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(54) A device for applying an internal coating in tubes

(57) A device for applying an internal coating in tubes comprises a nozzle (16), a mixing casing (12) arranged in connection with the nozzle and configured to receive at least two coating material components. Driving means intended to be located outside the tube to be coated and configured to drive an elongated flexible member (18) to rotate also causes said nozzle to rotate by being connected to said flexible member while throwing said coating material substantially radially outwards towards inner walls of the tube. Mixing members (28, 29) inside a mixing compartment (24) of the mixing casing are brought to carry out a stirring movement inside said compartment for mixing the coating material components arriving thereto to a substantially homogenous mixture, which is drained to said nozzle.

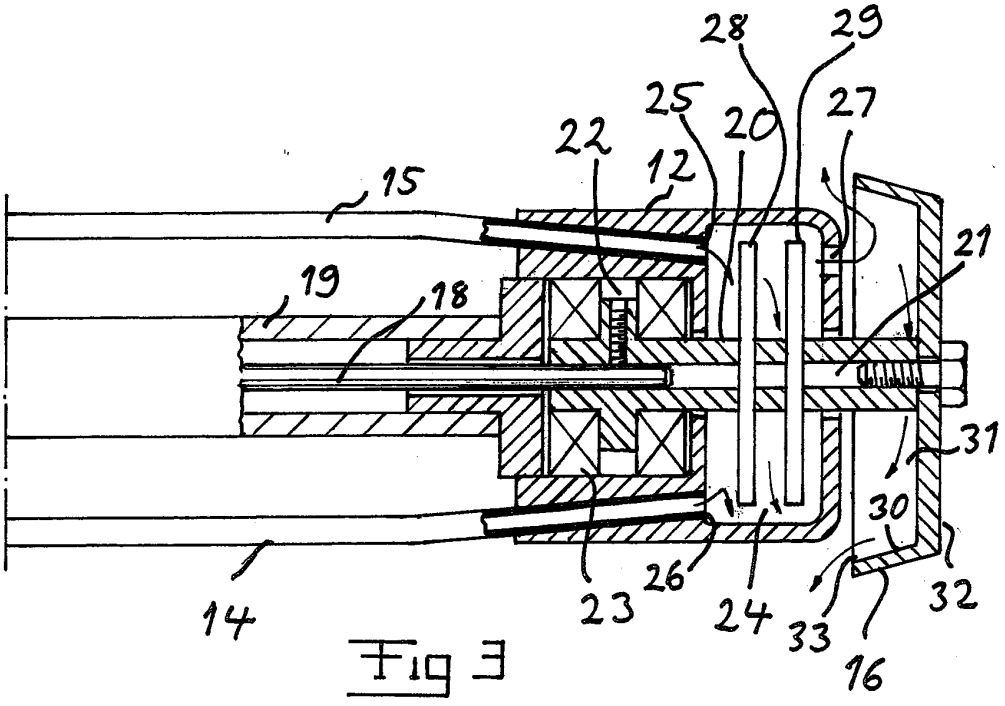

Fig 3

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Description

FIELD OF THE INVENTION AND BACKGROUND ART

[0001] The present invention relates to a device for applying an internal coating in tubes, said device comprising:

- a nozzle configured to apply a coating material onto an inner wall of a said tube,
- a mixing casing arranged in connection with said nozzle and configured to receive at least two coating material components,
- means configured to feed said at least two coating material components separately to said mixing casing,
- an arrangement configured to mix said at least two coating material components inside said casing for providing said coating material constituted by a mixture of said components to said nozzle, and
- driving means intended to be located outside the tube to be coated and configured to drive an elongated flexible member to rotate, the end of which member being rigidly connected to the nozzle with respect to rotation for making the nozzle to rotate while throwing said coating material substantially radially outwards towards inner walls of the tube.

