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Description

The present invention relates to an ultrasonic transducer arrangement having an in particular pocket-shaped housing for mounting the ultrasonic transducer arrangement in a through-hole in a housing of an ultrasonic water meter. Moreover, the present invention relates to an ultrasonic water meter, which uses a corresponding ultrasonic transducer arrangement.

Prior art

DE OS 2 309 605 discloses an ultrasonic transducer arrangement in accordance with the preamble of Claim 1. The ultrasonic transducer arrangement comprises a transducer carrier having an acoustic window, which is oriented at an oblique angle to the mounting plane, and an ultrasonic transducer is situated behind said acoustic window, said ultrasonic transducer being held in position by a holding device, which is situated within the transducer carrier. The holding device comprises a spring pre-loaded thrust rod and a shoulder on which one end of the spring is braced while the other end of the spring is braced against an adjusting screw. The holding device is fixed by means of a stopper and a splint within the transducer carrier and is oriented perpendicular to the mounting plane or to the measuring tube. The thrust rod has on its end a bevelled region in order to deflect the holding force onto the ultrasonic transducer body which is positioned obliquely to the mounting plane.

The ultrasonic transducer arrangement, which is disclosed in EP 0 260 335 A1, comprises a pocket-shaped housing in which a transducer body is situated, said transducer body being pressed against the housing wall by means of a coil spring in order to avoid the appearance of air gaps between the transducer body and housing wall, said air gaps being caused by temperature stress. The ultrasonic transducer arrangement is installed in closure boxes, which are in turn connected to bases of the pipe via screws or flanges. The coil spring is consequently oriented perpendicular to the mounting plane of the ultrasonic transducer

arrangement on the pipe.

GB 2 429 061 A discloses an ultrasonic throughflow meter in which ultrasonic meters are fastened to wedge-shaped projections of the wall of the ultrasonic meter.

Ultrasonic transducer arrangements are respectively disclosed in US 2010/0313676 and DE 10 2009 046 159 A1 in which a housing, which respectively accommodates a transducer body, is inserted into a receiving arrangement of the measuring pipe, said receiving arrangement extending at an oblique angle.

Ultrasonic water meters in which ultrasonic transducer arrangements, which are accommodated in a dedicated housing, are accommodated in the region of a through-hole in a housing of an ultrasonic water meter are sufficiently known. In this case, the ultrasonic water meters are predominantly "bulk water meters" having an increased nominal diameter.

Accordingly, for example EP 2 333 495 A1 describes an ultrasonic water meter in which each ultrasonic transducer arrangement, which is accommodated in a dedicated housing, is placed on an associated through-hole, which is cut into the housing of the ultrasonic water meter, and said ultrasonic transducer arrangement is subsequently welded. Two ultrasonic transducer arrangements of this type are arranged in such a manner that the measuring path that results therefrom scans diagonally through the through-going duct of the ultrasonic water meter. The respective through-hole is introduced along the curved upper surface contour of the housing of the ultrasonic water meter by means of a laser. The housing of the ultrasonic transducer arrangement is open towards the measuring duct of the ultrasonic water meter so that the ultrasonic transducers are held in position in direct contact with water by means of the water pressure.

US 8,438,935 B2 and EP 2 386 835 A1 discloses an ultrasonic throughflow meter in which two ultrasonic transducer bodies are

arranged lying opposite one another along the housing periphery outside the housing in order to scan a part region of the flow cross section.

US 7,735,380 discloses a diagonal arrangement of ultrasonic transducer bodies in the outer region of an ultrasonic water meter.

This ultrasonic transducer arrangement, which is disclosed in WO 2011/141 167, comprises a beaker-shaped housing insert that it is possible to scan through in which a transducer body is housed. The beaker-shaped housing insert is immersed in a through-hole in the housing of the water meter. In this case, the transducer body is positioned parallel to the mounting plane of the housing insert in the latter case. The contacting arrangement of the transducer body is provided via a spring, which presses against the transducer body. In order to fix the transducer body in the housing insert, this spring comprises a cover-type closing part having an inner chamber, which is accessed from one side so as to receive the spring. The transducer body is fixed by means of mounting the cover or an upper-side circuit board. A corresponding ultrasonic transducer arrangement may only be used in the case of a transducer body, which is oriented perpendicular to the measuring duct.

Finally, GB 2 101 318 A discloses an ultrasonic throughflow meter in accordance with the preamble of Claim 1. In this case, the transducer body is positioned at an oblique angle to the mounting plane of the housing on the housing of the ultrasonic meter. The transducer body is cast using epoxy resin in order to fix the transducer body on the housing wall, which is to be scanned through. As a result of pressure fluctuations in the supply network and temperature fluctuations in the environment there is the risk that the transducer body detaches from the adjacent housing wall or that other influences that disrupt the measurement occur. Moreover, the epoxy resin causes an emission of sound towards the rear, which leads to a clear loss of efficiency.

Object of the present invention

The object of the present invention is to provide an alternative ultrasonic transducer arrangement and a corresponding ultrasonic water meter.

Solution of the object

The above-mentioned object is achieved in the case of an ultrasonic transducer arrangement of the generic type by virtue of the features of the characterizing part of Claim 1. The object is achieved in the case of the likewise-claimed ultrasonic water meter by virtue of the features of the characterizing part of Claim 18. Expedient embodiments of the present invention are claimed in the dependent claims.

The holding device comprises an elastic element and a moulded part, which holds the elastic element against the transducer body under a maintained contact pressure or holding pressure with the result that said transducer body is secured in its position. In addition to the function of generating a certain contact force, the elastic element also has the function of compensating reversible deflections of the housing wall, said deflections being caused owing to so-called pressure surges in the water supply network and as a consequence has the function of ensuring a permanent acoustic contacting arrangement. By virtue of the fact that in the mounted state the holding device exerts a holding force P onto the transducer body, said holding force being oriented directed towards the housing wall, in the event of pressure surges in the water supply network or in the event of intense temperature fluctuations and material changes that are consequently caused, a uniform secure contacting arrangement of the transducer body on the housing wall is nevertheless achieved. In accordance with the present invention, in this case it is provided that the moulded part is able to be latched accommodated within the housing of the ultrasonic transducer arrangement.

The ultrasonic transducer arrangement in accordance with the invention renders it possible moreover to provide a mounting unit that may be easily handled, said mounting unit being embodied from the pocket-shaped housing of the transducer body and the holding device in the case of a transducer body, which is positioned in the housing at the oblique angle to the mounting plane.

The housing of the ultrasonic transducer arrangement comprises a housing wall section that is arranged extending approximately perpendicular to the housing wall that is to be scanned through. The two housing walls form a pocket within which the transducer body and the holding device are situated.

It is possible in accordance with the invention to provide formations on the housing wall section, which extends perpendicular to the housing wall that is to be scanned through, in order to render it possible to latch and/or to guide and/or to pivot the moulded part towards the housing. The corresponding formations may be moulded in a simple manner during the course of the injection moulding procedure. It is therefore possible to reduce the number of parts.

