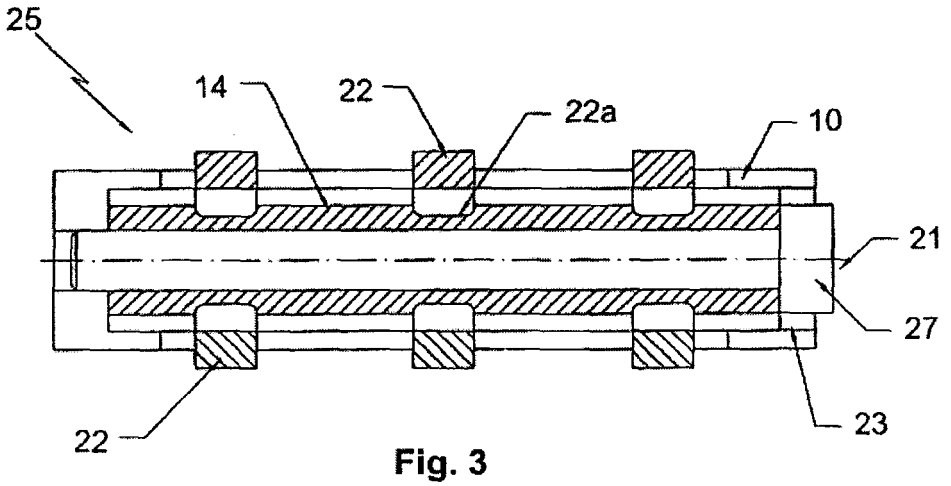

Fig. 3

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Description

FIELD OF THE TECHNIQUE.

[0001] More specifically the invention refers to the design and characteristics of a machined tool formed by equally spaced rings on a holder and to the manufacturing process used for this tool to obtain a convoluted tube from a conventional tube.

SCOPE OF THE INVENTION.

[0002] The invention has the aim of obtaining convoluted tubes from a conventional tube used in the manufacture of steering columns and universal joints by the automobile sector on cars and similar vehicles with a double cardan shaft. The process places a previously machined tube to produce recesses on its side surface inside a tool to change the aforementioned normal tube into a convoluted tube.

STATE OF THE ART.

[0003] A known technique for manufacturing convoluted tubes is the hydrolining process. This process is expensive and technologically complex in which the tube has to be successively extracted until the required wall thickness is achieved.

[0004] The use of convoluted tubes in the manufacture of steering columns and universal joints is based on achieving significant improvements in safety against front or side impacts on cars. Convoluted tubes are normally used in this areas as they have two positive affects on energy absorption via the a steering column in the event of an impact:

- Bending due to the lateral bending forces produced in the event of an impact, preventing these forces being transmitted to the driver via the tube.
- Compressing as a result of frontal compression forces produced in the event of an impact, preventing these forces being transmitted to the driver.

DISCLOSURE OF THE INVENTION.

[0005] The invention comprises the tool, formed by a support containing rings located at equal distances on a holder, which is used in the manufacture of the convoluted tube and its characteristic features, and the tube's manufacturing process using the aforementioned tool after the tube has been previously rebated into slots located at predetermined gaps.

[0006] The tool used is the combination of a support fitted with the relevant head which fits inside the tube to be transformed and a set of discs surrounding the tube to be transformed supported by a holder a predetermined spaces. The ends of these discs are applied to the tube to be transformed to allow the corresponding slots to be folded when a compression force is applied to the aforementioned rebated tube to obtain the convoluted tube.

DESCRIPTION OF THE FIGURES.

[0007] A numbered list of the main parts in the invention is given below. These are shown in diagrams attached to this report:

(10) Support.

(11) Volute.

(12) Inner diameter of tube (14).

(13) Outer diameter of recessed areas.

(14) Rebated tube.

(15) Height of recess.

(16) External radius of the volute (11).

(17) Width of volute.

(18) Recesses.

(19) Diameter of tube (14).

(20) Thickness of recesses (18).

(21) Support.

(22) Internal parts.

(22a) Inner surface of rings (22a).

(23) Lugs.

(24) Width of recesses (18).

(25) Tool.

(26) Convoluted tube.

(27) Head.

(28) Starting tube.

