(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 September 2012 (13.09.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/120317 A2

(51) International Patent Classification:
A01G 25/02 (2006.01) *F16L 47/34* (2006.01)

(21) International Application Number: PCT/GR2012/000013

(22) International Filing Date: 12 March 2012 (12.03.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
20110100149 10 March 2011 (10.03.2011) GR

(72) Inventor; and
(71) Applicant : DERMITZAKIS, Emmanuil [GR/GR]; 34 Ethnikis Aminis Str., 15669 Papagos, Attikis (GR).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: DERMITZAKIS, Aristeidis [GR/GR]; 34 Ethinikis Aminis Str., 15669 Papagos, Attikis (GR).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

(54) **Title**: LATERAL UNION BASE FOR RECEIVING WATER FROM AN IRRIGATION PIPE

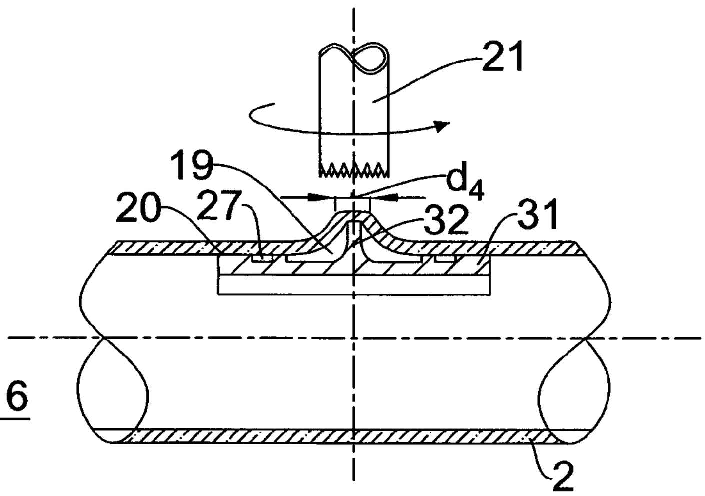

Fig. 16

(57) **Abstract**: A lateral union base (31, 17) for receiving water from a lateral irrigation pipe (2), which is employed for the connection and supply of distributors (3, 4). It consists of a curved surface (20) of very limited dimensions with an elevated protrusion (d4) preferably in the form of a tip (32) with a closed or open bottom. The bases (31, 17) are incorporated in the interior of the lateral irrigation pipe (2) at predefined distances by the method of simple extrusion during manufacturing of the pipe (2) and are covered by the pipe (2) which is swollen and protrudes locally at the welding areas. For the connection of the distributors (3, 4) which have a coupling nipple portion of respective form, a hole is opened on the pipe (2) at the area of the local swelling (d4). The distributor (3, 4) with its respective end (14,15) is inserted by applying radial pressure and is fixed in the interior of the socket (19) of the base (31, 17).

WO 2012/120317 A2

LATERAL UNION BASE FOR RECEIVING WATER FROM AN IRRIGATION PIPE

The present invention relates to lateral union bases or components for lateral water reception having small dimensions, which are inserted and welded in the interior of an irrigation pipe during manufacturing the latter.

State of the art

The modern irrigation systems consist of: a) a main or primary water supply network, b) secondary or lateral distribution pipes, and c) the distributors, i.e. emitters (online and inline), micro-pipes and micro-sprinklers for the final distribution of water to the roots of the plants and trees.

As main or primary pipes, plastic pipes are typically employed, such as for example a) flexible (PVC) pipes which are flattened when empty ("hoses" or lay-flat pipes), or b) flexible, harder (PE) pipes, which retain their profile even when they are empty.

The secondary or lateral irrigation pipes are typically flexible plastic pipes which exhibit a relatively small diameter and a significant wall thickness, and are so hard that they retain their profile even when empty. These secondary pipes are typically manufactured from polyethylene (PE) by simple extrusion, are supplied from the primary pipes and are connected to the primary pipes by means of suitable fittings (saddles or unions) which may be incorporated or not (WO 2005/084418). The secondary pipes are arranged perpendicularly to the primary ones, and extend over long and dense lines along the rows of trees and plants (one or two lines per row) and bear the final water distributors.

It is evident that due to the large number of lines and their huge total length the secondary pipes constitute along with the distributors (emitters, micro-sprinklers, micro-pipes) the major contributors in the cost of an irrigation installation.

The most significant parameters affecting the cost and the efficiency of a secondary pipe are two: a) the weight (wall thickness), b) the securing of the connection of the distributors thereto.

For their attachment and supply with water, the distributors typically have a coupling nipple portion with a cylindrical member and a swollen conical end. The connection of the distributors to the secondary or lateral pipes is performed: a) directly, via simple holes opened on the walls of the pipes by a cylindrically-cutting drilling tool, or by simple drilling with the hard and sharp end of the distributor/emitter (US 2009/0243146), or b) indirectly by interposing independent intermediate micro-unions (nipples) which are also directly connected to holes of the secondary lateral pipes, and micro-pipes of small length.

In order to have a direct connection, a minimum wall thickness is required, being not less than 1.8-2.0 mm due to the significant radial pressure needed in order to avoid a disassembling. The plastic pipe must initially be drilled with a cylindrically-cutting tool in order to create a hole through which the conical end of the coupling nipple portion of the distributor will be inserted by applying significant radial pressure, thereby instantly and locally widening the hole. The edges of the hole are bent inwards and remain constantly deformed and under significant stress in the form of a conical crater, tightly surrounding the cylindrical member of the coupling nipple portion of the distributor.

It is clear that if the pipe does not have a specific wall thickness, it will not retain a stable cylindrical shape and will present a poor resistance to deformation, and the connection of a distributor will be impossible due to the significant radial pressure needed to be exert around the cylindrical member of the coupling nipple portion. Another important problem is due to the shape of the hole opened on the cylindrical surface of a simple secondary pipe by a cylindrically cutting tool. The configuration of the hole due to the perpendicular cutting/drilling of the cylinder (pipe) by a cylinder (tool) has in fact an elliptical shape, the large axis thereof extending peripherally while the smaller, perpendicular one extending along the axis of the pipe. As a result, the forces that develop during tightening of the edges around the cylindrical member of the distributors will be necessarily inhomogeneous and the expected sealing and connection will be uncontrolled and problematic.

Additionally, there is danger of disconnection of the distributors during withdrawal and winding of the secondary pipe at the end of the irrigation period, when the pipe must be removed from the field by mechanical means (e.g. by means of an agricultural tractor), weeds and plants having selectively grown around the plurality of distributors, thereby increasing the resistances and the required pulling force.

However, a significant disadvantage is still the weight and cost of the secondary pipe, which must have a specific thickness despite the fact that the quality and composition of the modern plastic materials ensure that the pipe will show strength even when the wall thickness is less than the half of that required (e.g. 0.8 instead of 1.8-2.0 mm). It should be noted that in all known technologies of the state of the art and with all the types of plastic material that may be employed and satisfy the imposed restrictions is employed, a wall thickness of ca. 1.8-2.0 mm is still required, so that the pipe is strong to hydraulic pressures exceeding 16-20 bar, whereas for the operation of the irrigation system 1.5 to 2.5 bar would suffice. In other words, the thickness could potentially be reduced to 0.5-0.8 mm, which however would not be able to hold distributor's coupling nipple portions.

