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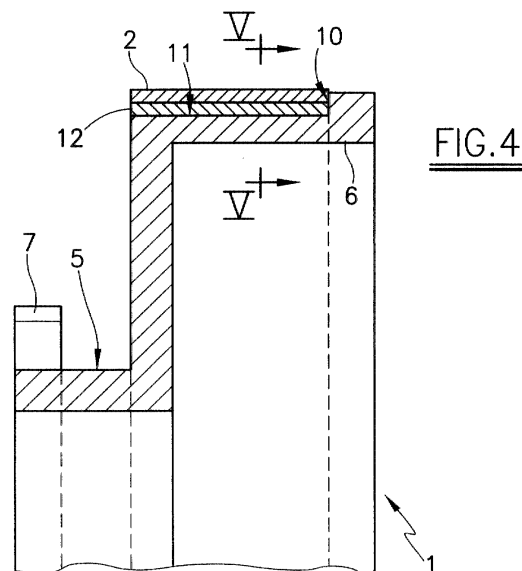
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(54) **Method for preparing cylindrical screens for silk-screen printing, and a sectional printing unit equipped therewith**

(57) A method for preparing cylindrical screens for silk-screen printing, comprising the following operational steps: associating a flexible cylindrical tube piece (300), suitably taut circumferentially and longitudinally, with two identical opposing coaxial annular ring structures (1), and forming on said tube piece at least one decorative region, in which said association comprises the following operations: providing each of said annular structures with a totally extending outer circumferential seat which opens into the outer lateral face of the respective annular structure; mounting in said seats, as a precise fit, two inextensible flexible annular members, to rest against the respective shoulders of said seats; and permanently joining the end circumferential edges of said tube piece to the outer surfaces of said annular members.



Description

[0001] This invention relates generally to cylindrical screens for silk-screen printing, a typical but not exclusive application of which is in decorating ceramic tiles.

[0002] For decorating ceramic tiles, widespread use has been made for some time of rotary silk-screen printing machines comprising a horizontal tile conveying line and two opposing lateral shoulders which support a transverse horizontal cylindrical screen and rotate it synchronously with the arrival of the tiles as they are made to advance by said conveyor.

[0003] On the inside of the screen, which has at least one permeable region of the desired pattern, there is a doctor blade which urges the ink or silk-screen paste through said at least one permeable region, to simultaneously apply it to the underlying tile in transit.

[0004] Generally, known cylindrical screens comprise two opposing coaxial metal rings, typically of aluminium, to which a thin tubular piece of cloth or another suitable material forming the printing screen is non-removably fixed peripherally to their outer circumferential edges, typically by gluing.

[0005] When not in use, the screen is kept in shape by longitudinal rods fitted into respective seats provided in the mutually facing surfaces of the rings, to maintain the printing screen taut.

[0006] The widespread use of such cylindrical screens has highlighted the ensuing drawbacks.

[0007] A first drawback derives from the fact that the printing screen is, as stated, non-removably fixed to the metal rings, so that when the decoration is to be changed, the complete screen (screen fabric + rings) has to be removed from the printing machine and replaced with another.

[0008] In addition, when not in use, the screens are particularly bulky, giving rise to consequent storage and transport problems, and have to be handled with care to prevent undesirable contact with foreign bodies.

[0009] A further drawback lies in the fact that when a printing screen is obsolete or damaged, the rings have to be returned to the respective screen manufacturer to restore machine operability.

[0010] The main object of the invention is to provide means which overcome the aforesaid drawbacks.

[0011] This object is attained by a preparation method having the characteristics defined in claims 1 to 3, and a cylindrical silk-screen printing unit having the characteristics defined in claims 4 to 12.

[0012] The method of the invention comprises the following operational steps: associating a flexible cylindrical tube piece, suitably taut circumferentially and longitudinally, with two identical opposing coaxial annular ring structures in known manner, and forming on said tube piece at least one decorative region; and is characterised in that said association comprises the following operations: providing each of said annular structures with a totally extending outer circumferential seat which

opens into the outer lateral face of the respective annular structure; mounting in said seats, as a precise fit, two inextensible flexible annular members, to rest against the respective shoulders of said seats; and permanently joining the end circumferential edges of said tube piece to the outer surfaces of said annular members.

