



US 20050133941A1

(19) **United States**

(12) **Patent Application Publication**
Schuhmacher

(10) **Pub. No.: US 2005/0133941 A1**

(43) **Pub. Date: Jun. 23, 2005**

(54) **TUBE WITH A MARKING AND PROCESS
FOR THE PRODUCTION OF A MARKING
ON A TUBE**

Publication Classification

(51) **Int. Cl.⁷ E21B 47/022**

(52) **U.S. Cl. 257/E51**

(75) **Inventor: Walter Schuhmacher,**
Bietigheim-Bissingen (DE)

Correspondence Address:
Mr. Edward J. Timmer
P.O. Box 770
Richland, MI 49083 (US)

(57) **ABSTRACT**

To provide a tube comprising a wall, which comprises a fluoropolymer, in particular polytetrafluoroethylene (PTFE), a perfluoroalkoxy polymer (PFA) and/or a fluorinated ethylene propylene (FEP), and a colour marking and/or an X ray contrast marking, which may be identified and/or positioned through the colour marking and/or the X ray contrast marking without relinquishing the advantages of a tube made of fluoropolymer material, it is proposed that the colour marking or the X ray contrast marking comprises at least one marking element, which is produced separately from the wall of the tube and thermally welded to the wall.

(73) **Assignee: ElringKlinger AG**

(21) **Appl. No.: 10/914,344**

(22) **Filed: Aug. 9, 2004**

(30) **Foreign Application Priority Data**

Aug. 21, 2003 (DE)..... 103 38 338.7

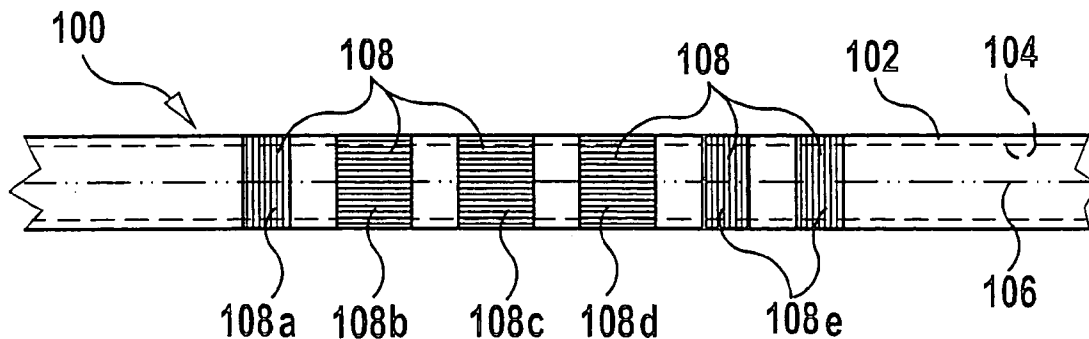


FIG.1

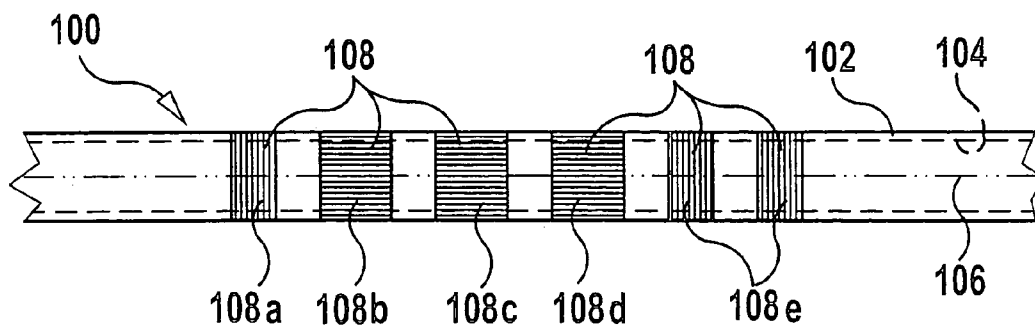


FIG.2

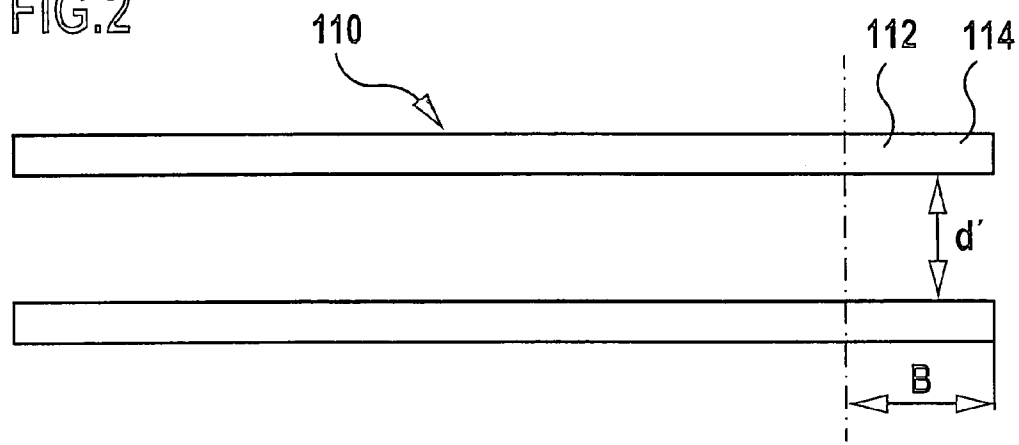


FIG.3

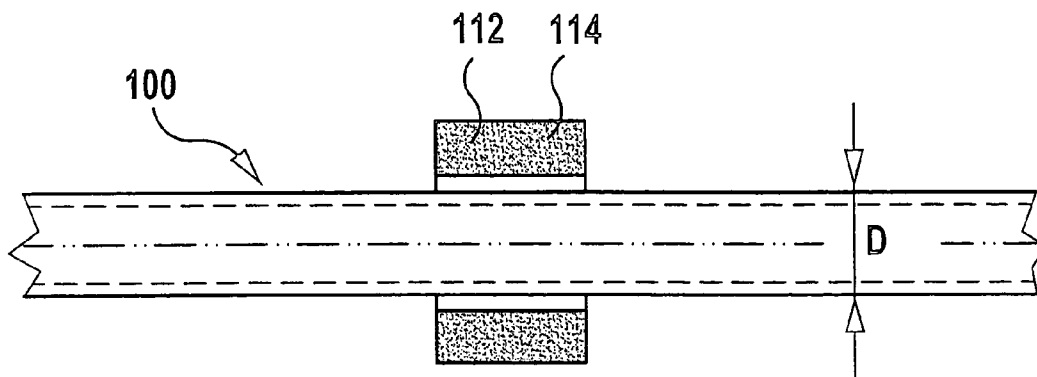


FIG.4

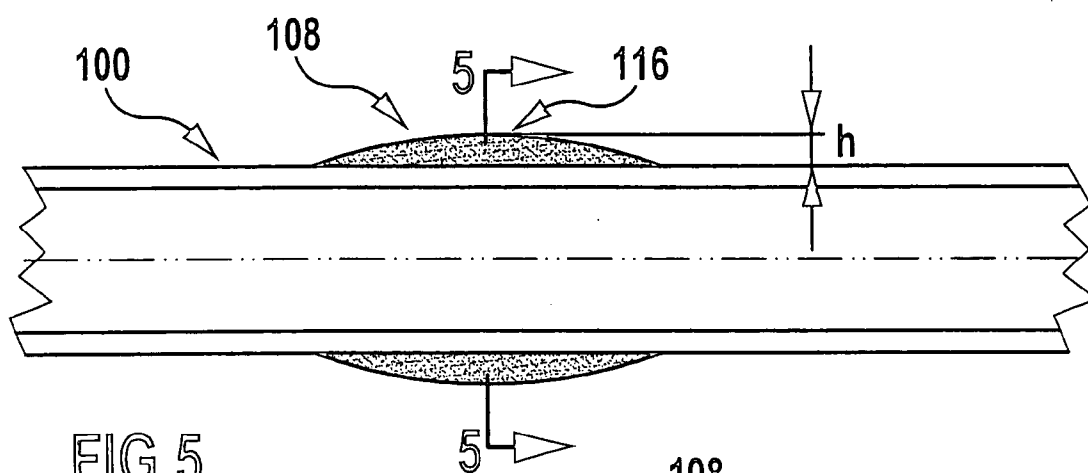


FIG.5

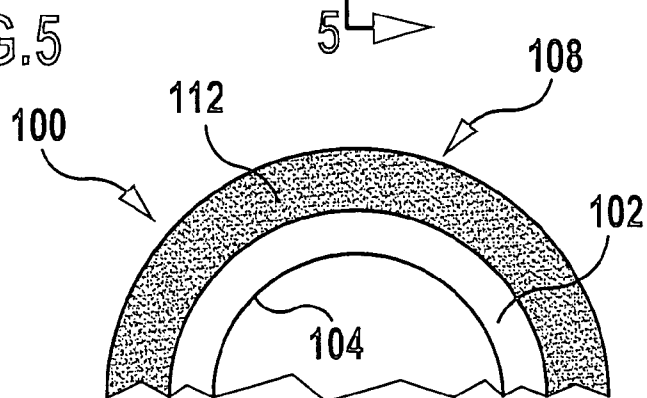


FIG.6

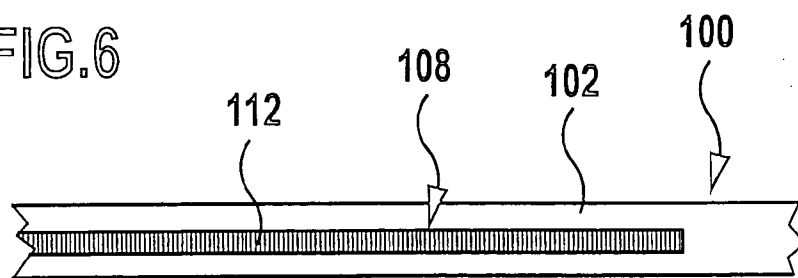
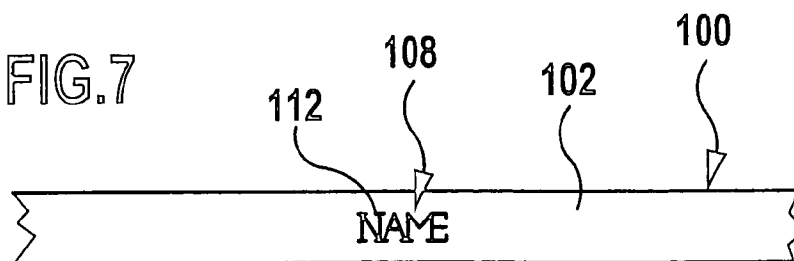


