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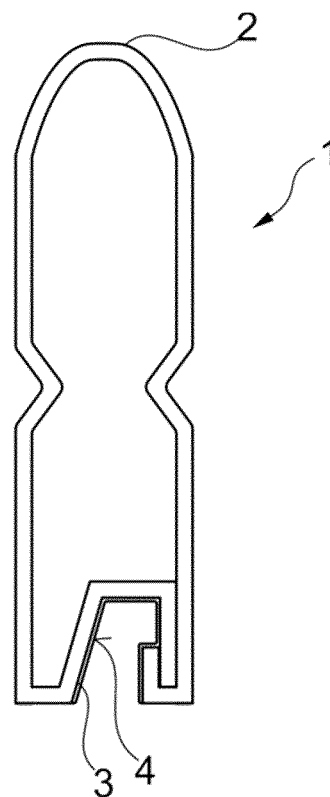
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(54) **Roller shutter slat, method of producing a roller shutter slat and apparatus for producing a roller shutter slat**

(57) The invention relates to a roller shutter slat (1) roll-formed from a coated aluminum strip to a hollow body profile having a male upper end (2) and a female lower end (3) for engagement with one or more other slats (1). According to the invention, at least one end (2, 3), preferably the female lower end (3), of the hollow body profile comprises a coating (4) based on a polytetrafluoroethylene (PTFE) solvent dispersion.

The invention further relates to a method and an apparatus for production of a roller shutter slat.



**Fig. 1**

## Description

**[0001]** The invention relates to a roller shutter slat according to the preamble of claim 1. Furthermore, the invention relates to a method and to an apparatus for producing a roller shutter slat.

### Background of the invention

**[0002]** Roller shutters for solar protection of a building often comprise a plurality of vertically moveable slats in order to lower them down into a closed position or to lift them up into an open position. The lowering and lifting action can be performed manually or automatically. Commonly known are roller shutter slats made from a coated aluminum strip roll-formed into a hollow body profile having a male upper end and a female lower end for engagement with other slats when lowered down into the closed position. The engagement of the slats prevents intrusion of surface water, in particular when the upper end of each slat has a male, i.e. convex formed, configuration and the lower end has a correspondingly female, i.e. concave formed, configuration.

**[0003]** When the roller shutter is lowered down, the slats contact each other thereby regularly producing, due to the material and the hollow body profile of each slat, an annoying noise. In order to reduce the noise it is known to fill the hollow body profile of each slat with an insulating material. Using an insulating material for filling the hollow body profile of the slats has the additional effect that the shutter provides a thermal insulation when closed.

**[0004]** EP 0 365 908 A1 discloses a roller shutter slat made of an aluminum strip roll-formed into a hollow body profile having a hooked and a G-shaped connecting end. For use in a soundproof shutter the slat has a plastic coating extruded or laminated on the inner face of the hollow body profile such that a double-layer plastic coating is formed in the area of the connecting ends for mutual sound isolation. In addition, the hollow body profile may be filled with a plastic foam material.

**[0005]** For the production of roller shutter slats it is well known to use coated aluminum strips. The coating is applied on the aluminum strip before it is roll-formed. In general the function of the coating is to improve the appearance and/or to increase the wear resistance of the slat made thereof. Thus the coating is applied to the side of the aluminum strip forming the later outside of the hollow body. For this purpose, very often coatings are used, that are prone to trap water in humid environments. Furthermore, it is common to use water-based coatings. Unfortunately, roller shutter slats made of such coated aluminum strips, in use, tend to stick together when exposed to high temperatures, e.g. temperatures of 35°C and more. As a consequence, during lifting the shutter the slats at first stick together and then drop with a loud noise.

**[0006]** It is an object of the present invention to improve a roller shutter slat roll-formed from a coated aluminum strip so that it does not tend to stick to an adjacent slat

when exposed to high temperatures.

**[0007]** This object is achieved by a roller shutter slat according to claim 1. Preferred embodiments of the invention are specified in the depending claims. This object is further achieved by a method for producing a roller shutter slat according to claim 6 and an apparatus for producing a roller shutter slat according to claim 12.

