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Stencils Online, 12/03/2017, TUBE-MARK Stencils, Stencils Online, [online], Available from: https://stencils-online.myshopify.com/products/tube-mark-stencil-2-off ,[Accessed: 21/06/2019]

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INT CL **B25H, B43L**
Other: **EPODOC, WPI, Internet**

(54) Title of the Invention: **A device for marking a tubular member**
Abstract Title: **A device for marking a tubular member**

(57) A device 1 for marking an external surface of a tubular member 20 having a body member 2 having an internal surface 4 adapted to at least partially encircle a portion of the tubular member , a side wall and a plurality of slots 5 formed in the side wall, each slot extending along the body member between a first end 6 of the body member and a second end 7 of the body member. The slots are spaced apart from each other in a circumferential direction around the body member. Each slot also extends at least partially around the body member in the circumferential direction. A method comprises using a marker pen to mark a tubular member by inserting the marker through the slots of the device in a first orientation and possibly again in a second orientation, the device being rotated by 180 degrees (Figs 4-7). This achieves accurate and reliable removal of oxidized polyethylene (PE) material from the end of a tube which is to be joined to another tube to form a pipeline via butt fusion jointing or electrofusion jointing.

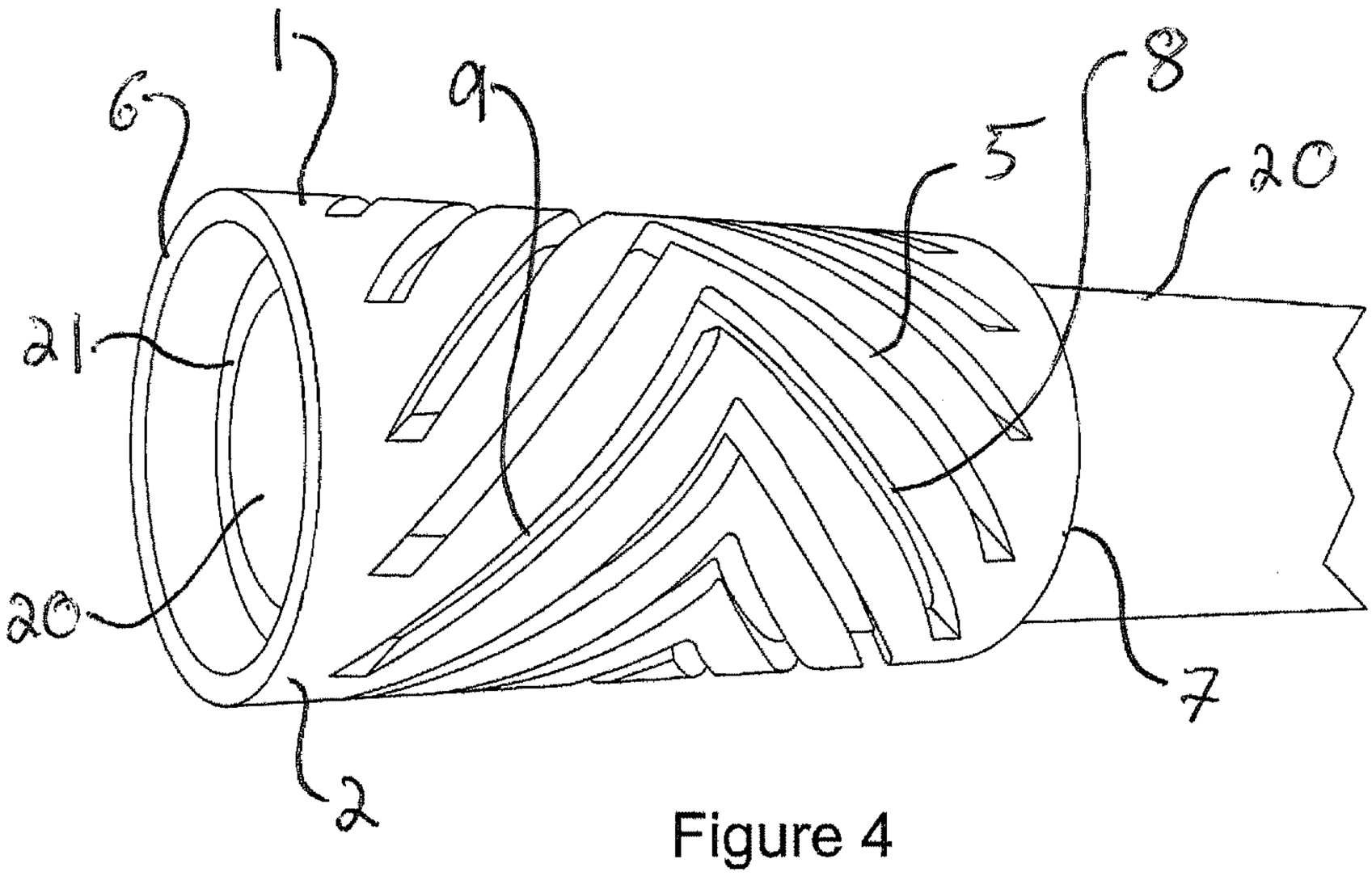

Figure 4

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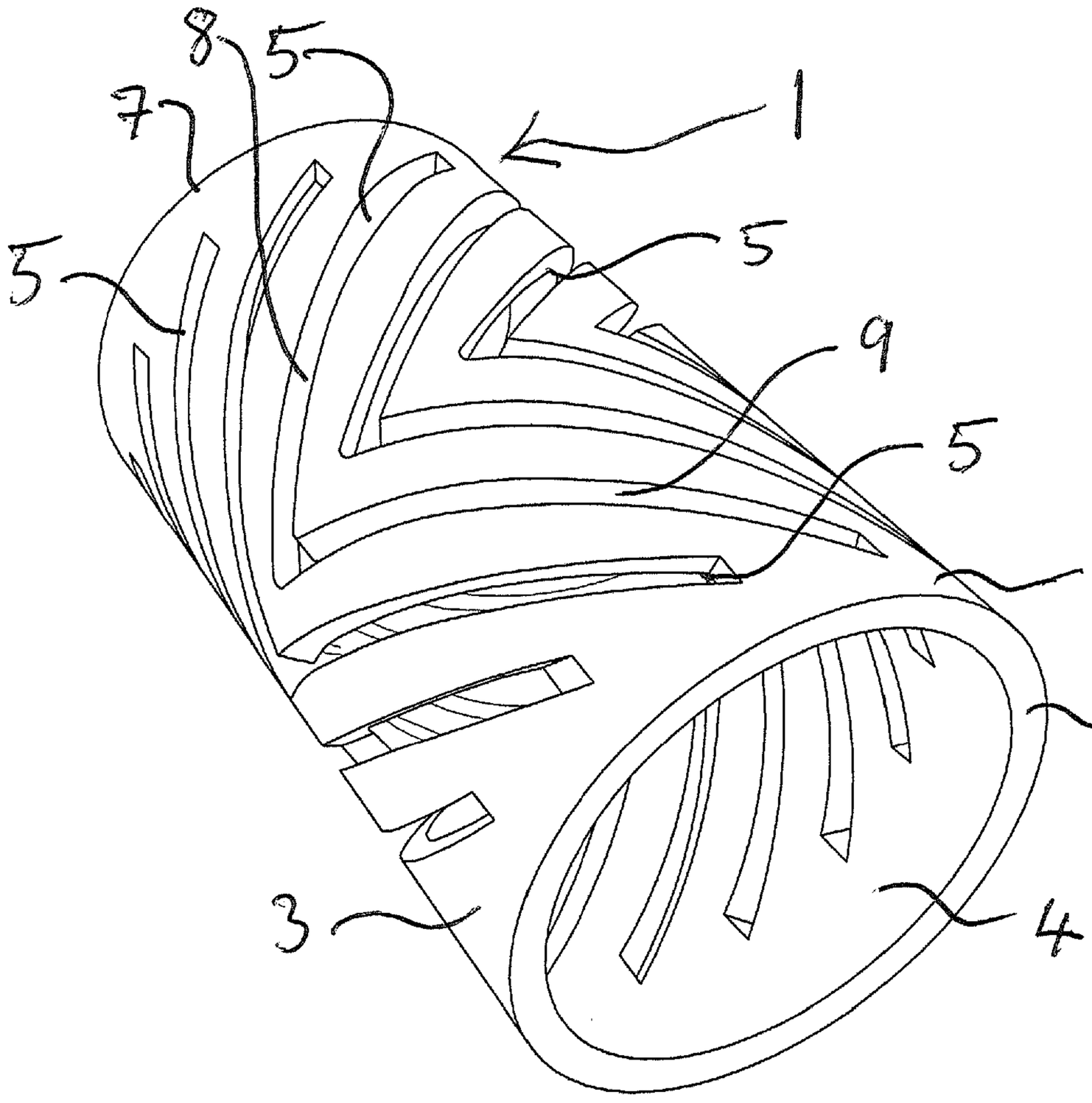