[0013] Said joining is preferably achieved by gluing.

[0014] Using the aforesaid method, a printing screen is obtained which can be removed from the respective annular support structures, to be either used on a printing machine as described hereinafter, or collapsed to minimum bulk for storage or transport.

[0015] To remove the screen, each of its ends is held while the respective annular support structure is pushed axially inwards until its seat disengages from the screen, after which the annular structure is turned about a diameter, the respective end portion of the screen is ovalized, and the annular structure is extracted from said ovalized portion.

[0016] The reverse procedure is used to mount a cylindrical silk-screen printing unit of the invention.

[0017] The unit comprises two rigid annular structures to be permanently connected to a rotary printing machine, and a tubular flexible printing screen which is removably connected to said rigid annular structures by its opposing ends.

[0018] Each of said ends is provided internally with an endless inextensible flexible member.

[0019] Said member is arranged to fit by one-sided engagement into a respective matching retention seat provided in the outer surface of the respective annular structure, so that the screen assumes a cylindrical configuration.

[0020] When in their rest state, said flexible members are uncoupled from said retention seats, and can be folded to arrange the screen in a collapsed state of minimum bulk.

[0021] Said retention seats each comprise a marginal sunken portion which at one end opens into the outer lateral face of the respective annular structure, and at the other end comprises a stop shoulder for the respective flexible member of the screen.

[0022] In a first embodiment, the base wall of the sunken portion is cylindrical, whereas in an alternative embodiment the base wall is of frusto-conical form with its minor base positioned at the base of said shoulder of the sunken portion.

[0023] Each flexible member consists of a thin flat ring having a cross-section which matches as an exact fit the respective cross-section of the sunken portion, and having its outer cylindrical surface of slightly greater diameter than the outer diameter of the respective annular structure.

[0024] The flexible member is formed of a strong material, such as a reinforced resin or a metallic material.

[0025] In addition, to increase the flexibility of said flexible member, its outer surface can be provided with a plurality of small identical longitudinal cuts which are

positioned close together and angularly equidistant.

[0026] Finally, the inner surface of each flexible member is provided with a longitudinal reference bar arranged to engage a respective matching slot provided in the base wall of the respective sunken portion.

[0027] A silk-screen printing unit as heretofore defined attains all the objects of the invention, which are strictly related to the indicated problems of the known art.

[0028] In this respect, when the decoration is to be changed, it is sufficient to remove from the printing machine only the printing screen used up to that moment, and replace it with another.

[0029] Moreover, those screens not in use, which are stored in a collapsed transverse configuration as described hereinafter, occupy a relatively small space, with obvious advantages both in terms of their storage and transport, and with regard to the risk of damage.

[0030] In addition, when a printing screen is to be changed, either because it is damaged or because the decoration is to be changed, it is not necessary to approach the screen manufacturer, as the screen is fitted to the annular structures removably, as stated.

[0031] Another advantage of the invention lies in the fact that for equal screen diameters, each printing machine need be provided with only a single pair of annular structures, able to be associated with any number of printing screens.

[0032] The operational steps of the proposed preparation method and the constructional merits of the corresponding sectional silk-screen printing unit will be apparent from the detailed description given hereinafter with reference to the figures of the accompanying drawings, on which:

[0033] Figure 1 is an exploded perspective view showing the elements required for preparing a sectional printing screen of the invention.

[0034] Figure 2 shows to an enlarged scale a part of the section II-II of Figure 1.

[0035] Figure 3 is a partial view similar to Figure 1, showing how the flexible rings are engaged with the respective retention seats in the annular structures.

[0036] Figure 4 shows to an enlarged scale a part of the section IV-IV of Figure 3.

[0037] Figure 5 shows a part of the section V-V of Figure 4.

[0038] Figure 6 is a view similar to Figure 4, showing how the printing screen is wrapped about the inextensible flexible rings, then tensioned and fixed.

