

The invention relates to a transition piece for pipes according to the features specified in the pre-characterising part of claim 1.

DE 37 21 577 C2 discloses a transition piece of this kind in the form of a plastic sleeve with a threaded insert made of metal. The threaded insert has an essentially cylindrical, tubular section provided on the exterior with tooth-like ribbing and an annular groove with an elastic sealing ring. During manufacture, the threaded insert is inserted into the inner wall of a receiving opening in the plastic sleeve by the application of pressure, at the same time, the said inner wall being heated in the region of the tooth-like ribbing in order to embed the teeth of the ribbing and the sealing ring being compressed so that it bears in a sealed manner against the inner wall of the plastic sleeve. Manufacture must be effected with great care so that the teeth are pressed in and the threaded insert is therefore anchored in the plastic and the elastic sealing ring remains compressed in a reliable manner to provide the required sealing action for a long service life. Very close tolerances must be observed so that the axial fixing of the threaded insert in the plastic sleeve and the resulting compression of the sealing ring can be achieved and maintained. This aspect is important above all with regard to series production in large piece numbers. As a result of axial tensile forces opposing the pressing force during manufacture, there is a risk that the axial fixing of the threaded insert in the plastic sleeve will be at least loosened and that the current high requirements with respect to gas-tightness and/or liquid-tightness will no longer be met.

EP 66 704 A1 discloses a transition piece to be installed in a

pipe conducting a fluid, composed of a metal part and a plastic sleeve. The metal part is provided in its outer surface with an expanded portion in which a circumferential channel with a dovetailed profile or a circumferential projection with a corresponding profile is formed. A complementary projection or a complementary channel with a dovetailed profile is formed on the inner face of the plastic sleeve during the injection moulding thereof. The manufacture of the metal part involves quite considerable expense. Taking account of the variations in temperature to which transition pieces of this kind are subjected in practice, tightness cannot be immediately guaranteed as a result of the different coefficients of thermal expansion of metal and plastic. Additional rings and seals are therefore provided, involving additional production costs, and assembly defects cannot be excluded with the required degree of certainty.

DE 88 09 742 U1 furthermore discloses a transition piece made of plastic for connecting plastic pipes to fittings or pipes made of metal materials, the metal insert or sleeve of which has at least one circumferential groove with a flank bevelled in a dovetailed manner. The groove cross section expands towards the groove base, the groove being completely filled with plastic after the injection moulding thereof. The inner face of the metal sleeve is also provided with an annular groove which is filled with the plastic of the sleeve. As the plastic engages the metal insert both from the exterior and from the interior, comparatively large radial dimensions are required and overall a high quantity of material is used. No elastic seals are provided, so there is a risk of problems with respect to tightness and operational reliability in view of the differing thermal behaviour of metal and plastic.

A transition element for connecting a fitting to a plastic pipe is known from DE 88 13 202 U1. In this transition element once again, the metal threaded bush is provided radially on the interior and on the exterior with grooves into which the plastic flows during injection moulding. A sealing ring is furthermore arranged in at least one groove. No special measures are taken to obtain initial elastic compression of the sealing ring after injection moulding of the plastic and to guarantee the entire service life.

Finally, DE 32 46 768 C1 discloses a gas- and liquid-tight connection between a plastic body and a metal body embedded therein by circulating a plasticised moulding compound under pressure. The metal body is provided on its outer face with at least one circumferential groove in which a sealing ring filling the groove in the axial direction is arranged. This groove is formed in such a manner that it has an expansion volume not filled by the sealing ring in the region of its groove base. The sealing ring is supposed to expand into this expansion volume during the injection moulding of the plastic, where it develops its resilience required for sealing after the hardening of the plastic. The said expansion volume must be provided by special measures. If the groove is designed to open radially towards the exterior in a wedge-shaped manner, quite considerable static friction forces have to be overcome during injection moulding and it is not immediately guaranteed that the required initial elastic compression of the sealing ring will be achieved. As the sealing ring projects partially from the groove during the injection moulding of the plastic, there is a risk that the sealing ring will be partially removed from the groove by the pressure of the plastic during the injection moulding of the sealing ring, so that plastic will

reach the groove base and reliable sealing will not ultimately be achieved.

