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(54) **Apparatus for removal of sediment**

(57) There is provided sediment removal apparatus 1 for removal of sediment from pipes 2 in a water distribution system, comprising an elongate extendible mem-

ber 3 adapted to extend under fluid pressure through bends and direction changes in pipework, the member defining a conduit 4 for fluid flow.

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Description

[0001] This invention relates to apparatus and a method for removal of sediment from pipes in water distribution systems and more particularly, to apparatus and a method for removing sediment from dead ends, or any section of pipe where cleaning velocity of water is not achieved.

[0002] For the most part, pipework in water distribution systems can be regarded as self cleaning, as water flowing in the system either continuously or periodically will remove debris, such as sediment. However, some areas of relatively quiescent water such as dead ends in water distribution systems have a tendency to collect sediment, the removal of which normally requires washing out via a wash out structure such as a hydrant adjacent to the area. Where there are no wash out structures present, or if present on such large diameter mains that flushing through a hydrant does not generate a cleaning flow to remove sediment to enable a wash out to be performed, removal of sediment can be difficult. It is therefore an object of the present invention to seek to mitigate this disadvantage.

[0003] According to the present invention there is provided a sediment removal apparatus for removal of sediment from pipe in a water distribution system, comprising an elongate extendible member adapted to extend under fluid pressure through bends and direction changes in pipework, the member defining a conduit for fluid flow.

[0004] The member may comprise a flexible material and may be adapted to be made relatively rigid.

[0005] The member may comprise a plurality of elongate longitudinally extending bores capable of being pressurised to impart rigidity to the member. The bores may extend substantially the length of the member, or a part, preferably a half thereof.

[0006] The apparatus may comprise a housing for storage of the member, the member being extendible from the housing by eversion of the member under fluid pressure. It is preferred that the conduit is formed by eversion of the member from the housing.

[0007] The housing may include rotatable means for retrieval of the member.

[0008] It is preferred that the member comprises an outer wall and an inner wall, the walls defining the bores, the inner wall becoming the outer wall and the outer wall defining the conduit on eversion of the member.

[0009] The material forming the member may have or be adapted to have a self-friction co-efficient of < 0.3 and is preferably capable of withstanding a differential pressure of > 1 bar.

[0010] According to a second aspect of the invention there is provided a method for removing sediment from pipes in a water distribution system, comprising extending an elongate extendible member adapted to extend under fluid pressure into the system, the member defining a conduit for fluid flow, and drawing off sediment con-

taining fluid through the conduit.

[0011] The method may include the step of making the member relatively rigid when it has reached its desired position. This may be achieved by applying fluid pressure to it.

[0012] It is preferred that the method includes the step of extending the member by eversion under fluid pressure from a housing.

[0013] The invention will further be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic illustration of the water flow in a pipe in a water distribution system;

Figure 2 is a schematic view of apparatus according to the invention attached to a hydrant of a water distribution system;

Figure 3 is a schematic cut-away side view of apparatus according to the invention;

Figure 4 is a view of a section of a part of apparatus according to the invention in a first position;

Figure 5 is a view of the part of Figure 4 in a second position;

Figure 6 is a view of the part of Figure 4 in a third position;

Figures 6a and 6b are longitudinal sectional views of a part of the apparatus of Figure 3;

Figures 7 and 8 are schematic views showing operation of apparatus according to the invention;

Figure 9 is a longitudinal sectional view of a coupling pipe for use with apparatus according to the invention.