The method described in WO 2005/084418 with incorporated bases for lateral unions bases relates to connections of secondary pipes to special primary conduits/pipes which have a flattened form when empty ("hoses" or lay-flat pipes with fabric reinforcement, etc.) and clearly refers to union bases of large dimensions connecting normal pipes and not for connecting the final distributors (e.g. emitter, micro-sprinklers and micro-pipes). It should be noted that this technology, as extensively described, does not regard simple common small-diameter (Ø12mm-Ø20mm) PE (polyethylene) pipes, which are manufactured by simple extrusion, but regards incorporation in large-diameter primary conduits/pipes having extremely thin walls and exhibiting a flattened form (lay-flat) and a multi-layered structure, and exclusively for connecting secondary pipes to primary ones, wherein voluminous union bases are required. It is otherwise known that the simple plastic pipes (which are manufactured by simple extrusion), if employed as primary ones, will have a significantly large wall thickness (over 2 mm) already at the very small orders of diameter, which make the additional internal incorporation of union bases, in order to connect simple water distributors, unnecessary. The wall thickness of the primary pipe by itself would suffice for the specific mechanical support of the distributors.

The same technology of WO 2005/084418 relates to a version of internal incorporation of union bases by the method of US 5,324,371. The latter regards a method for manufacturing smooth and relatively hard pipes by simple monolayered extrusion from polyethylene, LDPE (which have no association with the flattened, lay-flat ones which are typically manufactured by soft PVC with fabric reinforcement), and wherein the bases of the unions could potentially be incorporated in the interior of the smooth pipe. However, the bases which could potentially be incorporated cannot have elevated parts, since this method employs a cylindrical constant configuring mechanism (calibrator) which produces a pipe that is absolutely cylindrical and externally smooth. The bases would be necessarily covered by the wall of the absolutely cylindrical surface of the pipe that is produced by the specific method. Under these requirements, the external detection of the bases, which is a requirement in order to drill the wall by a cutting tool for the insertion and support of the coupling nipple portions of the distributors, would be impossible. It is clear that the detection and drilling of such a large number of bases (the same as the distributors to be connected) must be performed rapidly and with absolute accuracy in order to reveal the hole of the union base precisely, which is impossible in the case of an externally fully cylindrical (without any protrusion) and smooth pipe. Neither a base having a cylindrical cavity socket, nor a base with an inner thread for connection-reception of the conical end of the adaptor/distributor could be incorporated, since the precise location of the position of the cavity or the thread is impossible. It is noted that types of union bases with prefabricated cylindrical cavities, or with an inner thread (which are excluded by the above method US 5,324,371), are clearly more advantageous since less material is removed and discharged during cutting-off of the cylindrical part of the pipe and perhaps of the base. It is also known that the secondary pipes obtained by the method of simple extrusion are fabricated by much harder materials (exclusively by polyethylene, LDPE, LLDPE, MDPE, HDPE), in contrast to soft and flattened ones (soft PVC lay-flat pipes with inner fabric reinforcement). This fact makes any attempt to detect the position of the internally welded base by local compression, or touching of the surface, impossible. The bases would not be recognizable even if the pipe was manufactured by soft PVC, without considering the fact that the pipe itself would not have mechanical strength if such materials were employed. It is noted that if again soft PVC with inner fabric reinforcement is employed, such as in lay-flat pipes, a) the method of US 5,324,371 regarding simple extrusion cannot be employed, and b) it is too strong to hydraulic pressure, much more expensive, and its use for a simple secondary small-diameter distribution pipe working at low operation pressures would not be beneficial. It is also known that the pipe is twisted during winding on a reel, and the position of the non-visible inner bases is not on the same line. Another disadvantage of the same method would be the increased hydraulic resistances of the pipe, since the base with all the support mechanism of the union (base, socket, inner thread etc.) will be necessarily in the constant circular cross-section of the pipe and will protrude wholly inwards, thereby drastically reducing the free cross-section area of water passage.

As regards the incorporation of the union base between the two layers in a bilayered pipe, the disadvantages are many: a) at least two production lines (two extruders) are required, which will double both the investment cost and the production phases, b) a reduction of the pipe strength against inner hydraulic pressure to at least the half. The latter will occur over a narrow peripheral strip around the incorporated base. On this disadvantageous strip the two layers, inner and outer, are on one hand swollen (inwards and outwards respectively) and thus thinner and on the other hand slightly separated one from the other by the thickness of the interposed base.

Specifically, they cannot touch and get welded one to the other around the base due to the significant thickness of the base itself, wherein the thickness cannot be nullified for manufacturing reasons, thus the layers must deal with -successively and separately, and not in combination and welded- the high inner water pressure at this area, so that the inner wall will be ruptured first without involvement of or support from the outer one, and then the outer wall will be ruptured, after the water has come in contact with it since it will have passed between them. The same applies if the base has already the hole-thread open, whereas the base itself is auxiliary (i.e. it will not be employed directly but it will be opened in a second stage), so that the two layers are fully separated one from the other, covering the open hole at the front side and at the back side, resulting to a similar additional degradation of the pipe’s strength at the area of the hole.

Brief description of the invention

The present invention relates to a base for supporting lateral unions/adaptors for fixing and supplying preferably distributors/emitters on a secondary/lateral pipe. It consists of a curved surface of very limited dimensions with elevated parts, e.g. an elevated cylindrical crater with a flat bottom. The bases are incorporated in the interior of the irrigation pipe during manufacturing of the pipes and are covered by the pipe, which is swollen locally and protrudes clearly at the areas of the elevated parts.

The union bases are inserted at predefined distances which are determined by the kind and distances of the plants-trees, the quality of the soil, the climate, the supply to the distributor (emitter or micro-sprinkler) to be connected laterally, etc. The union base is covered by the locally swollen pipe and is inserted as having a closed or open hole at the bottom. The secondary/lateral pipe after manufacturing is wound to reels/coils of large length and stored. The distributors (emitters, micro-sprinklers etc.) have a coupling nipple portion consisting of a thin cylindrical member and a sharp conical end, or a thread, etc., which corresponds to the respective sockets of the bases.

The secondary/lateral pipe during installation is transferred to the field, where it is connected to the primary one by means of saddles and unions, extended to lines of considerable length along and almost in contact with the rows of plantation, and then the distributors (online emitters, etc) are mounted. Before that, the wall of the secondary/lateral pipe, and perhaps of the base at the area of the elevation and of the inner crater, is drilled to create the connection holes if the crater of the basis is not already open. The drilling tool is preferably of the cylindrically cutting type with material removal, or of the simple drilling type.