### Summary of the invention

**[0008]** Proposed is a roller shutter slat roll-formed from a coated aluminum strip to a hollow body profile having a male upper end and a female lower end for engagement with one or more other slats. According to the invention at least one end, preferably the female lower end, of the hollow body profile comprises a coating based on a polytetrafluoroethylene (PTFE) solvent dispersion. PTFE is resistant against temperatures up to 300°C and has a very low friction coefficient against other solids. As a consequence, the coating based on a PTFE solvent dispersion prevents the slats from sticking to each other when exposed to high temperatures. Further advantages relate to a reduced wear of the surface on which the coating is applied and of surfaces getting in contact with the coating. Accordingly, the coating may be applied to only one end of the hollow body profile.

**[0009]** PTFE is available in form of micro-spheres with an average diameter of less than 10 microns. Dispersed in a solvent, such as naphtha or propanol, it can be applied in a thin layer forming a colorless coating after drying. The solvent evaporates quickly, so that a coating based on a PTFE solvent dispersion dries fast. Thus, the application of the coating can be easily implemented in the current production process of a roller shutter slat without changing the production time.

**[0010]** Preferably, the coating stretches across an inwardly bent part of the female lower end of the hollow body profile. This region forms the contact area by engagement with the male upper end of a further slat in a closed position of the roller shutter. The coating on the contact area prevents that the two slats stick together when the roller shutter is lifted. Besides, due to the fact that the area is inwardly bent, the coating is not visible.

**[0011]** The area of contact is the area most prone to wear. Due to the low friction coefficient of the PTFE contained in the coating, wear is reduced as favorable side effect.

**[0012]** In a preferred embodiment of the invention the coating has a thickness of 5 µm to 20 µm, preferably of 7 µm to 15 µm. Such a thin layer coating does not build up, so that it is not necessary to change the dimensions of the respective end of the hollow body profile in order to fit the respective end of another slat for engagement.

**[0013]** Advantageously, the hollow body profile is filled with a thermal and/or acoustic insulation material, preferably with plastic foam material, most preferably with polyurethane. The insulation material inside the hollow body profile prevents the formation of a thermal bridge

and absorbs sound.

**[0014]** Furthermore, a roller shutter for solar protection is proposed, comprising at least two slats according to the invention. The slats are vertically movable such, that in a closed position a male upper end of a first slat engages with a female lower end of a second slat. Due to the coating on at least one end of the hollow body profile of each slat, the slats won't stick together when exposed to high temperatures. Accordingly, the loud noise, that occurs when the slats suddenly detach and drop down during lifting, is avoided. Thus, the roller shutter proposed allows for quiet operation.

**[0015]** In order to achieve the object named above, a method is proposed for producing a roller shutter slat from a coated aluminum strip. The method comprises the following steps:

- roll-forming the coated aluminum strip to a hollow body profile having a male upper end and a female lower end and
- depositing a PTFE solvent dispersion on at least one end, preferably the female lower end, of the hollow body profile. The deposition of the PTFE solvent dispersion follows the roll-forming process.

**[0016]** In order to achieve an anti-adhesion coating, preferably the PTFE solvent dispersion is deposited in a thin layer of few microns. Preferably, the PTFE solvent dispersion is deposited in a layer having a thickness of 5  $\mu\text{m}$  to 20  $\mu\text{m}$ , most preferably of 7  $\mu\text{m}$  to 15  $\mu\text{m}$ . According to a preferred embodiment of the invention, the PTFE solvent dispersion is deposited by spraying. Deposition by spraying facilitates the formation of thin layers. Besides, it enables an evenly spread coating.

**[0017]** The use of coated aluminum strips for the production of a roller shutter slat, may afford a further step, in particular by use of aluminum strips coated with a coating that tends to trap water in environments with high relative humidity. In order to eliminate water molecules present in the coating of the aluminum strip, it is proposed to heat the coated aluminum strip before being roll-formed and/or before applying the PTFE solvent dispersion. This action ensures permanent deposition of the PTFE solvent dispersion on the coated surface of the aluminum strip.