Figure 1

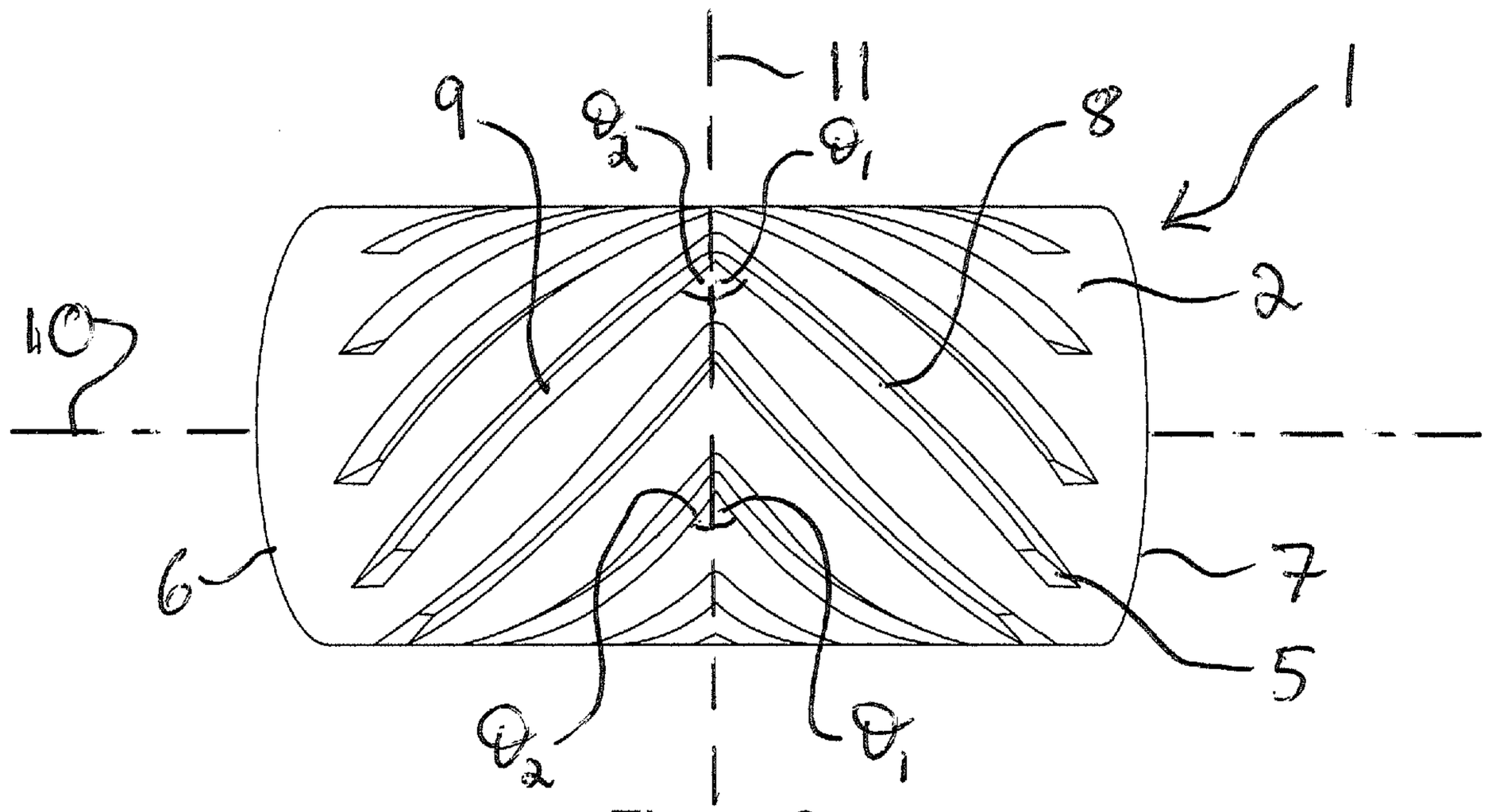

Figure 2

Figure 3

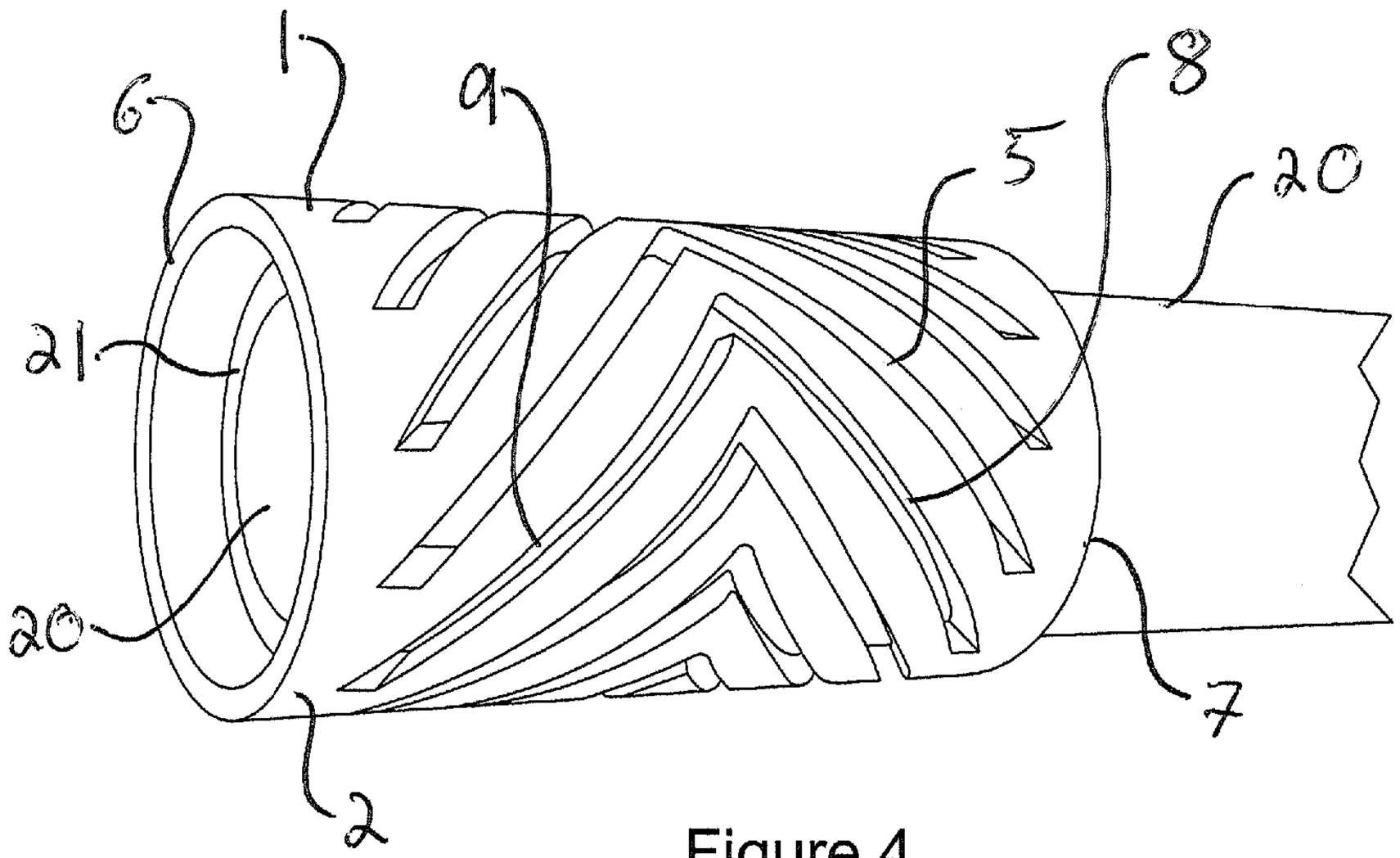

Figure 4

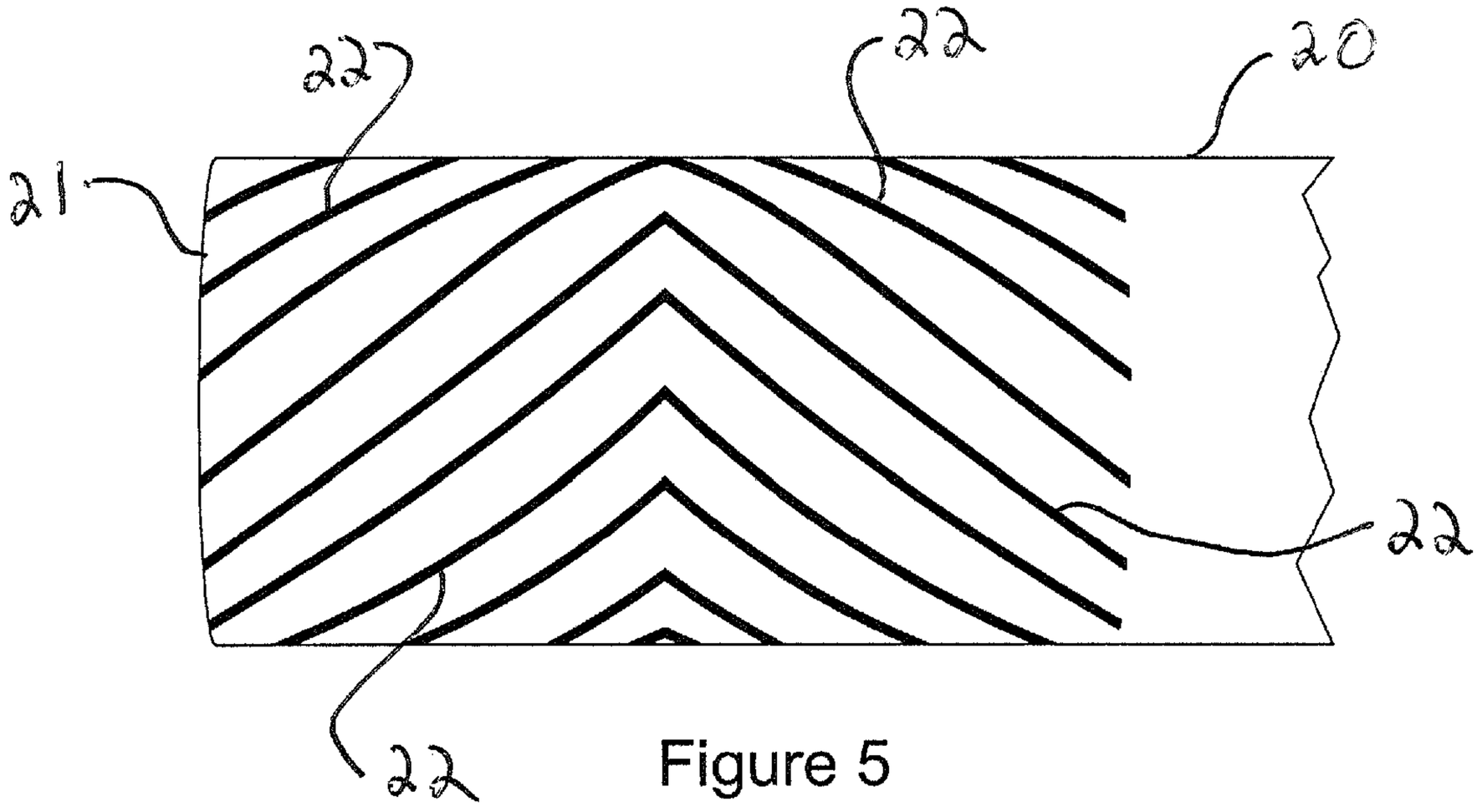

Figure 5

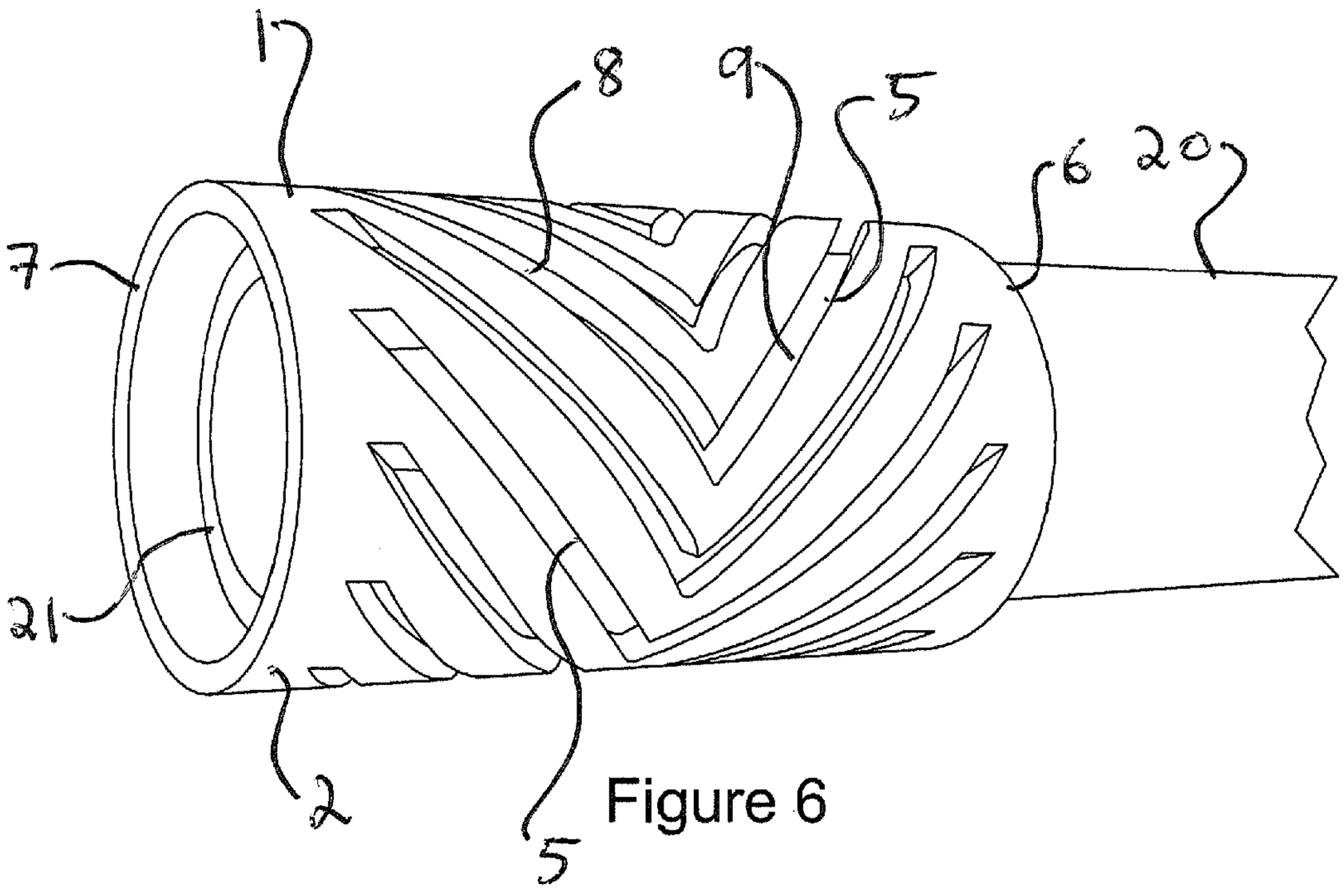

Figure 6

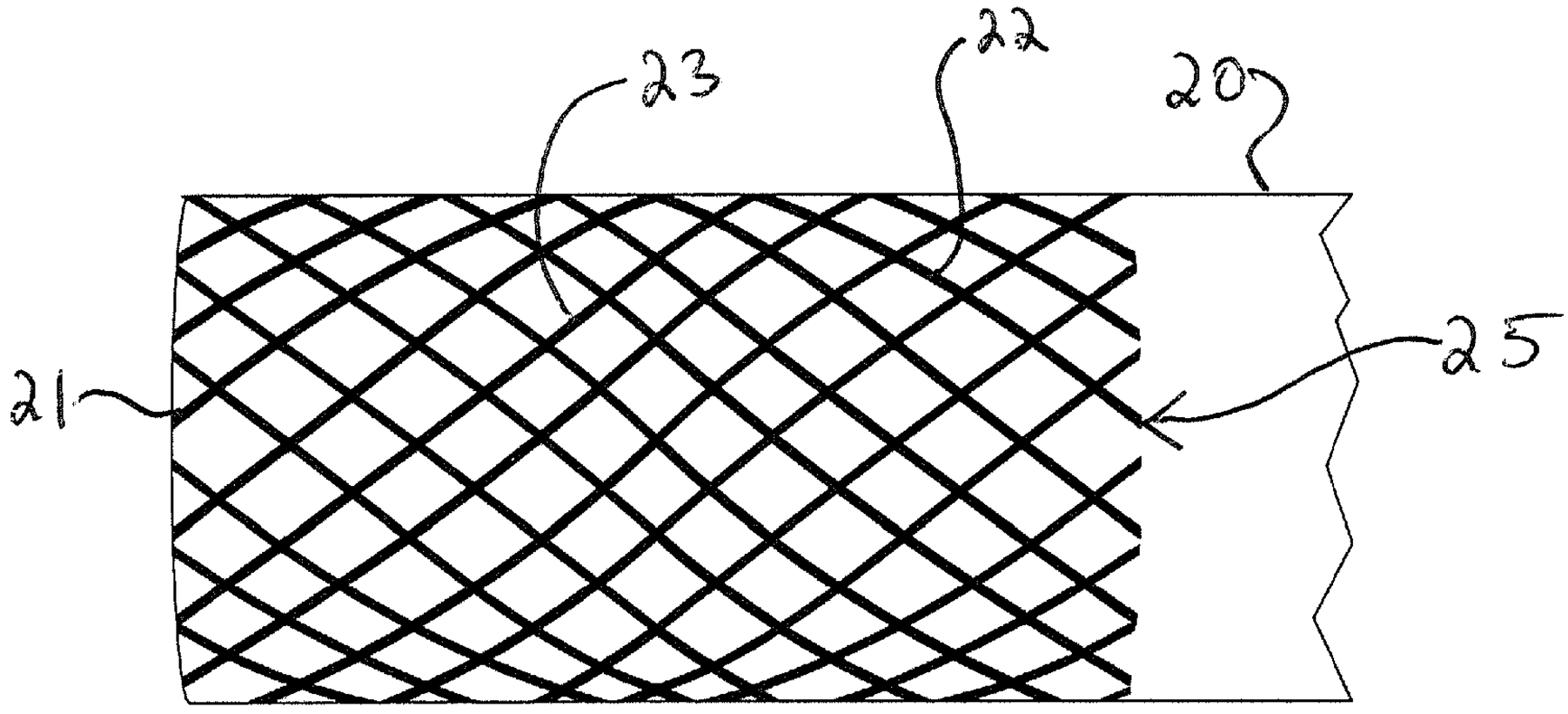

Figure 7

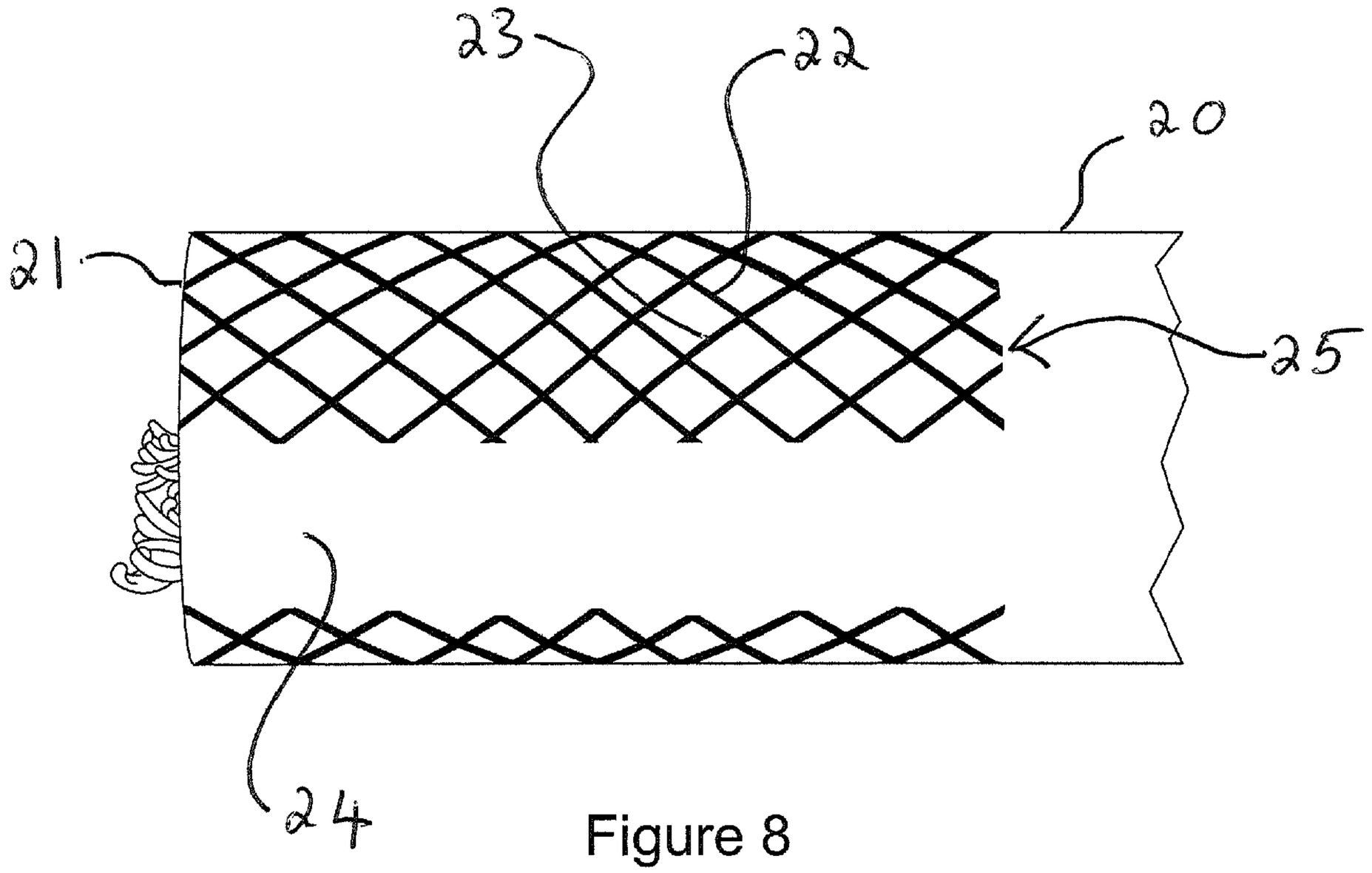

Figure 8

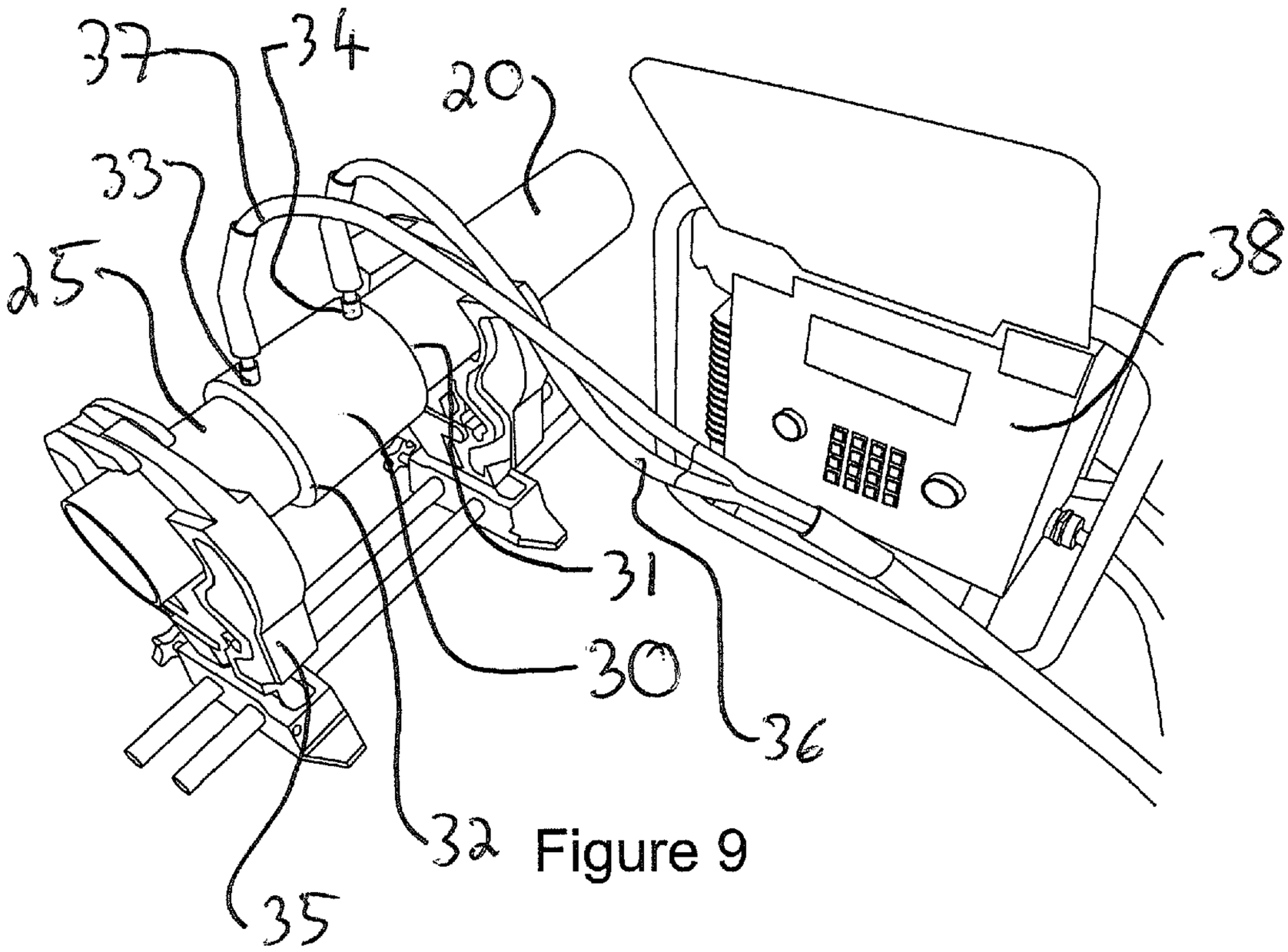

Figure 9

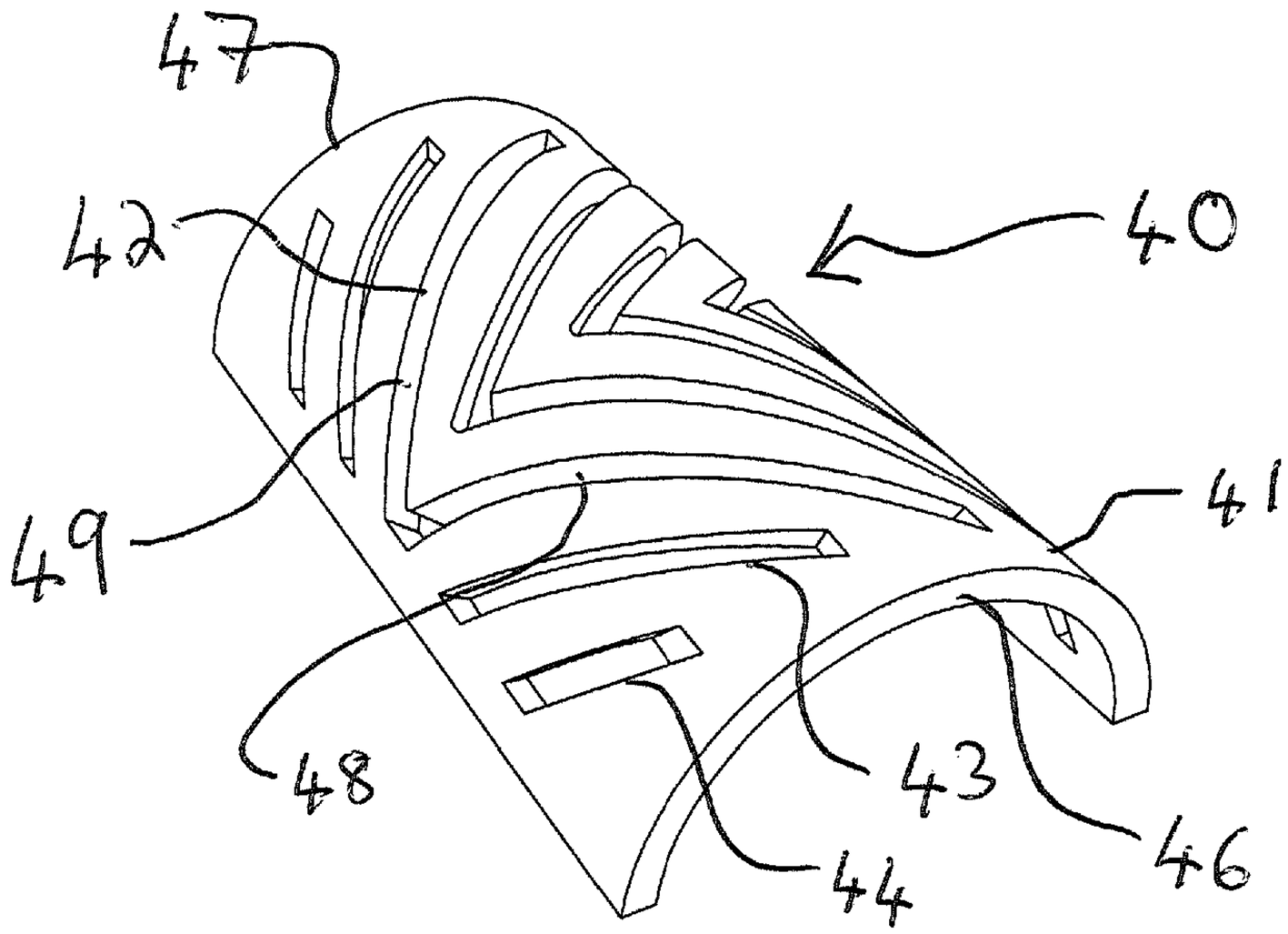

Figure 10

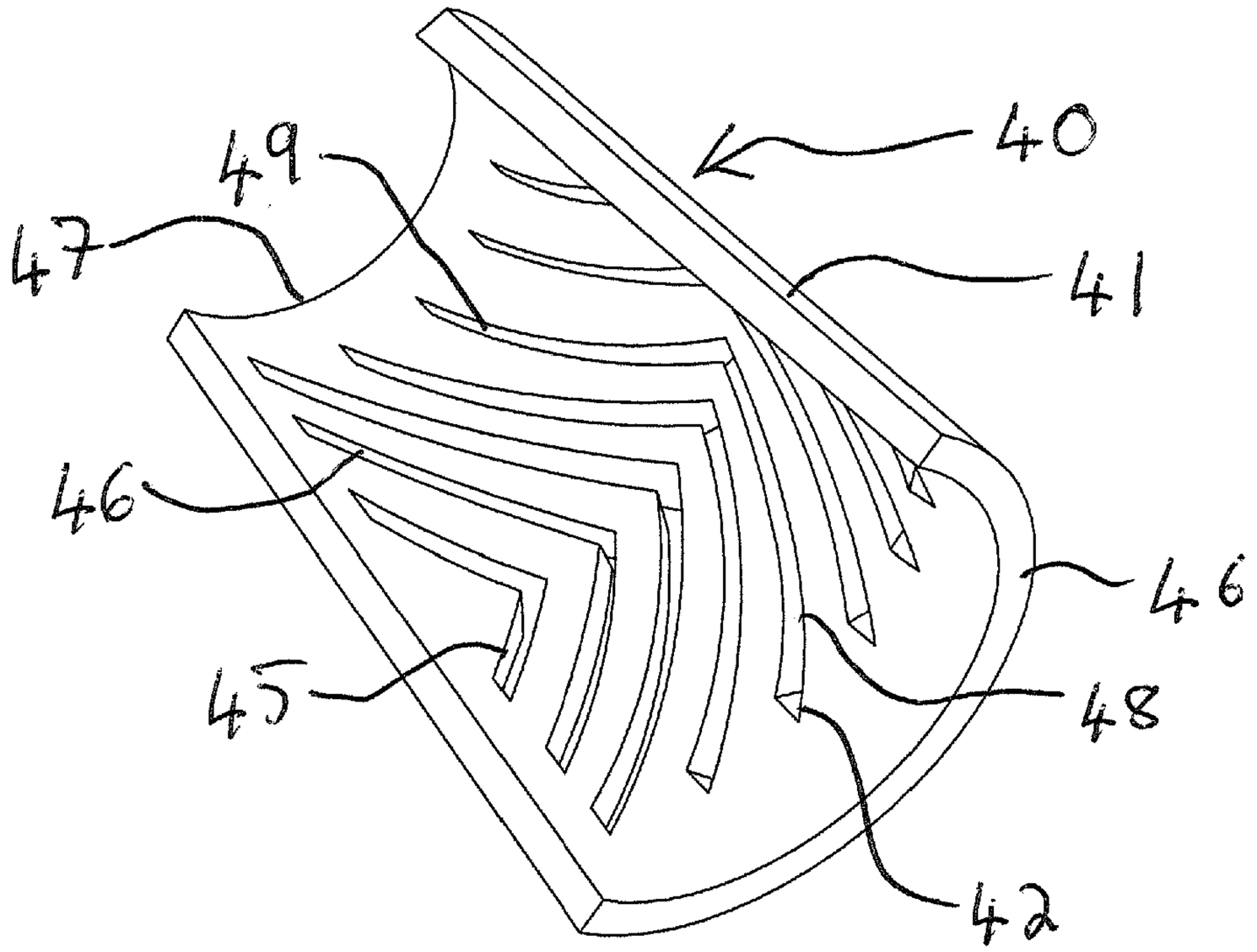

Figure 11

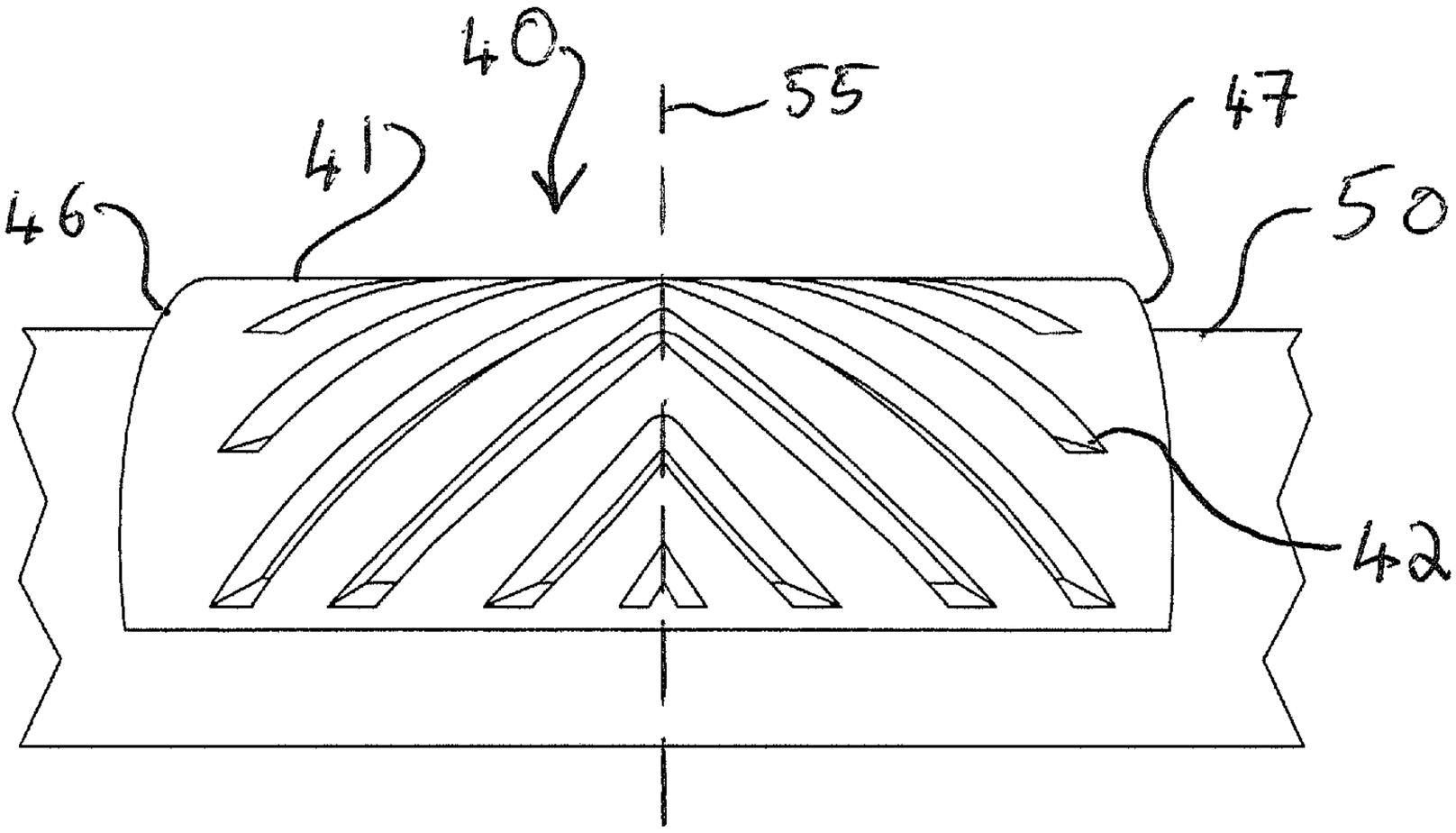

Figure 12

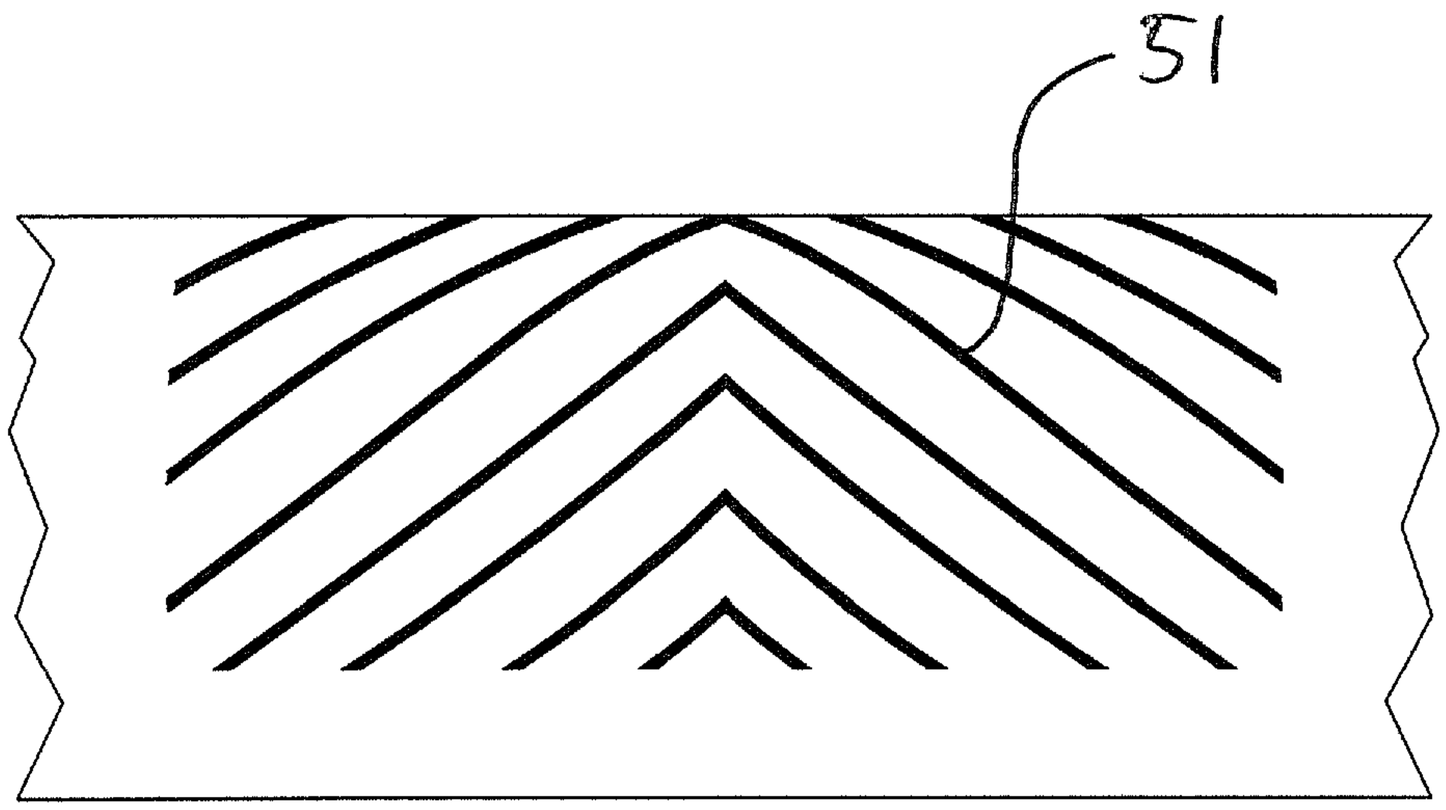

Figure 13

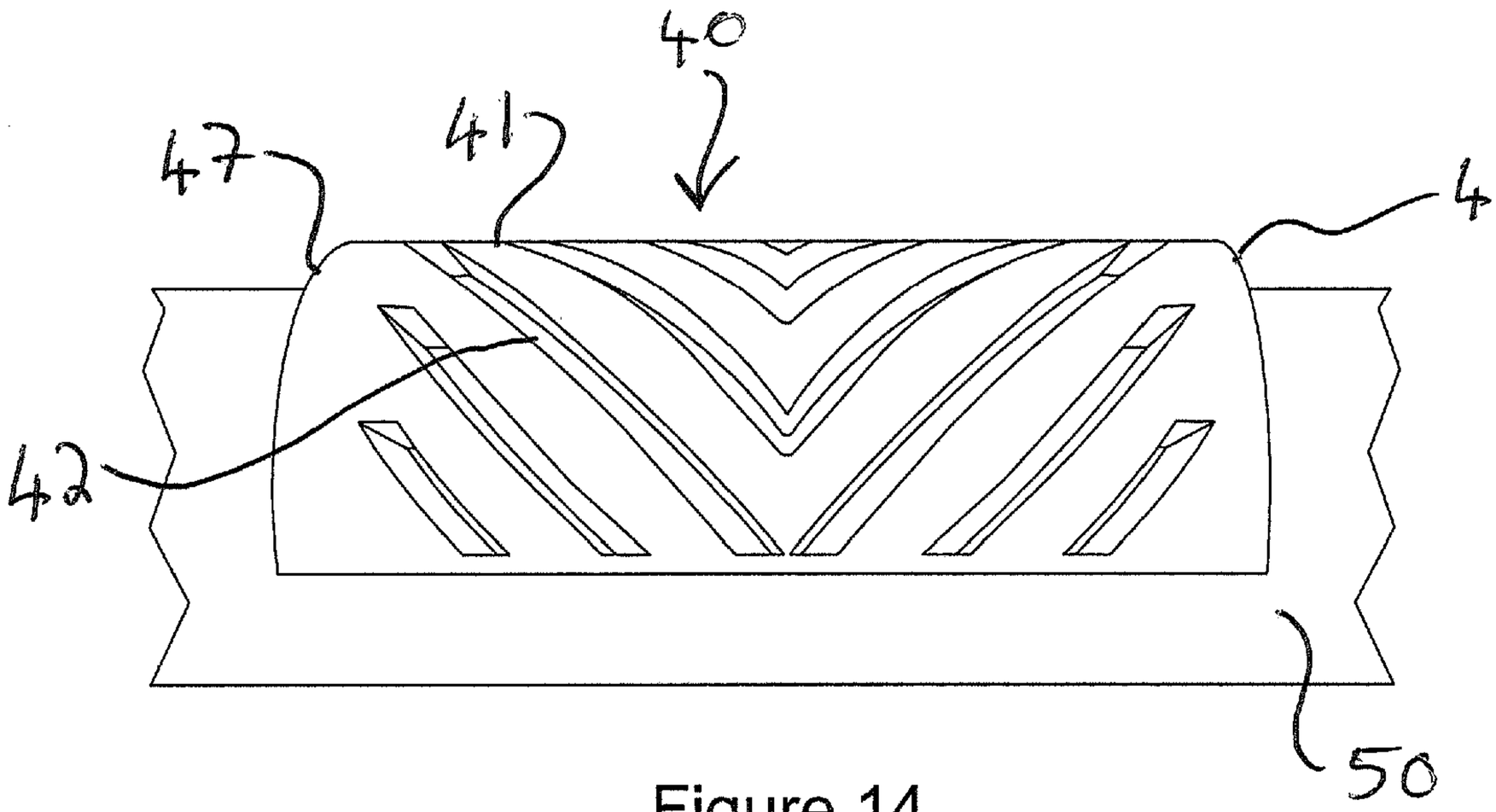

Figure 14

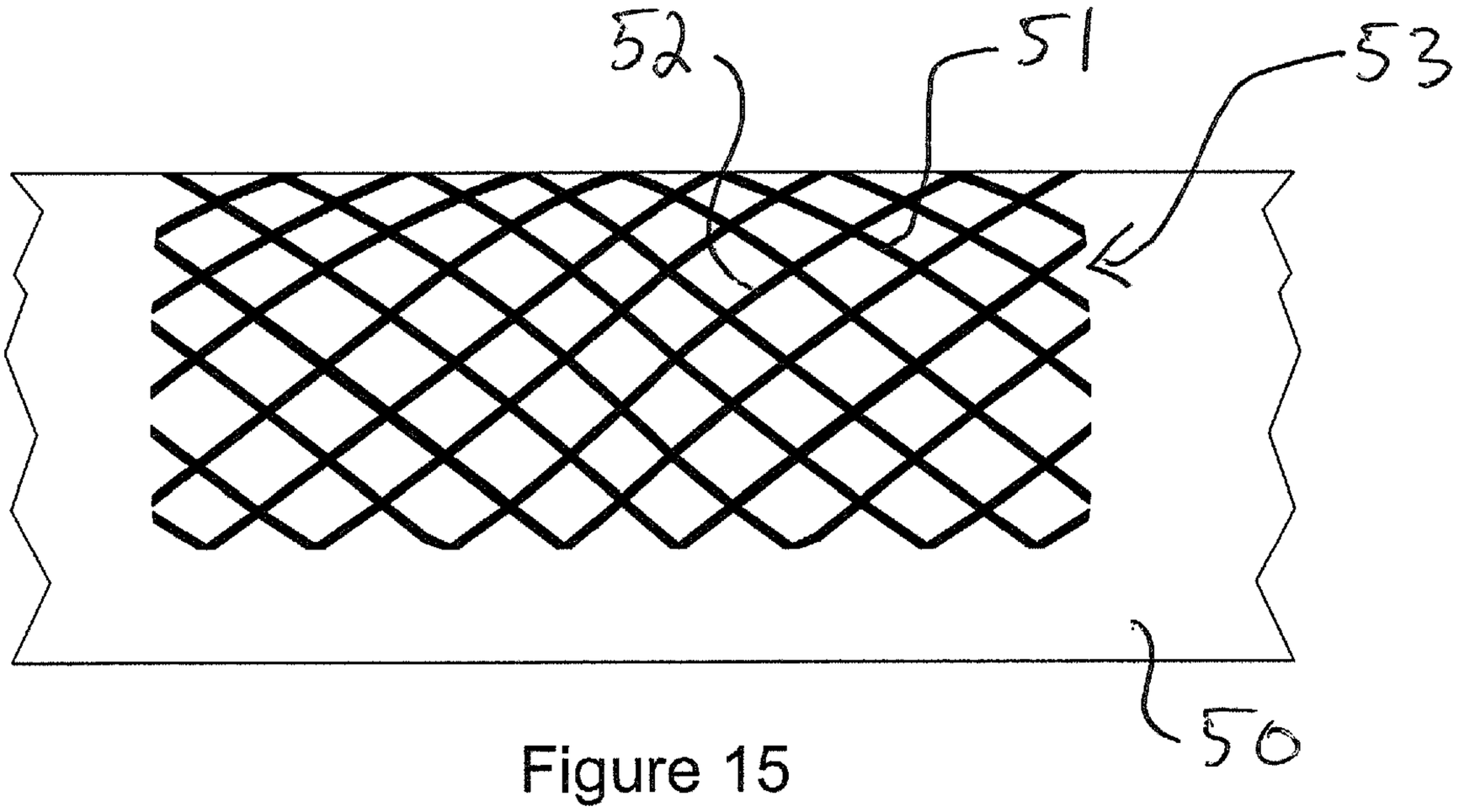

Figure 15

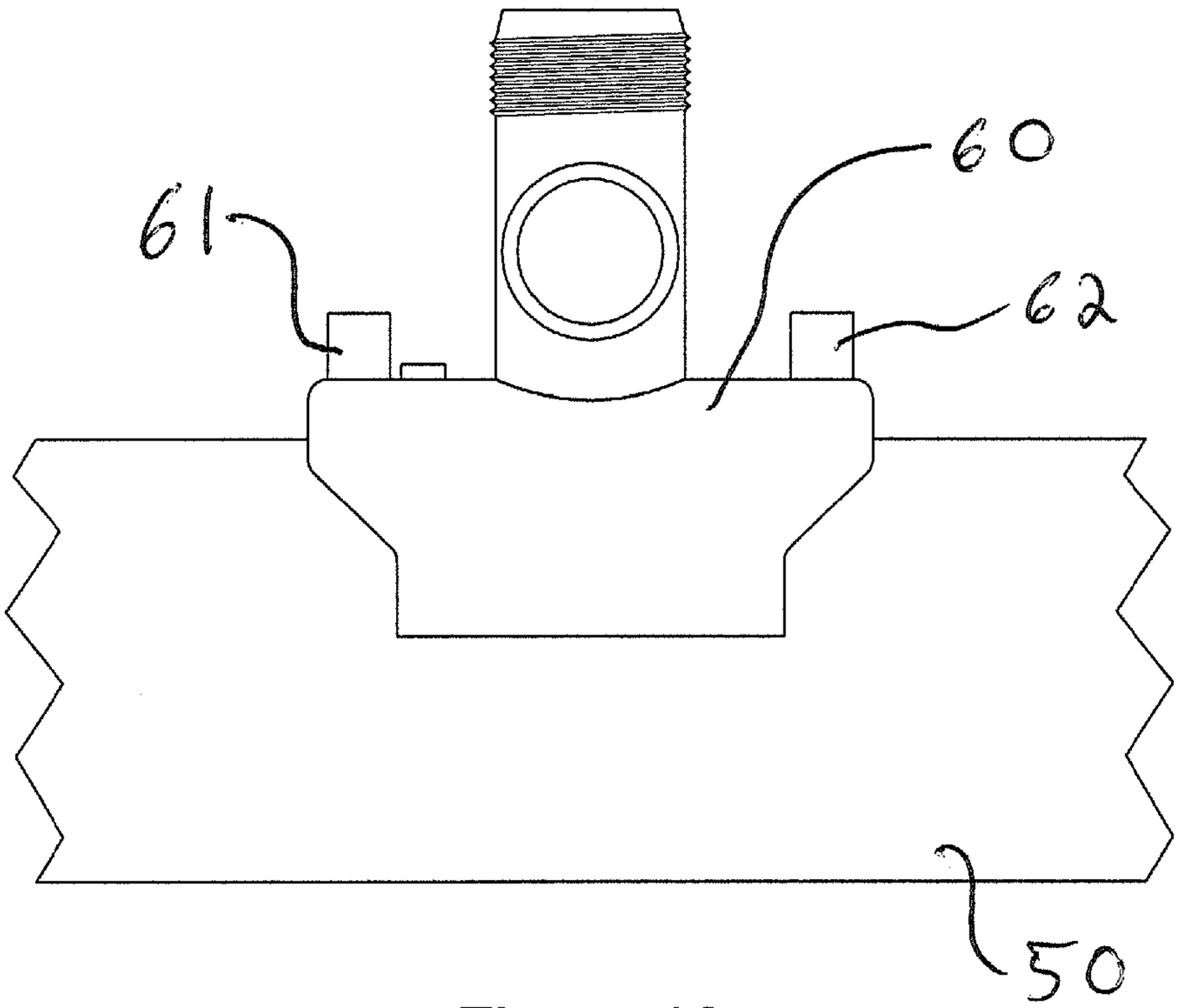

Figure 16

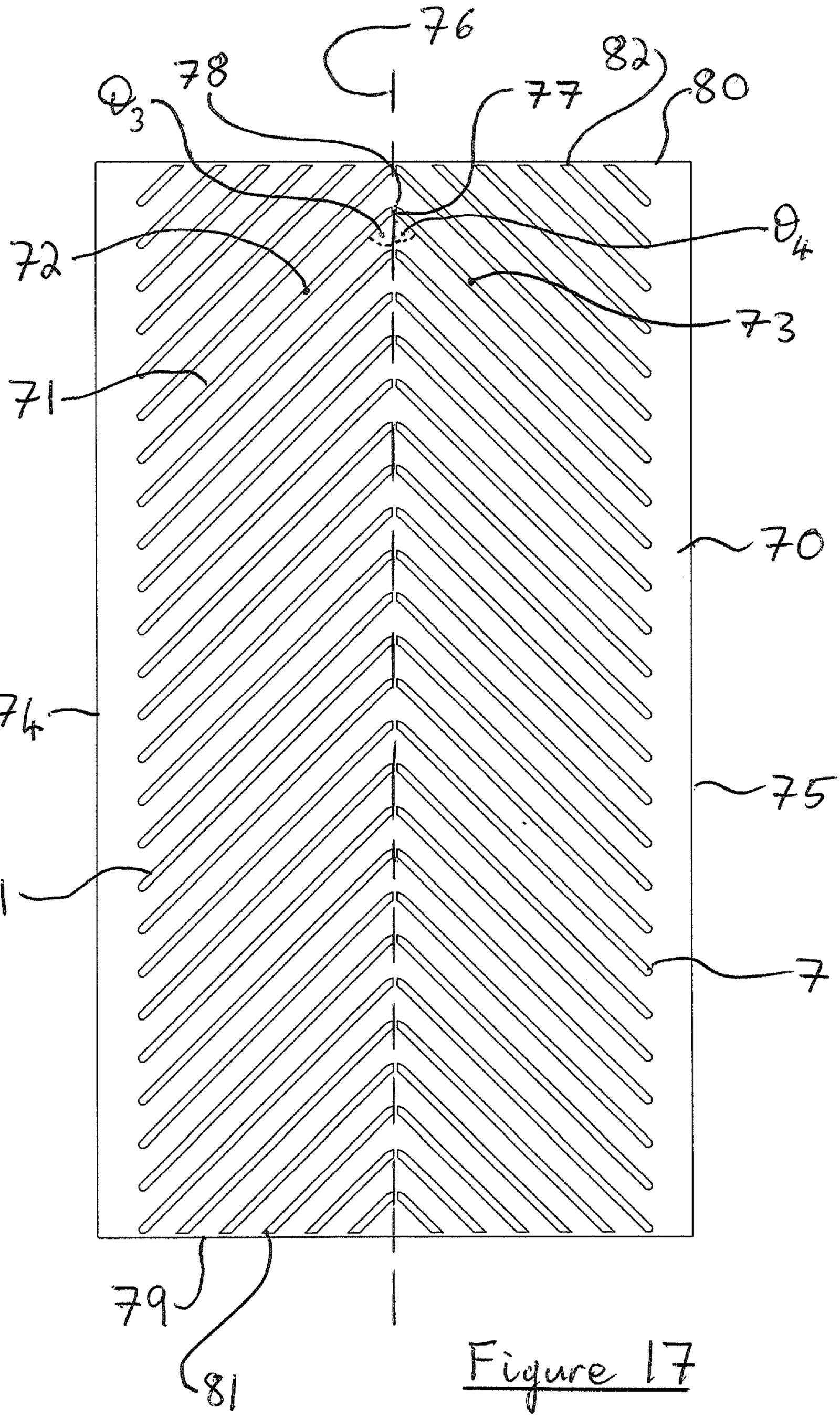

Figure 17

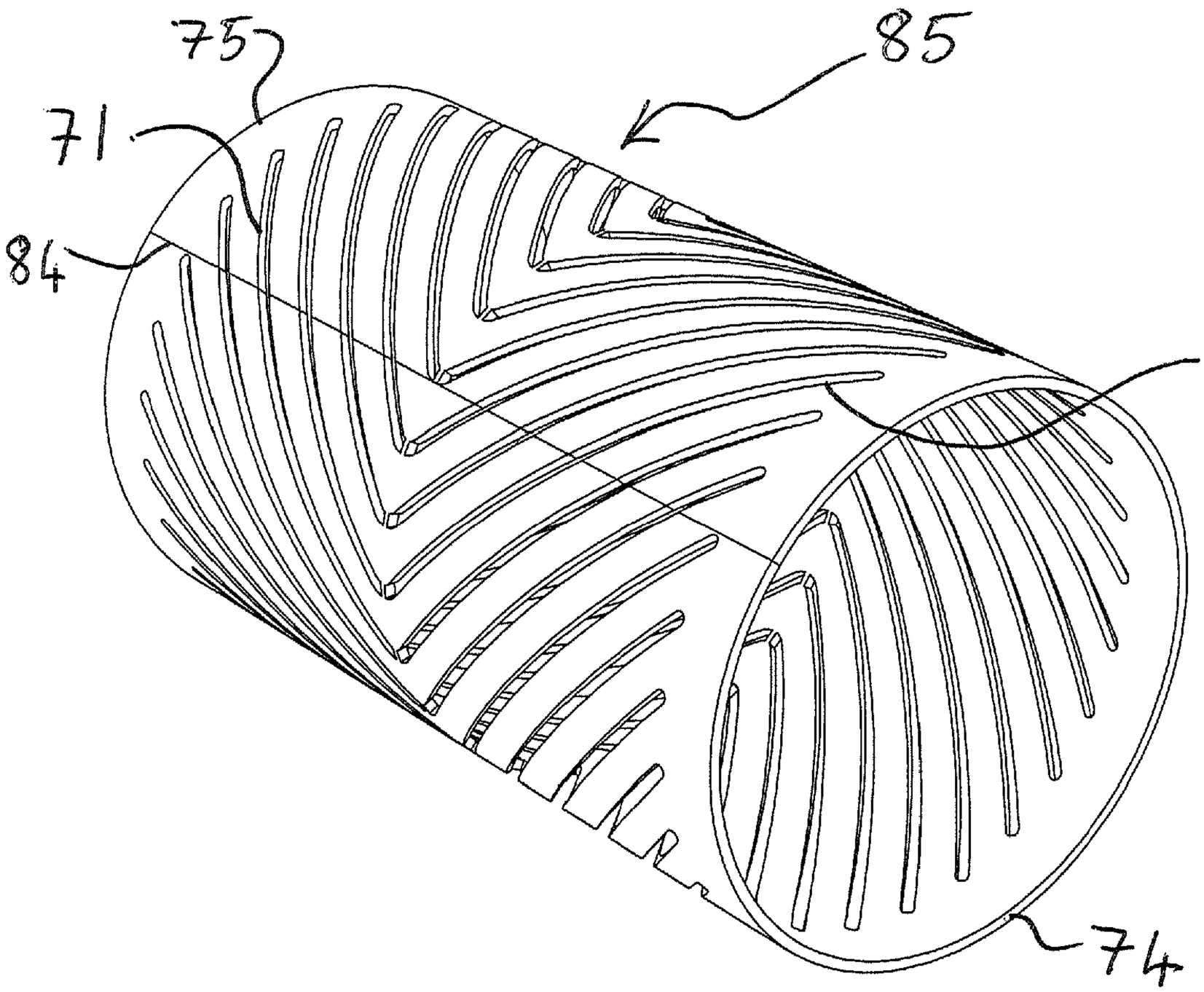

Figure 18

A DEVICE FOR MARKING A TUBULAR MEMBER

The present invention relates to a device for and a method of marking a tubular member, such as pipelines or sections of pipe.

Modern gas pipelines are generally formed from plastic pipe. The pipe used is usually polyethylene (PE), such as medium density polyethylene (MDPE) with the international standard designation PE80 or high performance polyethylene (HPPE) with the international standard designation PE100. PE80 pipe is usually suitable up to 2 bar and PE100 is usually used for higher pressures up to 7 bar. More recently, polyethylene mono-composite pipes have been developed that can be used with higher pressures, for example with gas pressures up to 60 bar or 70 bar. An example of a polyethylene mono-composite pipe is HexelOne® PE pipe which is composed of inner and outer layers of extruded PE100 that sandwich a layer of high-strength polyethylene tape.

One of the advantages of PE pipe is that it is more corrosion resistant than metal pipes and as it is smoother, PE pipe has lower pump energy requirements during its lifespan. Its superior chemical resistance help to reduce scaling and pitting, which also helps to reduce the required pump energy over time. As it is lighter than equivalent metal pipes it is also less expensive and easier to transport and install. The increased flexibility of PE pipe compared to comparable sized metal pipe, also makes it easier to install