[0039] Figure 7 is a view similar to the preceding, showing a modified silk-screen printing unit of the invention, in which the section plane lies external to the position of the reference means for the correct mutual positioning of the screen and the annular structure.

[0040] Figure 8 is a partial section similar to Figure 6, showing the disengagement of a terminal annular structure from the respective end of the printing screen.

[0041] Figure 9 is a partial perspective view showing

how the previously disengaged annular structure can be extracted from the printing screen.

[0042] Figure 10 is a schematic view showing a first method typically for storing a printing screen of the invention.

[0043] Figure 11 is a schematic view showing a second method of storing a printing screen of the invention.

[0044] Figure 12 is a schematic view showing a first method typically for transporting a printing screen of the invention.

[0045] Figure 13 is a schematic view similar to the preceding showing a different transport method.

[0046] Figure 14 is a schematic view showing a system suitable for arranging three printing screens of the invention for transport.

[0047] Said figures, and in particular Figure 1, show two identical opposing coaxial metal annular structures 1, two identical opposing coaxial rings 2 positioned external to said annular structures 1, a rectangular flat sheet 3 of silk-screen printing cloth, and one of a series of usual tensioning rods 4.

[0048] The said annular structures 1, typically produced by aluminium casting and then finished by machine tools, are intended to be connected to the usual support, drive and tensioning shoulders of a likewise usual rotary silk-screen printing machine.

[0049] Each annular structure 1 has an outer circumferential channel 5 for its connection to the respective shoulder of the rotary printing machine, and a circumferential ledge 6 for connecting the respective ring 2.

[0050] In the outer lateral wall of said channel 5 there is a notch 7, the purpose of which is to set the annular structures 1 in phase during their mounting on the printing machine.

[0051] According to the invention, as can be seen from Figure 2, along the outer marginal band of the ledge 6 there is provided a totally extending sunken portion 9 which at one end opens into said channel 5, and at the other end provides a stop shoulder 10 for the respective ring 2.

[0052] In a first embodiment, shown in Figures 1, 2, 3, 4, 6, 8 and 9, the base wall of said sunken portion 9 is cylindrical, whereas in the alternative embodiment of Figure 7 the said base wall is shaped as a cone frustum with its minor base positioned at the base of the shoulder 10.

[0053] As will be apparent hereinafter, said alternative embodiment facilitates the fitting and removal of the ring 2 to and from the respective sunken portion 9.

[0054] In the said base wall of the sunken portion 9 there is provided an elongate slot 11 parallel to the longitudinal axis of the annular structure 1.

[0055] As can be seen, each ring 2 consists of a thin flat strip or band of constant cross-section, formed from an inextensible elastically flexible material. According to the invention, said material is preferably a reinforced resin, for example polyethylene or polypropylene reinforced with glass fibres.

[0056] Alternatively, said ring 2 can consist of thin sheet metal, for example stainless steel.

[0057] In the case of resin the flat ring 2 has a thickness of for example between 2 and 3 mm, whereas in the case of metal the flat ring 2 has a thickness of for example between 0.5 and 0.9 mm.

[0058] Said sunken portion 9, whether its base wall is cylindrical or not, and said ring 2, whether flat or not, are shaped and dimensioned such that:

- the inner surface of the ring 2 (in circular configuration) is arranged to precisely engage the base wall of the sunken portion 9, with simultaneous resting of the ring 2 against the shoulder 10,
- the width of the ring 2 is practically equal to the longitudinal dimension of the sunken portion 9, and
- the outer surface of the ring 2 (in circular configuration) is cylindrical and has a diameter slightly greater than the outer diameter of the annular structure 1.

[0059] For example (see Figure 4), the outer diameter of the ring 2 exceeds that of the annular structure 1 by about 2 mm.

[0060] On the inner surface of the ring 2 there is a reference bar 12 having a shape and dimensions which match those of said slot 11.

[0061] Again, as can be seen in Figure 5, in order to give the ring 2 good flexibility, its outer cylindrical surface is preferably provided with a plurality of identical small cuts 13 located close together and angularly equidistant, parallel to the longitudinal axis of the ring 2.