**[0018]** Preferably, the coated aluminum strip is heated up by infrared radiation to a temperature of 100 to 250°C, most preferably 150 to 200°C.

**[0019]** Further preferably, the coated aluminum strip is cooled down to a temperature of 10 to 60°C, most preferably 20 to 40°C, directly after heating. Cooling down the aluminum strip may be done by a cold air flow.

**[0020]** As an optional step the method according to the invention may comprise the step of filling the hollow body profile with a thermal and/or acoustic material, preferably with plastic foam, most preferably with polyurethane, before deposition of the PTFE solvent dispersion. The optional step of filling the hollow body profile with an insu-

lating material may comprise a further step of heating, in particular when plastic foam is used as insulating material. Preferably, the slat is heated up to a temperature of 30 to 50°C, most preferably 35 to 45°C, in order to liquefy the plastic foam material for injection. After injection, the plastic foam material undergoes an exothermic process and expands inside the hollow body profile until the hollow space is completely filled with plastic foam.

**[0021]** During expansion and hardening of the plastic foam material, the PTFE solvent dispersion may be applied. Hence, the production of roller shutter slats according to the present invention does not afford more production time. The step of depositing the PTFE solvent dispersion on at least one end of the hollow body profile can be easily implemented in the current method of production.

**[0022]** In order to accelerate drying of the PTFE solvent dispersion after deposition, the hollow body profile may be exposed to an air flow preferably produced by a plurality of fans. The air flow boosts evaporation of the solvent.

**[0023]** At the end, when the coating on at least one end of the hollow body profile is dry and the insulating material inside has set - provided that the hollow body profile has been filled - the slat is ready to be punched and/or cut. For punching the slat a punch press can be used.

**[0024]** Furthermore, an apparatus is proposed for producing a roller shutter slat from a coated aluminum strip. The apparatus comprises:

- a heating device for heating up the coated aluminum strip, preferably by infrared radiation,
- a cooling device for cooling down the coated aluminum strip directly after heating,
- a profiling unit comprising a plurality of rollers for roll-forming the coated aluminum strip into a hollow body profile having a male upper end and a female lower end and
- a spraying device for depositing of a PTFE solvent dispersion on at least one end, preferably the female lower end, of the hollow body profile. The apparatus allows for production of a roller shutter slat according to the present invention.

**[0025]** Preferably, the components of the apparatus are arranged in the order of mention. Accordingly, the coated aluminum strip for production of a roller shutter slat at first passes the heating device. Preferably, the heating device comprises means for the generation of infrared radiation in order to heat up the coated aluminum strip to a temperature of 100 to 250°C, preferably 150 to 200°C. After passing the heating device, the coated aluminum strip passes the cooling device where the strip is cooled down, preferably to a temperature of 10 to 60°C, most preferably 20 to 40°C. The cooling device may comprise one or more fans for the generation of a cold air flow. Shortly after, the strip reaches the profiling unit,

where it is roll-formed into the hollow body profile having a male upper end and a female lower end. The spraying device for deposition of the anti-adhesion coating on at least one end of the hollow body profile follows the profiling unit.

**[0026]** The apparatus may further comprise a filling device for filling the hollow body profile with a thermal and/or acoustic insulation material, preferably with plastic foam, most preferably with polyurethane. Preferably, the filling device is arranged between the profiling unit and the spraying device.

**[0027]** In addition, a further heating device may be provided for heating up the hollow body profile, preferably to a temperature of 30 to 50°C, most preferably 35 to 45°C. This facilitates filling the hollow body profile with insulating material, in particular with plastic foam material due to its liquefaction. Thus, the further heating device may be a component of the filling device.

**[0028]** Optionally, an evaporating unit may be arranged after the spraying device. The evaporating unit may comprise one or more fans for generation of air flow. The air flow supports drying of the PTFE solvent dispersion deposited on at least one end of the hollow body profile.