The conical end of the coupling nipple portion of the distributor is inserted, instantly widening locally and successively the holes (one on the wall of the lateral pipe, and perhaps another one on the base) which have been opened. The edges of the holes are successively bent to the interior of the conduit-pipe and remain deformed and under stress in the form of a conical crater, tightly surrounding the cylindrical member of the coupling nipple portion of the distributor. If the edges of the holes of the union basis already have a regular conical configuration, the conical form is not under permanent and continuous stress.

The connection of the distributors is performed directly or indirectly by intermediate micro-unions (nipples) and micro-pipes.

In other variations, the union base has an inner thread or a slightly conical configuration (tapering bore) for distributors or intermediate micro-unions with a respective socket.

The precise position of the union base can be detected very easily, due to the considerable swelling of a part of the pipe around and on the elevations or the tips.

Description of the figures

Figure 1 shows a known typical arrangement of an irrigation installation with main pipes, lateral pipes, and distributors.

Figure 2 shows a detail of the known indirect connection of a micro-sprinkler of figure 1.

Figure 3 shows the known procedure for drilling the lateral pipe by direct fixation of the distributor.

Figure 4 shows a detail of the known direct connection of an online emitter on a lateral pipe of figure 1.

Figure 5 shows the cross-section 5-5 of the known direct connection of the online emitter of figure 3.

Figure 6 shows a plan view of the lateral pipe with the internally welded lateral union basis of the present invention.

Figure 7 shows the longitudinal cross-section A-A of the lateral pipe with the internally welded lateral union basis.

Figure 8 shows the cross-section B-B of the lateral pipe with the internally welded lateral union basis.

Figure 9, 9a show the plan view and a cross-section B_1-B_1 respectively of the lateral union base of the figures 6, 7, 8.

Figure 10 shows the drilling of the lateral pipe at the area of the elevation and of the inner crater.

Figures 11, 12 show in transverse and longitudinal cross-section respectively the insertion and fixation of the online emitters.

Figure 13 shows a variation with a union base having a thread at the crater.

Figure 14 shows a variation with a union base having a slightly conical configuration (tapering bore) at the crater.

Figure 15 shows a variation with a closed union base having a tip at the center of the cavity of the crater.

Figure 16 shows a cross-section C-C of the closed union base of figure 15.

Figure 17 shows a cross-section D-D of the closed union base of the figure 15.

Figure 18 shows a plan view of a lateral union base with a configured conical crater.

Figures 19, 20 show the cross-sections E-E and Z-Z respectively of the lateral union base of figure 18.

Figure 21 shows a lateral union base with an intermediate elastic ring having a peripheral inner incision.

Figure 22 shows a lateral-union base with an intermediate elastic ring having a U-shaped cross-section.

Figure 23 shows a detail of the intermediate elastic ring having a U-shaped cross-section of figure 22.

Figure 24 shows an indirect connection of a distributor to an intermediate micro-nipple and micro-pipe.

Detailed description of the invention

Figures 1, 2, 3, 4 depict a known typical arrangement of an irrigation installation with primary/main pipes 1, secondary/lateral pipes 2_1, distributors-emitters 3, distributors-micro sprinklers 4 with supports 5, micro-pipes 6, saddles 7, outer unions 8, micro-unions (nipples) 9, terminals 10 of the secondary/lateral pipes 2_1. Water from the primary/main plastic pipe 1 is supplied via the saddles 7 and the unions 8 to the perpendicular secondary/lateral pipe 2_1 which are arranged in lines along the rows of trees 11. The secondary/lateral pipes 2_1 have the distributors-emitters 3, or the distributors-micro sprinklers 4 with supports 5. Usually, one or more distributors per tree 11 are provided. The connection of the distributors 3 and 4 is effected either directly on the secondary/lateral pipe 2_1, or indirectly via micro-unions (nipples) 9 and micro-pipes 6. The emitters 3 are arranged on the secondary/lateral pipe 2_1 and are referred to as online emitters to be distinguished from the internally welded (inline) emitters.

Figures 3, 4, 5 show in cross-sections a detail of the known direct connection of an online emitter 3 to a secondary/lateral pipe 2_1 having a significant thickness t_1. The online emitter 3 has a connection/supply coupling nipple portion with conical end 14, a cylindrical member 15 having a diameter d, and a water outlet 16. By the drilling tool 21, a hole 13 having a diameter d_p ($d_p<d$) is opened on the secondary/lateral pipe 2_1 and the coupling nipple portion of the emitter 3 is inserted in the hole 13, thereby widening it locally and instantly by the application of considerable radial pressure by the emitter. The edges of the hole are bent towards the interior of the pipe and remain deformed and under stress, thereby configuring a conical crater and tightly surrounding the cylindrical member 15 of the coupling nipple portion and thus sealing it.

Figures 6, 7, 8 show a lateral union base 17 of the present invention internally welded on a secondary/lateral pipe 2 that has a thickness t_2 much smaller than the respective thickness t_1 of the pipe 2_1 of the known technologies of the state of the art. It applies $t_1 >> t_2$.

Figures 9, 9a show a plan view and a cross-section B_1-B_1 respectively of a lateral union base 17 of figures 6, 7, 8, without the pipe. The union base 17 consists of a convex surface 20 having at its center an elevated crater 18 of a diameter d_2 with a cylindrical closed cavity 19 of a diameter d_1 at its center. The union base

17 is introduced and welded with its convex surface 20 in the interior of the secondary/lateral pipe 2, which covers it completely, the elevated crater 18 protruding along with a part of the pipe wall above the cylindrical surface of the secondary/lateral pipe 2. The pipe is locally swollen at the area of the crater 18, becomes thinner around the crater, the total protrusion maintaining an outer diameter d_3 and an elevation h. The insertion and incorporation of the union base 17 in the interior of the plastic pipe 2 is effected during manufacturing of the pipe by special various methods (e.g. EP 1 541 014 A1, or WO 92/05689, or PCT/GR/2011/000039) suitable for incorporating rough and elevated insert components (e.g. inline emitters, etc) having parts clearly protruding to the outside also after the manufacturing of the pipe.

It is obvious that the smaller the diameter of the elevation, the easier, simpler, safer and faster the incorporation of the union bases. The insertion of the union bases is effected at specific and predetermined distances which are determined by the kind and distances of the plants-trees 11, the quality of the soil, the weather conditions, the supply to the distributor (emitter or micro sprinkler) to be laterally connected, etc. The union base 17 is in the present case closed. The lateral pipe 2 after manufacturing is wound on reels/coils of considerable length and stored. The large number of bases and thus of the local swellings of diameter d_3, which may reach up to five bases per meter of pipe, does not affect winding, since the total height of the elevation h is minimal (only 2.0-3.0 mm) and the surface of the pipe remains smooth enough and relatively even.

During installation, the pipe 2 is transferred to the field where it is connected to the main pipe 1 via saddles, screw unions or any other type of unions and adaptors 8, extended in lines of significant length along and almost in contact with the plantation rows, and then the online emitters 3 are mounted. Figure 10 depicts the drilling of the wall at the area of the elevation 18 and the crater 19 with a drilling tool 21, preferably of cylindrically-cutting type, to create the connection holes. The drilling tool 21 opens in this case two cylindrical holes successively, the hole 22 on the swollen wall, and a hole 23 on the union base 17 and in particular at the center of the closed bottom of the crater 19. The holes have a diameter d_p ($d_p<d$). The precise position of the union base 17 is easily detectable, due to the elevated crater 18 which creates around it a swollen part of pipe of diameter d_3 with the elevation h, which is more evident in the cross-section of the pipe 2.