Expediently it is possible owing to the invention to use a spring, preferably a coil spring, as an elastic element. Moreover, it is possible via such a spring for the transducer body to also be electrically contacted on the electronic system. Moreover, the spring has the advantage that air is situated on the rear-side of the transducer body, said air preventing a phase jump and therefore a propagation of sound towards the rear.

One expedient embodiment resides in the fact that the moulded part is able to be rotated about an axis in the pocket-shaped housing and preferably is able to be latched to the housing in a specific rotational position with respect to said housing. In this position, the spring may be held on the transducer body using a build-up of compressive stress. In this case, the spring

may be placed in the moulded part as a loose part and a locking arrangement may be provided via the moulded part.

Alternatively, the moulded part is also able to be displaced, preferably in a linear manner, along a guide within the pocket-shaped housing and may be designed so as to be able to be latched to the housing in one specific displacement position. In the latching position, the elastic element is likewise fixed under a certain compressive stress.

These measures in accordance with the invention render it possible to pre-fix the transducer body, which is placed obliquely in the pocket-shaped housing, in the case of restricted spatial conditions, which are predetermined by an in particular circular shape of the through-hole. A fixing arrangement by means of a closure cover is not possible in the case of an oblique arrangement of the transducer body. Nevertheless, the invention renders possible an effective pre-fixing arrangement.

The mounting procedure is also simplified by virtue of the fact that in accordance with a further embodiment, provided in the housing of the ultrasonic transducer arrangement is a connection contact for the free end of an electrical cable which runs into the housing. This renders possible a particularly simple contacting arrangement of the electronic module to the ultrasonic transducer arrangement.

Expediently, the free end of the spring, which influences the transducer body with a contact pressure may also be used as a connection contact. In this case, by way of example a second, for example small pot-shaped, electrode may be situated on the transducer body and the connection lug of said electrode is guided upwards by way of example through an opening in the holding device and is connected to a conductor of the cable.

Alternatively, at least one solder pad may also be arranged on the holding element or on the moulded part and a conductor of

the electrical cable may be soldered to said solder pad.

Expediently, for this purpose the moulded part is embodied as a so-called MID (moulded interconnect device. In this case the moulded parts are spatially injection-moulded circuit carriers, in other words moulded parts having integrated conductive pattern structures. These may be produced in various ways.

In accordance with the invention, the housing has a flat bearing region, preferably in the form of a stepped arrangement, which in the mounted state, is situated opposite the outer edge region of the through-hole. This results in the advantage that the through-hole may be produced using a milling tool in a simple manner.

A seal, by way of example an O-ring, is expediently provided between the bearing region and the outer edge region of the through-hole on the housing of the ultrasonic water meter.

By virtue of the fact that the housing has, on its upper side, a peripheral upwardly projecting web through which by way of example a through-opening may extend, an upper side space is provided, wherein simultaneously the electrical cable may run laterally into the interior of the housing of the ultrasonic transducer arrangement.

A cover may be expediently situated in the upper region of the housing, preferably at a certain distance with respect to the upper-side end of the projecting web. The cover has the advantage that the holding device and its electrical connectors are covered in the pocket-shaped housing however a space remains on the upper side, said space being caused by means of the web. This space renders it possible to cast the transducer in a watertight manner using a synthetic material compound.

The present invention further relates to, also claims in a coordinate manner, an ultrasonic transducer arrangement in which the housing wall on the outer side facing the ultrasonic water

meter is designed as an acoustic lens, in particular in that said housing wall has a spherical or parabolic geometry. As a consequence, disruptive reflections on the housing wall that adjoins the transducer body are avoided. In addition, the ultrasonic signal is focussed. These measures result in an improved efficiency of the acoustic system. The electrical receiving voltage is in this case to be so high that uncertainties owing to electronic noise components do not contribute a significant proportion to the total measurement uncertainty.

It is preferred that the housing wall has, on the outer side facing the ultrasonic water meter, at least one reinforcement rib, by way of example in the form of a reinforcement rib which extends diametrically through the housing wall. This renders it possible on one side to embody the housing wall of the housing of the ultrasonic transducer arrangement in a comparatively thin-walled manner, said ultrasonic transducer arrangement preferably being embodied from synthetic material which it is possible to scan through. As a consequence, it is possible to reduce signal losses and to increase the measuring accuracy. Moreover, in the case of increased pressures or pressure jumps a deflection of the housing wall is avoided or such a deflection is at least reduced. A corresponding reinforcement rib is moreover easy to realise using injection moulding technology.

Alternatively however, other structures, such as by way of example ring-shaped structures, are expedient for increasing the rigidity of the housing wall against deflections.

The present invention further relates to, likewise claims in a coordinate manner, an ultrasonic transducer arrangement and the housing wall of said ultrasonic transducer arrangement has, on the outer side facing the ultrasonic water meter, a Fresnel stepped geometry. In this case, this is a division of the housing wall into multiple ring-shaped regions, wherein in each of these regions the thickness reduces slightly with the result that a series of ring-shaped steps is provided. As a consequence, it

is possible to further optimize the sound emission characteristics.

It is preferred that in the case of a Fresnel stepped geometry being present, the housing wall has a largely constant wall thickness at least in the scanning region. The ring-shaped structures of the Fresnel stepped geometry are to be derived from the equations for defining the Fresnel lenses that are known from optics. In this case, the structure widths in the first line are dependent upon the wavelengths of the sound in the medium. It is preferred that each of the rings has an identical surface.

The spherical radius of the individual rings defines the focal length of the acoustic lens. The use of the Fresnel stepped geometry consequently causes an acoustic lens effect of the housing wall in the case of increased wall thickness and consequently causes an increased mechanical effectiveness against deflection.

Moreover, the present invention relates to an ultrasonic water meter in accordance with Claim 18.

By virtue of the fact that the through-hole, in the housing of the ultrasonic water meter, has a flat bearing region for the housing of the ultrasonic transducer arrangement, it is rendered possible to use conventional milling tools so as to introduce the through-hole. Accordingly, it is possible in the case of the present invention to provide the through-hole in the housing wall of the ultrasonic water meter using a milling cutter, preferably a multi-stage milling cutter since the ultrasonic transducer arrangement may preferably be mounted in a (flat) mounting plane A preferably having a ring-shaped geometry. It is not necessary to produce complex through-holes having three-dimensional contours, which are cut using lasers and require a corresponding mating contour. Nevertheless, in accordance with the invention the construction of the ultrasonic transducer arrangement having the oblique positioning of the transducer

body in the housing and the holding device ensures an effective holding arrangement of the transducer body and therefore an increased operational safety.

By virtue of the fact that the through-hole expediently has a ring-shaped contact region for the housing of the ultrasonic transducer arrangement, it is rendered possible to use milling cutters having a rotational axis which is perpendicular to the surface of the housing.