**[0029]** Advantageously, the apparatus allows for continuous production of a plurality of roller shutter slats. For this reason, the apparatus may further comprise a conveyor system for conveying the coated aluminum strip or the hollow body profile respectively. A continuous production reduces production costs.

**[0030]** Preferred embodiments of a roller shutter slat, a roller shutter and an apparatus for producing a roller shutter will be described in more detail hereafter. The description refers to the accompanying drawings. In the drawings:

Fig. 1 is a cross section of a slat according to the invention,

Fig. 2 a) is an elevational view and b) is a cross section of a lowered roller shutter comprising a plurality of slats according to fig. 1,

Fig. 3 is a partial cross section of two engaged slats according to Fig. 2b),

Fig. 4 is a schematic illustration of an apparatus according to the invention,

Fig. 5 is a schematic elevational view of a spraying device and

Fig. 6 is a schematic side view of the spraying device of fig. 5.

#### Detailed description of the drawings

**[0031]** As shown in fig. 1, the slat 1 has a hollow body

profile with a male upper end 2 and a female lower end 3. The male upper end 2 has a convex shape, whereas the female lower end 3 has a concave shape. Both ends 2, 3 are adapted to engage when arranged one on the top of the other. This is the case when a roller shutter comprising at least two of these slats is lowered down as can be seen in fig. 2a) and fig. 2b), which show a partial elevational view and a partial cross section of a roller shutter in closed condition. By engagement, the male upper end 2 of first slat 1 contacts the female lower end 3 of second slat 1. The area of contact is linear due to the differently curved shapes of both ends 2, 3. When engaged, a hollow space remains between the male upper end 2 of first slat 1 and the female lower end 3 of second slat 1 preventing jamming of the slats 1.

**[0032]** As shown in fig. 3, the female lower end 3 of second slat 1 has a coating 4 in the area of contact with the male upper end 2 of first slat 1. The coating is based on a PTFE solvent dispersion serving as anti-adhesion coating such that sticking of the slats 1 is prevented. In order to facilitate the deposition of the coating 4, the entire inwardly bent part of the female lower end 3 is coated.

**[0033]** By means of fig. 4, which is showing a schematic illustration of an apparatus according to the invention, the production of a roller shutter slat 1 will be described.

**[0034]** The present apparatus comprises a heating device 5 for heating up the coated aluminum strip to a temperature of 180°C in order to eliminate water molecules contained in the coating already deposited on the aluminum strip. The heating device 5 is followed by a cooling device 6 for cooling down the coated aluminum strip to a temperature of 30°C. After the cooling device 6 a profiling unit 7 is provided comprising a plurality of rolls 8 for roll-forming the coated aluminum strip into a hollow body profile. The apparatus further comprises a filling device 10 for filling the hollow body profile with a thermal and acoustic insulation material. During filling the hollow body profile is heated up to a temperature of 40°C by a further heating device 11 arranged in proximity of the filling device 10. After filling, the PTFE solvent dispersion is deposited on one end of the hollow body profile by means of a spraying device 9. The spraying device 9, as shown in fig. 5 and 6, uses compressed air 17 for the deposition of the PTFE solvent dispersion 19. The air facilitates the deposition in a thin even layer. The spraying device 9 is followed by an evaporating unit 12 comprising a plurality of fans 13 generating an air flow which boosts the drying of the PTFE solvent dispersion. At the end, the apparatus comprises a punching and/or cutting device 14 as well as a storage device 15 for storing the finished slats 1. The punching and/or cutting device 14 comprises a punch press.

**[0035]** The apparatus according to fig. 4 allows for continuous production of roller shutter slats 1. The coated aluminum strip material used for the production is coiled up (see coil 18), so it can easily be fed to the apparatus.

**[0036]** The drawings refer to preferred embodiments and therefore do not limit the scope of invention. Modifi-

cations are possible which may relate to the shape of a slat 1 and/or the complexity of the apparatus shown in the drawings.