over uneven terrain and typically, it requires less fittings during installation due to its flexibility. PE pipes also have a higher strain allowance than metal pipes, which assists in reducing breakage due to freezing.

Lengths of PE pipe are joined together to form a pipeline usually using either butt fusion welding, which is based on hot plate welding, or electrofusion jointing, which uses special fittings with built-in coils of resistive wire to heat the pipe and fitting and weld them together.

In electrofusion jointing the ends of the pipes to be joined are cleaned and inserted into the electrofusion fitting, which is electrically connected to an automatic electrofusion machine. The electrofusion machine applies a voltage (typically 40 V) to the fitting for a fixed time that depends on the size of the pipe and the fitting being installed. The built in heater coils in the fitting then melt the inside of the fitting and the outside of the pipe wall, which melt together to form a very strong homogeneous joint.

In both fusion processes it is important to ensure that the surfaces of the pipes that are being joined are clean and free of oxidised PE material to ensure the integrity of the joint. Where electrofusion is used to join the pipes, the circular outer surfaces of each pipe are prepared by scraping the outer surface adjacent the ends to be joined to remove the oxidised layer of PE material on the outer surface, which could contaminate and compromise the joint.

However, it can be difficult to ensure that the entire surface of the pipe is properly scraped all the way around the pipe as the oxidised surface is the same colour as the non-oxidised pipe material. If the pipe it is not properly scraped all the way round so that the oxidised layer is completely removed at the electrofusion joint, this can result in poor bonding of the pipe to the joint which may result in either a faulty joint or premature joint failure.

