

The invention relates to a process for producing an undetachable, hermetic connection for pipes in accordance with the generic concept of the main claim.

5 The production of an undetachable, hermetic connection for thin-walled pipes with a fitting surrounding the smooth-ended pipe ends, the bead-shaped ends of which fitting, which have a hook-shaped cross-sectional contour, each hold a sealing ring, whereby by means of an interchangeable holding device connected to an
10 actuating device and having articulated jaws, the bead-shaped end and at the same time the adjacent cylindrical region of the fitting is deformed plastically together with the pipe and the enclosed sealing ring is deformed elastically, is known (see the
15 brochure of Mannesmann Edelstahlrohre GmbH, issued 1988). The sealing function of the connection is achieved in that the sealing ring is elastically deformed by plastic deformation of the bead-shaped end and comes to bear in linear manner on the surface
20 regions of the bead-shaped end of the fitting and of the pipe which surround it over a certain portion of the periphery of the cross-section. In order to absorb the longitudinal forces which occur with corresponding internal pressure, the cylindrical region of the fitting
25 which is adjacent to the bead-shaped end is plastically deformed together with the pipe. In this cylindrical region a crimp having an approximately hexagonal cross-sectional configuration is formed on corresponding to the contour of the recess in the jaws of the pressing
30 tool. Upon pressing, the bead-shaped end and also the adjacent cylindrical region are deformed simultaneously by means of the actuating device. The jaws with the mouth-like recess are located in articulated manner in

the holding device and are closed either hydraulically or electromechanically in scissor-like manner by means of pressure rollers. With this known process, a connection is produced which is restricted to the low-pressure range of up to 16 bar and to a range of dimensions equal to less than 54 mm. A further restriction is provided by the fact that only specially produced conduit pipes with limited tolerances can be connected together using this process.

10 It is furthermore known from the non-generic patent GB-A-1,321,652 to press the bead-shaped end of a fitting which holds a sealing ring radially on to the pipe end by a suitably shaped tool which bears jaws. Upon the radial pressing, during which the diameter of the bead-shaped end is reduced, the sealing ring comes to lie on the pipe surface without the pipe being deformed as well. The bead-shaped end is axially stretched after pressing and a gap remains on the end face between the pipe surface and fitting. This pipe connection is not suitable for absorbing great longitudinal forces as a result of high internal pressures, since the fitting and pipe are not clamped together. The permanent elastic stress in the sealing ring is low since pressing only occurs radially and the bead-shaped end is axially stretched.

It is an object of the invention to modify the process already known and to provide an apparatus such that they make it possible to produce an undetachable, hermetic connection for pipes for internal pressures of more than 16 bar and by means of which even standard produced conduit pipes, in particular for the range of dimensions equal to or more than 54 mm, can be connected.

This object is achieved by the characterising features of the main claim. The process according to the invention is distinguished in that the jaws, once they have been placed on, are no longer moved in scissor-like manner, but simultaneously centrically to one another. Furthermore, the plastic deformation of the bead-shaped end is altered such that in addition to the predominant reduction in diameter of the apex region by radially acting forces, which has been usual hitherto, the regions adjoining the apex region are pressed towards one another by substantially axially acting forces, with the oblique region of the bead-shaped end which merges into the cylindrical region of the fitting being more strongly axially pressed than the end-face region. After pressing, in an ideal case these two regions adjoining the apex region are mirror-inverted to one another and form a parabolic contour together with the apex region. Both measures then result in the sealing ring being under a high stress distributed evenly over the periphery without squeezing after pressing and in each cross-sectional plane of the periphery a virtually equally large portion of the cross-section of the periphery of the sealing ring comes to lie on the surface regions of the bead-shaped end and of the pipe which surround it. Furthermore, the cylindrical region of the fitting adjacent to the bead-shaped end is reduced to a smaller diameter in virtually circular manner. The latter measure serves to absorb the longitudinal forces which become greater with increasing internal pressures.

For reliable long-term sealing at relatively high pressures, the sealing ring must be under as high an elastic stress as possible and this stress must be

evenly distributed across the periphery. If the stress is distributed unevenly, which was the case with the process known hitherto, the peaks and troughs of the stress distribution become evened out relatively quickly due to creep movements even after only a few hours' operation, so that an altogether lower level of stress is produced. The cause of the hitherto uneven distribution of the elastic pre-stress of the sealing ring was the irregular deformation of the bead-shaped end. The scissor-like closing movement of the jaws results in the portion of the bead-shaped end lying in the closing region of the jaws only undergoing a fraction of plastic deformation compared with the portion lying in the region of placement of the jaws.

Another feature of the invention is characterised in that the sealing ring in each cross-sectional plane of the periphery comes to bear in linear manner on the surface regions which surround it via a portion of the cross-sectional periphery of practically identical size. It can readily be seen that the sealing function is fulfilled better, the greater the portion of the cross-sectional periphery of the deformed sealing ring which comes to bear and the more evenly this contact is across the periphery. A value of 80% of the cross-sectional periphery of the deformed sealing ring is regarded as the bottom limit for contact. In this case it is essential to the invention for this great cross-sectional deformation of the sealing ring to take place without pinching. Pinched points would cause initial damage to the sealing ring and thus greatly reduce the service life. The critical pinched points are located in the resulting gore regions between the regions of the bead-shaped end which are pressed on to the pipe and the tangent pipe region.