#### Reference list

[0037]

- 1 slat
- 2 male upper end
- 3 female lower end
- 4 coating
- 5 heating device
- 6 cooling device
- 7 profiling unit
- 8 roller
- 9 spraying device
- 10 filling device
- 11 heating device
- 12 evaporating unit
- 13 fan
- 14 punching and/or cutting device
- 15 storage device
- 16 PTFE solvent dispersion
- 17 compressed air
- 18 coil
- 19 PTFE solvent dispersion

#### Claims

- 1. Roller shutter slat (1) roll-formed from a coated aluminum strip to a hollow body profile having a male upper end (2) and a female lower end (3) for engagement with one or more other slats (1),  
**characterized in that** at least one end (2, 3), preferably the female lower end (3), of the hollow body profile comprises a coating (4) based on a PTFE solvent dispersion.
- 2. Roller shutter slat according to claim 1,  
**characterized in that** the coating (4) stretches across an inwardly bent part (5) of the female lower end (3) of the hollow body profile.
- 3. Roller shutter slat according to claim 1 or 2,  
**characterized in that** the coating (4) has a thickness of 5  $\mu\text{m}$  to 20  $\mu\text{m}$ , preferably of 7  $\mu\text{m}$  to 15  $\mu\text{m}$ .
- 4. Roller shutter slat according to one of the preceding claims,  
**characterized in that** the hollow body profile is filled with a thermal and/or acoustic insulation material, preferably with plastic foam material, most preferably with polyurethane.
- 5. Roller shutter for solar protection comprising at least two slats (1) according to one of the preceding

claims, wherein the slats are vertically movable such, that in a closed position a male upper end (2) of a first slat (1) engages with a female lower end (3) of a second slat (1).

- 6. Method for producing a roller shutter slat (1) from a coated aluminum strip, comprising the steps
  - roll-forming the coated aluminum strip to a hollow body profile having a male upper end (2) and a female lower end (3) and
  - depositing a PTFE solvent dispersion on at least one end (2, 3), preferably the female lower end (3), of the hollow body profile.
- 7. Method according to claim 6,  
**characterized in that** the PTFE solvent dispersion is deposited by spraying.
- 8. Method according to claim 6 or 7,  
**characterized in that** the coated aluminum strip is heated before being roll-formed and/or before applying the PTFE solvent dispersion in order to eliminate water molecules present in the coating of the aluminum strip.
- 9. Method according to claim 8,  
**characterized in that** the coated aluminum strip is heated up by infrared radiation to a temperature of 100 to 250°C, preferably 150 to 200°C.
- 10. Method according to claim 8 or 9,  
**characterized in that** the coated aluminum strip is cooled down to a temperature of 10 to 60°C, preferably 20 to 40°C, directly after heating.
- 11. Method according to any one of the preceding claims 6 to 10,  
**characterized in that** the hollow body profile is filled with a thermal and/or acoustic material, preferably with plastic foam, most preferably with polyurethane, before deposition of the PTFE solvent dispersion.
- 12. Apparatus for producing a roller shutter slat (1) from a coated aluminum strip, comprising
  - a heating device (5) for heating up the coated aluminum strip, preferably by infrared radiation,
  - a cooling device (6) for cooling down the coated aluminum strip directly after heating,
  - a profiling unit (7) comprising a plurality of rollers (8) for roll-forming the coated aluminum strip into a hollow body profile having a male upper end (2) and a female lower end (3) and
  - a spraying device (9) for depositing of a PTFE solvent dispersion on at least one end (2, 3), preferably the female lower end (3), of the hollow body profile.