In order to avoid poor electrofusion joints, it is good operating practice for the pipe surfaces to be joined to be visually marked with a marker pen to indicate the area to be scraped. The marked area is then scraped using a suitable tool, such as a hand scraper or a mechanical scraper to remove the outer layer of oxidised PE material. The marking disappears as the outer surface is removed and this is used as an indicator that the entire marked surface has been scraped and is therefore, clean. In the situation where a first length of pipe is being electrofused to a second length of pipe, both ends to be joined are marked and scraped. In the case of a service junction being electrofused onto a pipe at a point along the length of the pipeline, the area around said point is marked and scraped.

Tools for marking pipes are known in the art. For example, a scribing device designed to mark tubing at a specified location from the end of the tube is disclosed in UK Patent Application No. 2523720. This document discloses the use of an ink based marking implement to scribe a line around the entire circumference at a fixed location from the end of the pipe. The tool as

described is used for clearly defining the depth to which the end of a pipe should be inserted into a joint for a successful seal.

Another pipe marking device is disclosed in Chinese Utility Model No. 204976608. This document discloses a cylindrical tool with a pivot located along its longitudinal axis that allows the device to be opened and placed around a pipeline. Extending from the pivot is a scriber that is used to mark the pipe as it is displaced around the circumference of the pipeline.

According to a first aspect of the present invention, there is provided a device for marking an external surface of a tubular member, the device comprising;

a body member having an internal surface adapted to at least partially encircle a portion of the tubular member, the body member comprising a side wall and a plurality of slots formed in the side wall, each slot extending along the body member between a first end of the body member and a second end of the body member and the slots being spaced apart from each other in a direction transverse to a line extending between the first and second ends and being parallel to a longitudinal axis of the body member; and