[0014] Referring to Fig. 1, there is shown the water flow path which exists in a common arrangement of pipes in a water distribution system. The pipe 2a is a mains supply pipe connected to a second pipe 2b which leads to a hydrant 22. The mains pipe 2a has a spur 2c which has leading from it a domestic supply pipe 2d. Usually there will be more than one pipe 2d, but one is shown here for clarity. It will be noted that the pipe 2d has a narrower diameter than the pipes 2a, 2b and 2c. The water main is full of water under mains pressure and water may flow at a relatively low rate from the domestic supply pipe 2d. Occasionally water is drawn off from the hydrant. Thus for the most part there is a gradual or gentle flow of water into the spur 2c, and an occasional large flow into pipe 2b to the hydrant. This flow pattern encourages the deposition of sediment in the spur 2c. Sediment will not generally deposit upstream

of the pipe 2b because opening the hydrant, and the ensuing large flow has a flushing effect. However, to achieve a cleaning velocity in the area marked "X" is not possible, even where there are as illustrated feed pipes 2d downstream of "X" for domestic supply, because a sufficient cleaning velocity cannot be generated.

[0015] Referring in particular to Figures 2 and 3, there is illustrated sediment removal apparatus 1 for removal of sediment from pipes 2 in a water distribution system, comprising an elongate extendible member 3 adapted to extend under fluid pressure through bends and direction changes in pipework, the member defining a conduit 4 for fluid flow.

[0016] Referring to Figure 3, the apparatus 1 comprises a cylindrical chamber or housing 5 which has an outer casing 6 which sits on legs 7. The casing 6 has an inner rotatable drum 8 and an outlet 9.

[0017] An elongate extendible member 3 illustrated in Figure 3 in the extended position is attached by one of its ends in a fluid tight manner to a rotatable connector 11 disposed at the centre of the drum 8. The member 3 has first 12 and second 13 walls, as illustrated, the first wall defining the conduit 4 and the second wall defining, with the first wall 12 a plurality of longitudinally extending bores 14. At the end attached to the rotatable connector 11 the bores 14 are closed off. The other end of the elongate extendible member 3 is attached to the cylindrical outlet 9 with the bores 14 in fluid communication with an inlet valve, as will be described below.

[0018] The housing 5 includes two fluid inlets 15 and 16 and a fluid outlet 17. Outlet 17 is in fluid communication with the conduit 4 defined by the extendible member 3 via the rotatable connector 11. A valve 18 is provided. A first fluid inlet 15 lets directly into the interior of the housing 5 and has a valve 19 and a second fluid inlet 16 is attached to the housing at the cylindrical outlet 9. The outlet 16 is attached so as to be in fluid communication with the bores 14 of the member 3. The inlet 16 has a valve 20.

[0019] Referring to Figures 4, 5 and 6 the structure of a part of the extendible member 3 is shown in detail. Referring to Figure 6, the member 3 comprises a first wall 12 and a second wall 13 in its extended condition. The first wall 12 defines the conduit 4 in the extended condition and together, the first wall 12, the second wall 13 and a plurality of radial walls 14a define a plurality of bores 14. The radial walls 14a extend between the first and second walls 12,13 so that the bores 14 constitute a number of longitudinally extending cells. The cells may extend some or all of the length of the member 3. In this embodiment the member 3 is formed from a plastics material. Examples of suitable materials useful for forming the member 3 are metalocene plastomer, butene copolymer or octene copolymer with slip additive.

[0020] Referring to Figures 6a and 6b the attachment of the extendible member 3 to the cylindrical outlet 9 of the housing 5 is illustrated. As mentioned the member 3 comprises a first wall 12 and a second wall 13 sepa-

rated by bores 14. Figure 6a shows the member 3 in its condition prior to extension from the housing 5, and in this condition the first wall 12 and second wall 13 are juxtaposed. At the end of the member 3 the walls 12,13 are separated from one another, and pass through the central bore 26 of a cylindrical disc 27 which disc 27 comprises end flanges 28 defining a first diameter and relative thereto a central body part 29 defining a second, smaller diameter. The central body part 29 includes two opposing through-apertures 30 which communicate with the interior of the bore 26. From the point of separation of the walls 12,13 the first wall 12 attaches by its inherent resilience to one flange 28 of the disc 27 terminating before the aperture 30. The second wall 13 attaches in the same manner to the other flange 28, again terminating before the apertures 30. The disc 27 seats in a bore 31 of the outlet 9 dimensioned to receive the flanges 28 as a snug fit. The bore 31 has an internal shoulder 34, and a seal 35. The outlet 9 is attached to the housing 5 via screw holes 32, with an 'O'-ring 33 provided to ensure a fluid-tight fit. Thus, with the housing 5, the outlet 9 defines a cavity in which the disc 27 is securely maintained and which keeps the walls 12,13 second to the flanges 28. An aperture 36 in the outlet 9 is in fluid communication with inlet 16 (Figure 3) which thus feeds into bore 14 of the member 3.

