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(54) Apparatus and method for coating the exterior surface of a pipe

VORRICHTUNG UND VERFAHREN ZUM BESCHICHTEN DER AUSSENOBEROBERFLÄCHE EINES ROHRES

APPAREIL ET PROCEDE POUR APPLIQUER UN REVETEMENT SUR LA SURFACE EXTERIEURE D'UN TUYAU

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Description

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention: The present invention relates to the application of a coating material to the outer surface of a pipe wherein neither the pipe nor the entire coating apparatus need be rotated to accomplish a coating around a complete circumferential area of the pipe.

[0002] 2. Description of Related Art: Pipelines laid overland or under water are assembled from generally cylindrical sections of hollow pipe that are suitably joined together. A typical section that is used to fabricate an oil or gas pipeline has a length of approximately 20 metres and an outside diameter ranging from approximately 1 to 20 metres. A suitable joining process, such as welding, is used to join the pipe sections together. Each section of pipe is manufactured with an exterior coating that typically consists of an inner protective coating layer and an outer insulative layer. The protective layer, with a typical thickness of 1 mm, is formed by rotating the section of pipe whilst the material is applied to the pipe. A suitable composition is a fusion-bonded thermoplastic powder with an epoxy, polypropylene or polyethylene base that is applied to a pre-heated rotating section of pipe. The insulative layer, with a thickness generally on the order of 50 to 60 mm, is typically applied by an extrusion process. In order to join sections together, the insulative and protective coating layers must be cut or stripped back from each end of a section to expose the pipe material for the joining process. After the joining is completed, the exterior coating must be restored in the field to ensure integral coating of the pipeline. When a thermoplastic material is used, the coating material, in powdered form, is applied to the exterior of a pipe that has been preheated to achieve fusion of the material when it comes in contact with the pipe. For ferrous pipes, heating is generally accomplished by magnetic induction. Prior art processes and apparatus for accomplishing this task are disclosed in U.S. Patent No. 4,595,607. An adhesive material, which can be a polypropylene-based composition, is normally applied over the protective coating by a similar process. Finally, the thicker insulative material is laid over the adhesive by an extrusion process.

[0003] Exterior protective coating of an entire pipe may be accomplished by an electrostatic process in which a pipe that has an induced charge on its surface is rotated over a coating material having an opposing charge.

[0004] A disadvantage of the prior art is that either the entire coating apparatus or the pipe must be rotated to achieve a full 360-degree coating of an area around the outer perimeter of the pipe.

[0005] US 5,725,668 discloses an apparatus according to the pre-amble of Claim 1. Therefore, there exists the need for apparatus and method that can apply a 360-degree perimetrical band of coating material to the exterior surface of a pipe without rotating either the pipe or the coating apparatus.

[0006] An object of the present invention is to provide apparatus and method for applying a coating material around the complete perimeter of the exterior of a pipe without rotating the pipe or the coating device. The entire coating device remains stationary whilst a 360-degree perimetrical coating of the pipe is achieved.

BRIEF SUMMARY OF THE INVENTION

[0007] In one aspect, the present invention is an apparatus and method wherein the pipe and entire coating apparatus remains stationary whilst a complete circumferential area on the exterior of the pipe is coated. Coating material is supplied at a positive air pressure into a compression chamber within a substantially annular body of the coating apparatus. The compression chamber is substantially continuous around an inner radius of the body. Air pressure forces the coating material through the compression chamber and into one or more diffusing chambers, which are also within the body of the coating apparatus and are substantially continuous around an inner radius of the body. Coating material exits the diffusing chambers into a gallery on the inner side of the annular body. An interchangeable centre section is positioned against the gallery. The centre section has one or more openings in it to eject coating material, from the galley and onto the exterior surface of the pipe.

[0008] This and other aspects of the invention will be apparent from the following description.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0009] For the purpose of illustrating the invention, there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIG. 1 is a front elevational view of one example of a coating apparatus of an illustrative example of subject matter related to the present invention.

FIG. 2 is a cross-sectional view of a coating apparatus with sectioning plane defined by line A—A in **FIG. 1**

FIG. 3 is a cross-sectional view of a coating apparatus with sectioning plane defined by line B—B in **FIG. 1**

FIG. 4 is a side partial cross-sectional detail of one example of a means for driving the rotor of the coating apparatus shown in **FIG. 1.**

FIG. 6 is a cross-sectional view of one example of a coating head used with the coating apparatus shown in **FIG. 1**.

FIG. 6 is a front elevational view of the coating apparatus of the present invention.

FIG. 7 is a cross-sectional view of the coating apparatus with sectioning plane defined by line C—C in

FIG. 6.

DETAILED DESCRIPTION OF THE INVENTION

[0010] There is shown in **FIG. 1** though **FIG.** 3 an illustrative example of a coating apparatus 10 which is related to the present invention. Substantially annular rotor elements **20** and **22** are suitably joined together to form a rotor. Enclosed within the rotor is a gallery **24** (hidden and shown by dashed lines in **FIG. 1)** that extends substantially around the rotor. The rotor has a central axis that is common with the central axis of pipe **90** (shown in cross-section in **FIG.** 1). Stator elements **26** and **28** are disposed around the rotor and suitably joined together to form a stator. Means for providing free rotation of the rotor relative to the stator such as the ball bearings **30** shown in **FIG. 2** are provided. Whilst the stator and rotor for the example in **FIG.** 1 are formed from two elements, they may be fabricated in different fashion to suit other materials and methods of assembly without deviating from the scope of the invention. Furthermore, whilst the stator in **FIG.1** is shown as a substantially annular structure, in other examples, the stator may be of another shape, such as rectangular. The stator and rotor may be machined from hard anodized aluminum and coated with a friction reducing material such as TEFLON to provide a favorable boundary surface in the internal passages as further described below.

[0011] As stated above, a suitable, but not limiting, coating material is a fusion-bonded epoxy in powdered form. The coating material is provided from an external source via a suitable pipe or tubing (not shown in the drawings) that is connected to material port **32** of vacuum displacement pump **34.** Air port **36** on the pump is connected to a regulated compressed air supply (typically from 30 to 30 psi for this example) by suitable pipe or tubing (not shown in the drawings). Regulating the supply of air to a venturi in pump **34** controls the intake draw of coating material into the coating apparatus and provides the means for keeping the coating material within the apparatus under positive air pressure. The term "fluidized" powder can be used to describe the coating material as it mixes with the injected air and reduces in density to a state suitable for passage within the coating apparatus of the present invention.

[0012] The non-rotating rotor provides a stationary structure for mounting each vacuum displacement pump. Therefore, the coating material and compressed air connections to each pump are not complicated by connecting to a rotating element.