Figure 1 is a front view in elevation of a longitudinal section in elevation of a starting tube (28) after the first machining on a lathe or similar machine transforming the tube (14), before it is attached to the support (21).

Figure 2 is a front view in elevation of a longitudinal section of a starting tube (28) after the volutes (11) have been made in its wall and after being subjected

to an axial compression force forming a tube(14) with recesses (18).

Figure 3 is a front view in elevation of a longitudinal section of a starting tube (28) to which the tool (25) has been applied tom manufacture the aforementioned convoluted tubes (26).

Figure 4 is a front view in elevation of a longitudinal section of a starting tube (28) which is transformed after machining the tube (26), in accordance with Figure 2.

DESCRIPTION OF AN EMBODIMENT OF THE INVENTION.

[0008] In order to better understand the invention, the starting tube before machining (28) is shown, see Figure 4, and after machining showing recesses in the form of rebated slots (18), the tube (14), after making the slots (18) in it. This is subjected to an axial compression force forming the convoluted tube (26), see Figure 2.

[0009] In one of the preferred set ups for this invention and as shown in Figure 3, the tool (25) is formed by a support (21) with a holder (10) on its periphery. The support (21) is surrounded by a succession of rings (22) aligned and spaced at equal distances, held to the lateral surface of the aforementioned holder (10), and fitted onto the aforementioned support (21). The head (27) is located on one of its sides using external lugs (23) on the holder (10).

[0010] The support (21), shown in Figure 3, is formed by a cylindrical body ending in a head (27) at one of its ends.

[0011] Machining the tube (28) starts with rebating the lateral surface on a lathe or similar machine to obtain recessed slots (18) on its lateral surface, then being fitted inside the tool (25) and its support (21), see Figure 3.

[0012] Turning the tube (28) transforms the said smooth tube (28) into a recessed tube (18) with a height of (15) and width of (24), which is called the rebated tube (14), see Figure 1.

[0013] The axial movement of the rings (22) in its inner parts (22a) supporting the lateral surface of the tube (14) and their recesses (18) as shown in Figure 3, transforms the machined tube (14) see Figure 1, into a convoluted tube (26), see Figure 2.

[0014] The result of the axial movement of the rings (22) and its inside (22a) on the recesses (18) on the lateral surface of the tube (24) in the tool (25), from the compression force on the end of the support (21), forms the volutes (11) as shown in Figure 2. The width of the volutes (11) shall be (17), see Figure 2 and their size will depend on the compression force applied on the end of the support (21), in addition to the type of material used for the aforementioned tube(28) and its thickness (20), in the recessed area (18).

[0015] It is possible, using the aforementioned manufacturing process, for convoluted tubes (26) to have the number of volutes (11) required and to move them to vary the gaps between the recesses (18). The external diameter of the volute (11) and its width (17) may be modified to match the final design of the tool (25) in which the invention is applied.

[0016] To form the volutes (11) in the tube (28), in accordance with one of the aims of the invention, the manufacturing process involves the following operations in order to obtain the convoluted tube (26):

- Turning the tube (28) rebating its lateral surface to a height "d" (13), and a width "a" (24) at regular intervals until the machined tube is obtained (14).
- Attaching the machined tube (14) inside the support (21).
- Attaching a tool (25) formed by a support (21) for the head (27) inside which is holder (10) is fitted comprising rings (22) at predetermined distances, the inner surfaces of which (22), (22a) wrap around the lateral surface of the tube (14), in its recesses (18).
- Prior to attaching the tool (25) the distance between rings (22) is determined for the lateral surface of the holder (10).
- Compression pressure applied to the end of the tube (14) by the support (21) and its head (27) forming the convoluted tube (26).

[0017] Having sufficiently described this invention using the Figures attached, it is easy to understand that any changes judged to be suitable may be made, whenever these changes do not alter of the essence of the invention summarised in the following claims.