FIG.7



TUBE WITH A MARKING AND PROCESS FOR THE PRODUCTION OF A MARKING ON A TUBE

[0001] The present disclosure relates to the subject matter disclosed in German Patent Application No. 103 38 338.7 of Aug. 21, 2003, the entire specification of which is incorporated herein by reference.

[0002] The present invention relates to a tube, which comprises a wall, which comprises a fluoropolymer, in particular polytetrafluoroethylene (PTFE), a perfluoroalkoxy polymer (PFA) and/or a fluorinated ethylene propylene (FEP), and a colour marking and/or an X ray contrast marking.

[0003] Within the scope of this description and the attached claims, the term "polytetrafluoroethylene", besides pure polytetrafluoroethylene (PTFE), also covers modified polytetrafluoroethylene, a polytetrafluoroethylene compound or a modified polytetrafluoroethylene compound.

[0004] In this case, a "modified polytetrafluoroethylene" should be understood to mean a substance similar to PTFE, in which the molecular structure of the PTFE has been chemically modified by the fluorine atoms of the PTFE being partially replaced by substituents.

[0005] Such a modified PTFE is known, for example, under the designation 62N and is available from DuPont.

[0006] A "polytetrafluoroethylene compound" should be understood to mean a mixture of PTFE and at least one organic or inorganic filler. Substances that may be considered for such fillers are in particular glass fibres, carbon fibres, coal, graphite, molybdenum sulphide, bronze, special steel, ceramic or organic fillers, in particular high temperature resistant thermoplastics and thermosetting plastics.