13. Apparatus according to claim 12,  
**characterized by** a filling device (10) for filling the hollow body profile with a thermal and/or acoustic insulation material, preferably with plastic foam, most preferably with polyurethane, whereby the filling device (10) is arranged between the profiling unit (7) and the spraying device (9). 5
14. Apparatus according to claim 12 or 13,  
**characterized by** a further heating device (11) for heating up the hollow body profile and/or an evaporating unit (12) arranged after the spraying device (9). 10
15. Apparatus according to any one of the preceding claims 12 to 14,  
**characterized in that** it allows continuous production of a plurality of roller shutter slats (1). 15

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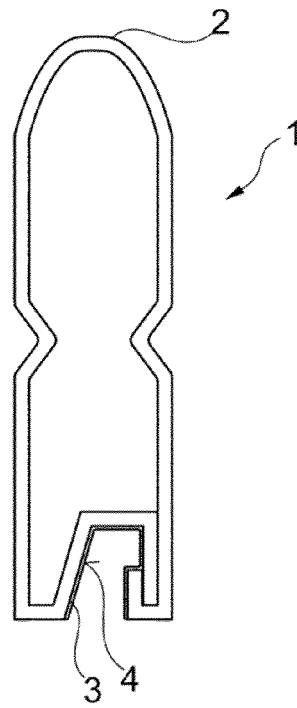