[0021] It will be noted that a support sleeve 36 is disposed within bore 26 which helps prevent collapse of the member 3 when pressurised.

[0022] Referring to Figure 6b, the member 3 is shown partially everted. From this it can be seen that on eversion, the walls 12,13 are juxtaposed, the first wall 12 defining the conduit 4 for fluid flow in the extended condition.

[0023] Referring to Figures 3 and 9, there is illustrated a coupling pipe 21 for use with the above described apparatus. The coupling pipe 21 has at one end a fitting dimensioned to co-operate with the outlet 9 to fix the pipe 21 to the chamber 5. The other end of the pipe is adapted to be attachable to a correspondingly shaped and dimensioned part of a hydrant 22 as shown in Figure 2. The pipe 21 defines a path into the hydrant 22 for the extendible member 3.

[0024] In use, the extendible member 3 is stored within the chamber 5. It is coiled in the housing 5 about the rotatable connector 11. To remove sediment from pipes in a water distribution system the apparatus 1 is placed adjacent to an entry point to the system such as hydrant 22. The coupling pipe 21 is attached to the outlet 9 and to a spur 23 of the hydrant 22 which is above the valve 24 of the hydrant thus, at this point water cannot flow from the water distribution system into the apparatus.

[0025] Application of fluid such as water or air from a pump or compressed gas cylinder to the first fluid inlet 15 by opening valve 19 causes the interior of the housing 5 to become pressurised. When the pressure in housing 5 has risen to equal roughly the pressure in the water main, the valve 24 of the hydrant 22 is opened.

The pressure thus prevents water from the main entering the pipe 21. As the pressure increases, it begins to push the extendible member 3 out of the outlet 9. It will be recalled that the end of the extendible member 3 adjacent the outlet 9 is fixed, and therefore the member 3 rolls out of the outlet turning inside out as it goes and forming the conduit 4. This process is illustrated schematically in Figures 7 and 8 wherein the member 3 is shown with a single wall for clarity. The member 3 passes along the coupling pipe 21 and down to the spur 23 of the hydrant 22.

[0026] Continued application of fluid pressure to the interior of the housing 5 via the inlet 15 causes further eversion of the member 3 which passes down into the hydrant, aided by its flexibility. Referring to Figure 2, when the member 3 reaches the junction 25 of the pipes the flow of the water towards the junction and into the part of the pipe marked "X" guides the end in the correct direction, again aided by its flexibility. A counter may be provided in the housing 5 to record the length of extendible member 3 which has been everted. As the approximate distance from the point of entry to the system to the pipe to be investigated/treated is known from a knowledge of the system, this provides a convenient guide to determine when the member 3 has reached the correct area. If desired it is possible to form the member 3 such that it is biased towards travelling in a particular direction when it reaches a junction. The member 3 can be formed with a part of the wall stiffer or thicker, or even shorter, or could be manufactured to be curved. Once the end of the member 3 has reached the desired area "X", to begin cleaning, fluid pressure such as for example air pressure is applied to the bores 14 via inlet 16 and valve 19. Due to the flexibility of the material the bores 14 expand to the position illustrated in Figure 6, which makes the member 3 relatively rigid and allows water to pass more easily up the conduit 4. Then valve 18 on housing 5 is opened permitting water from the system to flow into the conduit 4 to be drawn off via fluid outlet 17 and valve 18. Figure 6 illustrates the member 3 in its everted form, from which it will be noted that the first wall 12 and second wall 13 are now juxtaposed from Figure 4. In order to assist in this, the wall which forms the outer wall when the member 3 is in the housing may be made more flexible such that upon inversion when it becomes the inner wall there is some slack.