wherein each slot also extends at least partially around the body member in a circumferential direction and each slot penetrates through the side wall from an external surface of the body member to the internal surface.

According to a second aspect of the present invention, there is provided a method comprising:

(i) mounting a device for marking a tubular member on an outside surface of the tubular member in a first orientation, the device comprising a body member having an internal surface adapted to at least partially encircle a portion of the tubular member, the body member comprising a side wall and a plurality of slots formed in the side wall, each slot extending along the body member between a first end of the body member and a second end of the body member, and the slots being spaced apart from each other in a direction transverse to a line extending between the first and second ends and parallel to a longitudinal axis of the body member; wherein each slot also extends at least partially around the body member in a circumferential direction and each slot penetrates through the side wall from an external surface of the body member to the internal surface;

(ii) inserting a marking tool through the slots to engage with the outer surface of the tubular member to cause the outer surface of the tubular member to be marked with first lines corresponding to the slots; and

(iii) removing the device from the tubular member.

Preferably, each slot comprises at least two slot portions, the slot portions being at an angle to each other. More preferably, the longitudinal extent of the slot portions may be at an angle to each other. In one example of the invention the slot portions in each slot may be separated from each other. In another example each slot may be continuous so that the slot portions are not separated from each other. Each slot portion may extend in both longitudinal and circumferential directions.