[0007] Accordingly, a "modified polytetrafluoroethylene compound" should be understood to mean a mixture, which comprises a modified polytetrafluoroethylene, e.g. 62N, and at least one organic or inorganic filler.

[0008] Tubes with a wall made of polytetrafluoroethylene have a high resistance to chemicals, a good temperature resistance, are capable of being sterilised, and also have anti-adhesive properties, which is why such tubes are used in numerous applications in the chemical, electrical and mechanical industries as well as in medical engineering.

[0009] It is known in particular to use tubes made of polytetrafluoroethylene with colour ring markings in medical engineering as catheter tubes, papillotomes or as tubes for endoscopy.

[0010] In this case, the colour markings serve both to distinguish between different tubes and to position an identified tube in a desired location.

[0011] To be able to also identify a tube and position it in a desired location when the tube can only be observed in X ray light, as can be the case especially in medical engineering, but also in other applications, it is known to provide such a tube with an X ray contrast marking.

[0012] It is known in particular to press metal marking sheaths onto a PTFE tube or into a PTFE tube. However, this has the disadvantage that the outside diameter of the respective tube is increased at the marking location by the pressed-

on sheath or that the inside diameter of the tube is reduced by the metal sheath pressed into the tube.

[0013] An increase in the outside diameter has the disadvantage that it is more difficult to insert the tube into a passage. Moreover, the tube can become caught on an obstacle at the end sides of the metal sheath used.