Claims

1. - "IMPROVED METHOD AND TOOL FOR PRODUCING CONVOLUTED TUBES APPLICABLE TO STEERING COLUMNS AND UNIVERSAL JOINTS, which obtains the above tube using a process of machining the tube on its surface to create rebated areas characteristic of the convoluted tube (26) manufacturing process. This includes improvements to the process using the following operations:

   - Turning a tube (28) until rebates or recessed slots (18) are obtained with a width of (24) and height of (15), resulting in a machined tube.
   - Attaching the tube (14) in a tool (25) with a support (21) onto which the holder (10) is fitted comprising rings (22) at predetermined distances, the ends of the rings (22), (22a), pressed onto the surface of the tube (14) and the rebates

or recessed strips (18).
- Prior to attaching the tube (14) in the tool (25) the distance between rings (22) is determined for the lateral surface of the holder (10).
- Supplying a compression pressure onto the end of the tube (14), fitted into the tool (25) via the head (27) of the support (21), forming a convoluted tube (26), when the recesses (18) are bent on the lateral surface of the tube (14) and changing them into volutes (11), in the resulting convoluted tube (26).

2. - "TOOL FOR PRODUCING CONVOLUTED TUBES APPLICABLE TO STEERING COLUMNS AND UNIVERSAL JOINTS, **characterised in that** the tool (25) used in the manufacturing procedure for the convoluted tube (26), comprises a support (21) for the head (27) onto which a holder (10) is fitted equipped with discs (22) at predetermined distances with inner surfaces (22a) with lugs (23) on the end of the aforementioned holder (10), which is held in the support (21).

3. - "IMPROVED METHOD AND TOOL FOR PRODUCING CONVOLUTED TUBES APPLICABLE TO STEERING COLUMNS AND UNIVERSAL JOINTS, **characterised in that** the width of the volutes (11) in the convoluted tube (26), shall depend on the axial compression force applied during the convoluted tube's (26) manufacturing process at the end of the tube (14) by the head (27) of the support (21) on the tool (25).