Figures 11, 12 show the insertion and final fixation of the online emitters 3 by the application of pressure on the emitter 3. The pressure is applied radially on the pipe 2, and the conical end 14 of the coupling nipple portion of the emitter 3 is inserted, thereby widening locally, instantly and successively the holes 22 and 23. The edges of the holes are bent successively towards the interior of the pipe and remain deformed and under stress in the form of two superimposed and cooperating conical craters, tightly surrounding the cylindrical member 15 of the coupling nipple portion.

Figure 13 shows a variation with a union base 25 which has an inner thread for distributors or intermediate micro-unions (nipples) with a respective male thread.

Figure 14 shows a variation with a union base 26 which has a slightly conical form (tapering bore) for distributors or intermediate micro-unions (nipples) with a respective male conical form.

In variations where the base 17 of the union is not closed during insertion in the pipe, but already has an opening on the bottom of the cylindrical cavity 19, drilling of the base 17 in order to insert the distributor etc is not required, but only drilling of the swollen wall. The superimposed and cooperating respective conical craters are again formed during connection.

Figures 15, 16, 17 show in plan view and in cross-sections a lateral base 31 which is inserted as closed in the pipe 2 and has at the center of the bottom of the cavity 19 an elevated tip 32. The local swelling of the wall of the pipe is effected only around the tip 32 and thus in a very limited scale. The diameter d_4 of the swelling is very small in relation to the previous variations of the simple craters ($d_4 \ll d_3$) and the incorporation of the base by the known methods for distributors with elevated parts is even simpler. The drilling and removal of the elevated wall and of the part of the bottom along with the tip, is again effected preferably with a cylindrically-cutting tool 21, where the tip also aligns the tool during cutting. The precise position of the union base 31 can be detected very easily.

Figures 18, 19, 20 show a variation of a lateral union base 33, where the crater 34 has conical edges 35 and a flat bottom. The base may be introduced as having the hole 36 either open or closed. The advantage of this variation is that the inner diameter d of the hole 36 is almost equal to the diameter d of the cylindrical member 15 of the distributor 3, and thus no permanent stress is developed between the member and the conical edges 35 of the crater 34. The diameter d is considerably larger than the diameter d_p opened on the bottoms of the craters 19 or on the pipe 2_1 (d_p<d). The stress, which would create the sealing, is automatically generated when water flows in the pipe, since the conical edges 35 are pressed outwards, tightening the member 15 and sealing the connection. This variation does not stress the materials permanently (material fatigue, aging, cracks) and the conical edges 35 may become even thinner. The pipe 2 is depicted in the figures with a dashed line.

Figure 21 shows a lateral-union base 37 with an intermediate elastic ring 38 for connecting the micro-unions nipples 9, or distributors 3. The base 37 does not have a crater.

Figure 22, 23 show a lateral union base 39 with an intermediate elastic ring 40 having a U-shaped cross-section for connecting end tubes 9, or distributors 3. The base 39 does not have a crater. Figure 23 shows a detail of the ring 40 which is swollen when exposed to pressure from water flowing in the conduit.

Figure 24 shows an indirect connection of a distributor via an intermediate micro-union (nipple) 9 and micro-pipe 6. The micro-union 9 has the same type of the coupling nipple portion as the distributors, is connected as it is known to the incorporated union base 17 of the pipe 2, and via the short micro-pipe 6 indirectly connects and supplies the distributor 3 which is fixed at the other end of the micro-pipe 6.

The curved surface 20 of the union bases has shallow channels 27, preferably in front of and behind the protrusions 32 or 18, in order to ensure a better adhesion and welding on the interior of the pipe 2.

In another variation, the union bases may be incorporated in primary/main thin-walled conduits (lay-flat pipes) reinforced with fabric layers.

The differences and advantages in relation to the state of the art, where the distributor, or the intermediate micro-unions (nipples) are mounted directly by opening a simple hole 13 on the wall of the secondary conduit, are significant:

The surfaces of the elevation 24 and of the bottom of the crater 19 are flat and thus: a) the holes 22 and 23 and the edges of the holes are circular, b) the emitter is supported on a flat surface both ensure an optimal and controlled mounting/assembling.

The inner cones of the edges of the holes 22 and 23 are supported strongly and peripherally: a) by the strong crater 18 and the whole body of the union base 17, b) by the wall that is welded on the surface 20 of the base 17 and the local swelling of the pipe 2, which do not withdraw in time (material fatigue, aging, cracks) which weakens the mounting/assembling.

The base may also comprise a shallow cylindrical cavity 29 in the hollow inner surface 30 which covers and supports the conical end 14, ensuring a secure mounting.

The member 15 is preferably supported by two edge cones 22 and 23, thus the member is supported on two peripheral surfaces spaced apart between them and cooperating and supporting one another, ensuring higher strength to bending stress or disassembling stresses.

The union base 17, 31 is manufactured by the injection method, and its material is typically selected harder and stronger, e.g. hard, high density (HDPE) than: a) soft (LDPE), or b) linear (LLDPE) or c) medium-density polyethylene (MDPE), which are typically the materials used for manufacturing the flexible secondary/lateral pipe 2, which is manufactured exclusively by the method of simple extrusion. Thus, even the base 17, 31 which has a minimal weight, may become even thinner and thus lighter. In contrast, the pipe 2_1 of the known technologies must have a specific wall thickness, be flexible but not soft, and have the ability to retain its cylindrical form even when it is empty, in order that the opposite inner wall of the pipe is protected from being drilled by the sharp conical end 14 of the distributor which protrudes in the interior of the pipe. The stress and destruction is possible during the mechanical pulling and winding for storing the pipe on reels at the end of the irrigation period. The phase of mechanical pulling and winding in the field is also dangerous to cause disassembling of the distributors.

It is noted that the values per unit of weight of the various densities of the plastic materials (LDPE, LLDPE, MDPE), do not differ between them whereas in some cases the soft materials (LDPE) may be more expensive, and thus a reduction in the wall thickness of the pipe from 2.0 mm (t_1 , pipe 2_1) to 0.8 mm (t_2 , pipe 2), and at the same time the use of hard materials for the base 17,31 of the unions, will cause a linear reduction in the cost of the secondary/lateral pipe 2 without affecting the strength to hydraulic pressure or the securing of the connection and mounting/assembling. On the other hand, the weight added by the base 17,31 on the pipe is minimal, does not affect its cost, and thus a reduction in the wall thickness from t_1 to t_2 ($t_1 \gg t_2$) constitutes a significant cost advantage of the new pipe.