[0014] If the metal sheath is pressed into the tube, then the passage of probes, light guides and other objects through the internal space of the tube is hindered.

[0015] A further disadvantage of the use of metal sheaths is that dirt and bacteria can collect on the metal sheaths or in the gap between the metal sheath and the surface of the tube, and this renders cleaning or even sterilisation of the tube more difficult, or even impossible.

[0016] Since the metal sheaths and the PTFE material of the tube have widely different coefficients of thermal expansion, the metal sheaths can additionally become loose or even become detached from the tube in the event a temperature change.

[0017] A further disadvantage is that the flexibility of the PTFE tube is reduced in the region of the metal sheath.

[0018] Finally, it is also difficult to fasten the metal sheath on or in the comparatively soft PTFE tube securely against slipping. The possibility of the metal sheath being inadvertently stripped off cannot be excluded.

[0019] It is known from DE 101 34 008 A1 to provide a tube with a wall made of a fluoropolymer with a coating, which contains an X ray contrast material. This coating can be formed in particular by spraying on a suspension containing the X ray contrast material.

[0020] The object forming the basis of the present invention is to provide an alternative tube of the aforementioned type, which may be identified and/or positioned through the colour marking and/or the X ray contrast marking without relinquishing the advantages of a tube made of fluoropolymer material.

[0021] This object is achieved according to the invention with a tube with the features of the preamble of claim 1 in that the colour marking or the X ray contrast marking comprises a marking element, which is produced separately from the wall of the tube and which is thermally welded to the wall.

[0022] The term "thermal welding" in this description and in the attached claims should be understood to mean any process, in which the material of the marking element is at least partially softened and/or fused and in this softened and/or fused state is joined integrally with the material of the wall of the tube.

[0023] The term "wall" of the tube in this description and in the attached claims covers all of the material enclosing the cavity of the tube, including all coatings generated in any way before the marking element is attached to the tube.

[0024] Therefore, the tube to be marked can in particular be firstly provided with one or several coatings and then with the at least one marking element.

[0025] Because the tube according to the invention comprises a marking element produced separately from the wall of the tube, it is possible to produce such a tube with colour

markings of any desired colour and/or with X ray contrast markings of any desired X ray absorbency simply and quickly, since a stock of marking elements of the desired colours and/or X ray absorbency is held ready, which can then be very simply and quickly positioned on the tube to be marked and thermally welded to the wall of the tube.

[0026] The tube according to the invention can have colour markings of any desired colour in each desired colour intensity and/or X ray contrast markings of any desired X ray contrast capability.

[0027] The colour markings or X ray contrast markings provided in the form of a separately produced marking element thermally welded to the wall of the tube are abrasion-resistant, can be sterilised, are flexible and biocompatible.

[0028] In particular, these markings do not have any of the aforementioned disadvantages of metal sheaths, which are drawn onto the tube to be marked or are pressed into the tube to be marked.

[0029] The material from which the marking element is made can have the same coefficient of expansion as the material of the tube to be marked.

[0030] Moreover, the material of the marking element can also have the same resistance to chemicals as the material of the tube to be marked.

[0031] The flexibility of the tube to be marked is not impaired by such a marking element.

[0032] In a preferred embodiment of the tube according to the invention, it is provided that the marking element is fused with the wall of the tube. A particularly firm connection of the marking element with the tube to be marked is achieved in this way.

[0033] In principle, the marking element could be arranged on the inside or on the outside of the wall of the tube to be marked.

[0034] However, it is preferably provided that the marking element is welded to an outside of the wall. In this case, the inside diameter of the tube to be marked is not reduced; the outside diameter is increased only slightly by the marking element welded to the wall of the tube.

[0035] The marking element welded to the outside of the tube preferably has no faces projecting from the wall of the tube transversely to the longitudinal direction thereof, but instead has end regions, which are raised at a small acute angle from the wall of the tube and gradually rise to the region of greatest thickness of the marking element.

[0036] In this case, the region of greatest thickness of the marking element preferably has a thickness of less than approximately 0.4 mm, in particular of less than approximately 0.2 mm.

[0037] The marking element can have any desired form, in principle, and can be linear or spiral in shape, for example, and/or comprise alphanumeric characters, company logos and similar.

[0038] In a preferred configuration of the invention, it is provided that the marking element is configured in a ring shape and therefore surrounds the wall of the tube to be marked in a ring shape.

[0039] In order to adapt the chemical and physical properties of the marking element as far as possible to those of the wall of the tube, it is preferably provided that the marking element contains a fluoropolymer, in particular polytetrafluoroethylene (PTFE), a perfluoroalkoxy polymer (PFA) and/or a fluorinated ethylene propylene (FEP).