Departing from this, the aim of the invention is to develop a transition piece of this kind in such a manner that the safety requirements with respect to gas-tightness and/or liquid-tightness will always be met with a reliable construction. Manufacture should also involve low expenditure with regard to large piece numbers, while the transition piece should nevertheless guarantee reliable sealing for a long service life taking account of high temperature variations and the forces acting upon it. The transition piece should be assembled from simple components and a low quantity of material should be required with low weight.

This problem is solved according to the characterising features of claim 1.

The proposed transition piece is characterised by a reliable construction and a simple design. At least one side wall of the annular groove is arranged in such a manner that the groove width increases in the direction of the groove base. During the manufacture, in particular the injection moulding of the plastic part, deformation of the elastic sealing ring takes place essentially only in the radial direction. Deformation of the sealing ring in the axial direction and resulting frictional forces during deformation and a reduction in the radial compression are virtually prevented. Instead, the injection pressure in the annular groove is used essentially only for radial compression of the O-ring, thereby guaranteeing a high, reliable sealing effect. The insert is advantageously in the form of a threaded insert to allow for more simple

connection to a pipe made of metal. The mention of the threaded insert by no means limits the invention in this connection, as the insert can also be designed, e.g. as part of a bayonet joint or the like in order to allow for connection to a metal pipe. The insert is manufactured by essentially rotationally symmetrical machining, in particular on appropriate automatic lathes or the like, resulting in considerable manufacturing and cost advantages.

The inclination of the side wall and preferably both side walls of the annular groove and the mean spacing of the side walls are adapted to one another taking account of the core diameter of the sealing ring, so that the sealing ring bears essentially only in a linear manner against the conically inclined side wall or walls, thereby preventing plastic from circulating and penetrating into the region of the groove base during injection moulding. As a result of the conical design of the side walls and the adaptation of the angle of inclination, the sealing ring bears virtually only in a linear manner against the side walls over the circumference and planar contact is substantially excluded. During the injection moulding of the plastic part and the subsequent compression of the sealing ring, the radial movement of the outer face of the sealing ring on the side wall of the groove is substantially a rolling movement, wherein there is virtually no adhesive force to overcome and the injection pressure can ultimately be concentrated in an optimum manner on the radial deformation of the elastic sealing ring. After manufacture, the plastic part set in the annular groove is locked in the annular groove as a result of the inclination of at least one side wall proposed according to the invention. As the width of the annular groove is smallest in the region of its circumferential opening, the

plastic part set in the annular groove forms a wedge which counteracts undesired radial expansion and thus relaxation and reduction of the sealing effect of the sealing ring. Permanent compression of the sealing ring is always guaranteed, even taking account of the pressure and high temperatures prevailing in the pipe.

The threaded insert can consist equally of metal, in particular brass or red brass, and of plastic, which cannot or can only partially form an immediate tight connection with the plastic part as a result of melting or fusion during injection moulding. The plastic part can equally be designed as a sleeve for connection to a plastic pipe and as part of a fitting for a container or the like. CPVC or a comparable plastic characterised by good thermal stability and high strength is preferably used for the plastic part. The proportion of post-chlorinated PVC or of plastic in general in the overall volume of the transition piece is substantially higher than that of the threaded insert, this being advantageous from the point of view of the quantity of material used and overall weight. Although the use of CPVC has proven to be particularly advantageous nowadays, there is no limitation of the invention in this respect. Therefore, express reference is made at this point only by way of example to polypropylene and polyethylene and comparable plastics from which the plastic part can be manufactured in accordance with the prescribed conditions of use.