[0027] Sediment removal begins as soon as an appreciable flow through the conduit 4 and out of the outlet 17 has begun. The sediment which has accumulated in the pipe 2c containing the relatively quiescent water is disturbed by the faster water flow and water containing entrained sediment is drawn off from the system up conduit 4 and is thereby prevented from contaminating water in the system.

[0028] When sufficient water has been withdrawn the valve 17 is closed and valve 15 is opened. The fluid pressure is maintained equal to the pressure in the pipe and the extendible member is withdrawn by turning the

rotatable drum 8. The fluid which earlier entered the drum 5 and the bore 14 is allowed its escape via inlets 15 and 16 respectively, at a rate commensurate with the rate of withdrawal of the extendible member 3.

[0029] When the whole of the member 3 has been wound onto the drum, the valves 24, 15 and 16 are closed and the coupling 21 is removed.

10 Claims

1. Sediment removal apparatus, for removal of sediment from pipes in water distribution system, comprising an elongate extendible member adapted to extend under fluid pressure through bends and direction changes in pipework, the member defining a conduit for fluid flow.
2. Apparatus according to claim 1, the member comprising a flexible material.
3. Apparatus according to claim 2, the member being adapted to be made relatively rigid.
4. Apparatus according to claim 3, the member including a plurality of elongate longitudinally extending bores capable of being pressurised to impart rigidity.
5. Apparatus according to claim 4, the bores extending substantially the entire length of the member.
6. Apparatus according to claim 4, the bores extending for approximately one half of the length of the member.
7. Apparatus according to any of claims 2 to 6, wherein the material has, or is adapted to have a self-friction coefficient of < 0.3 .
8. Apparatus according to any of claims 2 to 7, wherein the material is capable of withstanding a differential pressure of > 1 bar.
9. Apparatus according to any preceding claim, comprising a housing for storage of the member, the member being extendible from the housing by eversion of the member under fluid pressure.
10. Apparatus according to claim 9, wherein the conduit is formed by eversion of the member from the housing.
11. Apparatus according to claim 10, the member comprising an outer wall and, an inner wall, the walls defining the bores, the inner wall becoming the outer wall, and the outer wall defining the conduit on eversion of the member.

12. Apparatus according to any of claims 9 to 11, the housing including rotatable means for retrieval of the member.
13. Apparatus according to any of claims 9 to 12, the housing having means to attach a pump to increase the differential pressure between the system and atmosphere. 5
14. A method for removing sediment from pipes in a water distribution system, comprising extending an elongate extendible member adapted to extend under fluid pressure through bends and direction changes in pipework into the system, the member defining a conduit for fluid flow, and drawing off sediment containing fluid through the conduit. 10 15
15. A method according to claim 14, including the step of making the member relatively rigid when it has reached the desired position. 20
16. A method according to claim 15, including the step of making the member relatively rigid by applying fluid pressure to it. 25
17. A method according to any of claims 14 to 16, including the step of extending the member by eversion under fluid pressure from a housing.

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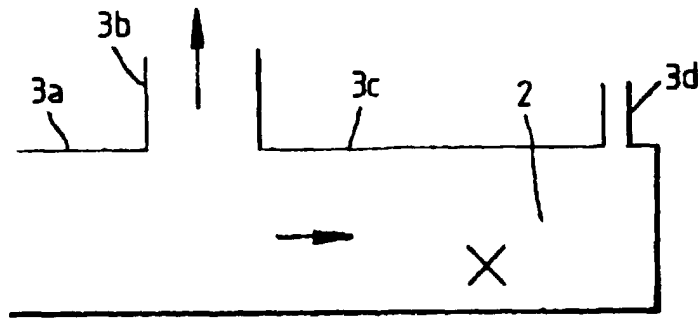