[0040] In order to give the marking element X ray contrast capability, it can be provided that the marking element contains an X ray contrast material.

[0041] In this case, an X ray contrast material should be understood to mean a material, which has a clearly higher X-radiation absorbency than the material of the wall of the tube, so that marked locations of the tube are clearly distinguishable from unmarked locations in the X ray image.

[0042] Bismuth carbonate, barium sulphate, titanium dioxide and/or a metal powder in particular can be used as the X ray contrast material.

[0043] In order to obtain a particularly high X ray contrast capability of the marking and thus a particularly good visibility of the marking in the X ray image, it is advantageous if the marking element contains at least approximately 20% by weight, preferably at least approximately 50% by weight, in particular at least approximately 70% by weight of X ray contrast material.

[0044] To enable the marking to be recognisable in visible light, it can be provided that the marking element contains at least one pigment.

[0045] In particular, it is also possible that the marking element contains both at least one X ray contrast material and at least one pigment, in particular a colour pigment. It can furthermore be provided that the marking element contains a material, which is both X ray contrast capable and has the properties of a pigment.

[0046] To enable the tube to not only be identified by means of the marking, but also positioned in a desired position along its longitudinal axis and/or in a desired angular position with respect to its longitudinal axis, it is favourable if the marking element covers less than the entire outer surface of the tube.

[0047] In a preferred embodiment of the invention, it is additionally provided that the tube comprises several marking elements.

[0048] In particular, it can be provided that at least two of the marking elements differ from one another with respect to their X-radiation absorbency. This causes these markings to appear in different grey values in the X ray image and as a result to be distinguishable from one another.

[0049] Alternatively or additionally hereto, it can be provided that at least two of the marking elements differ from one another with respect to their colour. This causes these markings to appear in different colours and as a result to be distinguishable from one another.

[0050] In a preferred configuration of the tube according to the invention, it is provided that at least two of the marking elements are spaced from one another, in which case the marking elements can be spaced from one another in the longitudinal direction of the tube and/or in the peripheral direction of the tube.

[0051] A further object forming the basis of the present invention is to provide an alternative process for the production of a marking on a tube of the aforementioned type, which enables perfect identification and/or positioning of the tube, and thus attains the advantages of a tube made of a fluoropolymer.

[0052] This object is achieved in a process with the features of the preamble of claim 15 by the following process steps:

[0053] production of a marking element separately from the tube;

[0054] positioning of the marking element in a desired position relative to the tube;

[0055] thermal welding of the marking element to the wall of the tube.

[0056] In particular, it can be provided that the step of producing the marking element comprises the following:

[0057] production of a tube or a sheath from a marking material;

[0058] separation of a ring-shaped marking element from the tube or from the sheath.

[0059] In order to increase the inside diameter of the ring-shaped marking element before positioning relative to the tube to be marked, it can be provided that the tube or the sheath are widened before separation of the ring-shaped marking element.

[0060] Alternatively or additionally hereto, it can be provided that the ring-shaped marking element is widened before positioning relative to the tube, for example, by drawing the ring-shaped marking element over a truncated cone-shaped spike.

[0061] Marking elements that are not ring shaped can be produced particularly simply if the step of producing the marking element comprises the following:

[0062] production of a foil from a marking element;

[0063] separation of a marking element from the foil.

[0064] This separation can be achieved in particular by the marking element being cut out or punched out of the foil.

[0065] In particular, the marking element produced in this way can be configured in essentially linear form and/or in essentially spiral form.

[0066] In a preferred configuration of the process according to the invention, it is provided that the marking element is fused with the wall of the tube.

[0067] Further features and advantages of the invention are the subject of the description and the drawing representing embodiments.

[0068] FIG. 1 is a side view of a section of a tube with a wall made of PTFE, PFA or FEP and several markings;

[0069] FIG. 2 is a schematic view in longitudinal section through a tube filled with X ray contrast material and/or with colour pigment, from which a marking ring is cut out;

[0070] FIG. 3 is a schematic view in longitudinal section through the tube to be marked and a marking ring drawn onto the tube to be marked;

[0071] FIG. 4 is a schematic view in longitudinal section through the tube and the marking ring from FIG. 3 after the marking ring has been fused with the wall of the tube to be marked;

[0072] FIG. 5 is a schematic sectional view through the tube to be marked and the marking ring from FIG. 4, taken along line 5-5 in FIG. 4;

[0073] FIG. 6 is a schematic side view of a section of a second embodiment of a tube with a marking element fused with the wall of the tube, which extends in the longitudinal direction of the tube to be marked; and

[0074] FIG. 7 is a schematic side view of a section of a third embodiment of a tube with a marking element fused with the wall of the tube, which comprises alphanumeric characters.