[0013] Whilst the coating apparatus **10** shown in **FIG.** 1 uses two vacuum displacement pumps disposed on one of the two stator elements, other examples of the invention can have a different number of pumps that are attached to one stator face, or distributed between both stator faces.

[0014] Pump outlet **38** injects the fluidized powder into gallery **24.** Seals 40 serve as means to keep the powder within the gallery as the rotor rotates relative to the stator and pump outlet **38.** The seals are designed to withstand the positive air pressure exerted on the powder within the gallery. As shown in **FIG. 3,** pressurized air may optionally be blown into one or more ports **33** on the rotor to assist in maintaining a positive air pressure on the seals **40.**

[0015] Coating material is ejected from the gallery **24** through one or more coating heads **42** that are attached to the rotor and have an internal passage connected to the gallery. When the coating material is a thermoplastic material, pipe **90** will be preheated prior to the application of coating material to fuse the material onto the exterior surface of the pipe.

[0016] Optionally the exterior surface of pipe **90 can** be grit blasted prior to coating by providing a suitable grit from an external source via a suitable pipe or tubing that is connected to material port 32 of one or more of the vacuum pumps **34.** Alternatively one or more dedicated grit vacuum pumps can be provided around one or both of the stator faces.

[0017] As shown in **FIG. 5,** a coating head **42** can be provided with one or more interior diffusers **46** in the form of a disc or other shape to control the flow of coating material through the head and onto the exterior surface of the pipe. The coating head, including opening **44,** can be configured as best to suit coating material ejection for a particular application. In the present example, diffuser **46** deflects the fluidized powder to the side wall **45** of the coating head so that the powder exits opening **44** in a generally uniform flow profile across the entire width of the opening. Preferably each coating head is removably attached to the rotor so that it can be removed and exchanged with a head of differing length, or fitted with a length extension fitting so that differing diameters of pipe can be accommodated.

[0018] Suitable drive means are provided to rotate the rotor. One method of driving the rotor is shown in **FIG.** 4. Motor **48** is connected to sprocket **50** via output shaft **52.** A chain (not shown in the drawings) engages sprocket **50** and radially projected teeth (not shown in the drawings) on the circular side surface of the rotor to deliver rotational power from the drive motor to the rotor. Whilst two motors are used in this example, a differing number and configuration may be used to suit a specific application.

[0019] In applications where the coating apparatus is slipped onto a section of pipe or slid along pipe sections as a pipeline is assembled, the stator and rotor can be formed as continuous elements around their circumferences. In other examples of the apparatus, the stator and rotor can include means for opening and closing around a section of pipe, such as two split or hinged members with interface boundaries **92** shown in **FIG. 1.** Either the pipe or the coating device may be moved in its axial direction to effect coating along the length of the pipe. When the coating material is a thermoplastic material, pipe **90** will be preheated prior to the application of coat-

ing material to fuse the material onto the exterior surface of the pipe.

[0020] Optionally when application of a gas prior and during coating is desirable, the gas may be supplied to one or more of air ports **36** or one or more dedicated gas ports provided around one or both of the stator faces to inject the gas into gallery **24** prior and during coating. This is of particular value when polypropylene is the coating material and the gas is heated air that is applied prior and during coating.

[0021] Subsequent to coating, a quench fluid, either in liquid or gaseous form, can be supplied from an external source via a suitable pipe or tubing that is connected to material port **32** of one or more of the vacuum pumps **34.** Alternatively one or more dedicated quench fluid pumps can be provided around one or both of the stator faces.

[0022] In applications where a combination of grit blasting and/or quenching are used, suitable valve arrangements can be provided upstream of the input to material port 33 to facilitate selection of the substance that is fed to the port.

[0023] There is shown in **FIG.** 6 and **FIG. 7** a coating apparatus **10** of the present invention. The apparatus comprises a substantially annular body **60,** which has a plurality of entry ports **62** protruding from it. The number of entry ports for a particular application is governed by the diameter of the pipe **90** (shown in cross-section in **FIG. 6** and **FIG. 7**) that is being coated and are, in general, symmetrically arranged around its outer perimeter. The annular body **60** can be formed from two machined halves. Hard anodized aluminum is a suitable material. A coating of a friction reducing material such as TEFLON is preferable to provide a favorable boundary surface in the entry ports and other internal passages as further described, bellow.

[0024] A mixing chamber **64** is connected to each of the entry ports. The mixing chamber is used as a means to introduce the coating material into the entry port at a positive air pressure. For this particular example, the coating material is introduced into the mixing chamber from fitting **66.** Fitting **66** is attached to chamber **64** and has a material port **68** for connection to an external source of coating material via suitable pipe or tube (not shown in the drawings). Air port **70** in fitting 66 is connected to a regulated compressed air supply (generally with a range from 30 to 40 psi (206.8 to 275.8 kPa) for the present example) by suitable pipe or tubing (not shown in the drawings). Regulating the supply of air to a venturi in fitting **66** controls the intake draw of coating material into the coating apparatus and provides the means for keeping the coating material (fluidized powder) within-the apparatus under positive air pressure. Mixing chamber **64** has an air port **72** attached to it by which generall low pressure (in the range of 4 to 5 psi (27.6 to 34.5 kPa) and high volume (in the range of 20 to 25 cfm (9440 to 11800 $cm^3 s^{-1}$) air from a suitable source such as a low pressure air compressor (not shown in the figures) is supplied. The low-pressure air serves to force the coating material entering the mixing chamber from fitting **66** into entry port **62** and to further reduce the density of powder if required for a particular application.

[0025] Intake chamber **74** (hidden and shown as dashed lines in **FIG. 6)** within body **60** transfers the coating material from an entry port to compression chamber **76** that runs substantially around an inner diameter of body **60** (hidden and shown as dashed lines in **FIG. 6)**. In this example, the intake chamber has a generally circular cross-section, and the compression chamber has a combination oval and funnel-shaped cross-section. Other shapes are suitable for the compression chamber as long as the chamber serves to compress the coating material under positive air pressure. The coating material is forced by air pressure down through compression chamber **76** and into diffusing chamber **78**. In this example, the diffusing chamber is a substantially oval passage that opens into the sides of gallery **80.** Interchangeable centre section **82** is a collar that is seated within the inner radial surface of annular body **60** to accommodate the outer diameter of the pipe **90** to be coated. One or more appropriate openings **84** are provided through the thickness of the centre section **82** to permit ejection of coating material onto the outer diameter of pipe **90.** In the present example, opening **84** is a substantially continuous circumferential opening in the centre section to permit ejection of coating material 360 degrees around the perimeter of the pipe **90.** In this manner, neither the pipe **90** nor coating device **10** need to be rotated to achieve a complete coating around the perimeter of the pipe. In alternative examples, satisfactory rotating means maybe provided with the coating device to rotate it if required for a particular coating process. Either the pipe or coating device may be moved in its axial direction to effect coating along the length of the pipe. When the coating material is a thermoplastic material, pipe **90** will be preheated prior to the application of coating material to fuse the material onto the exterior surface of the pipe.