[0002] Such devices may be used for internally coating all types of tubes or pipes, wherein such devices for internally coating water pipes will hereinafter be discussed for illuminating but not in any way restricting the invention to this particulary application. "Water pipes" is defined as comprising all types of tubes or pipes that conduct water, also waste water and discharge pipes, larger main pipes in the soil as well as pipes in the heating, water and sanitation system of accommodations. The condition of pipes of this type is impaired with age, and for instance rust in tubes of cast iron tends to create holes in the walls thereof at some exposed locations, which may lead to leakage having sometimes severe consequences, such as costly moisture damages in buildings, leakage of substances being harmful to the environment into the soil and so on. Also tubes of plastic are changed over a period of time and fissures therein may arise as a consequence of ageing. There is therefore a need of either completely or partly replacing such pipes, which may be hard when they are hidden inside building walls, deep in the soil etc. or to recondition the pipes after a certain period of time through an internal coating thereof by a protecting layer, so that holes or fissures in the pipes resulting in damages of the environment will never appear. A series of devices of this type are therefore known, which have any form of slide or carriage that is usually pulled through a tube to be reconditioned while spraying coating material onto the inner wall of the tube through a nozzle arranged at the slide or the carriage.

[0003] The coating material has to have at least two coating material components, i.e. a component able to form an inner layer or shell inside a said tube and a coating material component in the form of a hardening or curing agent ensuring that said coating mass will efficiently harden once sprayed on the inner wall of said tube. Thus, these components have to be mixed for obtaining the coating material to be sprayed by said nozzle. It seems comfortable to obtain such mixing outside a said tube and then feed the premixed coating material to said nozzle. There are also devices of similar type to that defined in the introduction which utilizes this technic and the premixed coating material is then transported through a hose, which may typically have a length of 15-35 meters, to the rotating nozzle. However, this results in a need of flushing the mixer and the hose by a solvent, such as acetone, after each coating run, which is bothersome. Furthermore, if these parts harden, which may occasionally take place, they have to be replaced, which results in considerable extra costs and loss of time.

[0004] Devices of the type defined in the introduction have therefore been proposed so as to avoid these problems, and such a device is known through US patent 4 216 738. Thus, the coating material components are in that device fed to a mixing casing close to the nozzle where they are mixed before being further fed to the nozzle and thrown out towards inner walls of the tube by rotation of the nozzle. Other devices of this type are known through US patent 4 950 356 and GB 2 160 289 A.

SUMMARY OF THE INVENTION

[0005] The object of the present invention is to provide a device of the type defined in the introduction being improved in at least some aspect with respect to such devices already known.

[0006] This object is according to the invention obtained by providing such a device in which said arrangement comprises mixing members configured to carry out a stirring movement inside said casing for mixing said at least two coating material components and means configured to transfer said rotation of said elongated flexible member to said mixing members for obtaining said stirring movement thereof.

[0007] By in this way using the same driving means for obtaining the mixing of said at least two coating material components and the rotation of the nozzle causing the coating material to be thrown onto said inner walls of the tube the device may be given a simplified construction with respect to such devices already known and by that become highly reliable in operation and attractive from the cost point of view. Furthermore, by making said mixing members to carry out a stirring movement inside said casing for mixing said coating material components a possibility to obtain a very intimate and efficient mixing of said components to a homogenous coating material mass is at the same time achieved, which in its turn results in excellent properties of the layer of coating material obtainable by such a device inside a said tube.

[0008] According to an embodiment of the invention said transfer means is configured to transfer said rotation of said elongated flexible member to a movement of said mixing members in the form of a rotation thereof inside a mixing compartment of said casing, and said casing has at least one outlet for draining coating material mixed to said nozzle. Providing means for obtaining a stirring movement in the form of a rotation of said mixing members constitutes a simple and efficient way of obtaining the results aimed at by the present invention.

[0009] According to another embodiment of the invention said transfer means is configured to connect said flexible members substantially rigidly with respect to rotation to said mixing members, which is a very simple way of obtaining mixing and spraying of mixed material inside a said tube by the same driving means.

[0010] According to another embodiment of the invention said driving means is configured to make said elongated flexible member and thereby the nozzle to rotate with a rotation speed with a number of revolutions of 800-20000 rpm, preferable 4000-15000 rpm, which are suitable rotation speeds for a nozzle in a device of this type.