[0075] Identical or functionally equivalent elements are given the same reference numerals in all the figures.

[0076] A tube shown in FIGS. 1, 4 and 5 and given the overall reference 100 comprises a flexible, hollow cylindrical wall 102, which encloses a cylindrical internal space 104 the tube and extends in a longitudinal direction 106 of the tube.

[0077] The wall 102 of the tube 100 is formed, for example, by a paste extrusion process from polytetrafluoroethylene (PTFE), from modified polytetrafluoroethylene, from a polytetrafluoroethylene compound or from a modified polytetrafluoroethylene compound, or is formed, for example, by a thermoplastic extrusion process from PFA or FEP.

[0078] The tube 100 is provided with several markings 108, which surround the wall 102 of the tube 100 in a ring shape and are spaced from one another in the longitudinal direction 106.

[0079] The markings 108 differ with respect to their colour. Thus, for example, a first marking 108a surrounding the wall 102 in a ring shape is black in colour.

[0080] Further ring-shaped markings 108b, 108c, 108d, which are spaced from one another in the longitudinal direction 106 of the tube, following the first black marking 108a are, for example, respectively green, yellow and red in colour.

[0081] A further black coloured marking 108e, for example, follows the red marking 108d, is configured as a double marking and comprises two ring-shaped, black coloured part-markings.

[0082] The different colours enable differentiation of the markings 108, if it is possible to observe them in visible light, e.g. by means of a video camera. In order to also make the markings 108 distinguishable from one another when observed with X ray light, the markings 108 are provided with different absorbencies for X-radiation in a manner described in further detail below.

[0083] Each of the markings 108 is produced by making a marking ring with the desired colour and the desired X-radiation absorbency, drawing the marking ring onto the tube 100 to be marked and subsequently welding the marking ring to the wall 102 of the tube 100.

[0084] This production process is explained below with reference to FIGS. 2 to 6:

[0085] Firstly, the marking material tube **110** shown schematically in longitudinal section in FIG. 2 is produced in an extrusion process known per se, e.g. a paste extrusion process or a thermoplastic extrusion process.

[0086] The material, from which the marking material tube **110** is produced by extrusion, can comprise the same base material as the tube **100** to be marked. Thus, if the tube **100** to be marked comprises PTFE, then the marking material tube **110** can also comprise PTFE.

[0087] However, to weld the marking ring to the tube to be marked, it can also be advantageous if the marking ring comprises a base material, which has a lower melting temperature than the material of the tube to be marked. Hence, the marking material tube **110** can comprise FEP as base material, for example, and the tube **100** to be marked can comprise PTFE as base material, which has a higher melting temperature than FEP.

[0088] In order to obtain the desired colour of the subsequent marking **108**, a pigment of the desired colour is added to the material, from which the marking material tube **110** is extruded.

[0089] The proportion by weight of the added colour pigment advantageously amounts to approximately 0.1% by weight to approximately 20% by weight of the whole of the material of the marking material tube **110**.

[0090] In order to obtain the desired X ray absorbency of the marking **108**, an X ray contrast material, e.g. barium sulphate, bismuth carbonate, titanium dioxide and/or a metal powder, is added to the material, from which the marking material tube **110** is extruded.

[0091] The proportion of the X ray contrast material in the material of the marking material tube **110** preferably amounts to approximately 50% by weight to approximately 95% by weight, preferably approximately 70% by weight to approximately 90% by weight.

[0092] Depending on the desired colour and the desired X ray absorbency, the very same material can also be used both as pigment and as X ray contrast material.

[0093] The total proportion of the pigments and X ray contrast fillers added to the material of the marking material tube **110** in the material of the marking material tube **110** preferably amounts to approximately 3% by weight to approximately 95% by weight, in particular approximately 5% by weight to approximately 90% by weight.

[0094] The marking material tube **110** is widened so that its widened inside diameter d' is slightly larger than the outside diameter D of the tube **100** to be marked.

[0095] This widening can be achieved, for example, by drawing the marking material tube **110** over a spike, the largest diameter of which corresponds to the desired inside diameter d' .

[0096] A marking element **112** in the form of a marking ring **114** with the desired width B (extent in the longitudinal direction of the marking material tube **110**) is then separated, in particular cut off (see FIG. 2), by means of a suitable tool.

[0097] The separated marking ring **114** is drawn onto the tube **100** to be marked and positioned at the location, at which the marking **108** is to be generated (see FIG. 3).