An anti-rotation device, in particular in the form of a hexagon, is furthermore provided in an advantageous manner and is advantageously arranged downstream of the sealing ring in the direction of compression. The sealing by means of the

sealing ring is arranged upstream of the anti-rotation device and/or the longitudinally non-positive connection between the plastic part and the threaded insert, thereby reliably preventing the moulded-in plastic part from being lifted. The said hexagon or the like can furthermore be brought out of the region of the plastic part, thereby allowing for the application of a suitable tool in order to prevent stress between the plastic part and the threaded insert during assembly.

In a particularly advantageous embodiment, the annular groove is defined at one side by a retaining ring which is connected rigidly and permanently to the transition piece, in particular via a threaded connection or a press fit. An additional stop can furthermore be provided within the scope of this invention so that the retaining ring and the transition piece are held together by the locking force of the injection moulding machine. Before the retaining ring is connected to the transition piece, the sealing ring can be slipped over the free end of the transition piece and positioned on the latter, a simple rolling movement being effected. As the core diameter of the sealing ring is greater than the width of the annular groove in the region of the groove opening, the two-part design prevents the sealing ring from being forced through the narrow groove opening and possibly being damaged. There is no risk of the outer wall of the sealing ring being corrugated or sitting in folds as a result of torsion in the annular groove, on the one hand, allowing plastic to flow past the sealing ring and penetrate into the groove base during injection moulding and, on the other hand, jeopardising reliable sealing. Precise, defined alignment of the sealing ring is guaranteed and the problems arising when the sealing ring is slipped on and

inserted with radial deformation are prevented. Furthermore, this results in quite considerable manufacturing advantages as the sealing ring can be slipped on to the transition piece by a pure axial movement by means of simple automatic machines and the retaining ring can then be connected in a problem-free manner to the transition piece, in particular in the end region thereof.

According to a further embodiment, the sealing ring is arranged in the annular groove with minimal initial compression. This initial compression is advantageously in the region of between 1 and 3 % of the internal diameter of the sealing ring. This ensures that the sealing ring sits well in the annular groove, taking account of any manufacturing tolerances, although, on the other hand, in practice, it is not yet deformed prior to the action of the plastic during the manufacture of the plastic part. It should be noted that conventional sealing rings, in the form of O-rings are inserted into the associated grooves with comparatively high initial compression, considerable extension being present in the circumferential direction. The only minimal initial compression according to the invention ensures that, in practice, the entire possible deformation of the sealing ring takes place in the radial direction during the manufacture or injection moulding of the plastic part.

Other special features and embodiments of the invention are given in the subclaims and in the subsequent description.

The invention will now be described in more detail with reference to the embodiment illustrated in the accompanying drawings, in which:

Figure 1 is an axial longitudinal section through the transition piece,

Figure 2 shows the threaded insert and the sealing ring prior to assembly and encapsulation with plastic, and

Figures 3 - 5 show the phases of the deformation of the sealing ring during manufacture on an enlarged scale.

Fig. 1 is an axial longitudinal section showing the transition piece containing an insert in the form of a threaded insert 2 and a plastic part 4. The threaded insert 2 has an internal thread 6, although it could also be provided on the exterior at the free end 8 with an external thread in a corresponding manner. For the sake of simplicity, only the threaded insert 2 will be discussed hereinafter, although the insert can also have other connecting means instead of the thread 6. The plastic part 4 partially surrounds the threaded insert 2 and contains a sleeve 10 which is designed in the known manner for connection to a plastic pipe. The outer face of the plastic part 4 can also optionally be designed for connection to a plastic pipe.

The threaded insert 2 is provided on its exterior with an annular groove 12 with an elastic sealing ring 14. The side walls of the annular groove 12 are inclined in such a manner that the width in the direction of the longitudinal axis 16 is greater at the groove base 18 than in the region of the groove opening 20. The elastic sealing ring 14 compressed essentially only radially during the injection moulding of the plastic part 4 is locked by the plastic entering the annular groove and

anchored there in a wedge-shaped manner as a result of the inclination of at least one side wall of the annular groove, inadmissible relaxation thereby being prevented.

