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(71) Applicant: **Thomassen & Drijver-Verblifa N.V.**
Zutphenseweg 51
NL-7418 AJ Deventer(NL)

(72) Inventor: **Meijer, Anton**
Coudewijnstraat 8
NL-7415 BT Deventer(NL)

(74) Representative: **Schumann, Bernard Herman**
Johan et al
OCTROOBUREAU ARNOLD & SIEDSMA
Sweelinckplein 1
NL-2517 GK The Hague(NL)

(54) **Method and apparatus for manufacturing metal can bodies having an internal coating.**

(57) A process is provided for manufacturing internally coated can bodies from metal sheets in one continuous processing run, comprising the steps of:

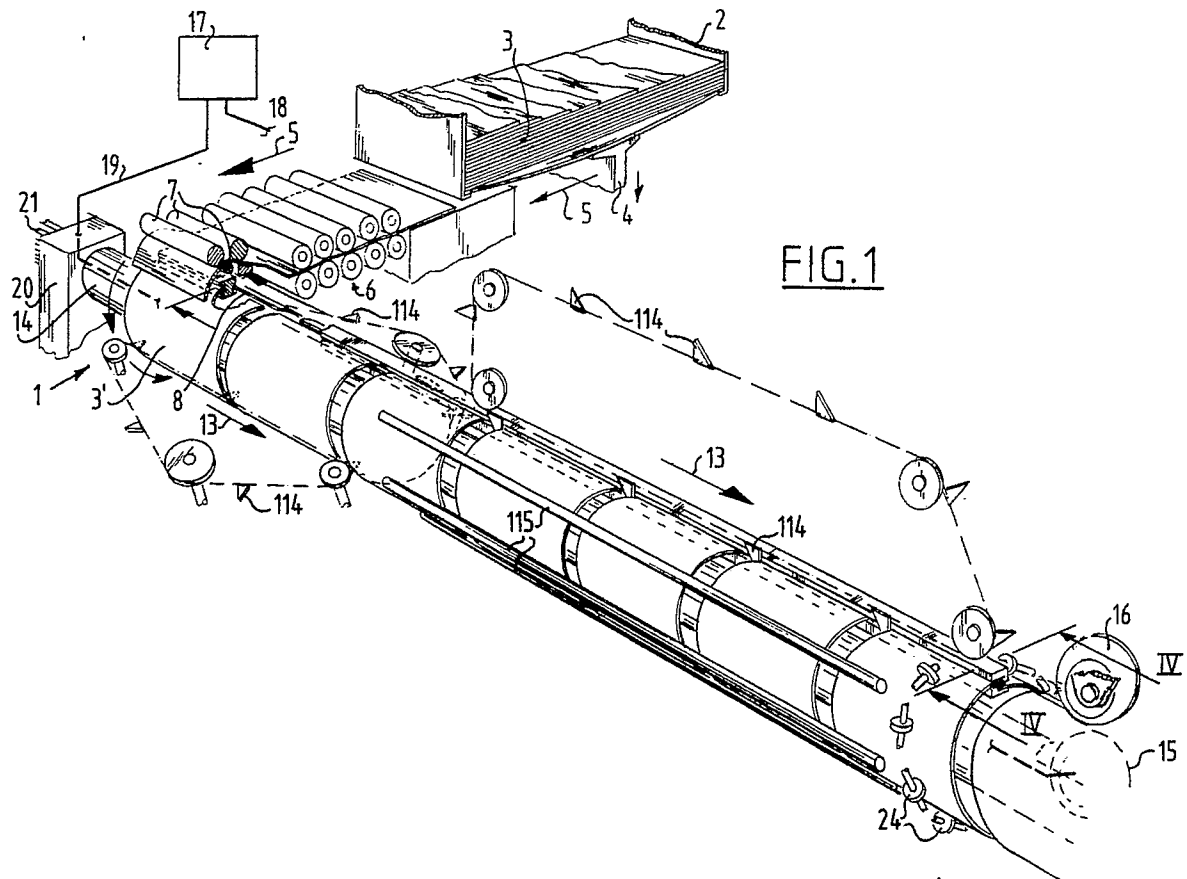
- providing metal sheets of which the width is a little greater than the periphery of a can body and the length corresponds to the height of a can body
- transporting successive sheets in lengthwise feed direction
- bending the metal sheets transversely of the lengthwise feed direction such that their edge zones mutually overlap
- mutually adhering or joining the overlapping portions of the edge zones, preferably by welding
- applying an internal coating on the thus formed tubular bodies, pushing one against the other, by means of a coating device carried by an arm extending in lengthwise direction inside said successive can bodies, said coating being preferably obtained by applying electrically charged plastic powder and causing said powder coating to melt, spread out and enamel by supplying heat and then curing the thus

formed coating by cooling.

An apparatus for performing the inventive method comprises

- conveyor means (2, 4) for feeding metal sheets (3) to a flattening station (6)
- bending means (7) for bending the flattened sheet transversely of the conveying direction (5) to a rounded shape (3') with overlapping edge portions
- means for joining said overlapping portions so as to form successive can bodies
- transporting means (114, 115) for transporting the can bodies in an axial direction (13)
- applying device for applying an internal coating of plastic powder on said bodies, which device is carried by an arm (14) which extends in axial direction inside said bodies from a region located upstream relative to said adhering/joining means
- heat treating means for causing said powder coating to melt, spread out, enamel and cure.