[0062] Finally, of the two main dimensions of the starting rectangular silk-screen printing sheet 3, which at the moment is completely permeable, ie is not provided with specific decorative regions, one is slightly greater than the circumference of the rings 2, and the other is greater than the distance apart of the annular structures 1, this being determined by the rods 4.

[0063] Starting from the configuration shown in Figure 1, a silk-screen printing unit of the invention is assembled as follows, using a cloth tensioning machine which is not shown as it is of normal use in this specific sector.

[0064] Firstly, the rings 2 are engaged with the sunken portions 9 of the annular structures 1 by sliding the bars 13 into the slots 11.

[0065] After this, the two annular structures 1 are fitted into the appropriate seats in two grooved opposing coaxial discs of the cloth tensioning machine, and are set at the correct distance apart by the rods 4.

[0066] During this arrangement, the notches 7 of the annular structures 1 are positioned exactly in phase.

[0067] The silk-screen printing sheet 3 is then wrapped about the rings 2 so that its two edges 33 (Figure 6) parallel to the axis of the annular structures 1 become superposed, the other two edges extending beyond the annular structures 1.

[0068] The two usual strangling cords associated with said grooved discs of the cloth tensioning machine are

then tightened, after which these discs are moved apart (again see Figure 6) to tension the cloth 3 axially.

[0069] At this point said superposed edges 33 of the sheet 3 are joined together, and the respective circumferential portions of the sheet 3 are joined to the rings 2.

[0070] This joining is achieved using a suitable bonding material, indicated by 99 in Figure 6, compatible with the constituent materials of the sheet 3 and rings 2.

[0071] Said bonding material can be a glue, such as a neoprene or polyurethane glue, or an adhesive, such as a polychloroprene adhesive or a cyanoacrylate adhesive.

[0072] When said bonding material 99 has hardened, the discs of the cloth tensioning machine are released and the flexible tube formed from the sheet 3 is separated from the opposing terminal parts (as indicated by the dashed and dotted line 101 shown in Figure 6), either leaving or not leaving a small projecting marginal edge, such as that shown in Figure 7.

[0073] The unit obtained in this manner (annular structures + flexible tube + rods) is then fed to the subsequent operational stations where at least one permeable silk-screen printing region is formed on said flexible tube in the usual manner.

[0074] At this point the silk-screen printing unit can be removed as explained hereinafter with reference to Figures 8 and 9.

[0075] The rods 4 are removed to release the annular structures 1, which are then extracted from the printing screen 300.

[0076] For said extraction, while holding the respective end of the screen 300, each annular structure 1 is pushed axially inwards (Figure 8) to disengage its sunken portion 9 from the respective ring 2, then the annular structure 1 is turned about a diameter while at the same time ovalizing the respective end portion of the screen 300, after which the annular structure can be extracted from said ovalized portion (see Figure 9).

[0077] The reverse procedure is used to mount a printing screen 300 of the invention on two annular structures 1 associated with a rotary printing machine.

[0078] As stated heretofore, the screen 300 can be reduced to a collapsed configuration to facilitate its storage and transport, as shown in Figures 10 to 14.

[0079] In the arrangement of Figure 10, typically for storage, two opposing cylindrical tubes 44, for example of cardboard or plastic, are inserted into the screen 300, one of these being hung on a horizontal rod 22 branching from a vertical support structure, so that the screen 300 assumes the shape of a vertical flattened ring.

[0080] In the arrangement of Figure 11, also typically for storage, two opposing cylindrical tubes 55 are inserted into the screen 300, the central portion of the screen 300 then being hung over a horizontal support tube 66 so that the screen 300 assumes the shape of a flattened ring folded about itself into two substantially vertical parts.

[0081] In the arrangement of Figure 12, typically for

transporting a single screen 300, two opposing cylindrical tubes 77 are inserted into the screen 300, then the screen is rested (in the shape of a horizontal flattened ring) on the bottom of a cardboard or expanded polystyrene box 771, preferably provided with a lid, a prismatic tube 770 then being positioned between the two cylindrical tubes 77 to act as a retention spacer.