Description of the invention with the aid of exemplary embodiments

Expedient embodiments of the invention are further explained with the aid of exemplary embodiments. In the drawings:

Fig. 1 illustrates a sectional view through an ultrasonic water meter having an ultrasonic transducer arrangement in accordance with one example of the present invention;

Fig. 2 illustrates a sectional view of an ultrasonic transducer arrangement in accordance with a first exemplary embodiment of the present invention;

Fig. 3 illustrates a sectional view of an ultrasonic transducer arrangement in accordance with a second exemplary embodiment of the present invention;

Fig. 4 illustrates a plan view of the ultrasonic transducer arrangement of the second exemplary embodiment;

Fig. 5 illustrates a sectional view of an ultrasonic transducer arrangement in accordance with a third exemplary embodiment of the present invention;

Fig. 6 illustrates a sectional view of an ultrasonic transducer arrangement in accordance with a fourth exemplary embodiment of the present invention;

Fig. 7 illustrates a perspective view of the ultrasonic transducer arrangement in accordance with the invention having a reinforcement rib;

Fig. 8 illustrates a perspective view of the ultrasonic transducer arrangement in accordance with the invention having a ring-shaped structure and

Fig. 9 illustrates an enlarged detailed section of a housing wall having a Fresnel stepped geometry.

The reference numeral 10 in Fig. 1 refers to an ultrasonic water meter in its entirety. In the illustrated example, the ultrasonic water meter is an "ultrasonic bulk water meter". Ultrasonic bulk water meters are designed for nominal throughflow quantities (Qn) of 15 m^3/h to 1500 m^3/h. Typical pipe diameters of ultrasonic bulk water meters are in the range of DN 50 to DN 500. The ultrasonic water meter 10 comprises a housing 3, which in general is embodied from metal, said housing having an inlet 21 and an outlet 22, which is situated opposite the inlet. The inlet 21 and outlet 22 are connected to a (not illustrated) water supply network.

Multiple through-holes 15 are milled into the housing 3 in order respectively to be able to insert an ultrasonic transducer arrangement 1 into the housing 3 at the relevant site.

Multiple ultrasonic measuring paths 11 (one of which is illustrated in Fig. 1), which extend diagonally, for measuring the throughflow quantity of water in the case of the ultrasonic water meter that is illustrated in Fig. 1 are determined by means of multiple ultrasonic transducer arrangements 1, which are positioned diagonally opposite said ultrasonic measuring paths.

An enclosed electronic module 23 is situated placed on the upper side of the ultrasonic water meter 10. This electronic module

typically includes a battery as an electrical energy source, a processor, an evaluating electronic system, a storage device and a data output device. The latter is used for the purpose of directly or remotely reading the data.

Fig. 2 illustrates a first embodiment of an ultrasonic transducer arrangement 1 in accordance with the invention. The ultrasonic transducer arrangement 1 comprises a pocket-shaped housing 2, which is preferably produced as an injection moulded part and is embodied from material, which it is possible to scan through, preferably synthetic material.

The housing 2 comprises a ring-shaped bearing region 13, which in the mounted state is situated opposite the outer edge region of a through-hole 15 of an ultrasonic water meter, cf. Fig. 1, and determines a mounting plane A, which extends parallel to the through-flow direction in the example of an ultrasonic water meter that is illustrated in Fig. 1.

The housing 2 has a housing wall 5, which extends obliquely to the mounting plane A, and a transducer body 4 is positioned on the inner side of said housing wall. An electrode 3 having an electrode lug, which protrudes laterally, for the contacting arrangement of the electrode 3 is situated on the main surface of the transducer body 4, said main surface being assigned to the housing wall 5. It is possible to apply a suitable sound coupling compound, for example a paste, (not illustrated in Fig. 2) between the transducer body 4 and the inner side of the housing wall 5 so as to improve the acoustic coupling arrangement in order to avoid hollow spaces and air bubbles and therefore a negative impairment of the signal.

In accordance with the invention, the ultrasonic transducer arrangement 1 has a holding device 6 for the transducer body 4, which on one side has an elastic element, for example a spring 8, preferably a coil spring and a moulded part 7, which surrounds the elastic element. The moulded part 7, which is preferably likewise embodied from synthetic material and produced as an

injection moulded part, comprises a chamber that is open on one side and it is possible to insert the spring 8 into said chamber. Moreover, the moulded part 7 may have an end-face side through-hole 25, which is used to guide through the free end of the spring 8. The moulded part 7 is able to rotate or pivot about an axis of rotation 30 and is able to be locked in a specific rotational position and position with respect to the transducer body 4.

This locking arrangement may be realised by way of example by means of at least one lug 24 that is formed on the moulded part, said lug engaging on a housing-side bulge 27. In this case, for the mounting procedure it is only necessary to place the spring 8 into the moulded part 7, to press the moulded part 7 together with the spring 8 onto the transducer body 4 and simultaneously to pivot about the axis of rotation 30 until the lug 24 latches on the bulge 27 of the housing 2. In this case, the holding part 6 holds the transducer body 4 using a defined holding force P, which is directed towards the transducer body.

The contacting arrangement is provided via an electrical cable 12, for example a coaxial cable, which is supplied horizontally and the end region of which is likewise situated extending horizontally within the housing 2 of the transducer arrangement 1. For example, the shielding 28 of the cable 12 may be soldered in a simple manner to the connection lug of the electrode 3 for the contacting arrangement. Furthermore, it is possible to produce a soldered connection 26 between the core 29 of the cable 12 and the free end of the spring 8. The spring 8 is used so as to electrically contact the transducer body 4 on the side which lies opposite the electrode 31.

In accordance with the invention, the housing wall 5 may also be designed as an acoustic lens. In order to avoid disruptive reflections on the housing wall 5 that adjoins the transducer body 4 and in order to focus the ultrasonic signals, the outer wall of the housing wall 5 preferably comprises a spherical or parabolic geometry. As a consequence, it is ensured that the

electrical receiving voltage remains high with the result that uncertainties owing to electronic noise components do not contribute a significant proportion to the measurement uncertainty volume. In addition, the varying wall thickness ensures a maximum pressure stability of the component.

Fig. 3 illustrates an alternative embodiment of the ultrasonic transducer arrangement 1 in accordance with the invention. This arrangement differs from the arrangement that is illustrated in Fig. 2 by virtue of the embodiment of the holding device 6 and the contacting arrangement. In this case, the moulded part 7 is not mounted in a rotatable manner but rather is designed so as to be able to be displaced in a direction towards the transducer body 4. The latching arrangement of the moulded part 7 is provided in the case of a preferably determined displacement position of the moulded part 7 towards the transducer body 4. In the case of the displacement, the spring 8 is simultaneously stressed with the result that an electrical contacting arrangement is ensured. Here, the holding device 6 also holds the transducer body 4 in position using a directed holding force P. In this case, the contacting arrangement of the core 29 of the cable 12 is provided via a soldering pad 38, which is provided on the upper side of the moulded part 7. For this purpose, it is necessary to guide a conductor track 36 from the ring-shaped bearing surface of the spring 8 on the transducer body 4 around the moulded part 7 to the solder pad 38. Here, the holding device 6 also holds the transducer body 4 in position using a directed holding force P.