EP 0 426 258 A1



METHOD AND DEVICE FOR MANUFACTURING METAL CAN BODIES WITH AN INTERNAL COATING

Providing can bodies with an internal coating is known. Such a coating consists of a lacquer. This lacquer is applied in liquid form in an additional pre-treatment step. The solvent evaporates, whereby the lacquer forms a hard internal coating. The use of solvents is undesirable with respect to environmental requirements. The solvent can result in smell nuisance, certainly in the case of large-scale production.

The invention generally provides a method for manufacturing metal can bodies with an internal coating comprising the following steps of:

- 1) providing metal sheets of which the width is a little greater than the periphery of a can body and the length corresponds to the height of a can body;
- 2) transporting successive sheets in lengthwise direction;
- 3) bending the sheet metal transversely of the lengthwise direction of the path such that the edge zones mutually overlap;
- 4) mutually adhering the overlapping portions of the edge zones;
- 5) arranging an internal coating on these bodies using an applying device carried by an arm which extends in lengthwise direction from a region located upstream of the region where the edge zones are placed in overlap. With such a method a separate pre-treatment step is no longer required, and the manufacture of a can body takes place in one continuous process together with the applying of the coating.

Full continuity can be ensured for instance with a method characterized by

- 6) causing the sheets and the can bodies to push one against the other, also at the position step (5) takes place.

The method can be particularly characterized by

- 7) performing step 4) by welding.

The invention gives preference to a method which is characterized by

- 8) performing step 5) by applying a coating of a plastic powder;
- 9) causing said powder to melt, run out and enamel by supplying heat; and
- 10) causing the thus formed coating to cure by cooling.

The method can for instance be characterized by

- 11) performing step 5) by applying a coating on the entire inner surface of the successive bodies.

The method may also be characterized by

- 12) performing step 5) by applying a coating

over the seam of the overlapping zones.

In order to be certain that the critical region of the seam, where a sharp edge is in any case present, is completely covered by the coating, which is of decisive importance particularly for food products, the method can be characterized in a preferred embodiment by

- 13) performing step 11) in combination with step 12) such that a coating of increased thickness is situated over the said seam.

A highly effective application of the powder can be ensured by

- 14) performing step 8) by electrically charging the powder beforehand. This method can for instance be embodied such that it is characterized by

- 15) performing step 14) by subjecting the powder to a corona discharge.

In preference however this method is characterized by

- 16) performing step 14) by guiding the powder along the surface of an isolator.

The invention also relates to a device for performing the method according to the invention for manufacturing metal can bodies with an internal coating, which device comprises:

- conveyor means for feeding metal sheets and carrying away can bodies;
- bending means for bending the sheets transversely of the conveying direction during feeding thereof such that the edge zones are placed and held in overlap;
- adhering means for mutually adhering the overlapping portions of the edge zones for forming of successive can bodies; and
- an applying device for applying an internal coating on these bodies, which applying device is carried by an arm which extends in lengthwise direction from a region located upstream relative to the adhering means.

For mutually adhering the overlapping portions of the edge zones the device can advantageously display the feature that the adhering means comprise two co-acting welding rollers, whereof the first engages on the outside and the second on the inside of said overlapping portions, which first welding roller is supported by the arm carrying the applying device.

Very simple but nevertheless reliable production is ensured with a variant which has the feature that the overlapping portions are held in position by guide grooves in a block.

In an embodiment where the applying device is arranged for applying plastic powder the device can be further characterized by a heat treatment

station for causing powder to melt, run out and enamel through supply of heat and the thus formed coating to cure through cooling.

In a particular embodiment the device may have the feature that the applying means are arranged for applying a coating on the entire inner surface of the successive bodies. The device may also have the feature that the applying means are arranged for applying a coating over the seam of the overlapping zones. It is further possible for the device to have the feature that the applying means are arranged for applying a coating on the entire inner surface of the successive bodies and moreover a coating over the seam of the overlapping zones such that a coating of increased thickness is situated over the said seam.

For applying powder with great homogeneity and reliability over the entire surface for coating the device can be characterized by a charging station for electrically charging powder to be applied.

Use can be made for this purpose of corona means or of an isolator surface, along which the powder for applying is guided, at an interval from which surface is located a conductor surface with earth connection for draining charge. In this latter case the device can be characterized by at least one tube of an insulating substance, for instance PTFE (polytetrafluoroethylene) and a conductor for connection to earth arranged close fitting around it.

The device preferably displays the feature that via a conducting, for instance carbonaceous, medium such as a paste the isolator has a connection externally to metal, for example aluminium, for connection to earth. Hereby ensured is an effective charging of the powder in addition to a rapid draining of the static charge formed in the isolator.

The invention also relates to a can body manufactured with the method according to the invention in addition to a can with such a body.

The invention offers a number of important advantages. Compared to processes with wet lacquer a considerable energy saving is possible, namely in the order of 40 to 60%. The process according to the invention enables lacquer standardization. According to the invention, applying of the coating to successive objects takes place in a fluent, continuous movement relative to the applying station. The process therefore requires only one production line.