[0098] The marking element **112** is then heated by means of a suitable heating means to such a temperature that the fluoropolymer base material of the marking element **112**, i.e. the PTFE, PFA and/or FEP, for example, melts and bonds with the material on the outside of the tube **100** to be marked.

[0099] If the marking element **112** contains PTFE as fluoropolymer base material, then the marking element **112** is preferably heated to a temperature of more than 320° C., e.g. of approximately 340° C.

[0100] If the marking element **112** contains FEP as fluoropolymer base material, then the marking element **112** is preferably heated to a temperature of at least approximately 290° C.

[0101] It is additionally favourable if the material on the outside of the wall **102** of the tube **100** to be marked is also heated until it softens and thus bonds particularly well with the material of the marking element **112**.

[0102] As a result of the (at least partial) melting of the marking element **112** and the softening and/or melting of the outside of the wall **102** of the tube **100**, the marking element **112** and the tube **100** are thermally welded to one another, in which case the faces of the marking element **112** are deformed so that the outer surfaces of the marking element **112** rise gradually from the wall **102** of the marked tube **100** at a small acute angle up to the region **116** of greatest thickness of the marking element **112**.

[0103] In this region **116** of greatest thickness, the thickness of the marking element **112** welded to the tube **100** preferably amounts to less than 0.4 mm, in particular less than 0.2 mm.

[0104] The heating means for heating the marking element **112** and possibly also the outside of the wall **102** of the tube **100** to be marked can, for example, be an infrared radiation source, a halogen light source, a hot air fan and/or an electrical resistance heater, e.g. a strip heater.

[0105] The heating of the marking element **112** and possibly the outside of the wall **102** of the tube **100** to be marked can be achieved in particular by irradiation with infrared radiation, by irradiation with the spectrum of a halogen light source, by subjecting it to heated air or another heated gas or by heat transfer by means of an electrical resistance heater (which is transferred by heat radiation and/or by convection onto the marking element **112** and the wall **102** of the tube **100**).

[0106] If the marking element **112** configured as a marking ring **114** has been widened before heating, then the marking ring **114** contracts during melting and generates a contact pressure on the tube **100** to be marked. This is additionally assisted by the fusion of the marking element **112** with the tube **100** to be marked.

[0107] In this way, a marking **108**, which forms a no longer separable unit with the tube surface, is generated at the desired location of the tube **100**.

[0108] In order to generate several markings **108** on the tube **100**, which differ with respect to their colour in the

optical range and/or with respect to their X-radiation absorbency, marking elements **112** in the form of marking rings **114** are separated in the desired width from marking material tubes **110** made of a material with the desired colour and/or the desired X ray absorbency, are positioned on the tube **100** in the desired position and thermally welded to the wall **102** of the tube **100**.

[0109] In this case, the thermal welding can be conducted for individual markings **108** one after the other or simultaneously for all markings **108**.

[0110] In this way, the markings **108** shown in FIG. 1 are generated on the tube **100**.

[0111] The markings **108** produced in this way are abrasion-resistant, can be sterilised and are biocompatible. They have the same coefficient of expansion and the same resistance to chemicals as the base tube **100**. The inside diameter of the tube **100** is not reduced by the markings **108** and the outside diameter of the tube **100** is only increased slightly.

[0112] In addition, the flexibility of the tube **100** is not impaired by the markings **108**.

[0113] The shape of the markings **108** is not restricted to a ring shape but can assume any desired form.

[0114] Thus, the second embodiment of a tube **100** shown in FIG. 6 is provided on the outside of the wall **102** with a marking **108**, which does not surround the wall **102** in a ring shape, but instead extends linearly in the longitudinal direction **106** of the tube **100**.

[0115] In this case, the marking **108** can extend over the entire length of the tube **100** or only over a part-section of the tube.

[0116] As a result of such a marking it is possible in particular to determine the angular position of the tube **100** with respect to its longitudinal axis or to set a desired angular position of the tube. This is of interest in particular when the internal space **104** of the tube **100** is not rotationally symmetric.

[0117] In order to generate the linear marking **108** shown in FIG. 6, a marking material foil is produced from a material, which contains a fluoropolymer as base material and to which one or more materials are added, which provide the marking material with the desired colour and/or the desired X ray absorbency.

[0118] In particular, the marking material foil can be produced from the same materials, which have been specified above in association with the marking material tube **110**.

[0119] After production of the marking material foil, a marking element **112** is separated from the marking material foil, in particular cut or punched out of this, in the desired shape, e.g. in the form of an elongated rectangle, for example.

[0120] The separated marking element **112** is then positioned in the desired position on the outside of the wall **102** of the tube **100** and thermally welded to the wall **102** of the tube **100** by heating in the above-described manner, so that a marking **108** forming a no longer separable unit with the wall **102** of the tube **100** is generated.