[0011] According to another embodiment of the invention said elongated flexible member is a metal wire.

[0012] According to another embodiment of the invention the device comprises means configured to enable pulling of the nozzle together with said mixing casing through a tube with a nozzle being a part of the device coming at the end of the movement through the tube. This way of moving the device through a said tube is preferred, since no means for driving the nozzle and mixing casing forwards are then to be arranged in connection therewith and it may be ensured that parts of the device, such as the mixing casing, will not risk to touch coating material already sprayed by said nozzle on inner walls of a said tube.

[0013] According to another embodiment of the invention said feeding means is configured to feed at least a first component in the form of a hardening or curing agent and a second component in the form of a coating mass to said mixing casing. Said feeding means may then be configured to feed a coating mass comprising a polyester to said mixing casing, and said polyester is according to another embodiment of the invention a glass flake or glass fiber reinforced polyester, which results in a preferred coating material layer inside a said tube. Such a polyester is comparatively difficult to mix, and here is the present invention particularly efficient and advantageous.

[0014] According to another embodiment of the invention said nozzle comprises a wall delimiting a space for receiving said mixed coating material, and said delimiting wall tapers the cross-section of said space towards a free end of the nozzle located remotely with respect to said feeding means. The coating material will by this design of the nozzle move away from said free end when the nozzle is rotated for being sprayed out towards a said inner wall of a tube. This design of the space of the nozzle also makes it possible to design the nozzle so that it may be moved through thin tubes, i.e. tubes having small inner diameters, without any risk that the nozzle will with an edge thereof hit the inner wall of the tube when moving through bends and sharp curves.

[0015] According to another embodiment of the invention said nozzle has at least one aperture in said delimiting wall, and this aperture is directed substantially radially with respect to an axis of rotation of the nozzle and at a distance from said free end for throwing said coating material through this aperture out from the nozzle towards tube walls.

[0016] The invention also relates to a method for applying an internal coating in tubes according to the appended independent method claim. The advantages of carry out such a method and the advantageous features of this method and methods according to embodiments of the invention appear clearly from the above discussion of a device according to the present invention.

[0017] Furthermore, the invention also relates to a use of a device according to the invention for coating inner walls of water pipes for reconditioning thereof, which is a preferred use of such a device. According to an embodiment thereof the device is used for internal coating of pipes in heating, water and sanitation-systems of buildings.

[0018] Further advantages as well as preferred features of the invention will appear from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] With reference to the appended drawings below follows a specific description of an embodiment of the invention cited as an example.

In the drawings:

[0020]

Fig 1 is a partially section view illustrating a prior art device and simply used to explain how internal coating may be applied in tubes by use of devices discussed in this document,

Fig 2 is a very simplified view illustrating the overall construction of a device according to the invention, and

Fig 3 is a partially sectioned view enlarged with respect to fig 2 and illustrating a part of the device shown in fig 2.

BRIEF DESCRIPTION OF THE FUNCTION OF A PRIOR ART DEVICE

[0021] Fig 1 shows a prior art device as known through

WO 97/01724 for applying an internal coating onto inner walls 1' of a tube 2', and the function of this prior art device will now be briefly explained for facilitating the understanding of the present invention, although this device is not of the same type as that according to the present invention. This device has a hose 3' feeding a coating material to a nozzle 4'. The nozzle is driven to rotate by being connected to an elongated flexible member 5' such as a metal wire. The rotation of the nozzle will cause the coating material to be thrown outwards towards said inner walls 1' of the tube while resulting in a coating layer 6' thereon. The nozzle is pulled through a said tube while applying a said coating layer 6' onto the inner walls thereof and by that reconditioning the pipe by for instance covering through holes 7' therein. It is shown that the device has a member 8' used for centering the nozzle 4' when pulled through the tube. The coating material sprayed onto said inner walls contains a coating mass and a hardening or curing agent resulting in a hardening of the coating material for forming a rigid inner wall layer inside the already existing tube.