[0026] The configuration of the coating apparatus **10** shown in **FIG. 6** and **FIG. 7**, namely with four entry ports **62** arranged substantially 45 degrees apart from each other, can preferably (but not in limitation) be used to deposit a complete 360-degrees band of coating material around the exterior perimeter of a pipe having an outside diameter ranging from approximately 5 to 13 cm. For pipes of larger diameter, a greater number of entry ports can be used without deviating from the scope of the invention.

[0027] In applications where the coating apparatus shown in **FIG. 6** and **FIG. 7** is slipped onto a section of pipe or slid along pipe sections as a pipeline is assembled, body **60** can be formed as a continuous element around their circumferences. In other examples of the apparatus, the body can include means for opening and closing around a section of pipe, such as two split or hinged members with interface boundaries **94** shown in **FIG. 6**.

[0028] Options similar to those disclosed for the illus-

trative example of subject matter related to the invention can be used for the invention shown in **FIG. 6** and **FIG. 7**. Suitable grit can be provided to material port **68** of one or more of the fittings **66**. Alternatively one or more dedicated grit material and entry ports can be provided around the perimeter of annular body **60** for injecting grit into compression chamber **76**. A gas can be supplied to one or more air ports **70** prior and during coating. Alternatively one or more dedicated gas ports can be provided to inject the gas into the intake and compression chamber. A quench fluid can be provided to material port **68** of one or more of the fittings **66**. Alternatively one or more dedicated quench fluid fittings can be provided around the perimeter of annular body **60**.

[0029] In other examples of the invention, a magnetic induction heating assembly may be combined with the coating apparatus of the present invention to form a single stationary apparatus for preheating and coating around a complete circumferential area of the pipe.

Claims

1. An apparatus for application of a coating material to the exterior surface of a pipe (90), the apparatus comprising

a substantially annular-shaped body (60) for disposition around the exterior of a pipe to be coated,

at least one entry port (62) peripherally disposed around the annular-shaped body (60), the entry port being connected to a first end of an intake chamber (74) within the annular-shaped body, and

a gallery (80) disposed within the inner circumferential side of the annular-shaped body,

characterised by

a compression chamber (76) disposed within the annular-shaped body, a first end of the compression chamber (76) being connected to the second end of the intake chamber (74),

at least one diffusing chamber (78) disposed within the annular-shaped body, a first end of each of the at least one diffusing chambers (78) being connected to a second end of the compression chamber (76),

means for supplying the coating material from an external source to each of the at least one entry ports (62), and

means for applying positive air pressure to each of the at least one entry ports (62) whereby the coating material is forced under air pressure successively through the intake (74), compression (76) and diffusing (78) chambers,

and in that

the compression chamber (76) extends in the circumferential direction of the annular-shaped body,

the at least one diffusing chamber (78) extends in the circumferential direction of the annular-shaped body,

the gallery (80) is disposed within the annular-shaped body inwardly of the compression chamber (76),

the second end of each the at least one diffusing chambers (78) opens into the gallery (80),

an interchangeable sleeve (82) is disposed against the inner circumference of the annular-shaped body (60), the interchangeable sleeve (82) having one or more openings (84) for fluid connection of the gallery with the outer surface of a pipe (90) to be coated, and

the means for applying positive air pressure forces, in use of the apparatus, a coating material into the gallery (80) and ejects the coating material through the one or more openings (84) in the interchangeable sleeve (82) onto the exterior surface of a pipe (90) to be coated around the entire circumference thereof.

2. An apparatus according to claim 1, wherein the means for supplying the coating material and the means for applying positive air pressure include a mixing chamber (64) attached to at least one entry port (62), the mixing chamber (64) having a fitting (66) for connection to an external source of coating material and a port (72) for connection to an external source of compressed air.

3. An apparatus according to claim 1 or 2, wherein the annular-shaped body (60) includes means for opening and closing around a pipe (90) to be coated.

4. An apparatus according to of any of claims 1 to 3, including means for supplying a grit from an external source to the at least one entry ports (62), whereby, in the use of the apparatus, the grit is forced under air pressure successively through the intake (74), compression (76) and diffusing (78) chambers, into the gallery (80) and ejected through the one or more openings (84) in the interchangeable sleeve (82) onto the exterior surface of a pipe (90) to be coated around the entire circumference thereof.

5. An apparatus according to any of claims 1 to 4, including means for supplying a gas from an external source to the at least one entry ports (62), whereby, in use of the apparatus, the gas is forced under air pressure successively through the intake (74), compression (76) and diffusing (78) chambers, into the gallery (80) and ejected through the one or more openings (84) in the interchangeable sleeve (82) onto the exterior surface of a pipe (90) to be coated around the entire circumference thereof.

6. An apparatus according to any of claims 1 to 5, including means for supplying a quench liquid from an external source to the at least one entry ports (62), whereby, in use of the apparatus, the quench liquid is forced under air pressure successively through the intake (74), compression (76) and diffusing (78)

chambers, into the gallery (80) and ejected through the one or more openings (84) in the interchangeable sleeve (82) onto the exterior surface of a pipe (90) to be coated around the entire circumference thereof.

7. An apparatus according to any of claims 1 to 6, including at least one magnetic induction heater to heat a pipe prior to placement of the coating material on to the exterior surface of a pipe.

8. A method of applying a coating material to the exterior surface of a pipe (90), the method employing a substantially annular-shaped body (60) disposed around the exterior of the pipe (90) and comprising the step of:

supplying a coating material to an at least one intake chamber (74) within the substantially annular-shaped body (60) surrounding the pipe; **characterised by**:

applying a positive air pressure to each of an at least one entry port (62) whereby the coating material is forced under air pressure to each of the at least one intake chamber (74);
compressing the coating material received from the at least one intake chamber (74) in a compression chamber (76) within the substantially annular-shaped body (60);
substantially surrounding the exterior of the pipe (90) with the compression chamber (76);
diffusing the coating material exiting the compression chamber (76) in at least one diffusing chamber (78) substantially surrounding the exterior of a pipe (90) within the substantially annular-shaped body (60);
injecting the coating material into a gallery (80) disposed within the annular-shaped body; and
ejecting the coating material from one or more openings (84) in the gallery (80) onto the exterior surface of the a pipe (90).