In this case, it is possible to use a moulded part 7 having moulded circuit carriers or a so-called MID (moulded interconnect device) moulded part. In this case, the moulded part is a moulded part having integrated conductive pattern structures.

The illustration in accordance with Fig. 4 illustrates a plan view of the embodiment of the ultrasonic transducer arrangement in accordance with Fig. 3 with the cover removed. It is apparent

in the illustration that the moulded part 7 has a groove 34 on both sides into which a web 33 engages, which is preferably provided on the housing 2 or is moulded into said housing with the result that the moulded part 7 may be displaced together with the spring 8 that is not illustrated in Fig. 4 onto the transducer body 4 and the spring 8 and therefore the transducer body 4 may be placed under stress and therefore exerts a holding force P. In addition, a (not illustrated) latching mechanism is provided which is capable of receiving the resilient force that is provided.

An ultrasonic transducer arrangement 1 is apparent from the illustration in Fig. 5, said ultrasonic transducer arrangement essentially corresponding to the embodiment according to figures 3 and 4. In lieu of a contacting arrangement of a solder pad, a second electrode 35 is provided that is soldered to the core 29 of the cable 12 and is situated on the side of the transducer body 4, which lies opposite the electrode 31. This second electrode 35 may comprise a small pot shape. This renders it possible prior to the mounting procedure to plug the second electrode onto the first spring coils of the spring 8 and subsequently to place and to mount the spring 8 together with the second electrode 35 into the moulded part 7. Here, the holding device 6 also holds the transducer body 4 in position using a directed holding force P.

The embodiment according to Fig. 6 illustrates an embodiment that is slightly modified with respect to the embodiments in figures 4 and 5. It is possible to provide a cover 32 on the upper side of the ultrasonic transducer arrangement at a specific distance with respect to the upper side end of the web 19, said cover covering the connection region of the electrical cable 12. At the same time, as a consequence the possibility is provided of casting in a watertight manner the space that remains as a result of the web 19 and that is situated above the cover 32 using a (not illustrated) synthetic material compound. Furthermore, a soldered connection 26 is provided between the core 29 of the cable 12 and the free end of the spring 8.

A further embodiment of the ultrasonic transducer arrangement 1 in accordance with the invention in accordance with one of the above-mentioned constructions is apparent in Fig. 7, in which in addition a reinforcement rib 17 that preferably extends diametrically is moulded on the outer side of the housing wall 5, which has a spherical or parabolic geometry. As a consequence, it is possible to achieve a reduction in the deflection of the housing wall 5 in the case of particularly high pressures. The dimensions of the reinforcement rib 17 are smaller than the wavelength of the excitation frequency of the transducer body 4 with the result that the reinforcement rib 17 does not have a negative effect on the emission of sound and/or on the entry of sound. A corresponding reinforcement rib 17 may be realised in a simple manner using injection moulding technology.

It is clear from the illustration in accordance with Fig. 7 how the cable 12 that runs horizontally extends through the through-opening 20 in the web 19.

In an alternative to the exemplary embodiment that is illustrated in Fig. 7, ring-shaped structures 37 may also be provided in the region of the housing wall 5 so as to ensure an increased stability against deflection, as is illustrated in Fig. 8.

These ring-shaped structures may be used in accordance with a further exemplary embodiment not only to reinforce the housing wall 5 but rather also may be provided for the purpose of ensuring an acoustic lens having a characteristic according to the Fresnel lens type. As a consequence, it is possible to further optimize the sound emission characteristic.

Fig. 9 illustrates in an enlarged part sectional image the possibility of the embodiment of the housing wall 5 according to the above-mentioned Fresnel principle. In this case, the wall thickness of the housing wall 5 may be designed as essentially constant. Multiple ring-shaped structures 37 are situated on the

outer side of the housing wall 5, said ring-shaped structures being derived from the equations for defining the Fresnel lenses that are known from optics. Accordingly, the widths of the structure are mainly dependent upon the wavelength of the sound in the medium (for example water). It is preferred that each ring has the same surface. The spherical radius of the rings defines the focal length of the acoustic lens that is formed and corresponds in the present case to the spherical radius of the spherical or parabolic surface of the outer side of the housing wall 5 in Fig. 1. A slightly parabolic or spherical curvature is provided in the centre region of the scanning region of the housing wall 5. This embodiment of the housing wall 5 has the advantage of an acoustic lens having a uniform wall thickness.

List of reference numerals

1	Ultrasonic transducer arrangement
2	Housing
3	Housing (ultrasonic water meter)
4	Transducer body
5	Housing wall
6	Holding device
7	Moulded part
8	Spring
9	Guide
10	Ultrasonic water meter
11	Ultrasonic measuring path
12	Electrical cable
13	Flat bearing region
14	Bearing region
15	Through-hole
16	Seal
17	Reinforcement rib
18	Fresnel stepped geometry
19	Web
20	Through-opening
21	Inlet
22	Outlet
23	Electronic module
24	Lug
25	Through-hole
26	Soldered connection
27	Housing-side bulge
28	Shielding
29	Core
30	Axis of rotation
31	First electrode
32	Cover
33	Web
34	Groove
35	Second electrode
36	Conductor track

37 Ring-shaped structure
38 Solder pad
A Mounting plane
P Holding force

Patentkrav

1. Ultralydstransducerarrangement (1) med
et hus (2) udført til montage af ultralydstransducerarrangementet i et gennemgangshul (15) i et hus (3) til en ultralydsvandmåler (10) i et montageplan A,
et transducerlegeme (4), der befinder sig i ultralydstransducerarrangementets (1) hus (2), til generering og/eller til modtagelse af et akustisk signal,
en til transducerlegemet (4) tilordnet husvæg (5), som det akustiske signal forløber igennem,
elektriske kontaktmidler til tilslutning af transducerlegemet (4) til en spændings-
eller strømkilde, hvor
den til transducerlegemet (4) tilordnede husvæg (5), som det akustiske signal forløber igennem, forløber i en skrå vinkel i forhold til ultralydstransducerarrangementets montageplan A på ultralydsvandmålerens hus (3),
transducerlegemet (4) er i ultralydstransducerarrangementets (1) hus (2) positioneret i den skrå vinkel i forhold til ultralydstransducerarrangementets montageplan A på ultralydsvandmålerens hus (3), og
inde i ultralydstransducerarrangementets (1) hus (2) er der indrettet en holdeindretning (6), der har et på transducerlegemet (4) virkende elastisk element samt et formstykke (7), kendetegnet ved, at formstykket (7) holder det elastiske element under kontakttryk på transducerlegemet (4) og på transducerlegemet (4) udøver en hen mod husvæggen (5) orienteret holdekraft P, hvor holdeindretningen (6) er orienteret i den skrå vinkel i forhold til ultralydstransducerarrangementets (1) montageplan A, og formstykket (7) kan gå i indgreb inde i ultralydstransducerarrangementets (1) hus (2).