Fig. 1

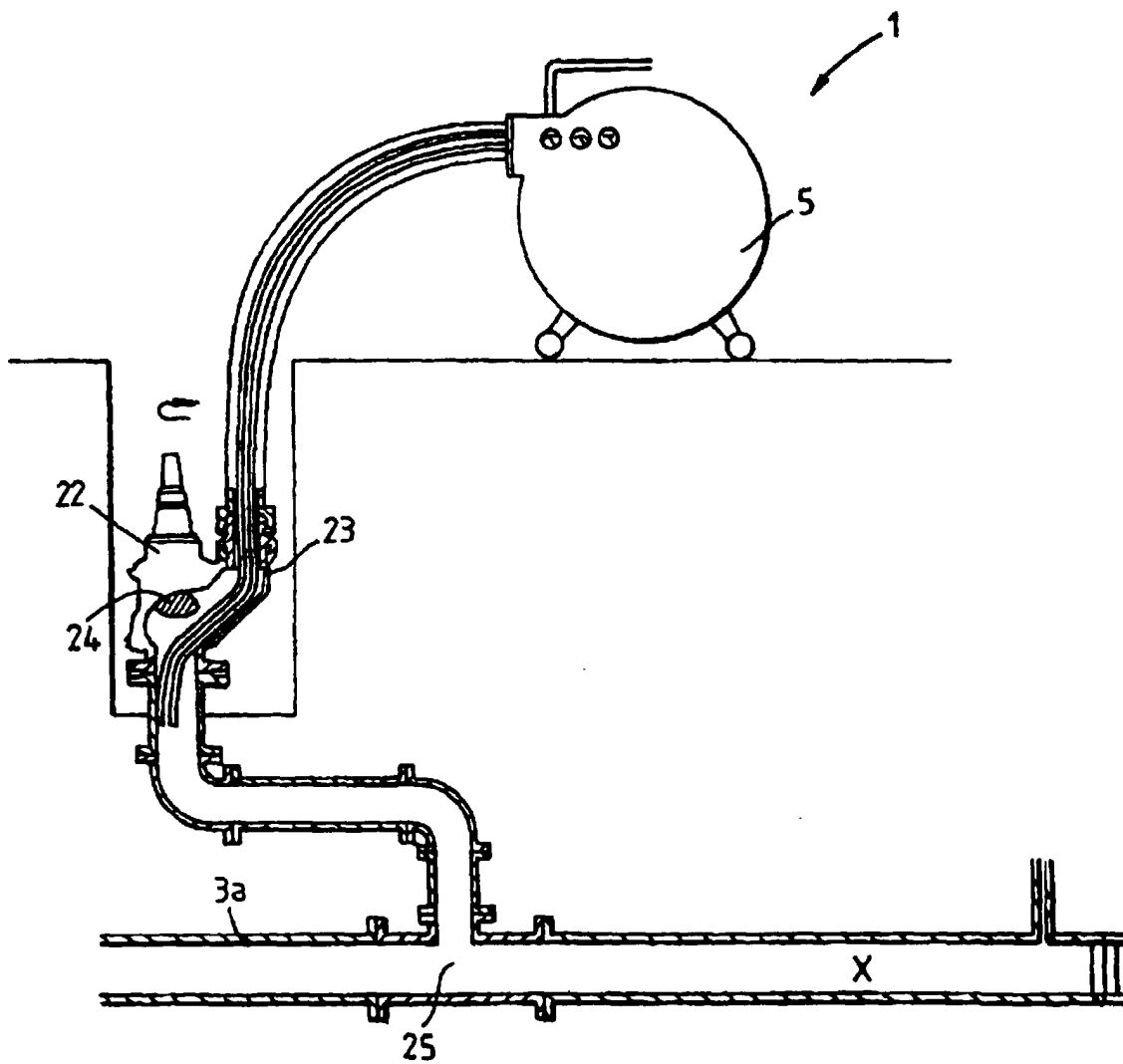


Fig. 2

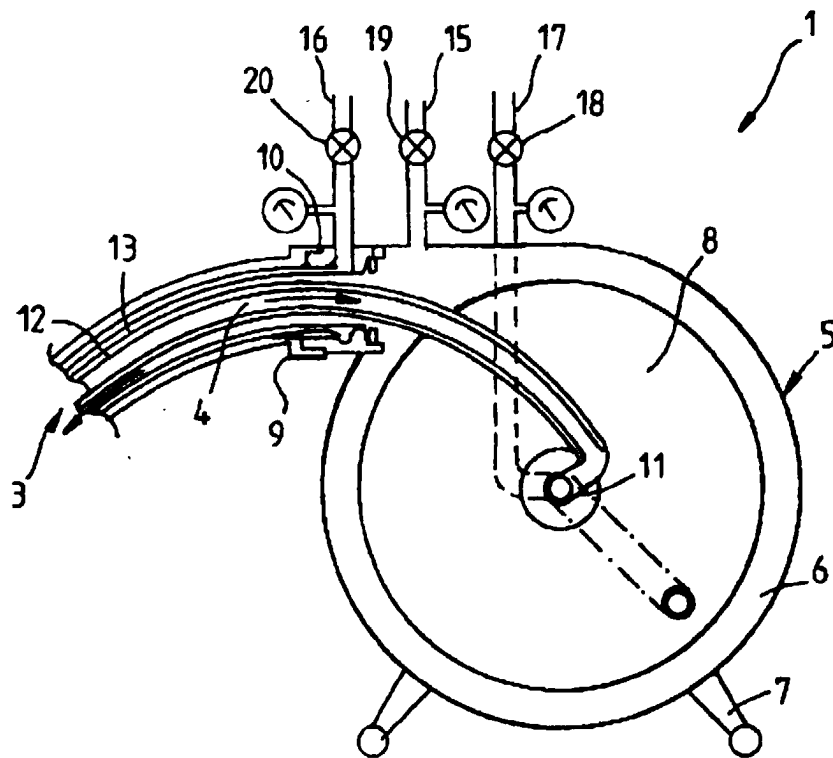


Fig. 3

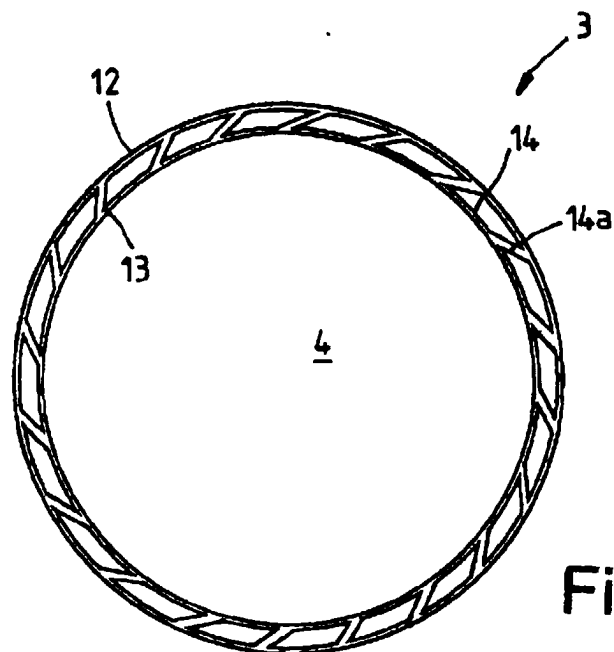


Fig. 4



Fig. 5