The invention will now be elucidated with reference to the annexed drawing, wherein:

Fig. 1 shows a partly broken away schematic perspective view of a first part of a device according to the invention, wherein the can bodies are made from sheets;

Fig. 2 shows a view corresponding with fig. 1 of a second part of the device according to the invention shown therein, wherein the can bodies

are provided internally with a layer of powder; Fig. 3 and 4 show respectively the details III and IV of fig. 1 in cross section on enlarged scale; Fig. 5 shows a view corresponding with fig. 2 of a variant which is arranged for also applying an additional layer of powder on the seams of the can bodies;

Fig. 6 is a partly broken away perspective view of the welding station;

Fig. 7 is a partly broken away perspective view of the spray nozzle on enlarged scale; and

Fig. 8 shows on enlarged scale a perspective view of one of the single charging tubes according to fig. 7.

Fig. 1 shows a device 1 for manufacturing metal can bodies with an internal coating. Device 1 comprises a stock holder 2 wherein a stack of metal sheets 3 is arranged. By means of a take-off member 4 the bottom sheet 3 is removed each time from the stack and guided in the direction of arrows 5 through a cracking station 6 in which the sheet is rid of residual stresses by light bending in opposing directions.

After leaving the cracking station 6 the relevant sheet is bent round by means of bending rollers 7 to the rounded shape designated 3'. The dimensioning of device 1 is such that the leading edge 8 of the bent round sheet 3' is arranged in a guide groove 9 in a guide block 10. This is shown in more detail in fig. 3. The trailing edge 11 is arranged in a second guide groove 12 of block 10.

After the described tangential in-feed an axial transport is performed in the direction of arrows 13 by means of carrier fingers 114 and guide rails 115.

The tangential in-feed and axial transporting are carried out around an arm 14 which serves to bear a welding roller 15 and a spray nozzle 22, 23 (see also fig. 2 and 5).

The bending of sheets 3' by the rollers 7 takes place such that the edges 8, 11 press through the tension of the sheets 3' themselves against the bottoms of the guide grooves 9, 12. These grooves gradually increase in depth in the direction of arrows 13 as will be apparent from comparing figures 3 and 4. The leading edge 8 and trailing edge 11 of sheets 3' are thus placed in overlap such that after leaving block 10 they can be welded fixedly to one another by the above mentioned internal welding roller 15 and an external welding roller 16.

An electric power unit 17 is connected via a power supply cable 18 to the outer welding roller 16 and via a power supply cable 19 to the inner welding roller 15. The cable 19 extends through the arm 14.

The arm 14 is supported by a frame 20 and is also arranged to encase diverse lines, at least one of which can be connected to a reservoir for pow-

der which has to be applied in a manner to be described hereinafter to the inner surface of the can bodies to be manufactured by device 1. The relevant powder line can also be connected to a source of medium under pressure, in particular compressed air, for transporting and distributing the powder.

In this embodiment the mentioned spray nozzles 22 and 23 according to fig. 2 and 5 respectively form a cardan coupling with the end of the arm 14. The guiding of the can bodies 3' in the vicinity of the welding rollers 15, 16 is performed by means of freely rotating rolls 24, the guiding function of which is taken over in the region of the spray nozzles 22, 23 by guide ropes 25. An encasing 26 serves via a suction line 27 to draw off excess powder at the position of the spray nozzles 22, 23.

The positioning of the spray nozzles 22, 23 is carried out by external rolls 28 which are supported via the meanwhile finished, i.e. fixedly welded, can bodies 3'' by means of rolls 29 present on the end of the nozzles 22, 23. Attention is drawn to the fact that the guiding by the ropes and rolls has to take place such that undesired variations of position are prevented. Three sets of rolls for instance, distributed over the underside of the periphery, are sufficient in practice.

The spray nozzles 22, 23 distribute the powder 30, electrically charged in a manner to be further described, homogeneously over the inner surface of the finished can bodies 3''. A homogeneous application of a coating consisting of powder hereby takes place. As a result of the electrical charge transferred to the powder 30 this powder 30 adheres well to the relevant inner surface.

As fig. 2 shows, the spray nozzle 22 delivers the powder 30 at its extremity 31.

The variant according to fig. 5 also comprises a slot-like powder delivery opening 32 which is arranged on top of the spray nozzle 23 and which is provided on its side edges with brushes 33. The opening 32 delivers a directed jet of electrically charged powder 30 for applying a coating over the seam 34 of the said overlapping zones of the can bodies 3'', namely the leading edge 8 and the trailing edge 11. The spray nozzle 23 thus first performs an application of powder onto the seam 34 and then applies a layer of powder homogeneously over the whole inner surface. Thus achieved is that a coating of increased thickness is situated over the said seam 34.

By means of a heat treatment station (not drawn) placed downstream of the spray nozzle 22, 23 is achieved that by supplying heat the powder 30 present on the inner surface of the can bodies 3'' melts, runs out and enamels, and can subsequently cure through cooling.

In this latter respect it is pointed out that applying a coating according to the invention can be carried out not only by making use of powder but use can also be made for instance of liquid means.

Means for electrically charging the powder are arranged in the spray nozzles 22, 23.

Use can for instance be made of a high-voltage transformer which receives its supply via the arm 14 and the frame 20. One of the mentioned lines 21 can therefore provide such a supply. A high-voltage transformer can be arranged in the spray nozzles 22, 23.

The embodiments of the invention discussed here are equipped however for charging the powder 30 by means of triboelectricity. Fig. 7 shows the spray nozzle 22. This comprises eight charging tubes 35 for electrically charging powder 30 passed through at great speed according to arrows 36.