Preferably, the method may further comprise:

(iv) turning the device to a second orientation and mounting the device on the tubular member in the second orientation so that the device overlaps the first lines;

(v) inserting a marking tool through the slots to engage with the outer surface of the tubular member to cause the outer surface of the tubular member to be marked with second lines corresponding to the slots of the device in the second orientation; and

(vi) removing the device from the tubular member.

Typically, the device may be positioned on the tubular member in the first orientation with an end of the body member facing in a first direction and in the second orientation, the first end faces in a second direction opposite to the first direction.

Preferably, turning the device to the second orientation comprises rotating the device about an axis perpendicular to the longitudinal axis of the body member. Typically, the rotation is a rotation of approximately 180º.

Typically, the slots are adapted to have a marking instrument inserted therethrough from the external surface of the body member to mark the external surface of a tubular member on which the device is mounted, in use.

Typically, the internal surface of the body member is configured to complement the external surface of the tubular member on which the device is mounted, in use.

Preferably, the external surface is substantially parallel to the internal surface.

Preferably, the internal surface comprises an at least partially cylindrical surface. In one example, the internal surface may define a substantially cylindrical surface. In another example of the invention, the internal surface may define a substantially hemi-cylindrical surface.

Preferably, the external surface comprises an at least partially cylindrical surface.

Preferably, the body member comprises an at least partially cylindrical shell. In one example of the invention, the body member comprises a cylindrical shell. In another example of the invention, the body member comprises a hemi-cylindrical shell.