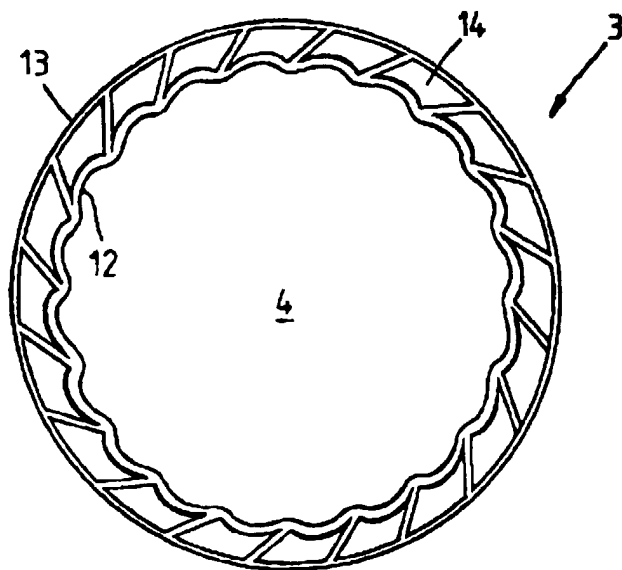


Fig. 6

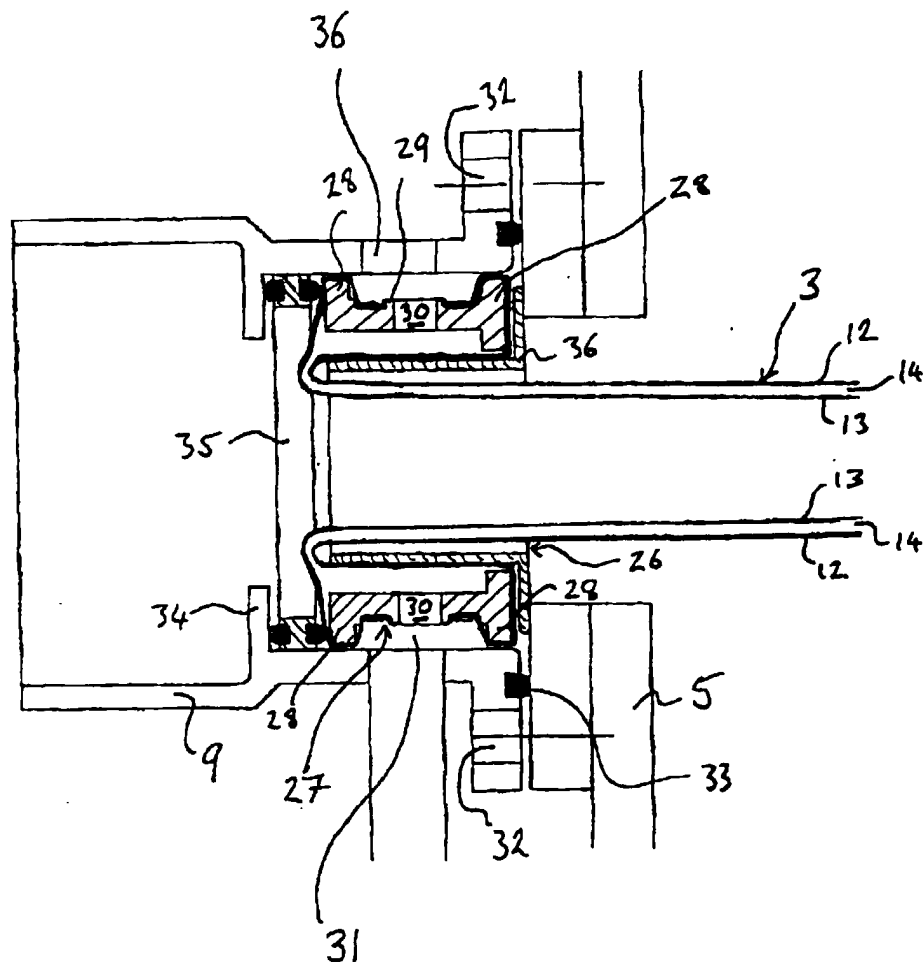


Fig 6a

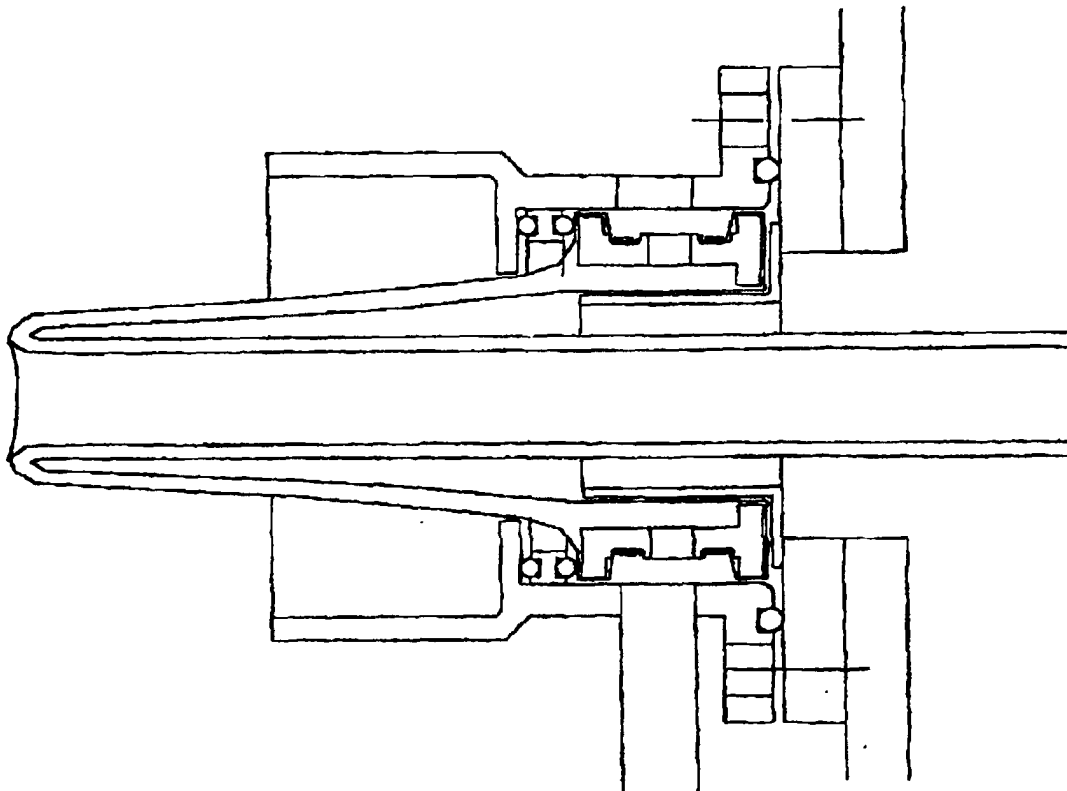


Fig 6b

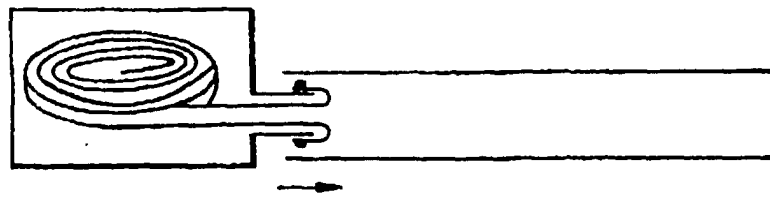


Fig. 7



Fig. 8

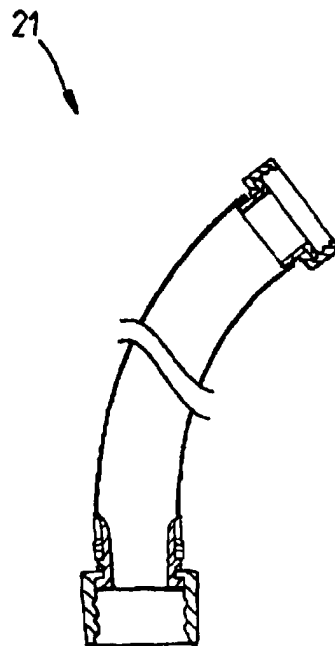


Fig. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 00 30 3347

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Place of search THE HAGUE		Date of completion of the search 1 August 2000	Examiner Vijverman, W
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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