Fig. 8 shows such a charging tube 35. It comprises a PTFE tube 37, an intermediate tube 38 arranged therearound which is conducting because it contains carbon and, arranged around this latter, an aluminium tub. 39 which is connected to earth 40 for draining static charge. This structure is capable of charging the powder 30 through electrokinesis or frictional electricity to a voltage in the order of 40-80 kV, whereby a very effective coating of the powder on the inner surface of the can bodies 3'' is ensured.

With regard to welding together of the edges 8 and 11 of the bent sheets 3' for forming the can bodies 3'' it is noted that at the location of the welding operation these sheets 3' and the bodies 3'' may not lie adjoining each other so as to avoid electrical short circuit. Use is made in practice of a mutual interval of several millimetres. It will be apparent that this requirement is not necessary beyond the welding station and that particularly in the applying of the powder it could even be advantageous if the bodies 3' processed there were to lie at least practically adjoining, since this could possibly stimulate the effectiveness of the application of the powder.

No attention is paid in the figures and description to control and measuring elements, such as temperature sensors, which can form part of the device.

The invention offers a method and a device enabling can bodies with internal coating to be manufactured with very simple means from metal sheets in one processing run. The performing of an additional manufacturing step, particularly the applying of a lacquer layer, is no longer necessary according to the invention. In the embodiment of fig. 5 the critical seam can be provided with an extra coating, while the rest of the surface is provided with the single, thinner layer. This is an

advantage compared to the prior art, wherein the layer thickness must always correspond with the required relatively great layer thickness for covering a seam. On the one hand a cost saving can be realized, while on the other hand a better quality can also be ensured.

Claims

1. Method for manufacturing metal can bodies with an internal coating comprising the following steps of:

- 1) providing metal sheets of which the width is a little greater than the periphery of a can body and the length corresponds to the height of a can body;
- 2) transporting successive sheets in lengthwise direction;
- 3) bending the sheet metal transversely of the lengthwise direction of the path such that the edge zones mutually overlap;
- 4) mutually adhering the overlapping portions of the edge zones;
- 5) arranging an internal coating on these bodies using an applying device carried by an arm, which extends in lengthwise direction from a region located upstream of the region where the edge zones are made to overlap.

2. Method as claimed in claim 1, **characterized by** 6) causing the sheets and the can bodies to push one against the other, also at the position, step (5) takes place.

3. Method as claimed in claim 1, **characterized by** 7) performing step 4) by welding.

4. Method as claimed in claim 1, **characterized by** 8) performing step 5) by applying a coating of a plastic powder;

9) causing said powder to melt, run out and enamel by supplying heat; and

10) causing the thus formed coating to cure by cooling.

5. Method as claimed in claim 1, **characterized by** 11) performing step 5) by applying a coating on the entire inner surface of the successive bodies.

6. Method as claimed in claim 1, **characterized by** 12) performing step 5) by applying a coating over the seam of the overlapping zones.

7. Method as claimed in claims 5 and 6, **characterized by**

13) performing step 11) in combination with step 12) such that a coating of increased thickness is situated over the said seam.

8. Method as claimed in claim 4, **characterized by** 14) performing step 8) by electrically charging the powder beforehand.

9. Method as claimed in claim 8, **characterized by**

15) performing step 14) by subjecting the powder to a corona discharge.

10. Method as claimed in claim 8, **characterized by**

16) performing step 14) by guiding the powder along the surface of an isolator.

11. Device for performing the method as claimed in any of the foregoing claims for manufacturing metal can bodies with an internal coating, which device comprises:

- conveyor means for feeding metal sheets and carrying away can bodies;

- bending means for bending the sheets transversely of the conveying direction during feeding thereof such that the edge zones are placed and held in overlap;

- adhering means for mutually adhering the overlapping portions of the edge zones for forming of successive can bodies; and

- an applying device for applying an internal coating on these bodies, which applying device is carried by an arm which extends in lengthwise direction from a region located upstream relative to the adhering means.

12. Device as claimed in claim 11, **characterized in that** the adhering means comprise two co-acting welding rollers, whereof the first engages on the outside and the second on the inside of said overlapping portions, which first welding roller is supported by the arm carrying the applying device.

13. Device as claimed in claim 12, **characterized in that** the overlapping portions are held in position by guide grooves in a block.

14. Device as claimed in claim 11, **characterized in that** the applying device is arranged for applying plastic powder.

15. Device as claimed in claim 14, **characterized by** a heat treatment station for causing powder to melt, run out and enamel through supply of heat and the thus formed coating to cure through cooling.

16. Device as claimed in claim 11, **characterized in that** the applying means are arranged for applying a coating on the entire inner surface of the successive bodies.

17. Device as claimed in claim 11, **characterized in that** the applying means are arranged for applying a coating over the seam of the overlapping zones.

18. Device as claimed in claims 16 and 17, **characterized in that** the applying means are arranged for applying a coating on the entire inner surface of the successive bodies and moreover a coating over the seam of the overlapping zones such that a coating of increased thickness is situated over the said seam.

19. Device as claimed in claim 14, **characterized by** a charging station for electrically charging pow-

der to be applied.

20. Device as claimed in claim 19, **characterized by** corona means.

21. Device as claimed in claim 19, **characterized by** an isolator surface, along which the powder for applying is guided, at an interval from which surface is located a conductor surface with earth connection for draining charge.