2. Ultralydstransducerarrangement ifølge krav 1, kendetegnet ved, at der som elastisk element er indrettet en fjeder (8).

3. Ultralydstransducerarrangement ifølge krav 1 eller 2,

kendetegnet ved, at formstykket (7) kan drejes omkring en akse (8) og i en drejestilling kan gå i indgreb med ultralydstransducerarrangementets (1) hus (2).

4. Ultralydstransducerarrangement ifølge krav 1 eller 2, kendetegnet ved, at formstykket (7) er forskydeligt langs en føring (9) og i en forskydningsstilling kan gå i indgreb med ultralydstransducerarrangementets (1) hus (2).

5. Ultralydstransducerarrangement ifølge i det mindste et af de foregående krav, kendetegnet ved, at ultralydstransducerarrangementets (1) hus (2) omfatter udformninger (27, 33), som med henblik på indgrebet og/eller føringen og/eller svingningen af formstykket (7) samvirker med sidstnævnte.

6. Ultralydstransducerarrangement ifølge i det mindste et af de foregående krav, kendetegnet ved, at der i ultralydstransducerarrangementets (1) hus (2) er indrettet en tilslutningskontakt for den frie ende af et elektrisk kabel (12), der
løber ind i ultralydstransducerarrangementets (1) hus (2).

7. Ultralydstransducerarrangement ifølge krav 6, kendetegnet ved, at der som tilslutningskontakt er indrettet den frie ende af fjederen (8).

8. Ultralydstransducerarrangement ifølge krav 6, kendetegnet ved, at der som tilslutningskontakt er indrettet et på formstykket (7) anbragt loddepunkt (38).

9. Ultralydstransducerarrangement ifølge krav 6, kendetegnet ved, at formstykket (7) er udformet som MID-element.

10. Ultralydstransducerarrangement ifølge i det mindste et af de foregående krav, kendetegnet ved, at ultralydstranducerarrangementets (1) hus (2), transducerlegemet (4) samt holdeindretningen (6) danner en montageenhed.

11. Ultralydstransducerarrangement ifølge i det mindste et af de foregående krav, kendetegnet ved, at ultralydstransducerarrangementets (1) hus (2) har et plant understøtningsområde (13), som i monteret tilstand ligger over for gennemgangshullets (15) ydre randområde.

12. Ultralydstransducerarrangement ifølge krav 11, kendetegnet ved, at der mellem understøtningsområdet (13) og gennemgangshullets (15) ydre randområde befinder sig en tætning (16).

13. Ultralydstransducerarrangement ifølge i det mindste et af de foregående krav, kendetegnet ved, at ultralydstransducerarrangementets (1) hus (2) på dettes overside har en omløbende opadragende ribbe (19), der er gennemtrængt af en gennemgangsåbning (20).

14. Ultralydstransducerarrangement ifølge i det mindste et af de foregående krav, kendetegnet ved, at husvæggen (5) på den mod ultralydsvandmåleren (10) vendte yderside har en sfærisk eller parabolsk geometri.

15. Ultralydstransducerarrangement ifølge krav 14, kendetegnet ved, at husvæggen (5) på den mod ultralydsvandmåleren (10) vendte yderside har i det mindste en forstærkningsribbe (17).

16. Ultralydstransducerarrangement ifølge i det mindste et af de foregående krav, kendetegnet ved, at husvæggen (5) på den mod ultralydsvandmåleren (10) vendte yderside har en Fresnel-tringeometri (18).

17. Ultralydstransducerarrangement ifølge krav 16, kendetegnet ved, at husvæggen (5) i det mindste i ultralydens gennemgangsområde har en i vid udstrækning konstant vægtykkelse.

18. Ultralydsvandmåler (10) med
et indløb (21),

et udløb (22),
et hus (3) til montering af ultralydsvandmåleren (10) i et vandledningsnet,
et elektronikmodul (23), der er anbragt på husets (3) yderside,
samt i det mindste et gennemgangshul (15) til montage af et ultralydstransducerarrangementet (1), kendetegnet ved
et ultralydstransducerarrangement (1) ifølge i det mindste et af de foregående krav.

19. Ultralydsvandmåler ifølge krav 18, kendetegnet ved, at gennemgangshullet (15) har et plant kontaktområde for ultralydstransducerarrangementets (1) hus (2).

20. Ultralydsvandmåler ifølge krav 18 eller 19, kendetegnet ved, at gennemgangshullet (15) har et ringformet kontaktområde for ultralydstransducerarrangementets (1) hus (2).