9. A method according to claim 8, including the steps of:

supplying at a positive air pressure a grit to the at least one intake chamber (74);
compressing the grit received from the at least one intake chamber in the compression chamber (76);
diffusing the grit exiting the compression chamber (76) in the at least one diffusing chamber (78);
injecting the grit into the gallery (80); and ejecting the grit from the one or more openings (84) in the gallery (80) onto the exterior surface of a pipe (90).

10. A method according to claim 8 or 9, including the steps of:

supplying at a positive air pressure a gas to the at least one intake chamber (74);
compressing the gas received from the at least one intake chamber (74) in the compression chamber (76);
diffusing the gas exiting the compression chamber (76) in the at least one diffusing chamber (78);
injecting the gas exiting the compression chamber (76) into the gallery (80); and
ejecting the gas from the compression chamber (76) onto the exterior surface of a pipe (60).

11. A method according to any of claims 8 to 10, including the steps of:

supplying at a positive air pressure a quench liquid to the at least one intake chamber (74);
compressing the quench liquid received from the at least one intake chamber (74) in the compression chamber (76); diffusing the quench liquid exiting the compression chamber (76) in the at least one diffusing chamber (78); injecting the quench liquid exiting the compression chamber (76) into the gallery (80); and
ejecting the quench liquid exiting the compression chamber (76) onto the exterior surface of the a pipe (60).

Patentansprüche

1. Vorrichtung zum Auftragen eines Beschichtungsmaterials auf die Außenfläche eines Rohrs (90), wobei die Vorrichtung Folgendes umfasst:

einen im Wesentlichen ringförmigen Körper (60) zum Anordnen um das Äußere eines zu beschichtenden Rohrs,
mindestens einen Eintrittsanschluss (62), der peripher um den ringförmigen Körper (60) angeordnet ist, wobei der Eintrittsanschluss mit einem ersten Ende einer Einlasskammer (74) in dem ringförmigen Körper verbunden ist, und
einen Durchgang (80), der in der inneren Umfangsseite des ringförmigen Körpers angeordnet ist,
gekennzeichnet durch:

eine Verdichtungskammer (76), die in dem ringförmigen Körper angeordnet ist, wobei ein erstes Ende der Verdichtungskammer

(76) mit dem zweiten Ende der Einlasskammer (74) verbunden ist,
mindestens eine Diffusionskammer (78), die in dem ringförmigen Körper angeordnet ist, wobei ein erstes Ende von jeder der mindestens einen Diffusionskammern (78) mit einem zweiten Ende der Verdichtungskammer (76) verbunden ist,
Mittel zum Zuführen des Beschichtungsmaterials von einer externen Quelle zu jedem der mindestens einen Eintrittsanschlüsse (62), und
Mittel zum Aufbringen von positivem Luftdruck auf jeden der mindestens einen Eintrittsanschlüsse (62), wodurch das Beschichtungsmaterial unter Luftdruck nacheinander **durch** die Einlasskammer (74), die Verdichtungskammer (76) und die Diffusionskammer (78) gedrückt wird,
und **dadurch**, dass
sich die Verdichtungskammer (76) in der Umfangsrichtung des ringförmigen Körpers erstreckt,
sich die mindestens eine Diffusionskammer (78) in der Umfangsrichtung des ringförmigen Körpers erstreckt,
der Durchgang (80) in dem ringförmigen Körper gegenüber der Verdichtungskammer (76) innenliegend angeordnet ist,
das zweite Ende von jeder der mindestens einen Diffusionskammern (78) in den Durchgang (80) öffner,
eine austauschbare Manschette (82) an dem inneren Umfang des ringförmigen Körpers (60) anliegend angeordnet ist, wobei die austauschbare Manschette (82) eine oder mehrere Öffnungen (84) für die Fluidverbindung des Durchgangs mit der Außenfläche eines zu beschichtenden Rohres (90) aufweist, und
das Mittel zum Aufbringen von positivem Luftdruck beim Einsatz der Vorrichtung ein Beschichtungsmaterial in den Durchgang (80) drückt und das Beschichtungsmaterial **durch** die eine oder mehreren Öffnungen (84) in der austauschbaren Manschette (82) auf die Außenfläche eines um den gesamten Umfang zu beschichtenden Rohrs (90) ausstößt.

2. Vorrichtung nach Anspruch 1, wobei das Mittel zum Zuführen des Beschichtungsmaterials und das Mittel zum Aufbringen von positivem Luftdruck eine Mischkammer (64) umfassen, die an mindestens einem Eintrittsanschluss (62) angebracht ist, wobei die Mischkammer (64) eine Armatur (66) für die Verbindung mit einer externen Quelle von Beschichtungsmaterial und einen Anschluss (72) für die Verbindung mit einer externen Quelle von Druckluft umfasst.

3. Vorrichtung nach Anspruch 1 oder 2, wobei der ringförmige Körper (60) Mittel zum Öffnen und Schließen um ein zu beschichtendes Rohr (90) umfasst.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, umfassend Mittel zum Zuführen eines Feinkieses von einer externen Quelle an die mindestens einen Eintrittsanschlüsse (62), wodurch beim Einsatz der Vorrichtung der Feinkies unter Luftdruck nacheinander durch die Einlasskammer (74), die Verdichtungskammer (76) und die Diffusionskammer (78) in den Durchgang (80) gedrückt und durch die eine oder mehreren Öffnungen (84) in der austauschbaren Manschette (82) auf die Außenfläche eines um den gesamten Umfang zu beschichtenden Rohrs (90) ausgestoßen wird.

5. Vorrichtung nach einem der Ansprüche 1 bis 4, umfassend Mittel zum Zuführen eines Gases von einer externen Quelle an die mindestens einen Eintrittsanschlüsse (62), wodurch beim Einsatz der Vorrichtung das Gas unter Luftdruck nacheinander durch die Einlasskammer (74), die Verdichtungskammer (76) und die Diffusionskammer (78) in den Durchgang (80) gedrückt und durch die eine oder mehreren Öffnungen (84) in der austauschbaren Manschette (82) auf die Außenfläche eines um den gesamten Umfang zu beschichtenden Rohrs (90) ausgestoßen wird.

6. Vorrichtung nach einem der Ansprüche 1 bis 5, umfassend Mittel zum Zuführen einer Abschreckflüssigkeit von einer externen Quelle an die mindestens einen Eintrittsanschlüsse (62), wodurch beim Einsatz der Vorrichtung die Abschreckflüssigkeit unter Luftdruck nacheinander durch die Einlasskammer (74), die Verdichtungskammer (76) und die Diffusionskammer (78) in den Durchgang (80) gedrückt und durch die eine oder mehreren Öffnungen (84) in der austauschbaren Manschette (82) auf die Außenfläche eines um den gesamten Umfang zu beschichtenden Rohrs (90) ausgestoßen wird.