The second end 22 of the annular groove 12 surrounded by the plastic part 4 is formed, on the one hand, by a flange 24 of the threaded insert 2 and, on the other hand, by a retaining ring 26. The flange 24 is an integral part of the threaded insert 2, while the retaining ring 26 constitutes an additional component which is permanently secured to the end 22 of the threaded insert, in particular via a press fit. The sealing ring 14 can be precisely positioned in a problem-free manner in the region of the second end 22 in that it is slipped on in a simple axial manner by virtue of the two-part design of the threaded insert 2 and the retaining ring 26. This reliably prevents rotation of the sealing ring with the formation of folds or warping on its outer face and the resulting risk of leaks. Once the sealing ring 14 and the retaining ring 26 have been slipped on axially, the central plane of the sealing ring 14 is situated essentially in a radial plane perpendicular to the longitudinal axis 16.

The threaded insert 2 is provided on its interior at its second end 22 with a stop 28 which reliably prevents a metal pipe from being screwed in too far or possible damage to the plastic part 4. The threaded insert 2 and the retaining ring 26 are rotationally symmetrical turned parts which can also be manufactured on automatic machines with no special production costs. The plastic part overlaps the flange 24 at its rear face directed towards the end 8, where it bears against an axial face 29 of the flange 24, so that axial fixing is guaranteed in an advantageous manner by means of the flange 24.

The threaded insert 2 is provided on its exterior at its free end 8 with a hexagon 30 for a tool, so as to prevent mechanical stress and, in particular, disadvantageous torque of the plastic part 4 when a pipe is screwed into the internal thread 6. A ring 32 integral with the threaded insert 2 is advantageously provided approximately in the centre of the threaded insert 2 with an end face 34. This end face 34 advantageously forms the bearing surface for defined alignment of the threaded insert 2 with respect to an injection mould or the like for the manufacture of the plastic part 4. The end face 34 of the ring 32 is thus situated in the same plane as an end face 36 of the plastic part 4. The threaded insert 2 is provided on its exterior between the ring 32 and the flange 24 with a second hexagon 38 serving to prevent rotation of the plastic part 4 relative to the threaded insert 2. Radial blind bores, knobs or the like for preventing rotation could be arranged in a corresponding manner on the outer face of the threaded insert. This anti-rotation device is arranged downstream of the sealing ring 14 in the form of an O-ring in the direction of compression. The upstream sealing ring 14 therefore prevents any lifting of the moulded-in plastic part from the anti-rotation device. The plastic part 4 is provided on its interior with an annular collar 40 bearing against the outer face of the stop 28, the internal diameter of which is essentially identical to that of the stop 28 and/or of the pipes to be connected together. This provides advantageous flow conditions and prevents the accumulation of deposits, dirt and the like.

Fig. 2 is an exploded-type view of the threaded insert 2, the sealing ring 14 and the retaining ring 26. Prior to assembly, the sealing ring 14 has an internal diameter 42 which is only

slightly smaller than the external diameter 44 of the threaded insert 2 in the region of the aforementioned annular groove. This means that only minimal initial compression is obtained, from 1 to a maximum of 3 % of the internal diameter of the sealing ring 14, which is therefore only deformed to a minimal extent prior to the action of the plastic. The retaining ring 26 has an inner face 46 which forms a press fit together with the associated outer face 48 of the threaded insert 2. Adjacent to the outer face 48, the threaded insert 2 is provided in a particularly advantageous manner with an annular collar 50 which forms a stop when the retaining ring 26 is slipped on. The axial width of the annular groove can therefore be predetermined by means of the annular collar 50. The stop, in this case in the form of an annular collar 50, is essential for those embodiments of the invention in which the retaining ring is fixed in a defined manner on the threaded insert by the locking force of the injection moulding machine.