DETAILED DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

[0022] A device according to an embodiment of the invention for internally coating tubes according to the principal shown in fig. 1 will now be described while making reference to fig. 2 and 3. The device comprises means 10, 11 in the form of containers providing a supply of an hardening or curing agent (container 10) and a coating mass (container 11) of a suitable material, such as a polyester, and more especially a glass flake reinforced polyester. The device further comprises means configured to feed these two coating material components to a mixing casing 12 of the device, and these feeding means comprise a pump 13 schematically indicated and a flexible hose 14, 15 leading from each container 10, 11 to said mixing casing for separately feeding the two coating material components to the mixing casing.

[0023] The device further comprises a nozzle 16 arranged in connection with the mixing casing and driving means 17 in the form of a suitable motor connected to said nozzle 16 through an elongated flexible member 18, such as a metal wire, for rotating this member and by that the nozzle 16 for throwing a coating material mixture received by the nozzle 16 from the mixing casing substantially radially with respect to the rotation axis of the nozzle outwards towards inner walls of a tube, when the nozzle and the mixing casing is arranged in a said tube.

[0024] Fig 3 shows how said elongated flexible member in the form of a metal wire 18 surrounded by a protecting jacket 19 of a suitable material, such as plastic, is fixed with respect to rotation to a shaft 20 with an inner through hole 21 in which the wire 18 is received. A screw 22 tightened for fixing the wire 18 to the shaft 20 will by this ensure a transfer of the rotation movement of the wire 18 to the shaft 20 and by that to the nozzle 16 secured to the end of said shaft. The shaft is journalled in bearings 23 received in the mixing casing 12 body.

[0025] The mixing casing has a mixing compartment 24 with inlets 25, 26 for said coating material components fed thereto through the hoses 14 and 15 and at least one outlet 27 for draining coating material mixed inside said mixing compartment 24 to said nozzle 16.

[0026] Mixing members 28, 29 are secured to said shaft 20 for rotating therewith and by that intimately mix the coating material components arriving to the mixing compartment 24 so as to form an homogenous coating material leaving said compartment through the outlet 27.

[0027] It appears from fig 3 that the nozzle 16 comprises a wall 30 delimiting a space 31 for receiving said mixed coating material. The delimiting wall tapers the cross-section of said space towards a free end 32 of the nozzle located remotely with respect to the feeding means 13-15. Furthermore, the nozzle has an opening or aperture 33 in said delimiting wall, more exactly where this ends, and this aperture is directed substantially radially with respect to an axis of rotation of the nozzle and at a distance from said free end 32 for throwing said coating material through this aperture out from the nozzle towards tube walls when the nozzle is rotated by rotation of the wire 18 through the driving means (motor) 17, which preferably rotates the wire and by that the nozzle with a rotation speed of 800-20000 rpm, here about 11000 rpm.

[0028] The way of operation of the device shown in fig 2 and 3 should appear clearly from the description above but will nevertheless now be briefly summarised.

[0029] It is intended that the nozzle 16 and mixing casing 12 are pulled through a tube to be coated by said coating material, and the device may include further means for obtaining this not shown in the figures. However, it is also within the scope of the invention to move the nozzle in any other conceivable way through a said tube, and the device may even carry out its task while, temporally, being in a fixed position with respect to said tube.

[0030] The coating material components are fed separately from the containers 10, 11 through the hoses 14, 15 to the mixing compartment 24, where they are mixed through the stirring action of the mechanical stirrers constituted by the mixing members 28, 29 driven to rotate by the rotation of the elongated flexible member 18 causing at the same time the nozzle 16 to rotate.

[0031] Coating material components mixed to a homogenous mixture will leave the compartment 24 through the outlet 27 and entering the space 31 of the nozzle for migrating to the aperture 33 for being thrown substantially radially with the respect to the rotation axis of the nozzle towards inner walls of a said tube for harden and forming a strong internal coating layer inside the tube thanks to the curing agent in the coating material.

[0032] The invention is of course not in any way restricted to the embodiment described above, but many possibilities to modifications thereof will be apparent to

a person with skill in the art without departing from the scope of the invention as defined in the appended claims.