7. Vorrichtung nach einem der Ansprüche 1 bis 6, umfassend mindestens eine Magnetinduktions-Heizvorrichtung zum Erwärmen eines Rohrs vor dem Platzieren des Beschichtungsmaterials auf die Außenfläche eines Rohrs.

8. Verfahren zum Aufbringen eines Beschichtungsmaterials auf die Außenfläche eines Rohrs (90), wobei das Verfahren einen im Wesentlichen ringförmigen Körper (60) nutzt, der um das Äußere des Rohrs (90) angeordnet ist, und folgenden Schritt umfasst:

Zuführen eines Beschichtungsmaterials zu mindestens einer Einlasskammer (74) in dem im Wesentlichen ringförmigen Körper (60), der das Rohr umgibt;
gekennzeichnet durch:

Aufbringen eines positiven Luftdrucks an jeden von einem mindestens einen Eintrittsanschluss (62), wodurch das Beschichtungsmaterial unter Luftdruck zu jeder der mindestens einen Einlasskammer (74) gedrückt wird;
Verdichten des von der mindestens einen Einlasskammer (74) empfangenen Beschichtungsmaterials in einer Verdichtungskammer (76) in dem im Wesentlichen ringförmigen Körper (60);
im Wesentlichen Umgeben des Äußeren des Rohrs (90) mit der Verdichtungskammer (76);
Diffundieren des aus der Verdichtungskammer (76) austretenden Beschichtungsmaterials in mindestens einer, im Wesentlichen das Äußere eines Rohrs (90) umgebenden Diffusionskammer (78) in dem im Wesentlichen ringförmigen Körper(60);
Einspritzen des Beschichtungsmaterials in einen Durchgang (80), der in dem ringförmigen Körper angeordnet ist; und
Ausstoßen des Beschichtungsmaterials aus einer oder mehreren Öffnungen (84) in dem Durchgang (80) auf die Außenfläche des Rohrs (90).

9. Verfahren nach Anspruch 8, das folgende Schritte umfasst:

Zuführen eines Feinkieses bei positivem Luftdruck an mindestens eine Einlasskammer (74);
Verdichten des von der mindestens einen Einlasskammer empfangenen Feinkieses in der Verdichtungskammer (76);
Diffundieren des aus der Verdichtungskammer (76) austretenden Feinkieses in der mindestens einen Diffusionskammer (78);
Einspritzen des Feinkieses in den Durchgang (80); und
Ausstoßen des Feinkieses aus der einen oder den mehreren Öffnungen (84) in dem Durchgang (80) auf die Außenfläche eines Rohrs (90).

10. Verfahren nach Anspruch 8 oder 9, das folgende Schritte umfasst:

Zuführen eines Gases bei positivem Luftdruck an die mindestens eine Einlasskammer (74);
Verdichten des von der mindestens einen Einlasskammer (74) empfangenen Gases in der Verdichtungskammer (76);
Diffundieren des aus der Verdichtungskammer (76) austretenden Gases in der mindestens einen Diffusionskammer (78);
Einspritzen des aus der Verdichtungskammer (76) austretenden Gases in den Durchgang (80); und
Ausstoßen des Gases aus der Verdichtungskammer (76) auf die Außenfläche eines Rohrs (60).

11. Verfahren nach einem der Ansprüche 8 bis 10, das folgende Schritte umfasst:

Zuführen einer Abschreckflüssigkeit bei positivem Luftdruck an die mindestens eine Einlasskammer (74);
Verdichten der von der mindestens einen Einlasskammer (74) empfangenden Abschreckflüssigkeit in der Verdichtungskammer (76); Diffundieren der aus der Verdichtungskammer (76) austretenden Abschreckflüssigkeit in der mindestens einen Diffusionskammer (78); Einspritzen der aus der Verdichtungskammer (76) austretenden Abschreckflüssigkeit in den Durchgang (80); und
Ausstoßen der aus der Verdichtungskammer (76) austretenden Abschreckflüssigkeit auf die Außenfläche des Rohrs (60).

Revendications

1. Appareil d'application d'un matériau d'enduction sur la surface extérieure d'un tuyau (90), l'appareil comprenant
un corps de forme sensiblement annulaire (60) destiné à être disposé autour de l'extérieur d'un tuyau à enduire,
au moins un orifice d'entrée (62) disposé en périphérie autour du corps de forme annulaire (60), l'orifice étant raccordé à une première extrémité d'une chambre d'admission (74) à l'intérieur du corps de forme annulaire, et
une galerie (80) disposée à l'intérieur du côté circonférentiel interne du corps de forme annulaire,
caractérisé par
une chambre de compression (76) disposée à l'intérieur du corps de forme annulaire, une première extrémité de la chambre de compression (76) étant connectée à la seconde extrémité de la chambre d'admission (74),
au moins une chambre de diffusion (78) disposée à l'intérieur du corps de forme annulaire, une première extrémité de chacune de l'au moins une chambre de diffusion (78) étant raccordée à une seconde extrémité de la chambre de compression (76),
un moyen d'amenée du matériau d'enduction depuis

une source externe jusqu'à chacun de l'au moins un orifice d'entrée (62), et
un moyen d'application d'une pression d'air positive à chacun de l'au moins un orifice d'entrée (62) si bien que le matériau d'enduction est forcé sous l'effet de la pression d'air successivement dans les chambres d'admission (74), de compression (76) et de diffusion (78),
et en ce que
la chambre de compression (76) s'étend dans le sens circonférentiel du corps de forme annulaire,
l'au moins une chambre de diffusion (78) s'étend dans le sens circonférentiel du corps de forme annulaire,
la galerie (80) est disposée à l'intérieur du corps de forme annulaire vers l'intérieur de la chambre de compression (76),
la seconde extrémité de chacune de l'au moins une chambre de diffusion (78) s'ouvre dans la galerie (80),
un manchon interchangeable (82) est disposé contre la circonférence interne du corps de forme annulaire (60), le manchon interchangeable (82) ayant une ou plusieurs ouvertures (84) pour le raccordement fluidique de la galerie avec surface externe d'un tuyau (90) à enduire, et
le moyen d'application de pression d'air positive, durant l'utilisation de l'appareil, force un matériau d'enduction dans la galerie (80) et éjecte le matériau d'enduction par les une ou plusieurs ouvertures (84) dans le manchon interchangeable (82) sur la surface extérieure d'un tuyau (90) à enduire autour de toute sa circonférence.