Typically, the tubular member comprises a pipe. The tubular member may be in the form of a cylindrical shell.

Preferably, each slot comprises two slot portions. At least one of the slot portions in each slot may extend in both a longitudinal direction and a

circumferential direction relative to the body member. More preferably, all the slot portions in each slot extend in both the longitudinal and circumferential directions. Even more preferably, a plane defined by each slot intersects the longitudinal axis at an oblique angle. The oblique angle may be substantially the same for all slot portions in each slot.

Preferably, each slot portion intersects a plane perpendicular to the longitudinal axis of the body member at an oblique angle. More preferably, each slot portion in a slot intersects the plane perpendicular to the longitudinal axis of the body member at substantially the same oblique angle. Preferably, adjacent slot portions intersect the perpendicular plane at adjacent angles which are each less than 90º. The adjacent angles may be complementary.

In one example, each slot portion is substantially perpendicular to each adjacent slot portion.

In one example, each slot is continuous from one end of the body member to the other. Alternatively, each slot may comprise a number of discrete slot portions, two or more of the slot portions being separated by a slot separating portion.

Each slot, or the slot portions forming a slot, may extend linearly and/or curvilinearly.

Each slot, or a part of each slot, may have reflectional symmetry.

Preferably, the slots are substantially parallel to each other.

Typically, the slots are distributed around the body member. More preferably, the slots are distributed substantially equally around the body member. Most preferably, the slots are spaced substantially equidistantly around the body member. The slots may be distributed circumferentially around the body member.

The body member may take any suitable shape for placement onto the tubular member. In this respect the shape of the device refers to the form that the body member takes in order to fit onto the tubular member and remain positioned and steady during use. As most pipelines are tubular with a constant radius, in one embodiment the device can be shaped to accommodate this. The body member, more specifically the internal surface is curved in a direction such that, in use, the internal surface is at least partially in contact with the external surface of the tubular member.

In a first example the body member extends only partially around the tubular member, preferably a maximum of 75% around the outside of the tubular member. For example, the body member may extend approximately halfway round the external surface of the tubular member to allow the device to be placed at a location on the tubular member. This embodiment is particularly

advantageous for applications where an end of the tubular member is not accessible or it is not possible or is difficult to position a body member that extends all the way around the tubular member on the tubular member.

Alternatively or in addition, this first example can be useful when installing a junction, such as a service junction, on the tubular member to enable another tubular member to be coupled to a side of the tubular member. In this example, where the body member may be elastically deformable so that it can be elastically deformed to fit over the tubular member and then elastically recover so that the body member positions itself on the tubular member. This feature may be particularly useful where the body member extends at least halfway around the tubular member. In other words, the body member may be a snap fit onto the tubular member. In this example, the body member be in the form of a partial cylindrical shell, such as a hemi-cylindrical shell.

In a second example, the body member extends around the entire outside surface of the tubular member, such that the device is in the form of a tubular shell, such as a cylindrical shell, and forms a sleeve on the tubular member when placed on the tubular member. This embodiment is particularly advantageous when a first length of pipe is to be electrofused to a second length of pipe and the ends to be joined are accessible, for example, when constructing a pipeline.

In order for the device to be easily positioned on the pipeline to be marked, it is preferred that the device has an internal dimension similar to but larger than an external dimension of the tubular member. For example, where the tubular member is in the form of a cylindrical shell, such as a pipe, and the body member is a cylindrical shell or part of a cylindrical shell, the internal radius of the body member may be greater than the external radius of the tubular member.

Typically, the internal radius of the body member is less than or equal to 10 mm greater than the external radius of the tubular member, preferably less than or equal to 5 mm greater and more preferably, less than or equal to 2mm greater than the external radius of the tubular member. Preferably, the internal radius of the body member is at least 0.25 mm greater than the external radius of the tubular member. An internal radius of curvature for the device that is slightly larger than the outer radius of the pipe is preferable to avoid friction in placing and removing the device. However if the size difference is too large, the device may be loose and difficult to maintain in position during use. Therefore in a preferred embodiment of the device, the ratio of the internal radius of the body member to the external radius of the tubular member is up to 1.05. Preferably between 1.01 and 1.04, more particularly about 1.03 is most preferable for many embodiments. The difference between the external radius of the tubular member and the internal radius of the body member is preferably approximately 0.5 mm to 3.0 mm. More preferably the difference is approximately 1.0 mm to 2.0 mm.

The slots provide a means of marking the tubular member using, for example, an ink based implement such as a felt tip pen or permanent marker. The slots help to ensure an even and clear pattern is marked onto the outer surface material. Having been marked, the surface is then scraped and the ink pattern is removed. Hence, if all the ink pattern is removed, this is an indication of sufficient and thorough material removal from the outer surface of the oxidised layer.

Preferably, each of the slot portions forming a slot, extend at an equal angle to a plane perpendicular to the longitudinal axis of the body member. More preferably, each slot portion extends at an adjacent angle to an adjacent slot portion, such that each slot forms a chevron shape. More preferably, the angle at which adjacent slot portions extend from the plane is between 40º and 50º, and even more preferably 45º. Preferably, the adjacent angles are substantially equal.

In one example the device is formed from a section of metal tubing. The device can be cut to its required length from a tube with an internal diameter close to the external diameter of the tubular member to be marked. The slots may be cut, ground or milled out of the body member of the device. Where the device only partially encircles the tubular member, in use, the tube may be cut along its length. This may be before or after forming the slots. Possible materials for forming the body member of the device are materials such as

metals or plastics. Aluminium is one example of a metal that could be used. However, the device could be formed from other metals, such as stainless steel or from plastics materials. Furthermore, the device could be formed, for example, by a moulding process. Moulding the device may have the advantage of avoiding the need to separately form the slots.

In one example, the device may be formed from sheet metal (such as stainless steel) with the slots being formed in the sheet prior to the sheet being formed into a cylindrical or partially cylindrical shell shape to form the device. The forming into the cylindrical or partially cylindrical shell shape may comprise bending the sheet into a cylindrical shell shape and then joining adjacent edges of the bent sheet, such as by a welding process.

Examples of a device for marking an external surface of tubular member will now be described with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a first example of a device for marking an external surface of a tubular member;

Figure 2 is a plan view of the device of Figure 1 in a first orientation;

Figure 3 is a plan view of the device of Figure 1 in a second orientation;

Figure 4 is a perspective view of a pipe with the device mounted on an end of the pipe;

Figure 5 is a plan view of the pipe after being marked using the device;

Figure 6 is a perspective view of the pipe with the device mounted on the end after being rotated relative to Figure 4 through 180º about an axis perpendicular to the longitudinal axis of the pipe;

Figure 7 is a plan view of the end of the pipe after being marked using the device in the position shown in Figure 6;

Figure 8 is a plan view of a pipe of Figure 7 with the end of the pipe being partially scraped;

Figure 9 shows two lengths of pipe being coupled to each other by an electrofusion coupling joint using an automatic electrofusion machine;

Figure 10 is a first perspective view of a second example of a device for marking a tubular member;

Figure 11 is a second perspective view of the device of Figure 10;

Figure 12 shows the device of Figure 10 mounted on a pipe in a first orientation;

Figure 13 shows the pipe of Figure 12 after being marked using the device of Figure 10;

Figure 14 shows the device of Figure 10 mounted on the pipe of Figure 13 after the device has been rotated relative to Figure 12 through 180º about an axis perpendicular to the longitudinal axis of the pipe;

Figure 15 shows the pipe after being marked using the device as shown in Figure 14;

Figure 16 is a side view of a service junction electrofused to the pipe shown in Figures 12 to 15;

Figure 17 is a plan view of a sheet of material with slots formed in it; and

Figure 18 is a perspective view of a third example of a device for marking a tubular member.

Figures 1 to 3 show a device (or tool) 1 for marking the external surface of a pipe 20 (see Figure 4). The tool 1 comprises a body member 2 in the form of a cylindrical shell with an external surface 3 and an internal surface 4. Because the body member 2 is in the form of a cylindrical shell, the external surface 3 is parallel to the internal surface 4 and is concentric with the internal surface 4. A number of slots 5 are formed in the body member 2. The slots 5 are substantially parallel to each other, are spaced apart from each other circumferentially around the body member 2. Preferably, the slots 5 are spaced equidistantly around the body member 2.

Each slot 5 extends from adjacent a first end 6 of the body member to adjacent a second end 7 of the body member 2. As shown in Figures 1 to 3, each slot 5 extends both in a longitudinal direction between the ends 6, 7 and also extends in a circumferential direction partially around the body member 2. In addition, each slot 5 comprises two slot portions 8, 9 which meet at a plane perpendicular to a longitudinal axis 10 of the body member 2 and on which a central axis 11 is located. As shown in Figure 2, the slot portions 8, 9 make adjacent angles θ_1, θ_2, respectively with the perpendicular plane that is coincident with the central axis 11. The angles θ_1, θ_2 are preferably substantially equal to each

other and the in the example shown, are each 45º. Hence, the angle between the slot portions 8, 9 where the slot portions 8, 9 meet at the perpendicular plane is substantially 90º. Therefore, each pair of slot portions 8, 9 defines an approximately V-shaped slot 5 with the vertex of the "V" located approximately on the perpendicular plane of the central axis 11.

Figure 3 is a view of the tool 1 that is similar to Figure 2 but with the tool 1 rotated 180º about the central axis 11. Hence, the vertices where the slot portions 8, 9 meet point downwards in the view of Figure 3, whereas in the view of Figure 2 they point upwards.

The tool 1 may be manufactured from any suitable material and may be manufactured, for example, from a metal material or a plastics material. The tool 1 may be formed from a section of a metal or plastic pipe and the slots 5 may be formed in the metal pipe by milling the slots 5 in the side wall of the pipe or any other process involving material removal from the body member 2 to form the slots 5. Alternatively, it is possible that the tool 1 could be formed by a moulding process. In the case of metal material this may be, for example, by casting the tool 1.

If the tool 1 is manufactured from a plastics material, it could be formed by a moulding process, such as an injection moulding process. Preferably, the slots 5 are formed during the molding process.

As can be seen from Figures 1 to 3, the slots 5 are distributed around the body member 2 in the circumferential direction and are also spaced from each other in the circumferential direction. Preferably, the slots 5 are spaced equidistantly from each other in the circumferential direction and are substantially parallel to each other. Typically, each end of each slot 5 is adjacent to but spaced from the respective end 6, 7 of the body member 2.

In use, the tool 1 is positioned on an end of a pipe 20, as shown in Figure 4, so that the tool 1 forms a sleeve around the end of the pipe 20. The tool 1 is positioned on the end of the pipe 20 such that the end 6 of the body member 2 is positioned adjacent end 21 of the pipe 20 and such that the end 21 of the pipe 20 is adjacent to the ends of the slots 5 adjacent end 6 of the body member.

After the tool 1 is positioned on the end 21 of the pipe 20, the tool 1 forms a stencil to enable a marker pen inserted through each of the slots 5 in turn to draw a line on the surface of the pipe 20, adjacent the end 21, that follows and corresponds to each slot 5. While the lines are being drawn on the pipe 20 using the tool 1 as a template, the tool 1 is maintained stationary with respect to the pipe 20. After lines have been drawn on the surface of the pipe 20 through all of the slots 5, the tool 1 is removed from the pipe 20 to reveal the marked pipe as shown in Figure 5 with lines 22 drawn on the curved external surface of the pipe 20.

After the tool 1 has been removed from the pipe 20, the tool 1 is rotated 180º about the central axis 11 and positioned again on the pipe 20, as shown in Figure 6. In this second orientation of the tool 1 on the pipe 20, the end 7 of the body member 2 is adjacent the end 21 of the pipe 20. As can be seen in a comparison of Figure 6 to Figure 4 when the tool 1 is positioned on the pipe 20 in the second orientation shown in Figure 6, the vertices of the slots 5 point in the opposite direction from the direction of the vertices of the slots 5 in Figure 4. The marker pen is then used to mark the external surface of the pipe 20 adjacent to the end 21 again using the tool 1 as a template in the second configuration shown in Figure 6. When the tool 1 is again removed from the pipe 20, the pipe 20 is marked as shown in Figure 7 with lines 22, 23 forming a hatched area 25 due to the different orientation of the tool 1 in position shown in Figure 6. The hatched marking 25 comprises the lines 22 drawn while the tool 1 was in the first orientation shown in Figure 4 and lines 23 drawn with the tool 1 in the second orientation shown in Figure 6.

After the end of the pipe 20 has been marked, as shown in Figure 7, the external surface of the pipe 20 adjacent to the end 21 (which is the hatched area 25) is scraped, using a manual or mechanical scraper, to remove the oxidized layer of polyethylene on the external surface of the pipe 20. As the hatched area 25 of the pipe 20 is scraped to remove the external surface, the lines 22, 23 are removed, as shown in Figure 8.