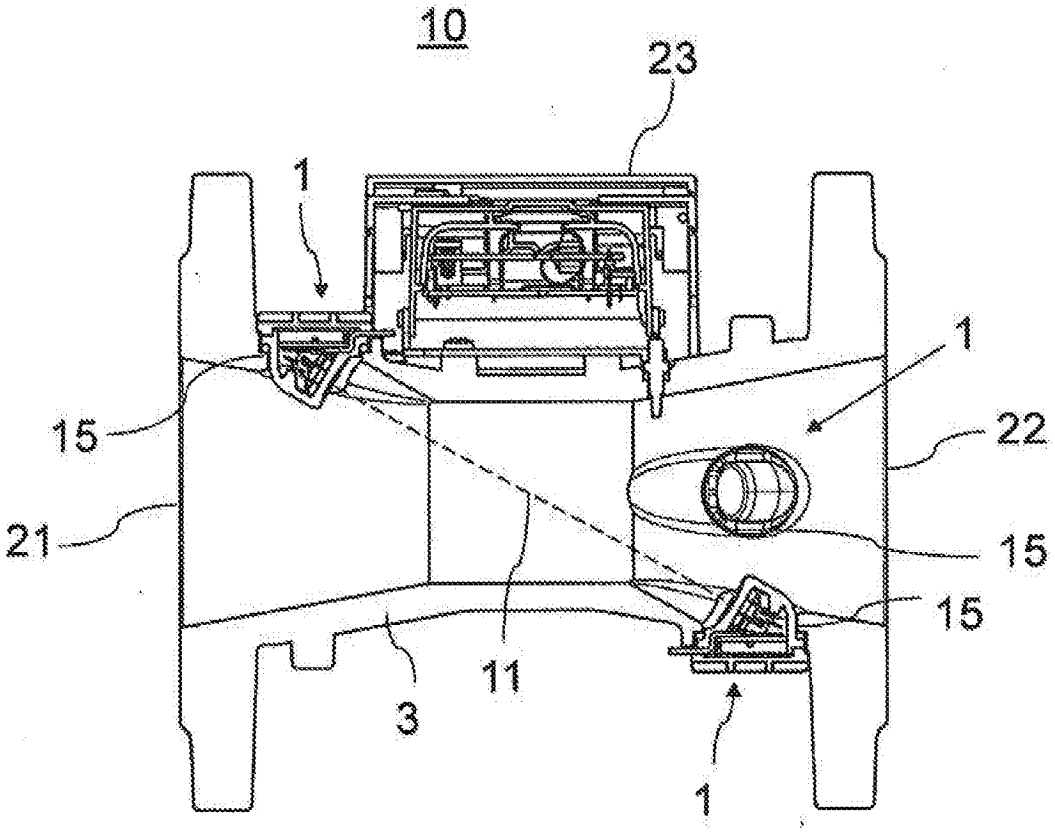

Fig. 1

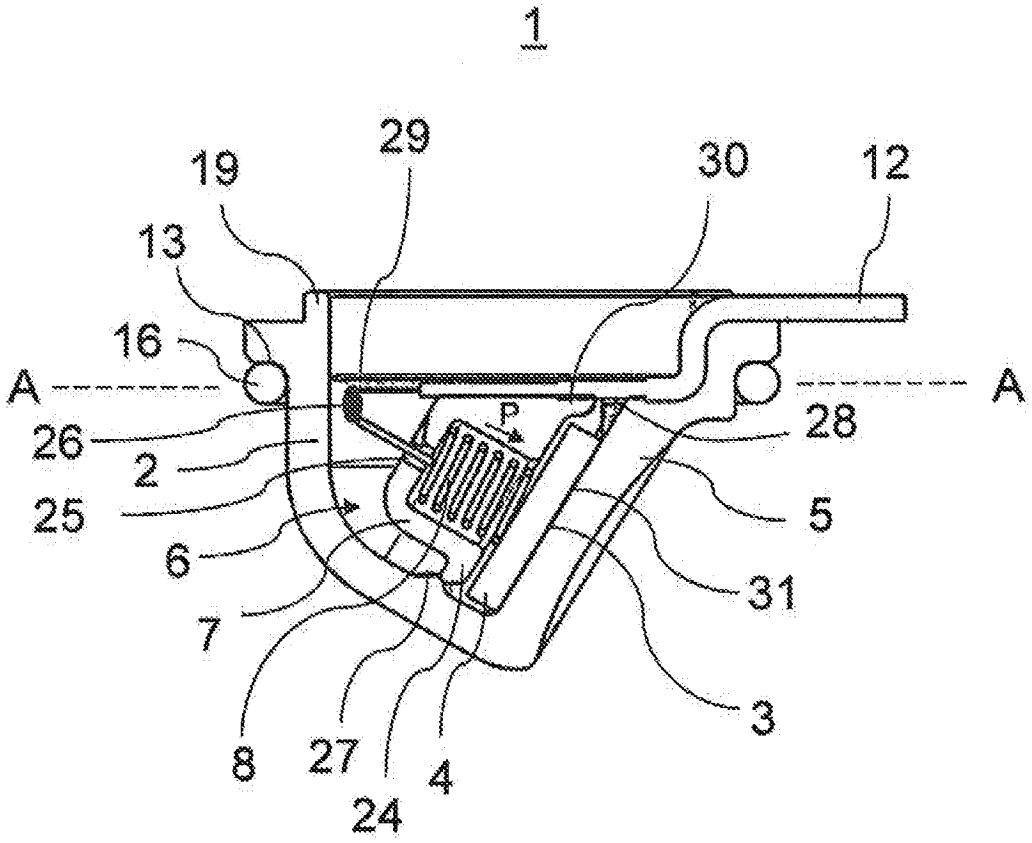

Fig. 2

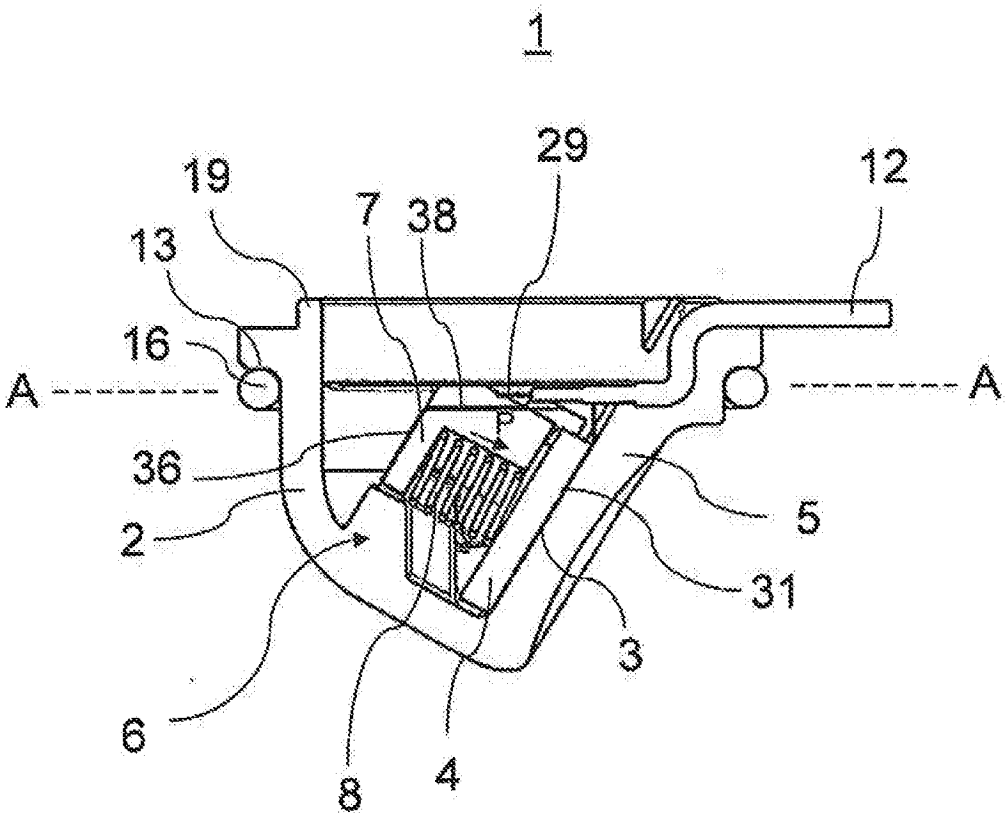

Fig. 3