2. Appareil selon la revendication 1, dans lequel le moyen d'alimentation du matériau d'enduction et le moyen d'application d'une pression d'air positive comportent une chambre de mixage (64) reliée à au moins un orifice d'admission (62), la chambre de mixage (64) comportant un raccord (66) destiné à être raccordé à une source externe de matériau d'enduction et un orifice (72) destiné à être raccordé à une source externe d'air comprimé.

3. Appareil selon la revendication 1 ou 2, dans lequel le corps de forme annulaire (60) comporte un moyen d'ouverture et de fermeture autour d'un tuyau (90) à enduire.

4. Appareil selon l'une quelconque des revendications 1 à 3, comportant un moyen pour amener un abrasif depuis une source externe jusqu'à l'au moins un orifice d'entrée (62), si bien que, durant l'utilisation de l'appareil, l'abrasif est forcé sous la pression d'air successivement à travers les chambres d'admission (74), de compression (76) et de diffusion (78), jusque dans la galerie (80) et éjecté par les une ou plusieurs ouvertures (84) dans le manchon interchangeable (82) sur la surface extérieure d'un tuyau (90) à enduire autour de toute sa circonférence.

5. Appareil selon l'une quelconque des revendications 1 à 4, comportant un moyen pour amener un gaz depuis une source externe jusqu'à l'au moins un orifice d'entrée (62), si bien que, durant l'utilisation de l'appareil, le gaz est forcé sous la pression d'air successivement à travers les chambres d'admission (74), de compression (76) et de diffusion (78), jusque ans la galerie (80) et éjecté par les une ou plusieurs ouvertures (84) dans le manchon interchangeable (82) sur la surface extérieure d'un tuyau (90) à enduire autour de toute sa circonférence.

6. Appareil selon l'une quelconque des revendications 1 à 5, comportant un moyen pour amener un liquide de trempe depuis une source externe jusqu'à l'au moins un orifice d'entrée (62), si bien que, durant l'utilisation de l'appareil, le liquide de trempe est forcé sous la pression d'air successivement à travers les chambres d'admission (74), de compression (76) et de diffusion (78), jusque dans la galerie (80) et éjecté par les une ou plusieurs ouvertures (84) dans le manchon interchangeable (82) sur la surface extérieure d'un tuyau (90) à enduire autour de toute sa circonférence.

7. Appareil selon l'une quelconque des revendications 1 à 6, comportant au moins un four à induction magnétique pour chauffer un tuyau avant le placement du matériau d'enduction sur la surface extérieure d'un tuyau.

8. Procédé d'application d'un matériau d'enduction sur la surface extérieure d'un tuyau (90), le procédé employant un corps de forme sensiblement annulaire (60) disposé autour de l'extérieur du tuyau (90) et comprenant l'étape suivante :

l'alimentation d'un matériau d'enduction jusqu'à au moins une chambre d'admission (74) à l'intérieur du corps de forme sensiblement annulaire (60) entourant le tuyau ;
caractérisé par :

l'application d'une pression d'air positive sur chacun d'au moins un orifice d'entrée (62) si bien que le matériau d'enduction est forcé sous l'effet de la pression d'air dans chacune de l'au moins une chambre d'admission (74) ;
la compression du matériau d'enduction reçu depuis l'au moins une chambre d'admission (74) dans une chambre de compression (76) dans le corps de forme sensiblement annulaire (60) ;
l'entourage sensible de l'extérieur du tuyau

(90) avec la chambre de compression (76) ; la diffusion du matériau d'enduction sortant de la chambre de compression (76) dans au moins une chambre de diffusion (78) entourant sensiblement l'extérieur d'un tuyau (90) dans le corps de forme sensiblement annulaire (60) ;
l'injection du matériau d'enduction une galerie (80) disposée à l'intérieur du corps de forme annulaire ; et
l'éjection du matériau d'enduction depuis une ou plusieurs ouvertures (84) dans la galerie (80) sur la surface extérieure du tuyau (90).

9. Procédé selon la revendication 8, comportant les étapes suivantes :

l'amenée à une pression d'air positive d'un abrasif jusqu'à l'au moins une chambre d'admission (74) ;
la compression de l'abrasif reçu depuis l'au moins une chambre d'admission dans la chambre de compression (76) ;
la diffusion de l'abrasif sortant de la chambre de compression (76) dans l'au moins une chambre de diffusion (78) ;
l'injection de l'abrasif dans la galerie (80) ; et
l'éjection de l'abrasif depuis les une ou plusieurs ouvertures (84) dans la galerie (80) sur la surface extérieure d'un tuyau (90).

10. Procédé selon la revendication 8 ou 9, comportant les étapes suivantes:

l'amenée à une pression d'air positive d'un gaz jusqu'à l'au moins une chambre d'admission (74) ;
la compression du gaz reçu depuis l'au moins une chambre d'admission (74) dans la chambre de compression (76) ;
la diffusion du gaz sortant de la chambre de compression (76) dans l'au moins une chambre de diffusion (78) ;
l'injection du gaz sortant de la chambre de compression (76) dans la galerie (80); et
l'éjection du gaz hors de la chambre de compression (76) sur la surface extérieure d'un tuyau (60).

11. Procédé selon l'une quelconque des revendications 8 à 10, comportant les étapes suivantes :

l'amenée à une pression d'air positive d'un liquide de trempe jusqu'à l'au moins une chambre d'admission (74) ;
la compression du liquide de trempe reçu depuis l'au moins une chambre d'admission (74) dans la chambre de compression (76) ; la diffusion du liquide de trempe sortant de la chambre de compression (76) dans l'au moins une chambre de diffusion (78) ; l'injection du liquide de trempe gaz sortant de la chambre de compression (76) dans la galerie (80) ; et
l'éjection du liquide de trempe hors de la chambre de compression (76) sur la surface extérieure du tuyau (60).