[0033] It is once again underlined that the device according to the invention is suited for internally coating all types of tubes or pipes, also pipes for transporting drinking water, such as coarse feeding pipes therefore, and there is then a problem to firstly remove lime depositions in such pipes. Additionally, the coating material has in such a case to have such characteristics that there is not the slightest risk that it will after a period of time have any negative influence upon the quality of the water transported therein. The tube may for instance also be a duct used for ventilation.

[0034] The patent claim definition "elongated flexible member, the end of which is rigidly connected to the nozzle" is intended to also comprise the case in which the member is through a non-flexible intermediate piece connected to the nozzle, such as is the case in the embodiment illustrated in the drawings, and it is also possible that the member has some portions that are not flexible. "Flexible" means that the member may be bent in any way, although it may well be comparatively stiff.

[0035] "Tubes" may also have another cross-section than a circular one, such as square, and "diameter" relates in such a case to the length of a cross-section dimension.

Claims

1. A device for applying an internal coating in tubes, said device comprising:

- a nozzle (16) configured to apply a coating material onto an inner wall of a said tube,
- a mixing casing(12) arranged in connection with said nozzle (16) and configured to receive at least two coating material components,
- means (13-15) configured to feed said at least two coating material components separately to said mixing casing,
- an arrangement (20, 28, 29) configured to mix said at least two coating material components inside said casing for providing said coating material constituted by a mixture of said components to said nozzle, and
- driving means (17) intended to be located outside the tube to be coated and configured to drive an elongated flexible member (18) to rotate, the end of which member being rigidly connected to the nozzle (16) with respect to rotation for making the nozzle to rotate while throwing said coating material substantially radially outwards towards inner walls of the tube,

characterized in that said arrangement comprises mixing members (28, 29) configured to carry out a stirring movement inside said casing (12) for mixing said at least two coating material components and means (20, 22) configured to transfer said rotation of said elongated flexible member (18) to said mixing members for obtaining said stirring movement thereof.

2. A device according to claim 1, **characterized in that** said transfer means (20, 22) is configured to transfer said rotation of said elongated flexible member (18) to a movement of said mixing members (28, 29) in the form of a rotation thereof inside a mixing compartment (24) of said casing (12), and that said casing has at least one outlet (27) for draining coating material mixed to said nozzle.

3. A device according to claim 2, **characterized in that** said transfer means (20, 22) is configured to connect said flexible member (18) substantially rigidly with respect to rotation to said mixing members (28, 29).

4. A device according to any of the preceding claims, **characterized in that** said driving means (17) is configured to make said elongated flexible member (18) and thereby the nozzle (16) to rotate with a rotation speed with a number of revolutions of 800-20000 rpm, preferably 4000-15000 rpm.

5. A device according to any of the preceding claims, **characterized in that** said elongated flexible member (18) is a metal wire.

6. A device according to any of the preceding claims, **characterized in that** it comprises means (19) configured to enable pulling of the nozzle (16) together with said mixing casing (12) through a tube with the nozzle being a part of the device coming at the end of the movement through the tube.

7. A device according to any of the preceding claims, **characterized in that** said feeding means (13-15) is configured to feed at least a first component in the form of a hardening or curing agent and a second component in the form of a coating mass to said mixing casing (12).

8. A device according to claim 7, **characterized in that** said feeding means (13-15) is configured to feed a coating mass comprising a polyester to said mixing casing (12).

9. A device according to claim 8, **characterized in that** said feeding means (13-15) is configured to feed a coating mass in the form of a glass flake or glass fiber reinforced polyester to said mixing casing (12).

10. A device according to any of the preceding claims, **characterized in that** said nozzle (16) comprises a wall (30) delimiting a space (31) for receiving said

mixed coating material, and that said delimiting wall tapers the cross-section of said space towards a free end (32) of the nozzle located remotely with respect to said feeding means (13-15).

11. A device according to claim 10, **characterized in that** said nozzle (16) has at least one aperture (33) in said delimiting wall (30), and that this aperture is directed substantially radially with respect to an axis of rotation of the nozzle and at a distance from said free end (32) for throwing said coating material through this aperture out from the nozzle towards tube walls.