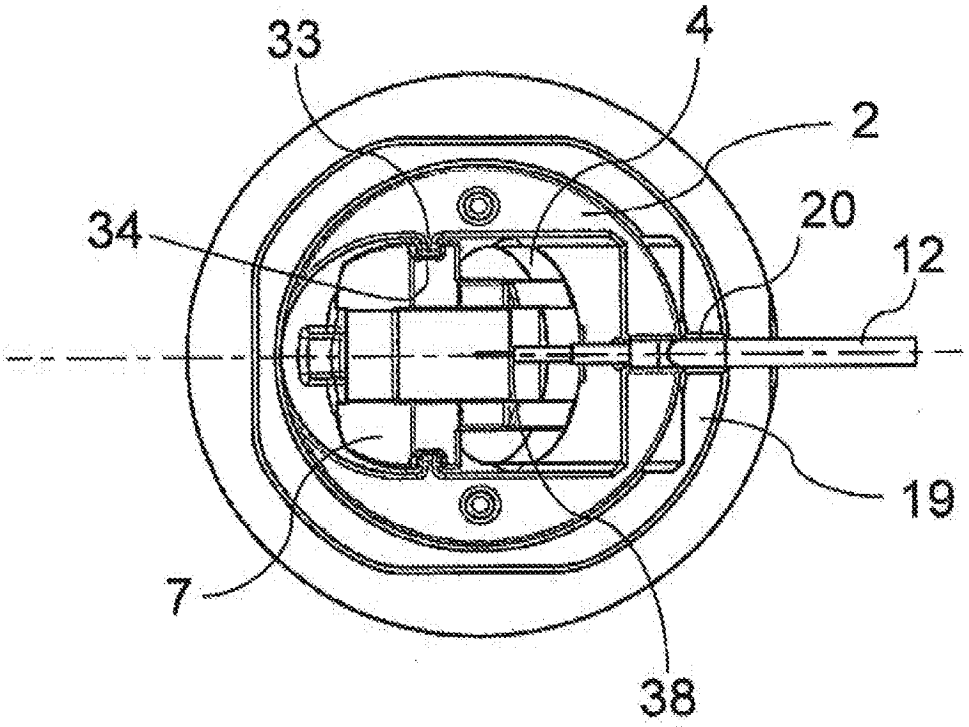

Fig. 4

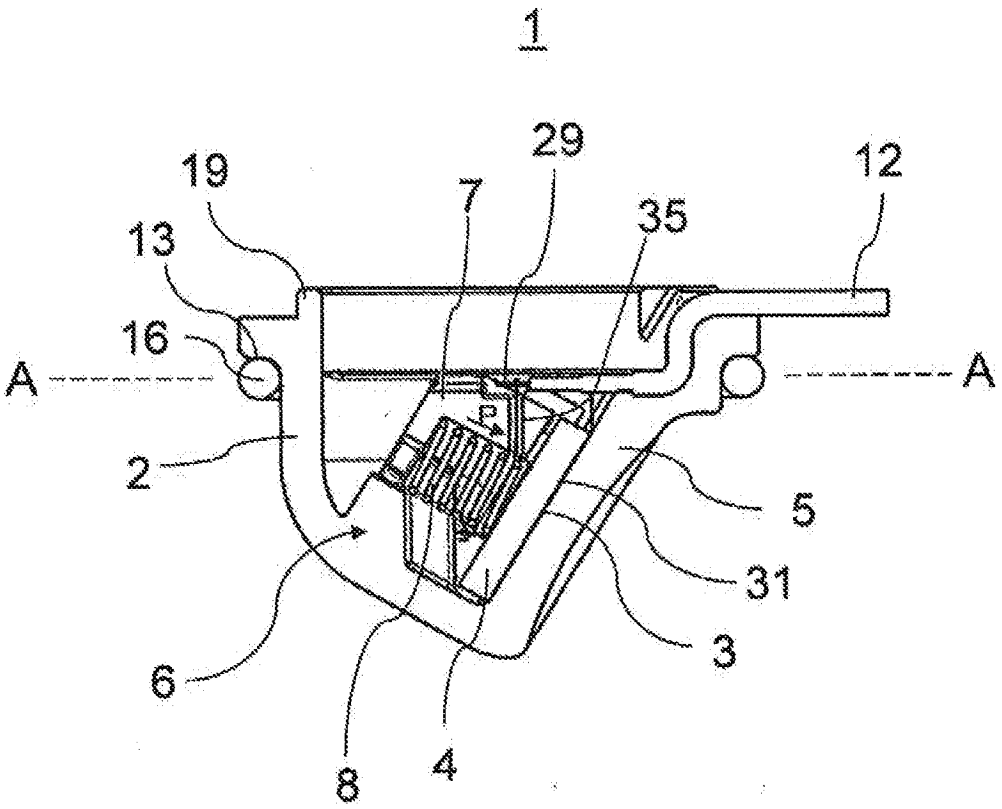

Fig. 5

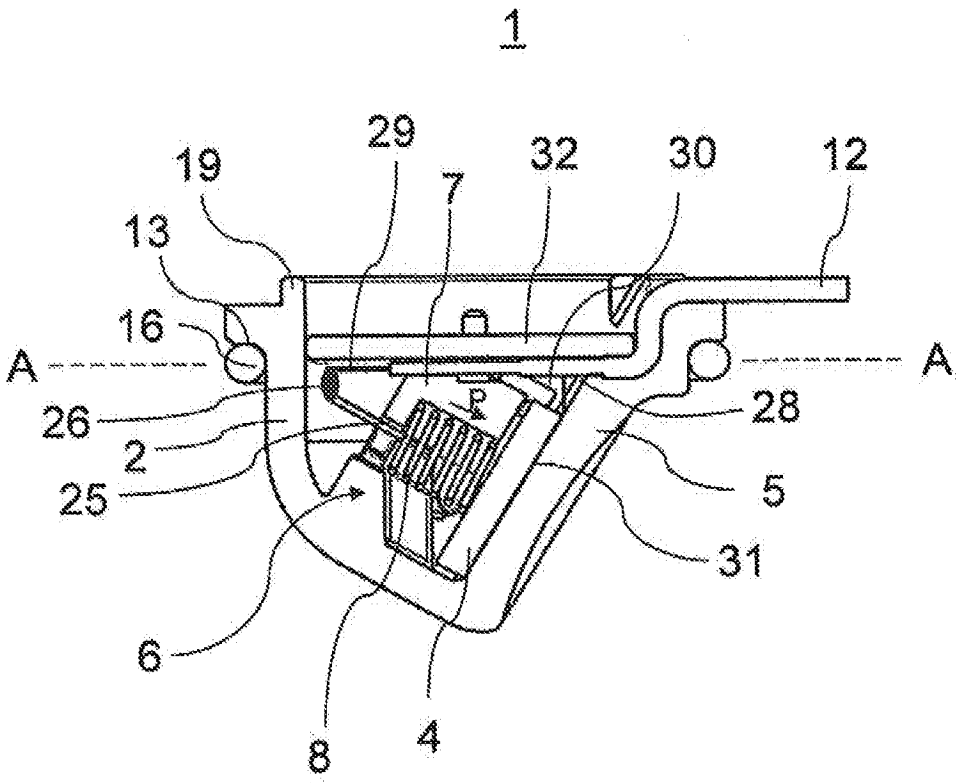

Fig. 6