[0082] In the illustration the prismatic tube 770 is positioned on the outside of the screen 300, however it could equally be positioned on the inside.

[0083] In the arrangement of Figure 13, typically for transporting a single screen 300, two terminal cylindrical tubes 77 are inserted into the screen 300, the screen is then folded about an intermediate third cylindrical tube 88, and the screen is placed in a box 771, to rest on its bottom with its generators corresponding to said tubes.

[0084] In the arrangement of Figure 14, typically for transporting three screens 300, a pair of opposing cylindrical tubes, 111, 112 and 113 respectively, are inserted into each screen, and the three screens, in the shape of a horizontal flattened ring, are positioned on the bottom of a box, with the tubes of one interposed between the tubes of the others.

[0085] Said arrangements are shown purely by way of example.

[0086] The merits and advantages of the invention are apparent from the foregoing, and from an examination of the accompanying figures.

[0087] The invention is not limited to that illustrated and described, but covers all technical equivalents of the invention, and their combinations, if implemented within the context of the following claims.

Claims

1. A method for preparing cylindrical screens for silk-screen printing, comprising the following operational steps: associating a flexible cylindrical tube piece (300), suitably taut circumferentially and longitudinally, with two identical opposing coaxial annular ring structures (1), and forming on said tube piece at least one decorative region, **characterised in that** said association comprises the following operations: providing each of said annular structures with a totally extending outer circumferential seat which opens into the outer lateral face of the respective annular structure; mounting in said seats, as a precise fit, two inextensible flexible annular members, to rest against the respective shoulders of said seats; and permanently joining the end circumferential edges of said tube piece to the outer surfaces of said annular member.
2. A method as claimed in claim 1, **characterised in that** said tube piece and said annular members are joined together by gluing.
3. A method as claimed in claim 1, **characterised in that** before permanently joining the tube piece to said outer surfaces of said annular members, said tube piece is put under tension in an axial direction.
4. A cylindrical silk-screen printing unit, **characterised by** comprising two rigid annular structures (1) to be permanently connected to a rotary printing machine, and a tubular flexible printing screen (300) which is removably connected to said rigid annular structures by its opposing ends, these latter being provided internally with two endless inextensible flexible members (2).
5. A unit as claimed in claim 4, **characterised in that** said retention seats each comprise a marginal sunken portion (9) which at one end opens into the outer lateral face of the respective annular structure, and at the other end comprises a stop shoulder (10) for the respective flexible member of the screen.
6. A unit as claimed in claim 4, **characterised in that** the base wall of said sunken portion is cylindrical.
7. A unit as claimed in claim 4, **characterised in that** the base wall of said sunken portion is of frusto-conical form with its minor base positioned at the base of said shoulder of the sunken portion.
8. A unit as claimed in claim 4, **characterised in that** each flexible member consists of a thin flat ring having a cross-section which matches as an exact fit the respective cross-section of the sunken portion, and having its outer cylindrical surface of slightly greater diameter than the outer diameter of the respective annular structure.
9. A unit as claimed in claim 8, **characterised in that** said flat ring consists of a strip of reinforced synthetic material, such as polyethylene reinforced with glass fibres.
10. A unit as claimed in claim 8, **characterised in that** said flat ring consists of thin sheet metal, such as stainless steel.
11. A unit as claimed in claim 4, **characterised in that** the outer surface of said inextensible flexible members is provided with a plurality of small identical longitudinal cuts which are positioned close together and angularly equidistant.
12. A unit as claimed in claim 4, **characterised in that** on the inner surface of said inextensible flexible members there is provided a reference bar arranged to engage a respective matching slot provided in the base wall of the respective sunken portion.