Hence, after all of the hatched area 25 has been scraped there will be no lines 22, 23 left on the surface of the pipe 20. This indicates that the pipe has been properly scraped and the external surface of the pipe 20 adjacent the end 21 removed prior to the end 21 of the pipe 20 being joined to an end of another pipe by electrofusion. If after the surface of the pipe 20 has been scraped, there are still part of the lines 22, 23 visible on the pipe, this indicates an area that has not been scraped properly and that needs to be re-scraped to fully remove the oxidized surface of the pipe 20.

After the hatched area 25 of the pipe 20 has been scraped, it can be inserted into the end of an electrofusion joint fitting 30 (see Figure 9) and an end of another pipe 25 (which has also been marked and scraped in a similar manner to that described above for the pipe 20) inserted into the opposite end 32 of the fitting 30. The two pipes 20, 25 are held in position in the fitting 30 by clamp assembly 35. Electrical contacts 33, 34 on the fitting 30 are electrically coupled by wires 36, 37 to an automatic electrofusion machine 38. The electrofusion machine 38 applies a set voltage (typically 40 volts) for a set period of time to the electrical contacts 33, 34 of the fitting 30 which causes resistive heating wire coils within the fitting 30 to heat up. The heating up of the coils causes the polyethylene on the inside of the fitting 30 to melt and the external surface of pipes 20, 25 which have been scraped and are inside fitting 30 to also melt. When the electrical supply to the contacts 33, 34 is switched off this permits the molten polyethylene inside the fittings to cool and causes the ends of the pipes 20, 25 that are inserted into the fitting 30 to be welded to the internal surface of

the fitting 30 to join the pipes 20, 25 to the fitting 30 and to thereby join the pipes 20, 25 together.

A second example of a tool 40 for marking the surface of a pipe 50 is shown in Figures 10 and 11. The tool 40 is similar to the tool 1 and comprises a body member 41 with slots 42 that are identical to the slots 5. The main difference between the tool 40 and the tool 1, is that the body member 41 has a hemi-cylindrical shape. In addition, due to the hemi-cylindrical shape of the body member 41, the tool 40 also includes truncated slot portions 43, 44, 45, 46. Similar to the tool 1, the tool 40 has two ends 46, 47 and each slot 42 comprises two slot portions 48, 49.

In use, the tool 40 is used in a similar manner to the tool 1. As shown in Figure 12, the tool 40 is placed on top of pipe 50 and used as a template to draw lines on the external surface of the pipe 50 using a marker pen in the slots 42. After the marker pen has been used in all the slots 42 and the truncated slot portions 43, 44, 45, 46, the tool 40 is removed from the pipe 50 and marked lines 51 are left on the external surface of the pipe 50. Because the tool 40 is hemi-cylindrical, the lines 51 on the pipe 50 only extend around a portion of the circumference of the pipe 50, as shown in Figure 13.

The tool 40 is then rotated 180º about the central axis 55 (see Figure 12) and placed back on top of the pipe 50 so that it covers the lines 51, as shown in Figure 14. The tool 40 is then used again as a template to draw further lines

on the surface using the marker pen in the slots 42 and the truncated slot portions 43, 44, 45, 46. Because the tool 40 has been rotated about the central axis 55, the slots 42 and the truncated slot portions 43, 44, 45 run in an opposite direction to the lines 51, lines 52 are marked on the external surface of the pipe 50 so that the combination of the lines 51, 52 form a hatched area 53.

This hatched area 53 is then scraped to remove the external surface of the pipe, in a similar manner to the scraping of the hatched area 25 on the pipe 20. When the lines 51, 52 have been completely removed from the external surface of the pipe 50, it indicates that the oxidized PE material on the external surface of the pipe has been completely removed from the hatched area 53.

A service junction 60 can then be placed on the scraped section of the pipe 50, as shown in Figure 16, and electrofused to the pipe 50 by connecting the automatic electrofusion machine 38 to electrical contacts 61, 62 on the electro-fusion service joint fitting 60 and operating it in a similar manner to that described above to electrofuse the pipes 20, 25.

Figure 17 shows a planar sheet of material 70 which has a number of slots 71 formed in it. The slots 71 may be formed by any material removal process such as by laser cutting or by milling material from the sheet 70. Each of the slots 71 comprises a first slot portion 72 and a second slot portion 73. The slot portions 72, 73 extend from respective edges 74, 75 of the sheet 70 towards central axis 76 of the sheet 70. At or adjacent the central axis 76, the slot

portions 72, 73 are separated from each other by a web of material 77. Each pair of slot portions 72, 73 together defines a vertex 78 at the central axis 76 and the web of material 77 joins opposite sides of the vertex 78 to each other. Therefore, each slot 71 is discontinuous in that the slot portions 72, 73 are separated by the web of material 77. Together, each pair of slot portions 72, 73 form a slot 71 that is substantially "V"-shaped with vertex of the "V" at approximately the central axis 76. In addition, each pair of slot portions 72, 73 form adjacent angles θ_3, θ_4 at the central axis 76, that are preferably equal.

After the slots 71 have been formed in the sheet 70, the sheet 70 is formed, or bent, into a cylindrical shell with opposite ends 79, 80 of the sheet 70 located adjacent each other. The opposite ends 79, 80 are then joined to each other, for example, using adhesive or by a welding process, such as spot welding. Typically, the ends 79, 80 are joined together along their length to form a seam 84, which extends from one edge 74 to the opposite edge 75 (see Figure 18) and this creates a third example of a tool 85 which can be used for marking tubular members, such as pipes.

The length of the sheet 70 and the separation of the slots 71 is selected such that, when the opposite ends 79, 80 are joined together, the slots 71 at end 80 are adjacent to the slots 71 at end 79. Hence, the slots 71 at end 80 coincide with slots 71 at end 79 when the ends 79, 80 are joined together. Therefore, the webs of material 81, 82 that terminate each slot 71 at the respective ends 79, 80 can be removed after the ends 79, 80 have been joined together so that

the slots 71 at end 79 are continuous into the slots 71 at end 80. This is shown in Figure 18, where it can be seen that at the seam 84 the slots 71 at the end 79 continue into the slots 71 at the end 80.

The sheet 70 of material could be made of any suitable material from which material may be removed to form the slots 71 and which can then be bent or formed into a cylindrical shell, as shown in Figure 18. In one example, the sheet 70 is stainless steel. Although the sheet of material 70 could be formed from stainless steel it could also be formed from other suitable materials such as plastics materials.

The tool 85 is used in the same way as described above for the tool 1 to mark a surface of a pipe, such as the pipes 20, 25, which is to be scraped to remove oxidized PE material prior to the pipes being joined together.

In order for the tools 1, 40, 85 to easily fit onto pipes it is preferable that the internal surface of the tools 1, 40, 85 have a radius of curvature which is approximately at least 0.25 mm greater than the external radius of curvature of the respective pipe on which the tool 1, 40, 85 is to be used. In addition, it is preferable that the radius of curvature of the internal surface of the tool 1, 40, 85 is no more than 4 mm greater than the radius of curvature of the external surface of the respective pipe. This is to facilitate easier positioning of the tool 1, 40, 85 on the pipe and to make it easier to maintain the tool 1, 40, 85 stationary on the pipe during the marking process. More preferably, the radius

of curvature of the internal surface of the tool 1, 40, 85 is between 0.5mm and 3.0 mm greater than the external radius of curvature of the surface of the respective pipe on which it is to be used and most preferably, the radius of curvature of the tool 1, 40, 85 is between approximately 1.0 mm and 2.0 mm greater than the external radius of the pipe on which it is to be used.

An advantage of the invention is that by clearly marking the section of the external surface of the pipes 20, 50 which are to be electro-fused, it is possible to more accurately and reliably remove oxidized PE material from the external surface of the pipes 20, 50 to improve reliability of electro-fusion joint fittings used on the pipes 20, 50.

CLAIMS

1. A device for marking an external surface of a tubular member, the device comprising:

a body member having an internal surface adapted to at least partially encircle a portion of the tubular member, the body member comprising a side wall and a plurality of slots formed in the side wall, each slot extending along the body member between a first end of the body member and a second end of the body member, and the slots being spaced apart from each other in a circumferential direction around the body member; and

wherein each slot also extends at least partially around the body member in the circumferential direction and each slot penetrates through the side wall from an external surface of the body member to the internal surface.

2. A device according to claim 1, wherein each slot comprises at least two slot portions

3. A device according to claim 2, wherein adjacent slot portions of one slot are at an angle to each other.

4. A device according to claim 2 or claim 3, wherein adjacent slot portions of one slot are separated from each other so that the slot is discontinuous.

5. A device according to claim 4, wherein the adjacent slot portions are separated by a portion of the body member.

6. A device according to any of claims 2 to 5, wherein at least one of the slot portions in each slot extends in both a longitudinal direction along and a circumferential direction around the body member.

7. A device according to any of claims 2 to 6, wherein each slot portion intersects a plane perpendicular to the longitudinal axis of the body member at an oblique angle.

8. A device according to claim 7, wherein adjacent slot portions intersect the perpendicular plane at adjacent angles which are each less than 90º.

9. A device according to any of the preceding claims, wherein at least a portion of each slot extends along the body member in a V-shape.

10. A device according to any of the preceding claims, wherein the longitudinal axis intersects a plane defined by each slot at an oblique angle.

11. A device according to any of the preceding claims, wherein the slots are substantially parallel to each other.

12. A device according to any of the preceding claims, wherein the slots are distributed around the body member.

13. A device according to claim 12, wherein the slots are spaced substantially equidistantly around the body member.

14. The device according to any of the preceding claims, wherein the body member has an at least partially tubular form.

15. The device according to a claim 14, wherein the body member is substantially hemi-tubular.

16. The device according to claim 14 or claim 15, wherein the body member is in the form of at least a portion of a cylindrical shell.

17. The device according to claim 16, wherein the body member is a cylindrical shell.

18. The device according to claim 16, wherein the body member is a substantially hemicylindrical shell.

19. A method comprising:

(i) mounting a device for marking a tubular member on an outside surface of the tubular member in a first orientation, the device comprising a body member having an internal surface adapted to at least partially encircle a portion of the tubular member, the body member comprising a side wall and a plurality of slots formed in the side wall, each slot extending along the body member between a first end of the body member and a second end of the body member, and the slots being spaced apart from each other in a direction transverse to a line extending between the first and second ends and parallel to a longitudinal axis of the body member; wherein each slot also extends at least partially around the body member in a circumferential direction and each slot penetrates through the side wall from an external surface of the body member to the internal surface;

(ii) inserting a marking tool through the slots to engage with the outer surface of the tubular member to cause the outer surface of the tubular member to be marked with first lines corresponding to the slots; and

(iii) removing the device from the tubular member.

20. The method according to claim 19, further comprising:

(iv) turning the device to a second orientation and mounting the device on the tubular member in the second orientation so that the device overlaps the first lines;

(v) inserting a marking tool through the slots to engage with the outer surface of the tubular member to cause the outer surface of the tubular

member to be marked with second lines corresponding to the slots of the device in the second orientation; and

(vi) removing the device from the tubular member.

21. The method according to claim 20, wherein in the first orientation an end of the body member faces in a first direction and in the second orientation, the first end faces in a second direction opposite to the first direction.

22. The method according to claim 20 or claim 21, wherein turning the device to the second orientation comprises rotating the device about an axis perpendicular to the longitudinal axis of the body member.

23. The method according to any of claims 19 to 22, wherein each slot comprises at least two slot portions and adjacent slot portions of one slot are at an angle to each other.

24. The method according to claim 23, wherein each slot portion intersects a plane perpendicular to the longitudinal axis of the body member at an oblique angle, and adjacent slot portions intersect the perpendicular plane at adjacent angles which are each less than 90º.

25. The method according to any of claims 19 to 24, wherein the slots are distributed around the body member in a spaced relationship.

Intellectual Property Office

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Claims searched:	1-25	**Date of search:**	24 June 2019

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-25	US 1568876 A (CAMPBELL & HERBSMAN [1]) See figure 1 in particular
X	1-25	US 1535980 A (CAMPBELL & HERBSMAN [2]) See figures 1-3 in particular
X	1-25	FR 1281893 A (DELLUC) See figures 1 and 4 in particular
X	1-25	US 2011/0030231 A1 (MUELLER [1]) See figures in particular
X	1-25	US 2007/0175059 A1 (MUELLER [2]) See figures in particular
X	1-25	Stencils Online, 12/03/2017, TUBE-MARK Stencils, Stencils Online, [online], Available from: https://stencils-online.myshopify.com/products/tube-mark-stencil-2-off ,[Accessed: 21/06/2019] See image in particular

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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

B25H; B43L

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI, Internet

Intellectual Property Office

International Classification:

Subclass	Subgroup	Valid From
B25H	0007/00	01/01/2006
B43L	0013/20	01/01/2006