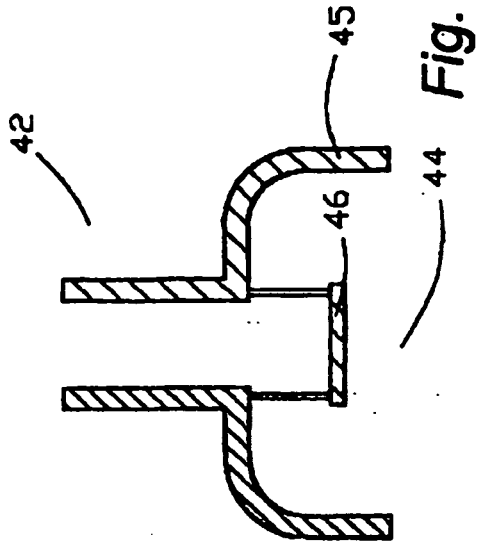

Fig. 5

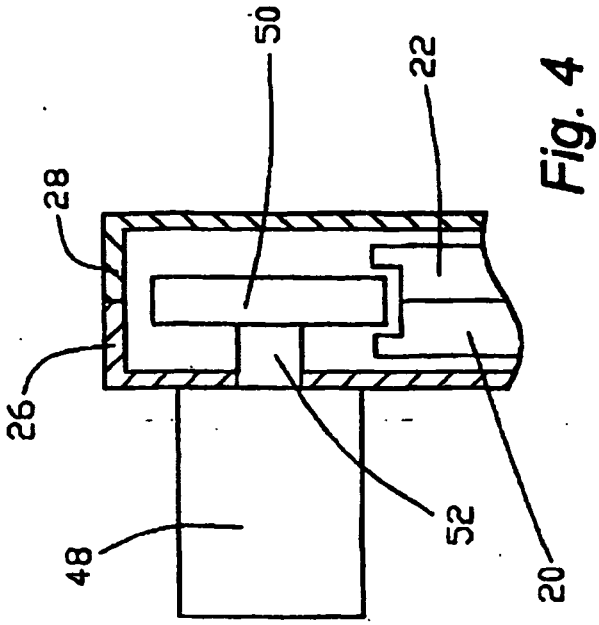

Fig. 4

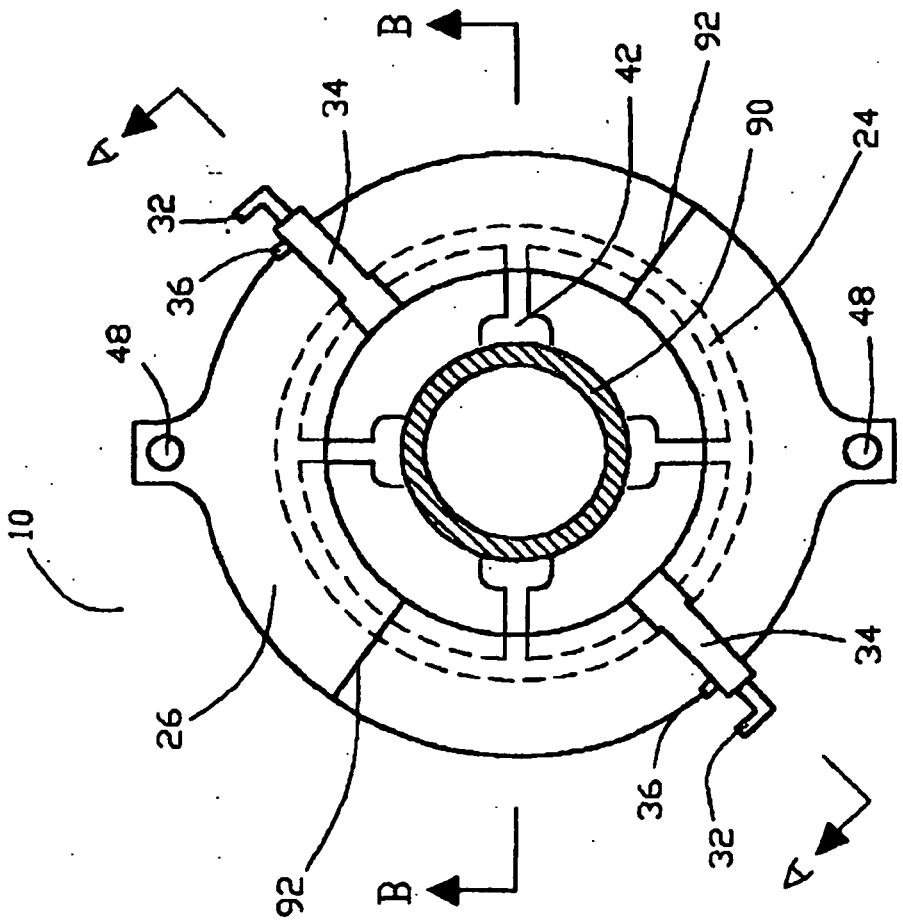

Fig. 1

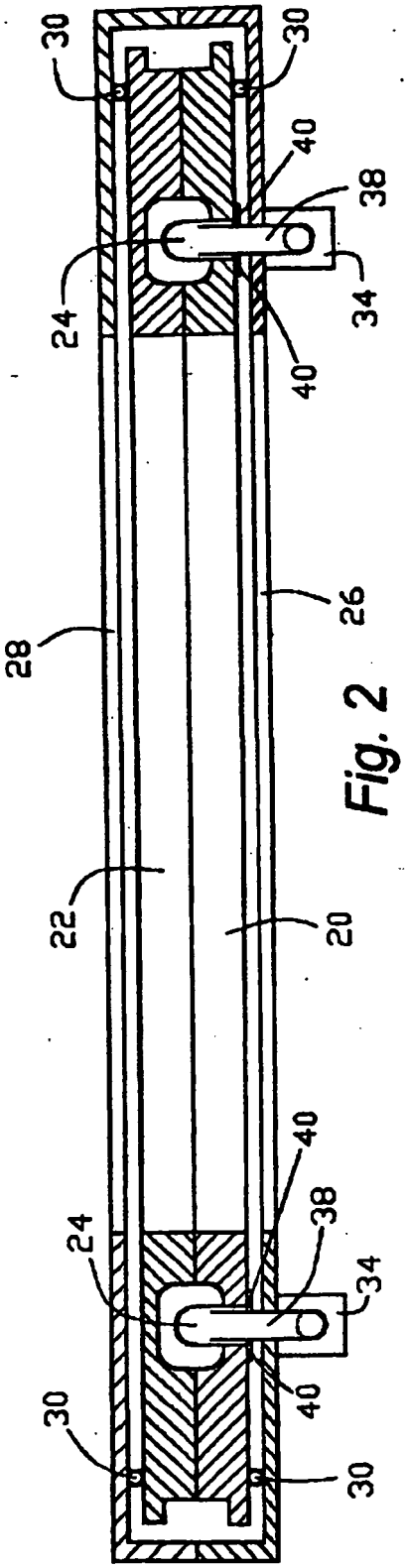
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Fig. 2