Fig. 1

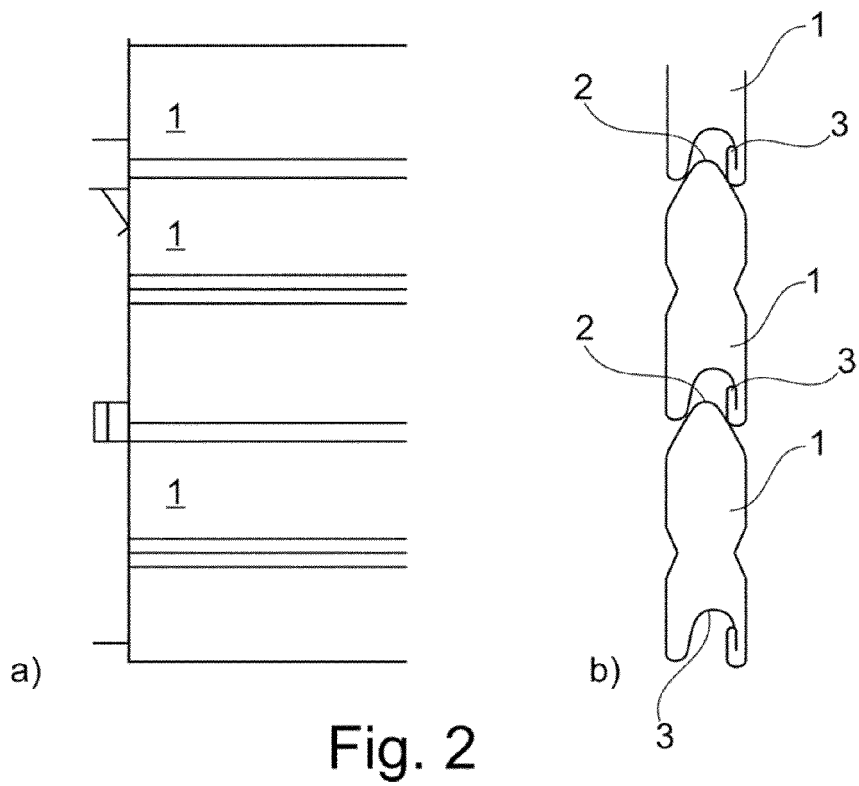


Fig. 2

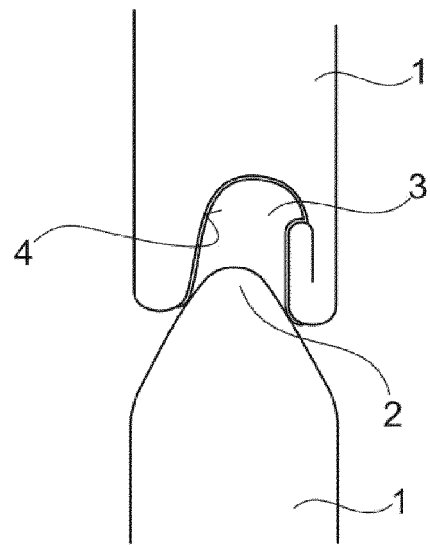


Fig. 3

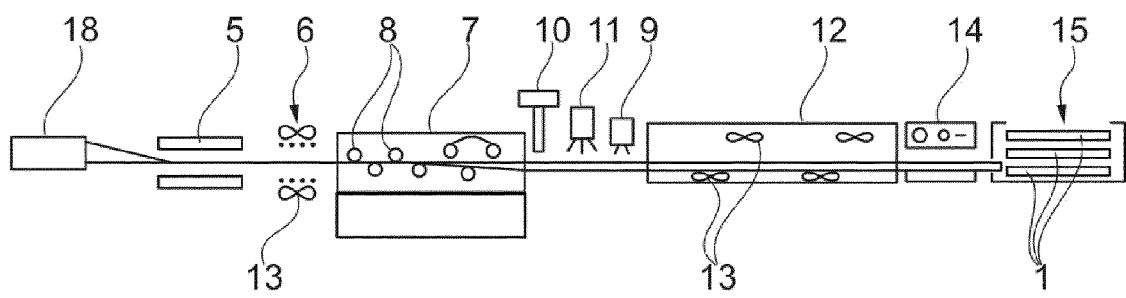


Fig. 4

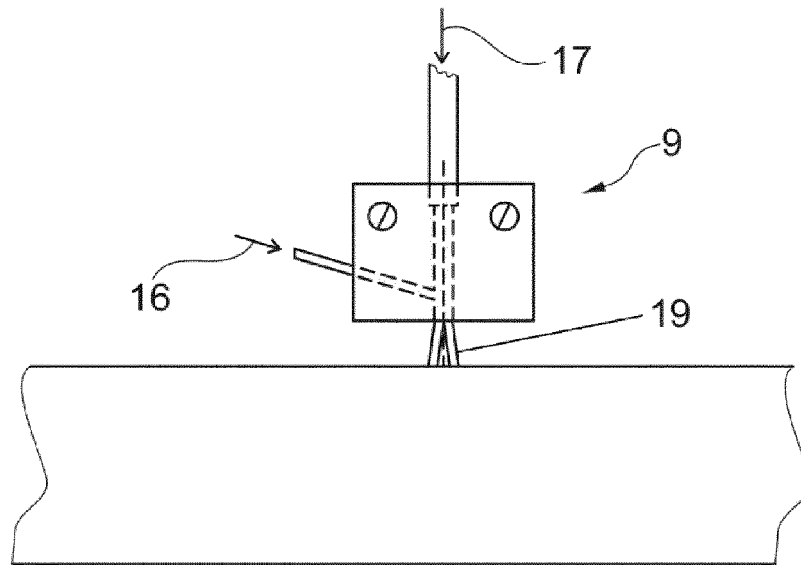


Fig. 5

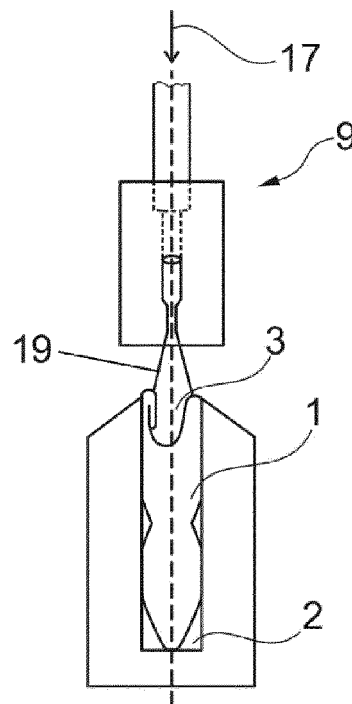


Fig. 6



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Application Number  
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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                      |                                                      |                                         |
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| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                      |                                                      |                                         |
| Place of search<br>Munich                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                      | Date of completion of the search<br>27 November 2013 | Examiner<br>Weißbach, Mark              |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                                                      |                                                      |                                         |

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 18 2330

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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27-11-2013

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**REFERENCES CITED IN THE DESCRIPTION**

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