The principle of the deformation and fixing of the elastic sealing ring 14 in the annular groove 12 of the threaded insert 2 is described in more detail with reference to Figures 3 to 5. The annular groove 12 is arranged on the outer circumference of the threaded insert 2, a one-piece design being shown instead of the retaining ring and both side walls 52, 53 being part of the threaded insert 2. It will be clear, according to the above statements, that the side wall 53 can advantageously be arranged on the separate retaining ring. Both side walls 52, 53 are inclined at an angle 56 relative to a radial plane 54. This angle 56 is between approximately 10 and 25, preferably between 15 and 20 angular degrees. The width 58 at the groove base 18 is greater than the width 60 in the region of the groove opening 20. As can be seen from Fig. 3, the core

diameter 62 of the sealing ring 14 is considerably greater than the width 60 of the groove opening 20. The core diameter 62, the inclination of the side walls 52, 53 and thus the mean width of the groove 14 are adapted to one another in such a manner that the sealing ring 14 bears essentially only in a linear manner against the side walls 52, 53 and the groove base 18 prior to encapsulation. In this state, the sealing ring 14 is in practice not significantly deformed in either the axial or the radial direction and essentially has a circular cross-sectional surface. The external diameter of the sealing ring 14 is advantageously no greater than the external diameter of the annular flange or in general of the threaded insert 2 in the region of the annular groove 12.

Fig. 4 is a diagrammatic representation of the beginning of the encapsulation of the threaded insert 2 with the plastic of the plastic part 4 to be produced. The sealing ring 14 in practice not yet deformed up to this point is then deformed almost exclusively in the radial direction by the pressure applied during the injection moulding of the plastic until it finally assumes the elastically deformed approximately oval shape shown in Fig. 5. As a result of the inclination of the side faces and the adaptation of the mean groove width to the diameter of the sealing ring 14, there is substantially only a rolling movement and/or sliding movement on the side walls 52, 53 of the annular groove 12 during the radial compression and deformation of the sealing ring 14, thereby preventing disadvantageous static friction. The injection pressure applied is thus used essentially for radial compression of the sealing ring 14.

As can be seen from Fig. 5, plastic is forced into the annular

groove 12 in the region of the groove opening during injection moulding, where it forms a wedge-shaped ring 64. According to the invention, this wedge-shaped ring 64 is an integral part of the plastic part 4 and guarantees reliable fixing of the deformed sealing ring 14 in the annular groove 12 and permanently counteracts inadmissible relaxation of the sealing ring 14. This applies above all when taking account of temperature variations and resulting variations in the dimensions of the annular groove and the plastic. Radial compression of the sealing ring is permanently guaranteed by the wedge-shaped fixing. It is moreover particularly important that this permanent compression is additionally supported by the different coefficients of thermal expansion of metal and plastic. As the plastic expands more than the metal threaded insert in the event of an increase in temperature, the increase in the volume of the plastic releases radial clamping forces on the sealing ring 14 in the wedge-shaped region in a particularly advantageous manner.

In the embodiments described hereinabove, the annular groove 12 has a symmetrical cross-sectional surface, both side walls 52, 53 being inclined conically at the same angle relative to the radial plane. Those embodiments in which optionally only one side wall is inclined at a correspondingly large angle relative to the radial plane are also within the scope of the invention, although a wedge-shaped ring guaranteeing firm anchoring and permanent compression of the sealing ring 14 in the annular groove 12 is formed by the plastic penetrating into the annular groove and acting on the sealing ring during injection moulding in all embodiments.

In the embodiments described hereinabove, the plastic part 4

surrounded the threaded insert 2 externally, the annular groove with the sealing ring being arranged in the region of the outer face of the threaded insert. The point of intersection of the side walls 52, 53 of the annular groove was thus situated on a larger radius outside the annular groove 12. In addition, or alternatively, the threaded insert 2 can also be provided in the region of its inner face with a corresponding annular groove with a sealing ring, the side walls of the internal annular groove intersecting radially on the interior close to the longitudinal axis 16. A radially outwardly directed pressure will thus result in corresponding deformation of the sealing ring during the injection moulding of the plastic part 4.