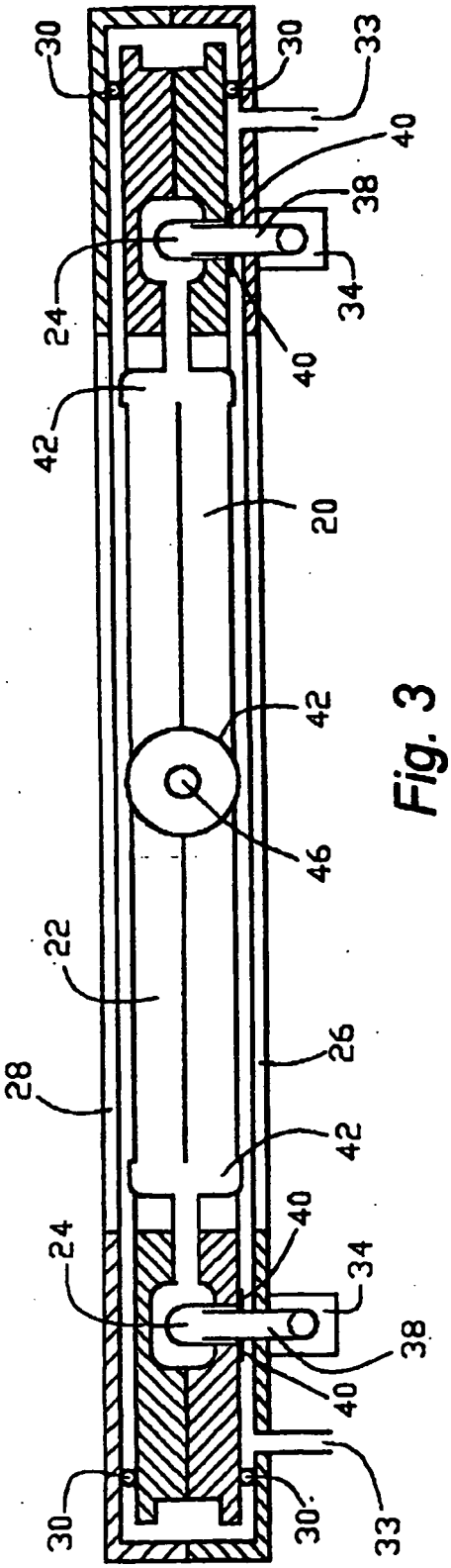
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Fig. 3

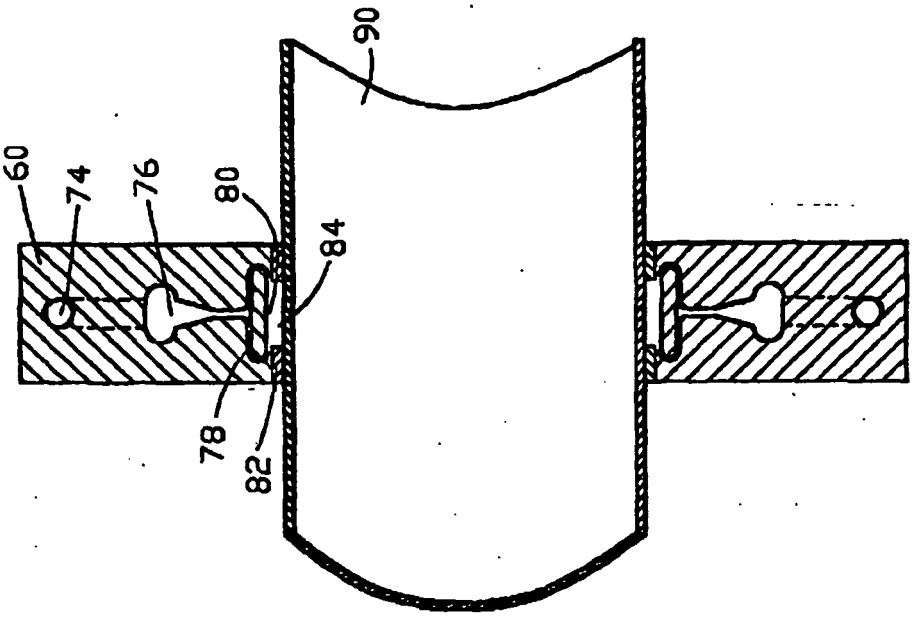

Fig. 7

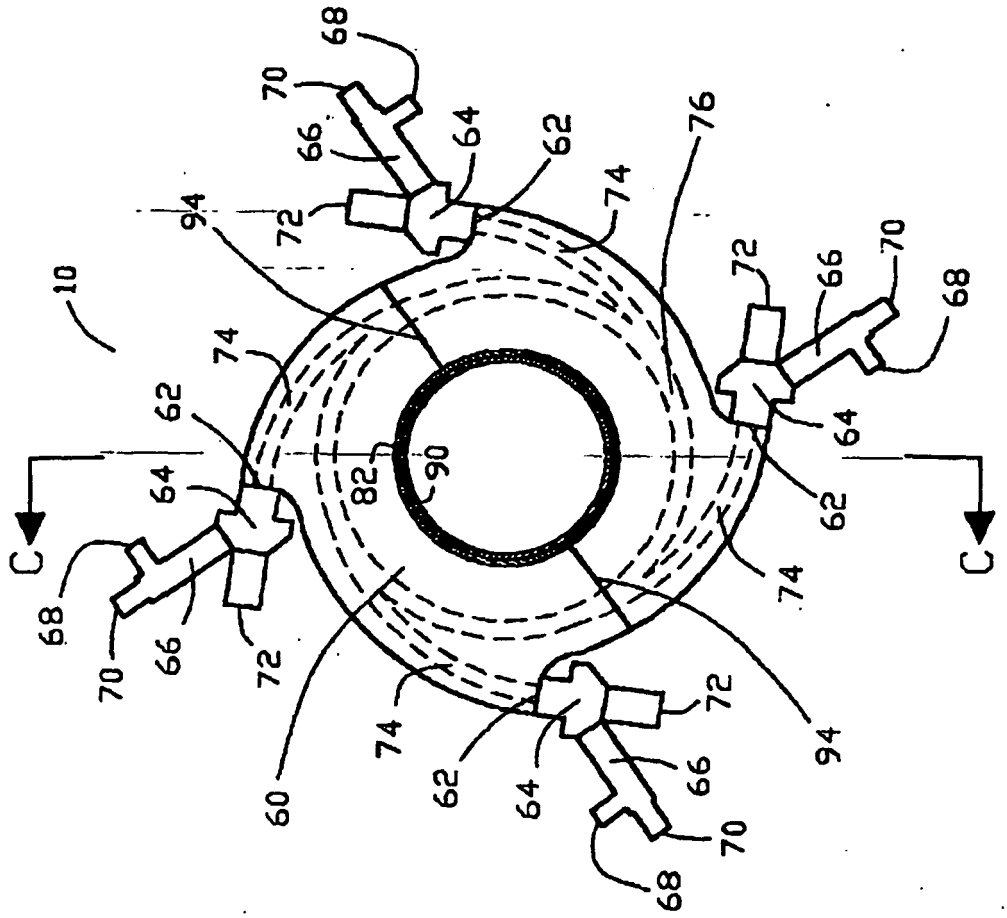

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- US 5725668 A **[0005]**