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22. Device as claimed in claim 21, **characterized by** at least one tube of an insulating substance, for instance PTFE (polytetrafluoroethylene) and a conductor for connection to earth arranged close fitting around it.

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23. Device as claimed in claim 22, **characterized in that** via a conducting, for instance carbonaceous, medium such as a paste the isolator has a connection externally to metal, for example aluminium, for connection to earth.

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24. Can body obtained with the method as claimed in any of the claims 1-10.

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25. Can **characterized by** a can body as claimed in claim 24.

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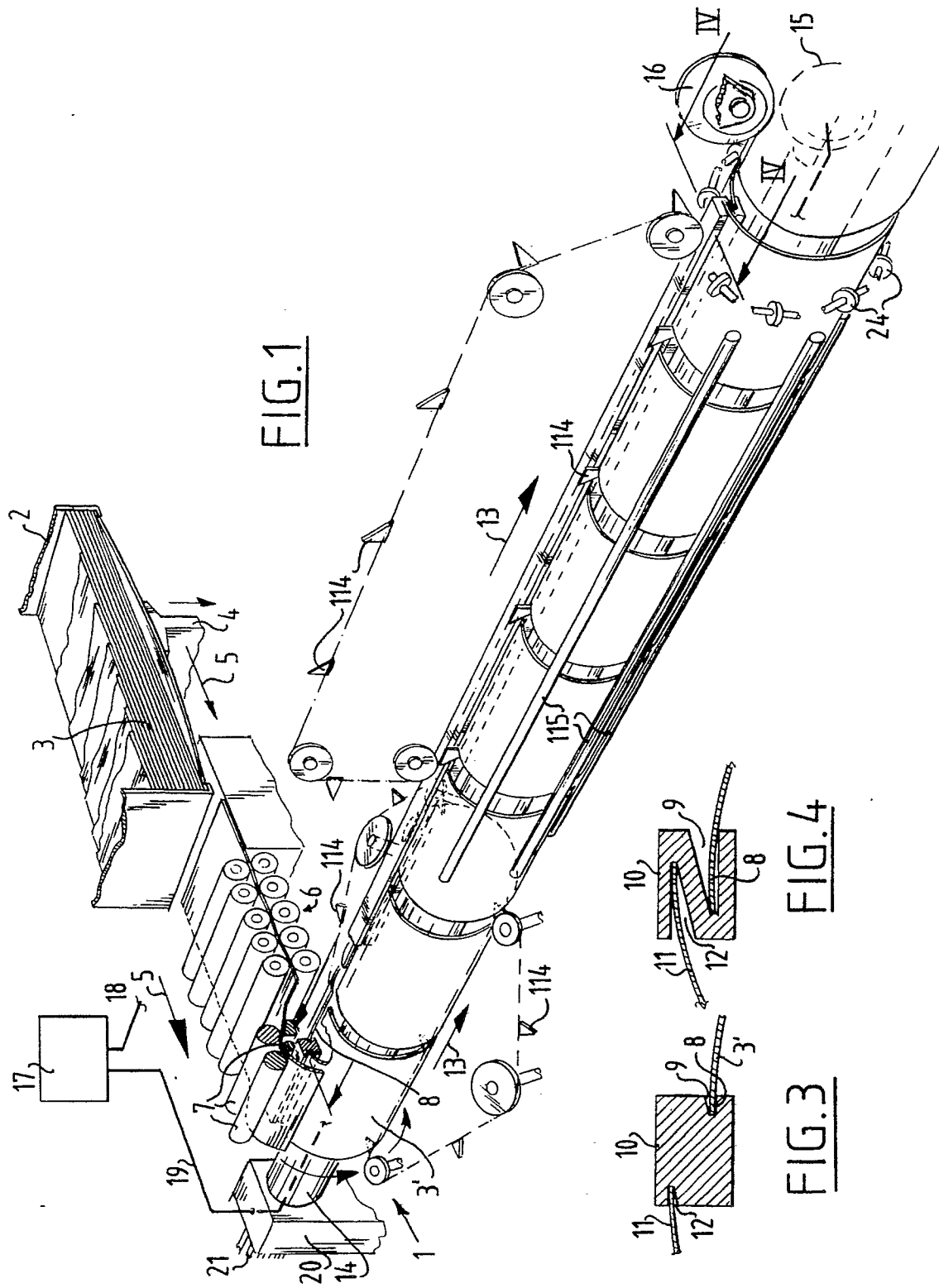
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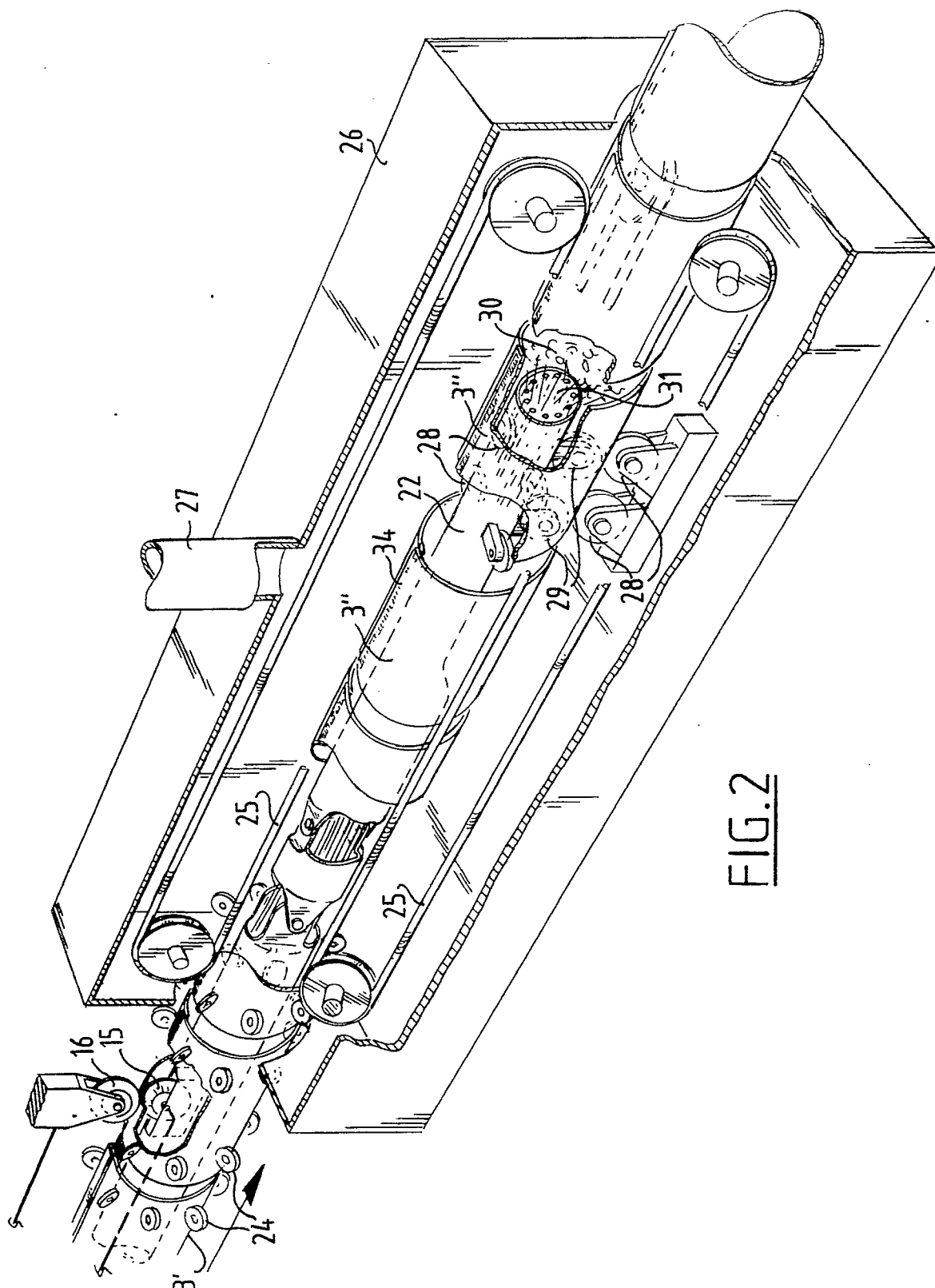
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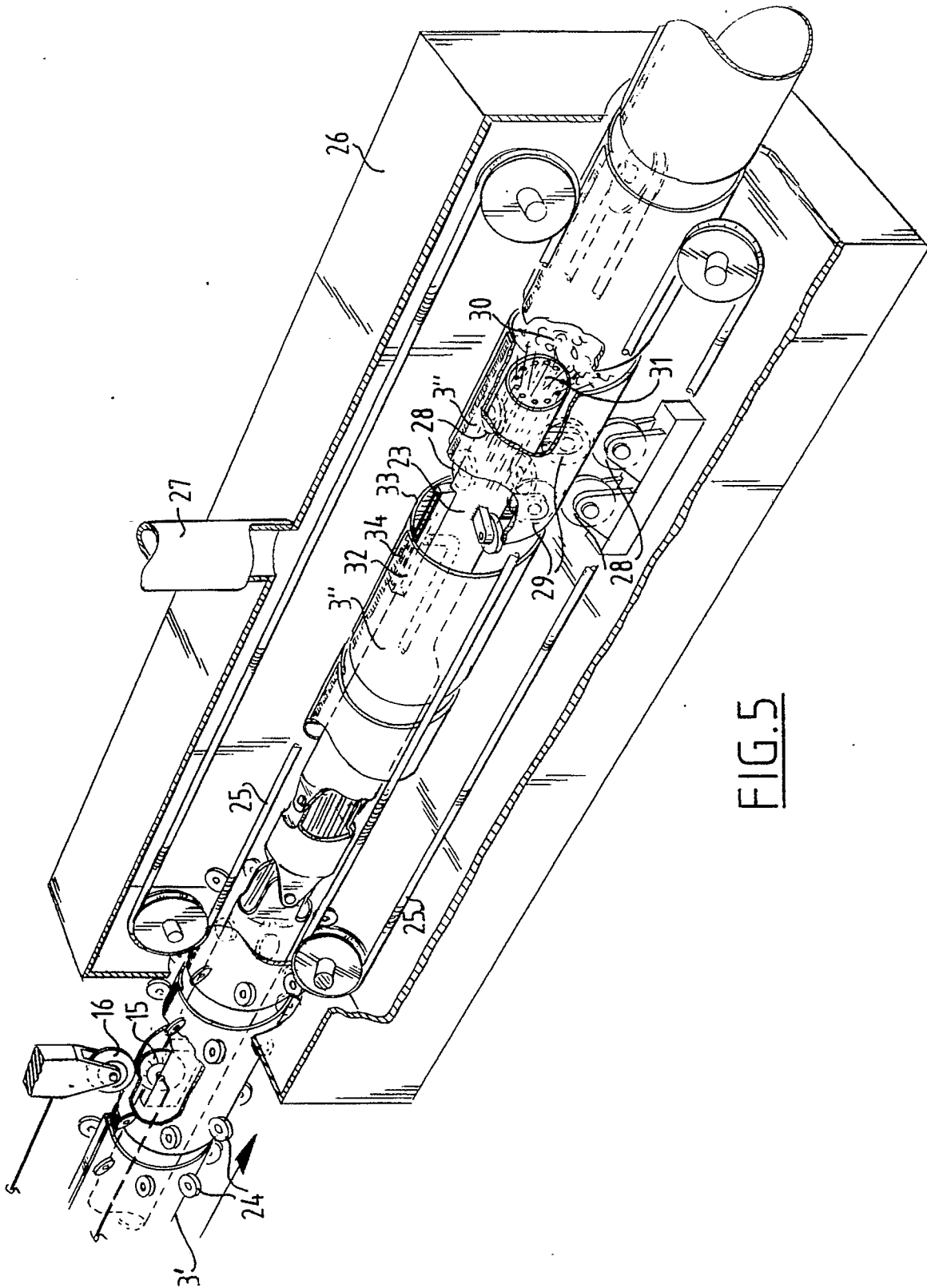
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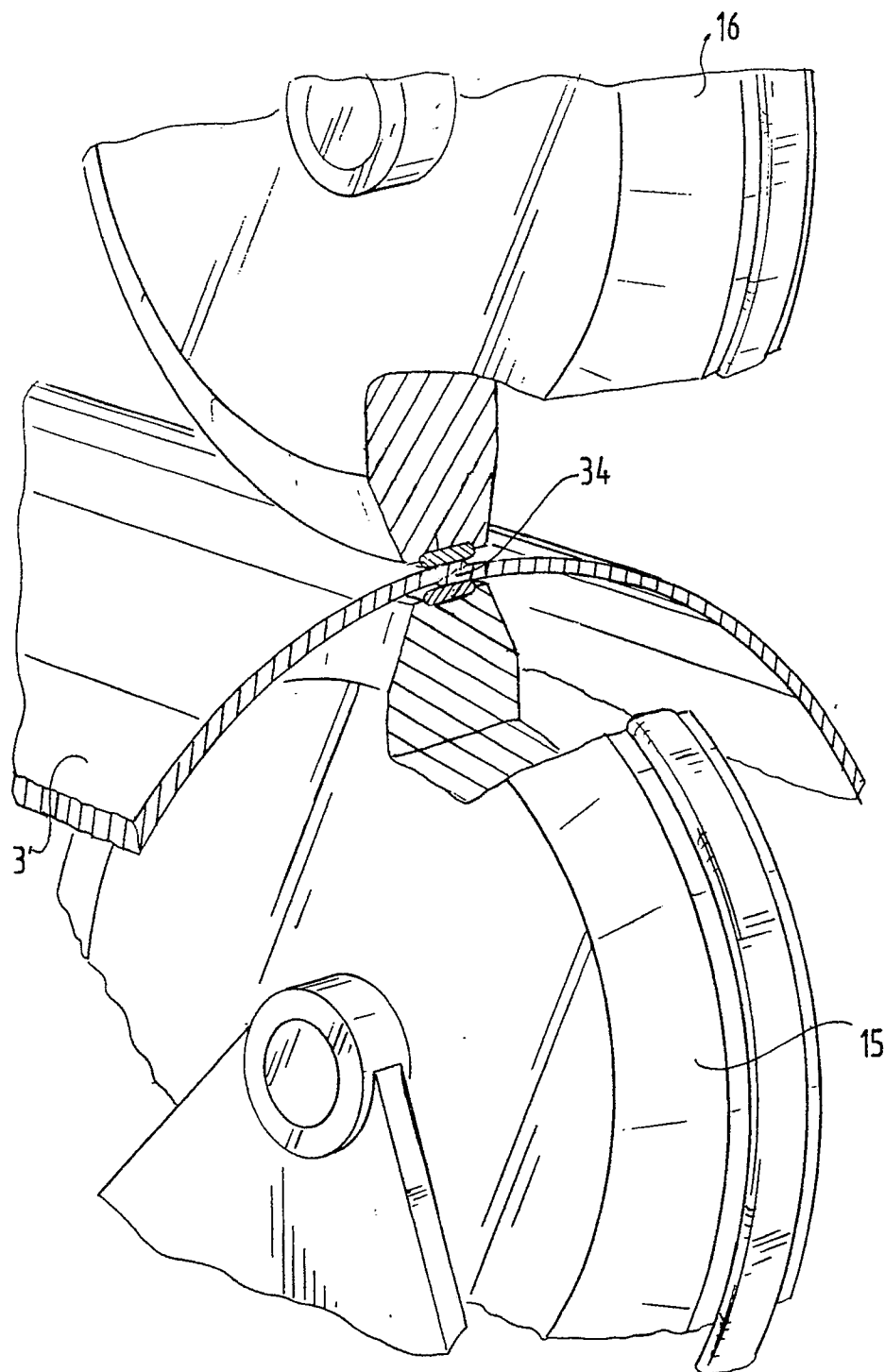