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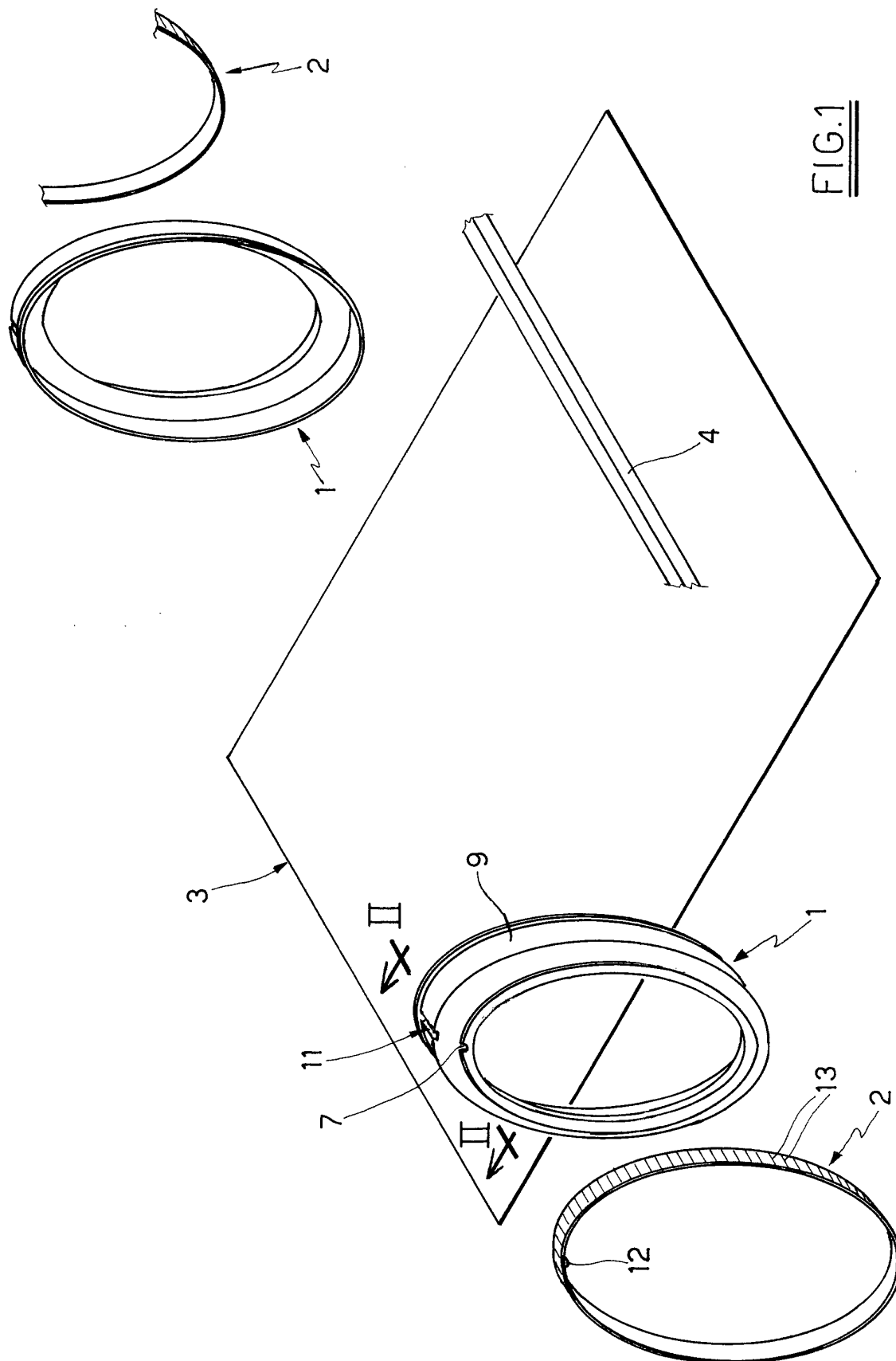