LEGEND

2	threaded insert / insert
4	plastic part
6	internal thread
8	free end of 2
10	sleeve
12	annular groove
14	sealing ring
16	longitudinal axis
18	groove base
20	groove opening
22	second end of 2
24	flange
26	retaining ring
28	stop
29	axial face
30	hexagon
32	ring
34	end face of 32
36	end face of 4
38	hexagon
40	annular collar
42	internal diameter of 14
44	external diameter of 18
46	inner face of 26
48	outer face of 2
50	annular collar
52, 53	side wall
54	radial plane
56	angle

58 width of 18
60 width of 20
62 core diameter of 14
64 wedge-shaped ring



CLAIMS

1. Transition piece for pipes, in particular for connecting plastic pipes and metal pipes, containing a plastic part (4) and an insert (2), in particular an insert provided with a thread (6), with an annular groove (12) in which an elastic sealing ring (14) surrounded by the plastic of the plastic part (4) is arranged, characterised in that at least one side wall (52, 53) of the annular groove (12) is inclined in such a manner that the groove base (18) has a greater width than the groove opening (20) and that the elastic sealing ring (14) is fixed by plastic flowing into the annular groove (12) in the region of the groove opening (20) during the manufacture of the plastic part (4), in particular in the form of a wedge-shaped ring (64).
2. Transition piece according to claim 1, characterised in that, in particular, both side walls (52, 53) are arranged at an angle in the region of between 10 and 25, preferably between 15 and 20 angular degrees, relative to a radial plane (54).
3. Transition piece according to claim 1 or claim 2, characterised in that, prior to compression of the sealing ring (14), the latter bears against the side walls (52, 53) of the annular groove (12) and/or the groove base (18) in an essentially linear manner and/or that the sealing ring (14) is arranged in the annular groove (12) with only minimal initial compression, preferably in the region of between 1 and 3 % of the internal diameter of the sealing ring (14).



4. Transition piece according to one of claims 1 to 3, characterised in that one side wall (53) of the annular groove is arranged on a retaining ring (26) which is rigidly connected to the insert (2), in particular once the sealing ring (14) has been slipped on to it, the insert (2) preferably having an annular collar (50) as a stop for the retaining ring (26).
5. Transition piece according to claim 4, characterised in that the retaining ring (26) is connected to the insert (2) preferably in the form of a threaded insert by means of a press fit or a thread.
6. Transition piece according to one of claims 1 to 5, characterised in that the insert (2) has a ring (32) the end face (34) of which is situated essentially in the same radial plane as an end face (36) of the plastic part (4) and/or that the insert (2) is provided at its free end (8) with a hexagon (38) or the like.
7. Transition piece according to one of claims 1 to 6, characterised in that the insert (2) is provided radially on the interior, in particular in the region of its second end (22), with a stop (28) and/or that the plastic part (4) is provided radially on the interior with an annular collar (40) as a stop for the pipe or pipes to be connected.
8. Transition piece according to one of claims 1 to 7, characterised in that an anti-rotation device is provided between the insert (2) and the plastic part (4), in particular downstream of the sealing ring (14) in the direction of compression and/or that this anti-rotation



device contains a hexagon (38) preferably arranged on the outer face of the insert (2).

9. Transition piece according to one of claims 1 to 8, characterised in that, for axial fixing of the plastic part (4) relative to the insert (2), the latter has an axial face (29) overlapped by the plastic part arranged in particular on the rear face of the flange (24) directed towards the free end (8).
10. Transition piece according to one of claims 1 to 9, characterised in that the core diameter (62) of the sealing ring (14) in the uncompressed state is greater than the width (60) of the groove opening (20) of the annular groove (12) and/or that the plastic part (4) consists of chlorinated PVC or a comparable plastic and that the plastic part (4) has a higher, in particular a substantially higher, coefficient of thermal expansion than the insert (2) which consists in particular of metal.