FIG. 6

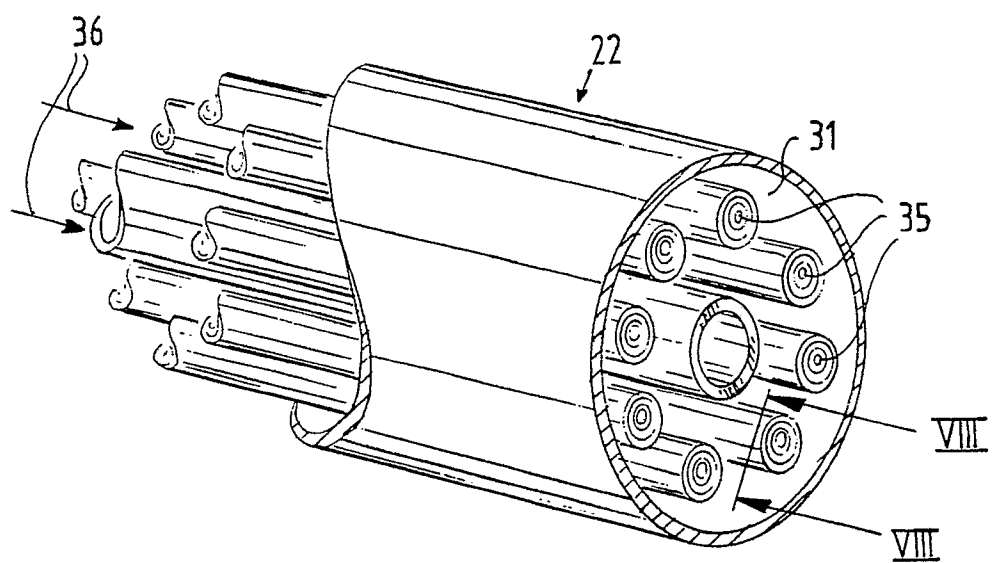


FIG. 7

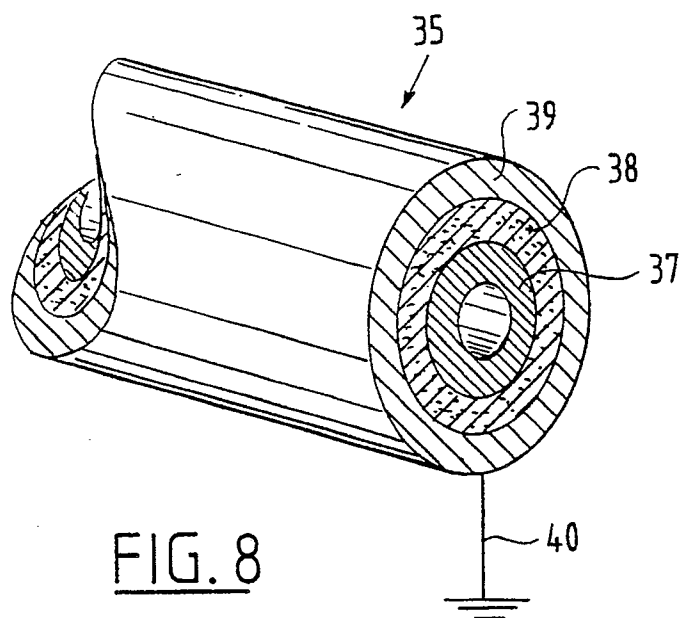


FIG. 8

EP 90 20 2885

DOCUMENTS CONSIDERED TO BE RELEVANT

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.5)
X	EP-A-0 167 088 (P. RIBNITZ) * Pages 1,2,7,8; figures *	1-5,8,9, 11,12, 14-16,19, 20,24,25	B 21 D 51/26 B 05 B 5/08 B 05 B 13/06
Y	---	6,7,10,13, 17,18,21 6,17	
Y	EP-A-0 120 810 (S. FREI) * Pages 1,2,5-7; claims; figures *		
Y	EP-A-0 312 918 (FAEL S.A.) * Column 8, lines 13-26; figure 10 *	13	
Y	US-A-3 733 670 (T.D. TROUGHTON) * Abstract; figure 1 *	7,18	
Y	G. SPUR: "Handbuch der Fertigungstechnik", vol. 4.1: "Abtragen, Beschichten", 1987, pages 530-537, Carl Hanser Verlag, Munich, DE; "Pulverbeschichtungsverfahren" * Page 532, last paragraph; figures 5,6 *	10,21	
A	US-A-3 702 107 (A.A. ROOD) * Abstract; claims; figures *	1-25	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	DE-C-7 146 69 (CONTINENTAL CAN) * Claims; figures *	1,11	B 21 D B 05 B
A	US-A-3 526 027 (E.H. MANUEL) * Claims; figures *	1,6,11,17	
A	US-A-3 745 295 (P.J. OPPRECHT) * Figure 1; column 1, lines 47-64 *	1,11	
	--- -/-		
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of search 15 January 91	Examiner BOMBEKE M.J.P.
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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EUROPEAN SEARCH REPORT

Application Number

EP 90 20 2885

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.5)
A	US-A-4 199 672 (C.V. SWORD) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
The present search report has been drawn up for all claims			
Place of search		Date of completion of search	Examiner
The Hague		15 January 91	BOMBEKE M.J.P.
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	