12. A method for applying an internal coating in tubes, said method comprising the following steps:

- a nozzle (16) configured to apply a coating material onto an inner wall of a said tube and a mixing casing (12) arranged in connection with said nozzle are introduced into a said tube,
- at least two coating material components are fed to said mixing casing,
- said at least two coating material components are mixed inside said casing,
- said coating material constituted by a mixture of said components are fed to said nozzle,
- an elongated flexible member (18) is driven to rotate for on one hand obtaining a stirring movement of mixing members (28, 29) inside said mixing casing for said mixing of said at least two coating material components and on the other rotating said nozzle (16) for throwing said coating material substantially radially outwards towards inner walls of the tube.

13. A method according to claim 14, **characterized in that** it further comprises the step of pulling said nozzle (16) together with said mixing casing (12) through said tube while coating the inner walls thereof with the nozzle being a part of a device including said mixing casing and nozzle coming at the end when pulled through the tube.

14. Use of a device according to any of claims 1-11 for coating inner walls of tubes, such as of water pipes, for reconditioning thereof.

15. Use according to claim 14, **characterized in that** the device is used for internal coating of tubes or pipes in heating, water and sanitation-systems of buildings or oil pipes.

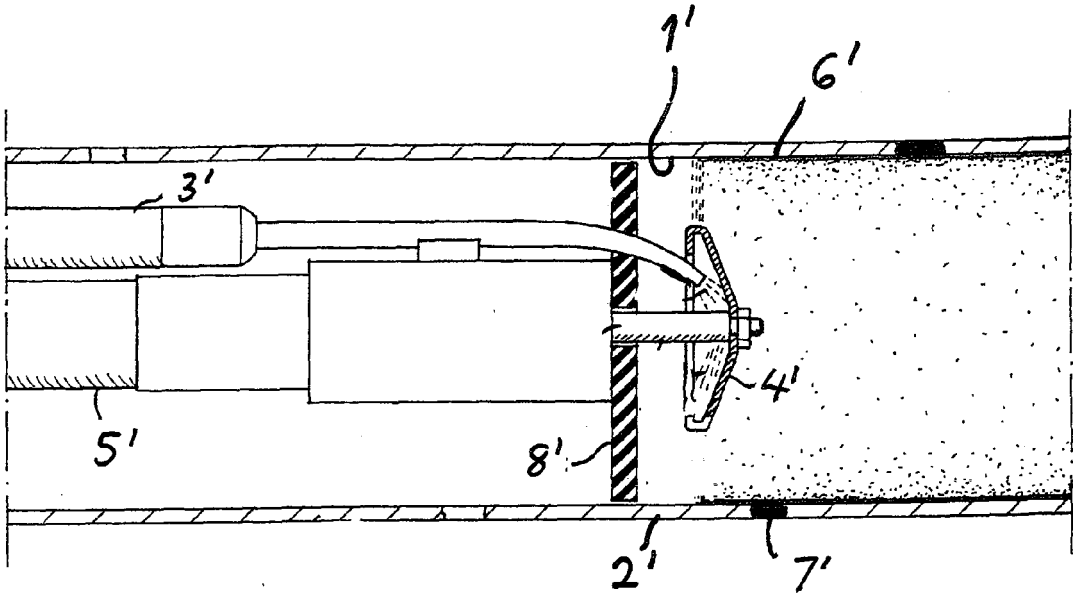

Fig 1

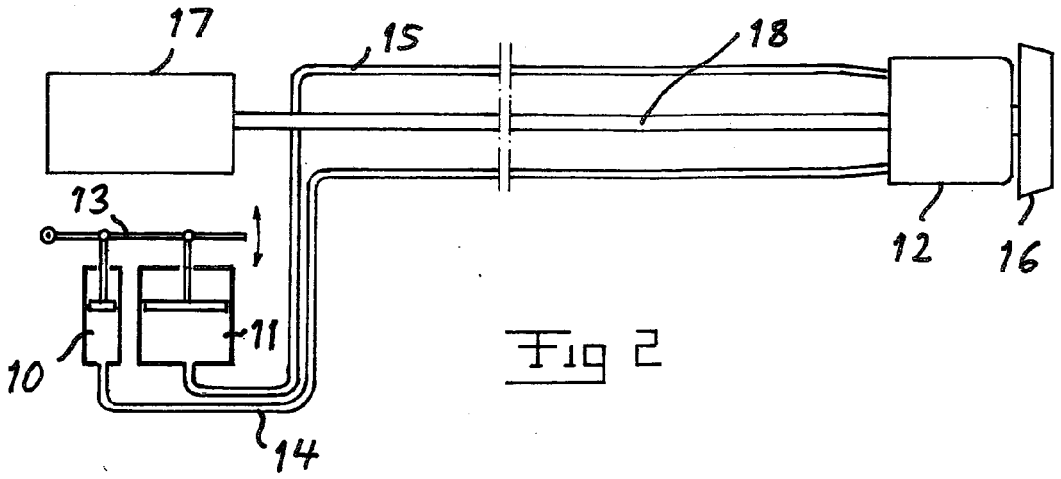
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Fig 2

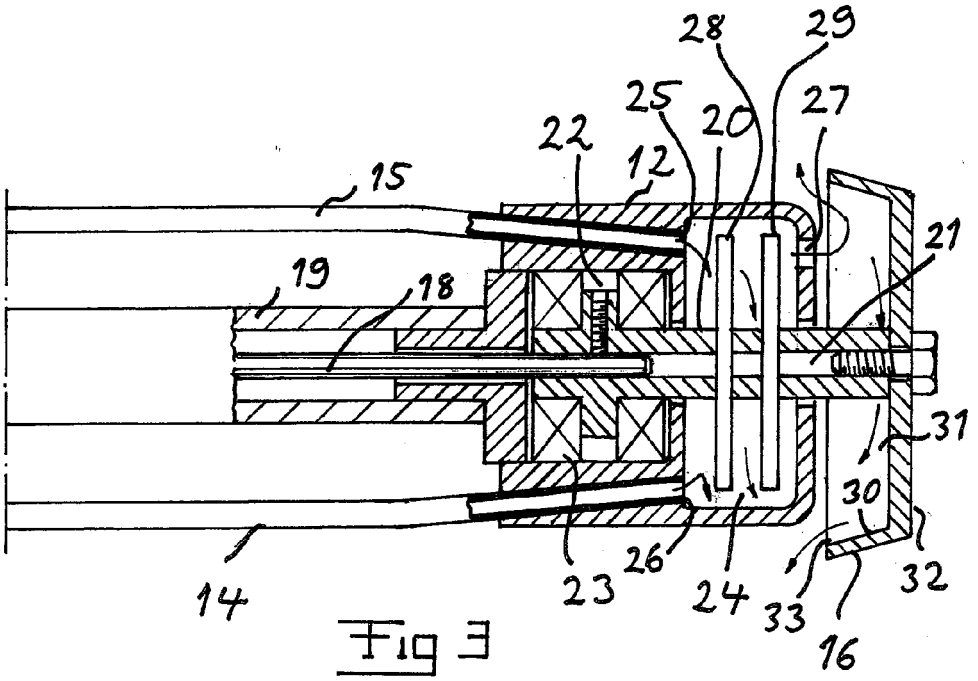
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Fig 3

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EUROPEAN SEARCH REPORT

Application Number
EP 09 15 5432

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 029 027 A (GRAY ARTHUR E) 10 April 1962 (1962-04-10) * page 3, column 2, line 43 - line 45 * * page 4, column 5, line 26 - line 53 * * page 5, column 1, line 66 - line 68 * * page 5, column 2, line 45 - page 6, column 1, line 8 * * figures 1,2 *	1-3,6-8, 10-12,14	INV. B05B13/06 B05C7/08 B05D7/22
A	US 3 233 580 A (LEVAKE RICHARD N) 8 February 1966 (1966-02-08) * the whole document *	1-15	
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TECHNICAL FIELDS SEARCHED (IPC)

G08B
B43L
B05B
B05C
B05D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 May 2009	Schork, Willi

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 15 5432

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25-05-2009

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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