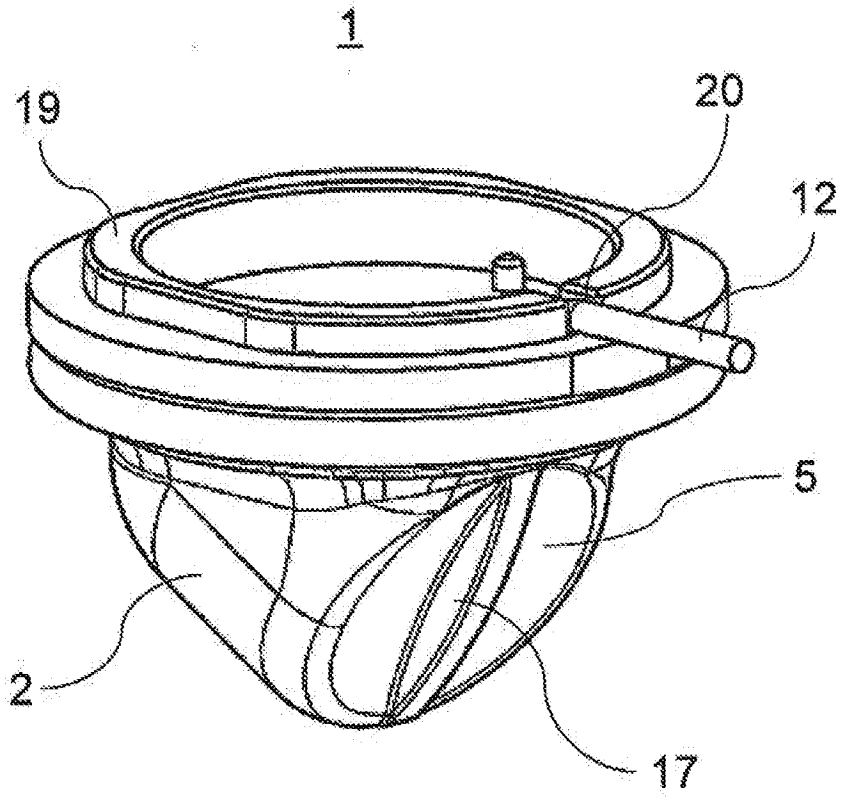

Fig. 7

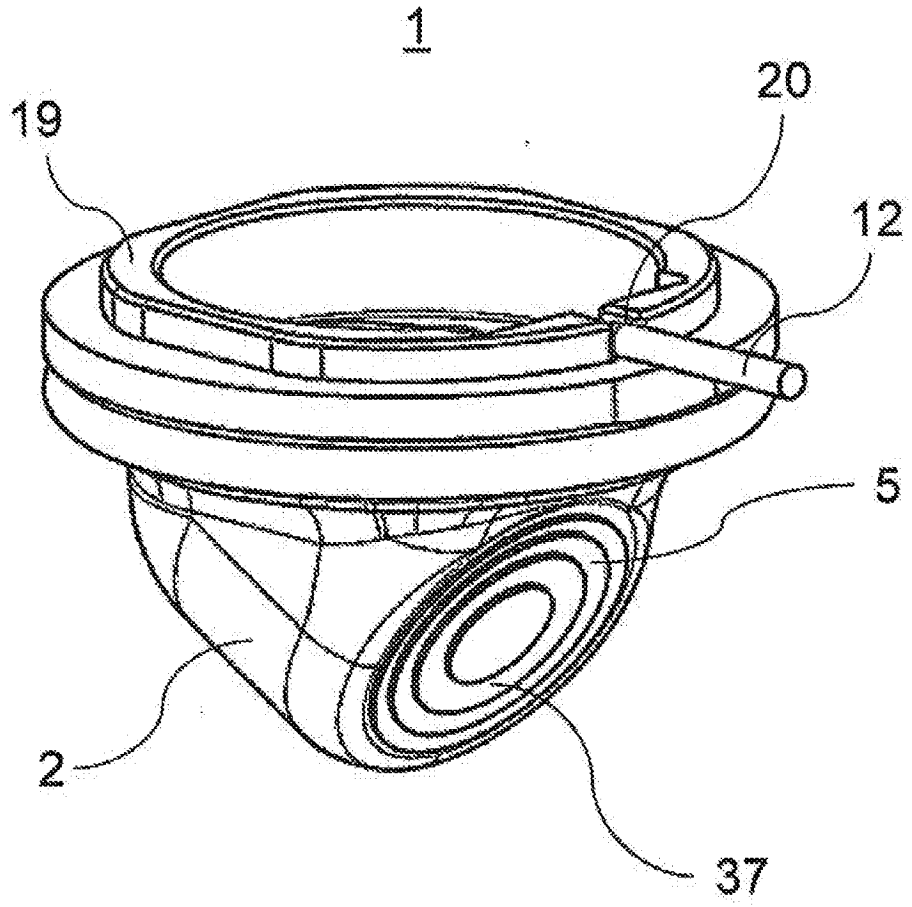

Fig. 8

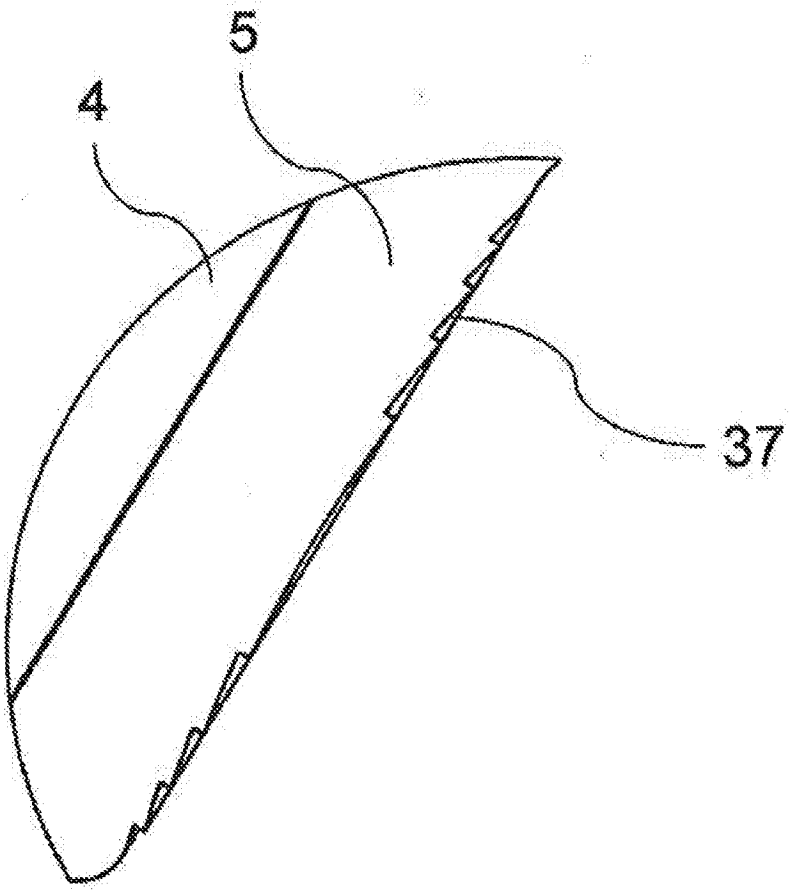

Fig. 9