The reason for the elevation of the union bases and associated components and the swelling caused by them on the surface of the pipe, is not only the easy and precise recognition of their position, but also the significant reduction in the hydraulic resistances in the interior of the secondary pipe 2 which are caused by the considerable penetration of the conical ends 14 of the distributors 3 along with the considerable conical bending of the edges of the hole towards the interior of the pipe 2_1, which is observed in the connections of the state of the art and which reduces the free cross-section of the pipe considerably.

The elevation of the crater 18 along with the selection of harder and stronger materials for injection/production of the bases: a) ensures a reliable mounting/assembling even on a narrower peripheral strip on the surface of the cylindrical member 15, and b) the major part of the connection is out of the lateral pipe 2, thereby increasing the free surface of the circular cross-section of the pipe. The latter constitutes also the additional advantage against the base incorporation technologies according to the method of US 5,324,371, wherein the whole connection is transferred in the interior of the constant circular cross-section of the conduit, thereby drastically reducing the free cross-section for water and increasing the hydraulic resistances of the conduit.

Variations are also possible by combining the above elements. In another variation, two sockets (craters) may be provided in a row on the same connection base (not shown).It is obvious that corresponding union bases may also be produced for the connection of secondary/lateral pipes to primary flattened conduits wherein the conduit/pipe is swollen and covers the internally welded union, thereby reinforcing the connection.

The drilling and the opening of holes on the base may be also effected by pressing with a sharp tool without material removal. In another variation, the bottom of the crater of the base has bayonet-type sockets for easy connection-disconnection of the removable part of the adaptor (not shown).

In another variation, the secondary/lateral pipe with the internally welded bases pass through the cutting system which consists of a rotating cutting mechanism (e.g. fraise) arranged at the end of the production line, where the ends of the protrusions are automatically cut, thereby revealing the cylindrical cavities of the bases (not shown).

The union bases may be also be incorporated in secondary/lateral pipes formed by folding and longitudinal bonding of plastic tapes (not shown)

CLAIMS

1. Base for lateral unions of a low pressure secondary/lateral irrigation pipe (2) of small diameter and small thickness (t_2), for fixing and supplying distributors (3, 4, 9), consisting of a curved surface (20) of limited dimensions which has cavities/craters (19) for supporting the coupling nipple portion (14, 15) of distributors (3, 4, 9) and elevated protrusions (d_3), suitable to be inserted in, welded on and covered by the interior of the pipe (2) during manufacturing of the pipe (2) using a simple extrusion method without inner fabric or similar reinforcements, wherein the pipe (2) swells locally and covers the protrusions, wherein drilling and opening of a hole is then performed to reveal or create the cavities/craters (19) and support the distributors (3, 4, 9), characterized in that the elevated protrusion (d_4) of the base (31) has the form of a thin tip (32).
2. Base for lateral unions according to claims 1, wherein the diameter (d_4) of the swelling is smaller than the diameter (d) of the cylindrical member (15) of the coupling nipple portion or of the hole (36, 23).
3. Base for lateral unions according to claims 1,2 wherein the tips (32) are more than one.
4. Base for lateral unions according to claim 1,2,3 wherein the tip (32) is located at the center of the cavity/crater (19).
5. Base for lateral unions according to claims 1, 2, 3,4, wherein the bottom of the cavity (35) is flat.
6. Base for supporting lateral unions according to claims 1, 2, 3, 4,5 wherein the cylindrical member

(15) of the coupling nipple portion is supported both on the cones of the edges of the wall (22) of the pipe, and of the walls of the base (23).

7. Base for lateral unions according to claims 1, 2, 3, 4, 5, 6, wherein the base has a shallow cylindrical cavity (29) on the hollow inner surface (30).

8. Base for lateral unions according to claims 1, 2, 3, 4, 5, 6, 7 wherein the cavity (34) has conical edges (35).

9. Base for lateral unions according to claims 1 to 8, wherein the curved part (20) of the base (31) has shallow channels (27).

10. Base for lateral unions according to claims 1 to 9, wherein the bases are inserted as having a closed or open hole (36).

11. Base for lateral unions according to claims 1 to 10, wherein the bases (39) bear an intermediate elastic ring (40).

12. Base for lateral unions according to claims 1 to 11, wherein the ends of the protrusions are automatically cut in a cutting station.

13. Base for lateral unions according to claims 1 to 11, wherein the ends of the protrusions are cut by cylindrically-cutting drilling tool (21).