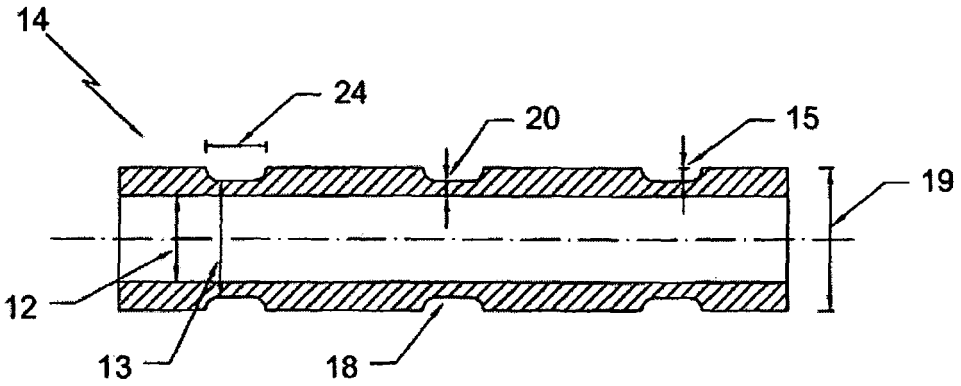

Fig. 1

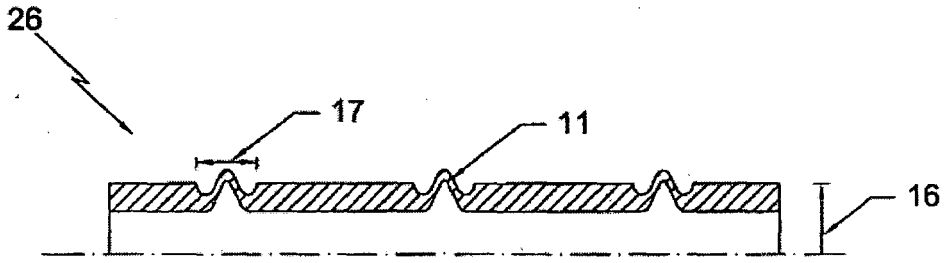

Fig. 2

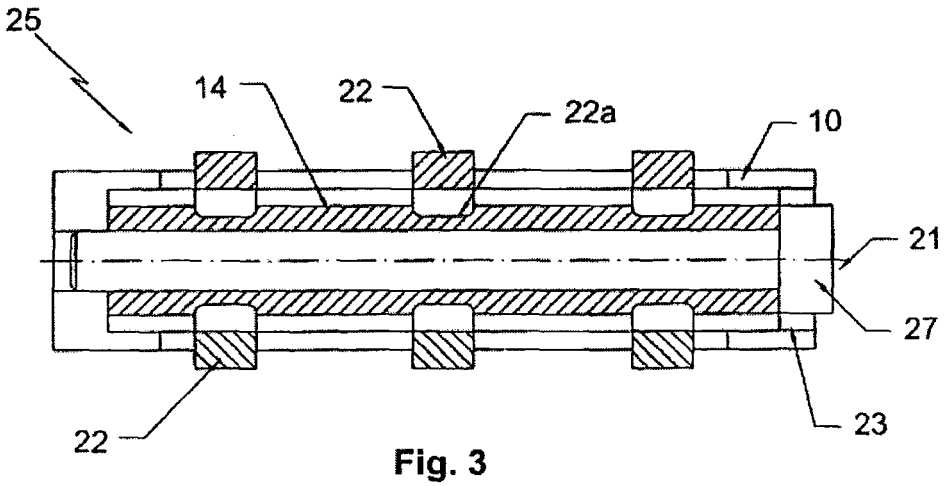

Fig. 3

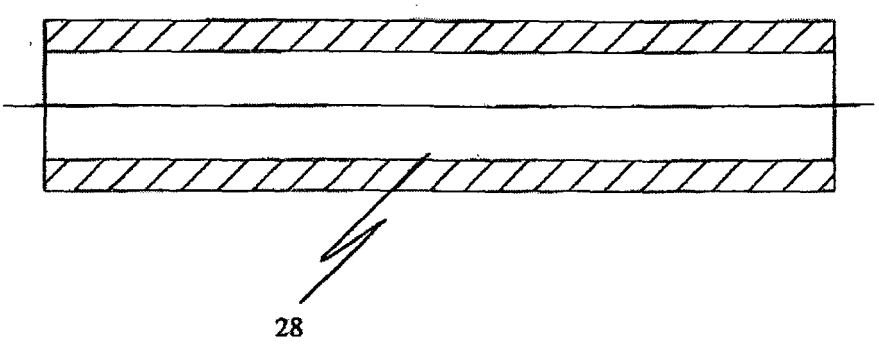

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES 2006/000601

A. CLASSIFICATION OF SUBJECT MATTER

see extra sheet
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)
B21C+, B21D+, B21K+

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CIBEPAT,EPODOC,WPI,PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2683928 A (CARSON) 20.07.1954, column 2, line 28 - column 3, line 61; figures 1-7.	1-3
Y	US 4590655 A (JAVORIK) 27.05.1986, column 4, line 22 - column 5, line 20; figures 1-4.	1-3
A	GB 1185437 A (NAKAMURA MASANOBU) 25.03.1970, the whole document.	1,2
A	US 2003173765 A1 (LUTZ) 18.09.2003, paragraphs [0033]-[0034]; figures 3-7.	

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance.
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure use, exhibition, or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other documents , such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26.March.2007 (26.03.2007)	**(30/03/2007)**
Name and mailing address of the ISA/ O.E.P.M. Paseo de la Castellana, 75 28071 Madrid, España. Facsimile No. 34 91 3495304	Authorized officer A. Andreu Cordero Telephone No. +34 91 349 30 55

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/ ES 2006/000601

Patent document cited in the search report	Publication date	Patent family member(s)	Publication date
US2683928 A	20.07.1954	NONE	
US 4590655 A	27.05.1986	EP 0150265 A	07.08.1985
		EP 19840111175	19.09.1984
		JP 60159118 A	20.08.1985
		DE 3621144 A	02.01.1987
		JP 62003835 A	09.01.1987
		US 4685323 A	11.08.1987
GB 1185437 A	25.03.1970	FR 2017593 A	22.05.1970
		US 3564886 A	23.02.1971
US 2003173765 A	18.09.2003	EP 1344708 A	17.09.2003
		EP 20020024231	31.10.2002
		EP 1344707 A	17.09.2003
		EP 20020024230	31.10.2002
		US 6908109 B	21.06.2005
		US 2003173764 A	18.09.2003
		US 6896290 B	24.05.2005
		DE 10211743 A	06.11.2003
		DE 50206882 D	29.06.2006
		DE 50209439 D	22.03.2007

INTERNATIONAL SEARCH REPORT

International application No.

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