FIG. 1

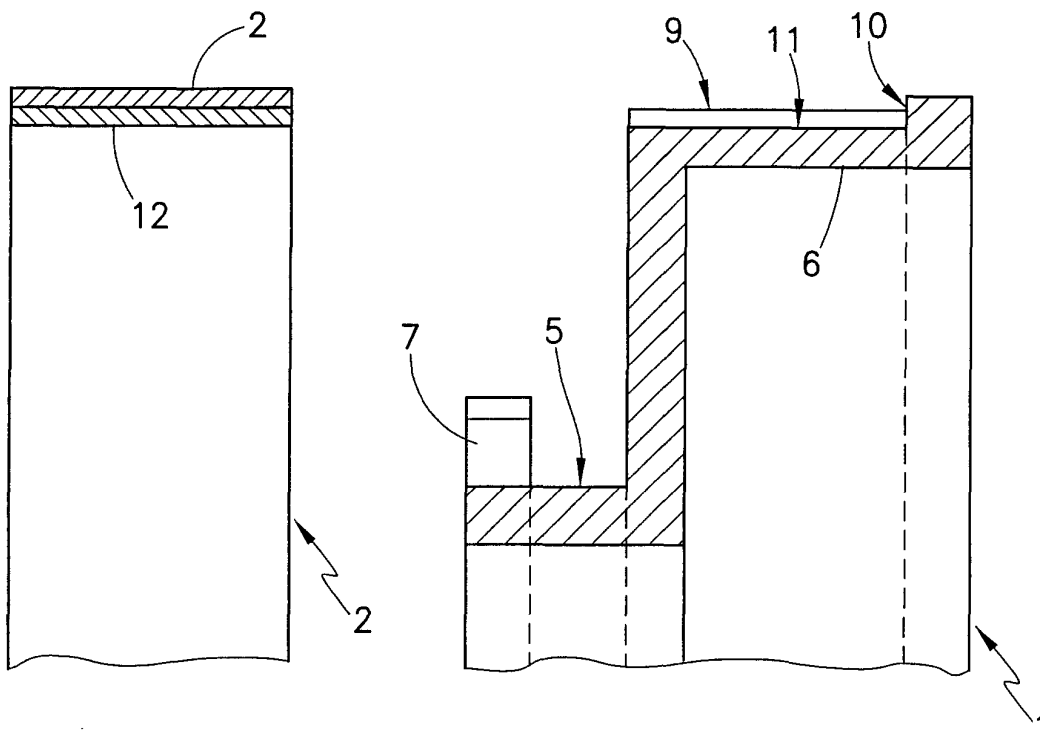


FIG. 2

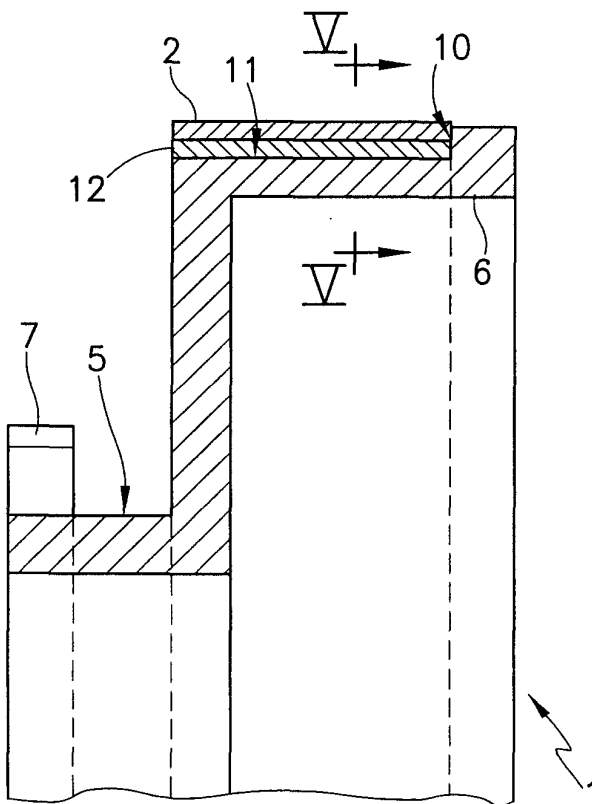


FIG. 4

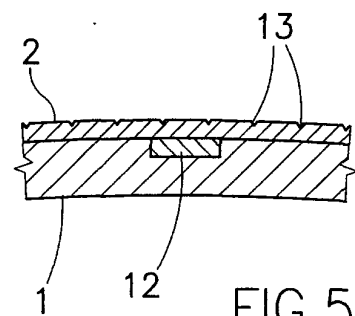


FIG. 5