14. Base for lateral unions according to claims 1 to 13, wherein the bases (26) bear tapering bores.

15. Base for lateral unions according to claims 1 to 13, wherein the bases (25) bear inner treads.

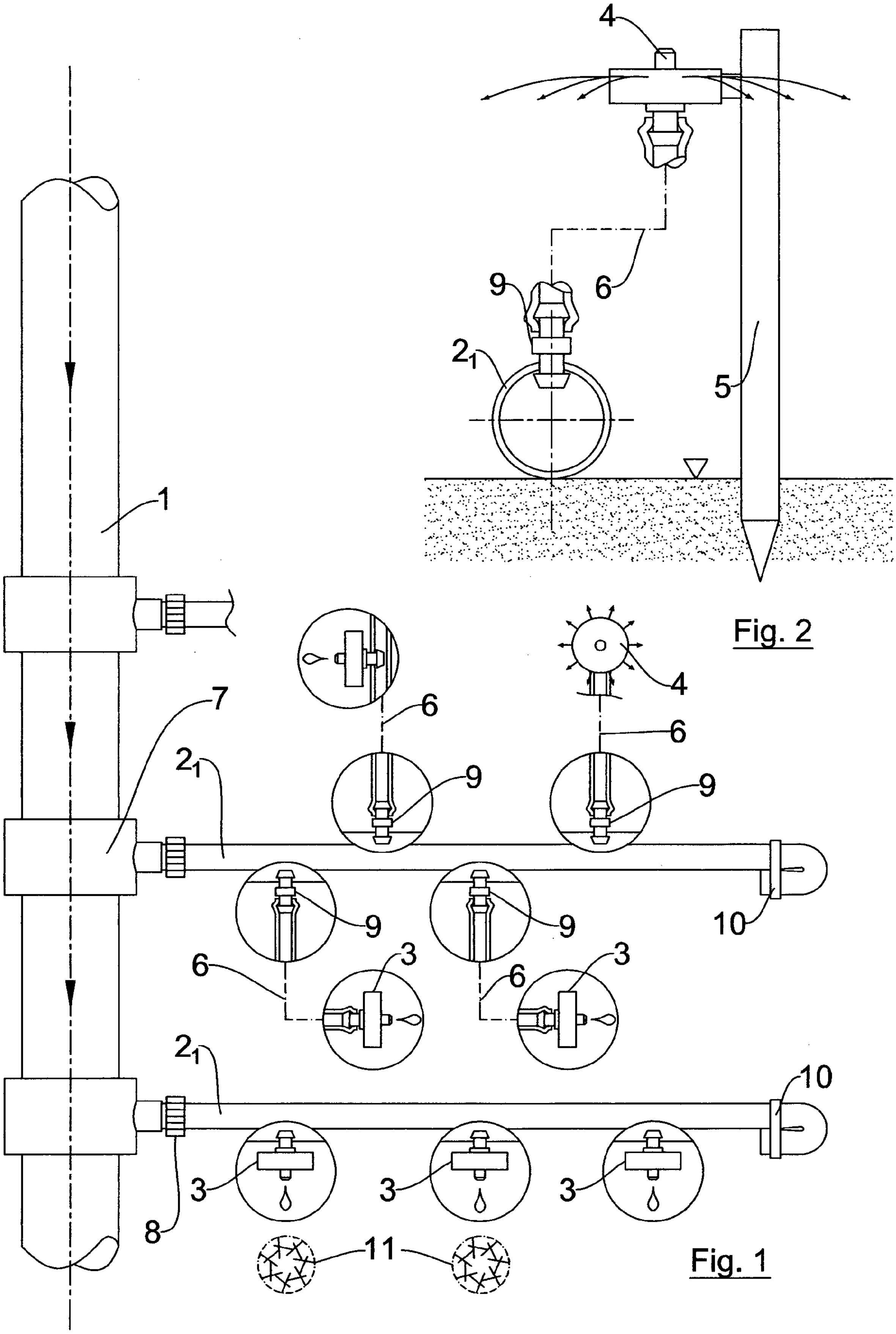

Fig. 1

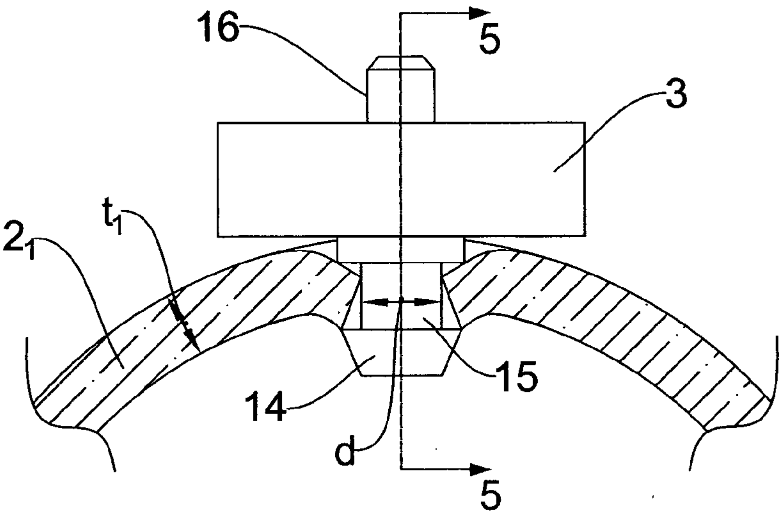

Fig. 4

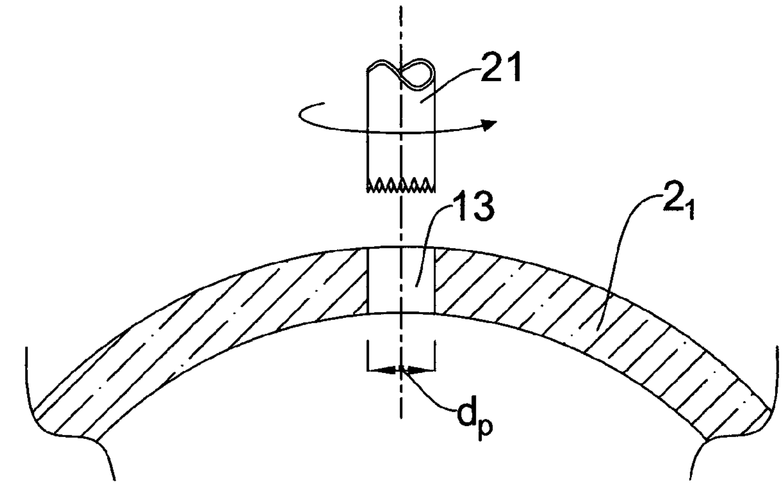

Fig. 3

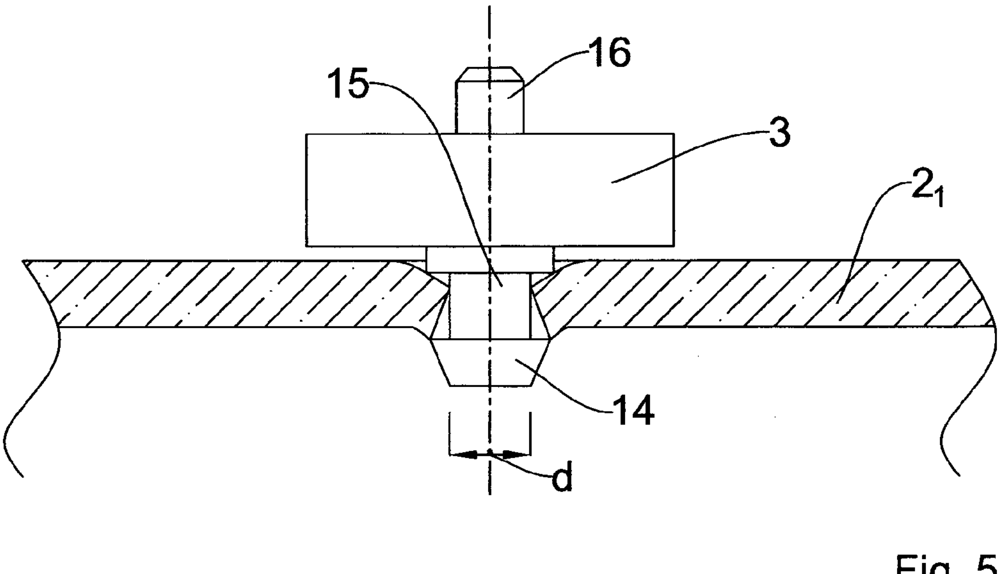

Fig. 5

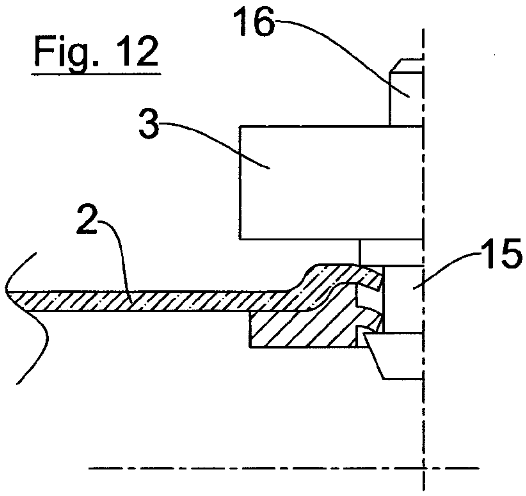

Fig. 12