[0121] The marking element **112** does not have to be rectilinear, but can have any other desired form, e.g. the form of a spiral, which winds around the tube **100** on the outside of the wall **102**.

[0122] Otherwise, the second embodiment of a marked tube **100** shown in FIG. 6 is the same as the first embodiment shown in FIGS. 1 to 5 with respect to structure, function and production, and on this basis reference is made to the above description thereof.

[0123] In a third embodiment of a tube **100** shown in FIG. 7, the marking **108** arranged on the outside of the wall **102** comprises a sequence of alphanumeric characters.

[0124] It is also possible through such alphanumeric characters to identify the tube and/or position it in longitudinal direction and/or in peripheral direction in the desired manner.

[0125] The markings **108** can also assume any further desired form that is not shown in the drawing; for example, markings in the form of barcodes, company logos or similar can be provided.

[0126] Marking elements **112** in the form of alphanumeric characters or with any other structure can be separated from a marking material foil, in particular cut or punched out. The marking elements **112** thus produced can then be positioned on the wall **102** of the tube **100** and thermally welded to the tube **100** by heating.

[0127] The X ray contrast material contained in a marking element **112** enables the respective marking **108** to be identified in the X ray image.

[0128] The coloured material contained in a marking element **112**, in particular a pigment contained therein, enables the respective marking **108** to be identified during observation with visible light, e.g. by means of a video camera.

[0129] Otherwise, the third embodiment of a marked tube **100** shown in FIG. 7 is the same as the two embodiments shown in FIGS. 1 to 6 with respect to structure, function and production, and on this basis reference is made to the above description thereof.

1. Tube comprising a wall, which comprises a fluoropolymer, in particular polytetrafluoroethylene (PTFE), a perfluoroalkoxy polymer (PFA) and/or a fluorinated ethylene propylene (FEP), and a colour marking and/or an X ray contrast marking, wherein the colour marking or the X ray contrast marking comprises at least one marking element, which is produced separately from the wall of the tube and thermally welded to the wall.

2. Tube according to claim 1, wherein the marking element is fused with the wall of the tube.

3. Tube according to claim 1, wherein the marking element is welded to an outside of the wall.

4. Tube according to claim 1, wherein the marking element is configured in a ring shape.

5. Tube according to claim 1, wherein the marking element contains a fluoropolymer, in particular polytetrafluoroethylene (PTFE), a perfluoroalkoxy polymer (PFA) and/or a fluorinated ethylene propylene (FEP).

6. Tube according to claim 1, wherein the marking element contains an X ray contrast material.

7. Tube according to claim 6, wherein the X ray contrast material comprises bismuth carbonate, barium sulphate, titanium dioxide and/or a metal powder.

8. Tube according to claim 6, wherein the marking element contains at least approximately 20% by weight,

preferably at least approximately 50% by weight, in particular at least approximately 70% by weight of X ray contrast material.

9. Tube according to claim 1, wherein the marking element contains at least one pigment.

10. Tube according to claim 1, wherein the marking element covers less than the entire outer surface of the tube.

11. Tube according to claim 1, wherein the tube comprises several marking elements.

12. Tube according to claim 11, wherein at least two of the marking elements differ from one another with respect to their X-radiation absorbency.

13. Tube according to claim 11, wherein at least two of the marking elements differ from one another with respect to their colour.

14. Tube according to claim 11, wherein at least two of the marking elements are spaced from one another.

15. Process for producing a marking on a tube, the wall of which comprises a fluoropolymer, in particular polytetrafluoroethylene (PTFE), a perfluoroalkoxy polymer (PFA) and/or a fluorinated ethylene propylene (FEP), comprising the following process steps:

production of a marking element separately from the tube;

positioning of the marking element in a desired position relative to the tube;

thermal welding of the marking element to the wall of the tube.

16. Process according to claim 15, wherein the step of producing the marking element comprises the following:

production of a tube or a sheath from a marking material;

separation of a ring-shaped marking element from the tube or from the sheath.

17. Process according to claim 16, wherein the tube or the sheath is widened before separation of the ring-shaped marking element.

18. Process according to claim 16, wherein the ring-shaped marking element is widened before positioning relative to the tube.

19. Process according to claim 15, wherein the step of producing the marking element comprises the following:

production of a foil from a marking element;

separation of a marking element from the foil.

20. Process according to claim 19, wherein the marking element is punched out of the foil.

21. Process according to claim 19, wherein the marking element is configured in essentially linear form and/or in essentially spiral form.

22. Process according to claim 15, wherein the marking element is fused with the wall of the tube.

* * * * *