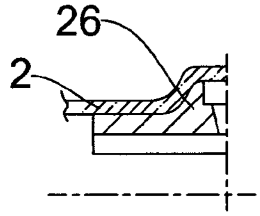

Fig. 14

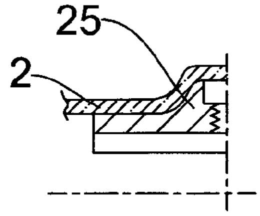

Fig. 13

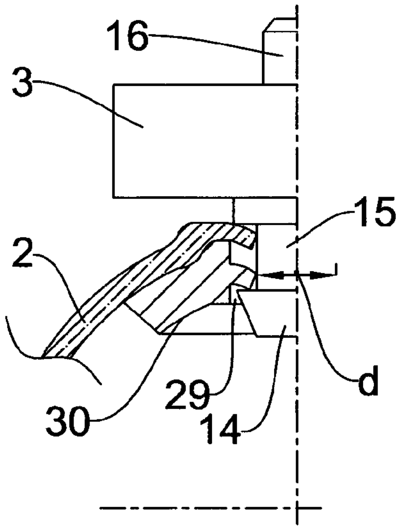

Fig. 11

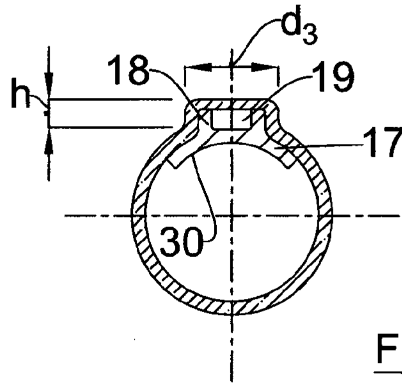

Fig. 8

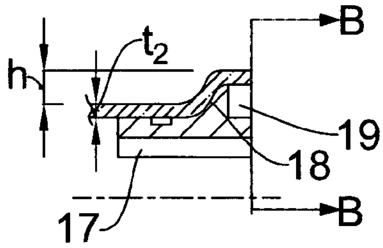

Fig. 7

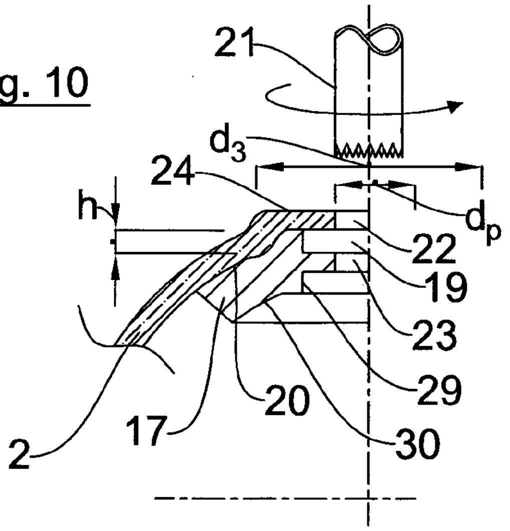

Fig. 10

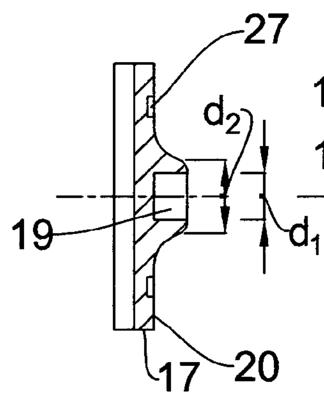

Fig. 9a

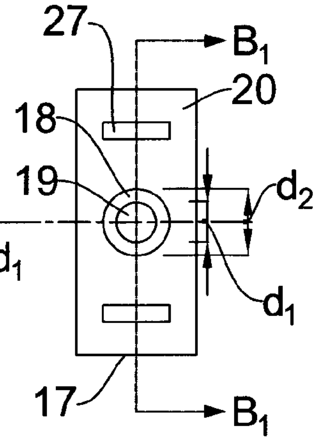

Fig. 9

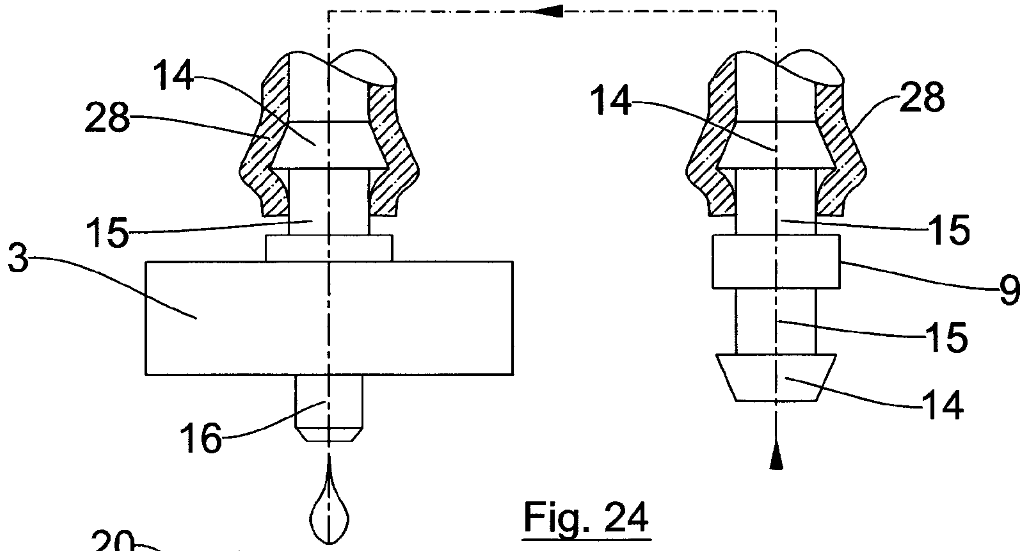

Fig. 24

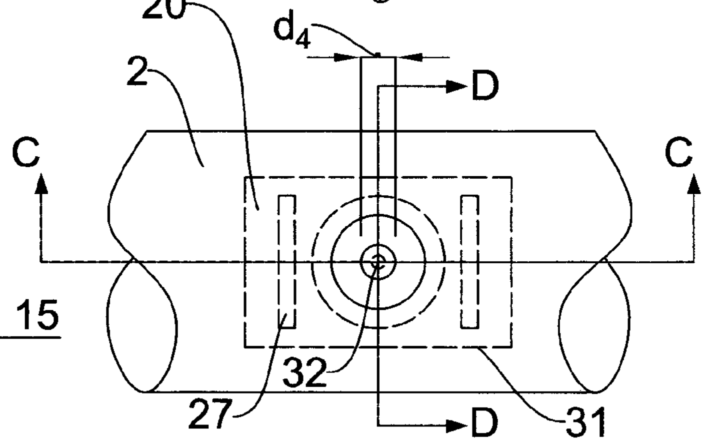

Fig. 15

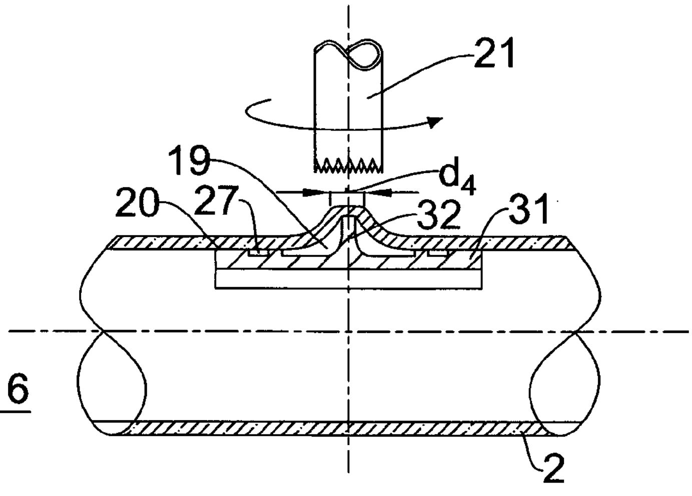

Fig. 16

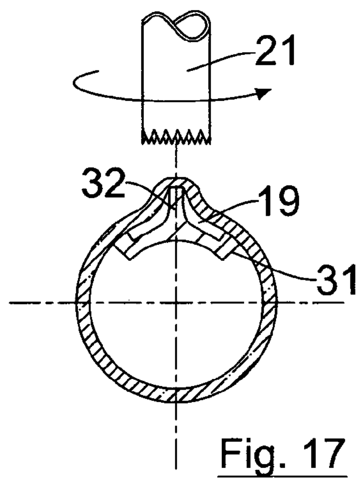

Fig. 17

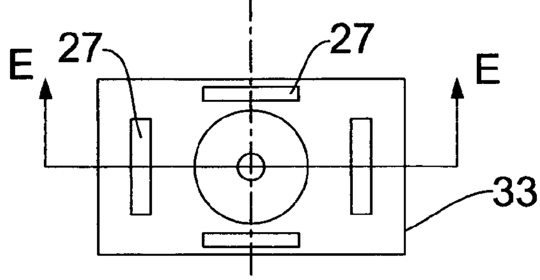

Fig. 18

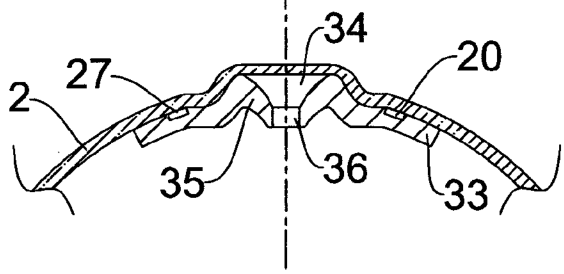

Fig. 20

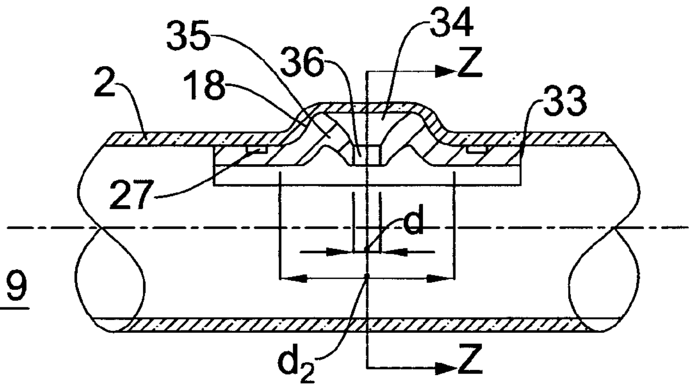

Fig. 19

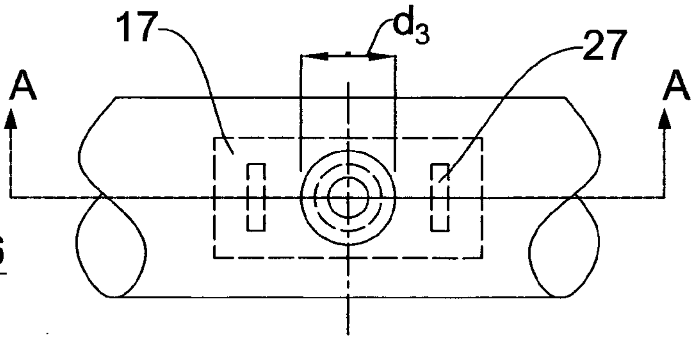

Fig. 6

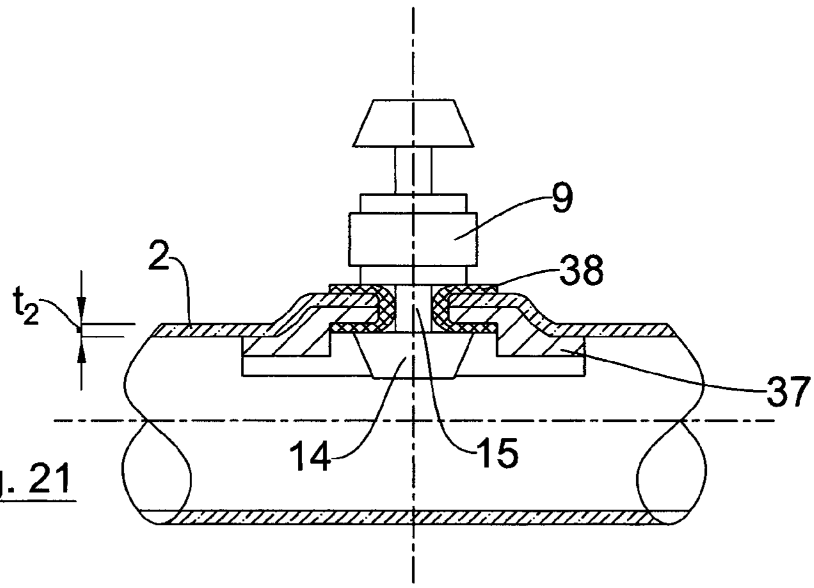

Fig. 21

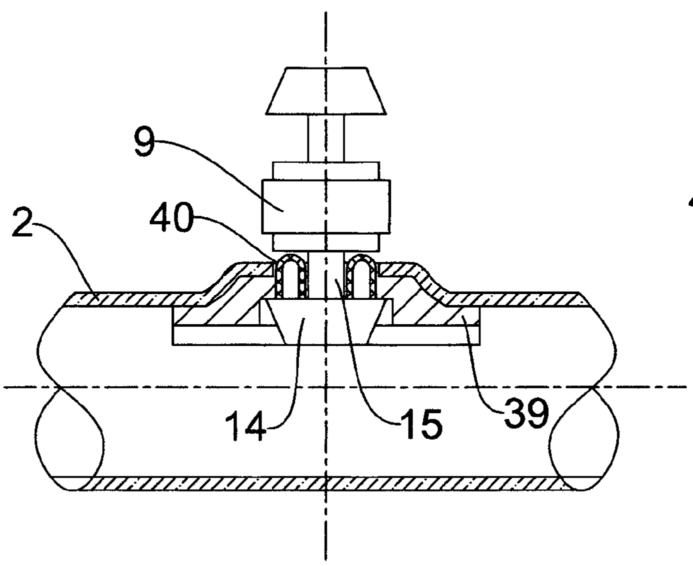

Fig. 22

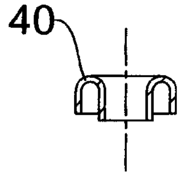

Fig. 23