The longitudinal forces which increase with increasing pressures and which endeavour to force the pipe out of the connection are absorbed according to the invention in that the diameter of the cylindrical region of the fitting adjacent to the bead-shaped end is reduced in
5 virtually annular manner. This means that the hitherto trapezoidal or hexagonal crimp is replaced by a virtually circumambient crimp. This substantially improves the clamping effect between the pipe and
10 fitting. The clamping effect can be increased still further in that additional circular crimps are pressed on to the cylindrical portion of the fitting.

The device according to the invention for performing the process has a holding device, provided with articulated
15 jaws, which is connected to an actuating device. The jaws no longer close in scissor-like manner, but move simultaneously and centrically relative to one another, comparably to the rollers of a roll bore. By means of this and the corresponding configuration of the contour
20 of the mouth-like recess of the jaw, the bead-shaped end of the fitting is plastically deformed evenly over the periphery.

The groove in the recess of the jaw formed correspondingly for the deformation of the bead-shaped
25 end has a smaller radius for the circular contour compared with the curved apex region of the bead-shaped end, so that the point of placement of the jaw is shifted further outwards. Thus the bead-shaped end of the fitting can be more greatly plastically deformed and
30 the regions adjoining the apex region can be pressed against one another more strongly in the direction of the sealing ring by axially acting forces, so that the

sealing ring is therefore more greatly elastically pre-stressed and the proportion of the cross-sectional periphery which comes to bear is increased.

5 For pressing on the virtually annular crimp, the recess
of the jaw has an end region which is half-shell-
shaped. Said end region is separated from the groove by
a cylindrical region, the internal diameter of said
intermediate region being smaller than that located in
10 the apex of the groove and being at least equal to or
larger than the external diameter of the cylindrical
part of the fitting. The axial extent of the
cylindrical intermediate region is selected such that
during the pressing operation the end region which forms
the crimp always lies in the cylindrical part of the
15 fitting. The size of the axial extent of the
intermediate region must be regarded as a compromise
between the increase in thickness of the jaw on one hand
and minimisation of the influence of the forming of the
crimp on the deformation of the bead-shaped end on the
20 other hand. If the intermediate region is made very
large, then although the end region is shifted further
into the cylindrical region of the fitting and thus the
unwanted influencing of the forming of the bead-shaped
end is minimised, the dimensions of the jaw are thereby
25 also increased, which at the same time means an
increase in the weight and hence increased difficulty in
handling.

In the case of an arrangement of two identical jaws, the
arcuate contour of the end region extends symmetrically
30 preferably over 130 degrees and then merges into a
section which forms the tangent. The maximum radial
extent of this end region, in this particular case in
the plane of division of the jaw, is equal to that of

the adjacent cylindrical region. In the closed state of the jaws, this end region yields a lemon-shaped cross-section in the case of two jaws. The predominantly annular contour of the end region produces a virtually circumambient crimp in the cylindrical region of the fitting, which crimp is substantially more effective in terms of its effect of clamping the fitting to the pipe than the trapezoidal or hexagonal crimp known hitherto. The two straight sections which adjoin it have the purpose that firstly a sufficiently high pressure can be exerted in the radial direction, which would not be possible in the case of complete enclosing of the cylindrical region of the fitting, and secondly space is provided into which the pressed material can flow away.

In order to improve the clamping effect between the fitting and pipe, additional annular crimps may be pressed on in the cylindrical part of the fitting. This may be done in that the actuating device is placed on for a second time and another crimp is pressed. In order that the crimp produced during the first pressing operation is not damaged, it is advantageous to place one end region in the recess of the jaw exactly into the crimp already pressed, and to press the additional crimp with the second end region. Another possibility consists in widening the jaw in the axial direction on one side and providing at least one additional end region arranged separately by means of a cylindrical region. Said second region which lies in the additional extent has the same contour and dimensions as the adjacent one. The advantage of this proposal resides in that two or more crimps can be pressed in the cylindrical part of the fitting with a single pressing operation. In such a case, one would dispense with the end region located on the other side of the groove,

which only has the purpose that the actuating device can be placed on at will. In order to facilitate handling in the case of the laying of pipes of different diameters, it is proposed to make the jaws replaceable in the holding device itself. This means that a range of differing pipe dimensions is covered with only one holding device. This proposal also makes it possible to lower the costs for a complete set of equipment.

The invention also proposes a new press fitting design which is distinguished in that it also ensures sealing at higher internal pressures in the range of above 16 bar and also commercially available conduit pipes having an external diameter of more than 54 mm can be connected reliably. To this end, the oblique section of the bead-shaped end was provided with an inclination within the range of 37 to 43 degrees, preferably 40 degrees. Hitherto, the inclination was only 34 degrees at most. This angle is relative to the enclosed angle between a horizontal running parallel to the longitudinal axis and the slope. With the more steeply inclined section, firstly the surrounding of the non-deformed sealing ring by the bead-shaped end is increased and it is now at least 127 degrees, preferably 130 degrees, and secondly the axial closing-up of this section on the sealing ring is facilitated. Another individual measure consists in increasing the diameter of the opening of the end-face section. For smaller pipe dimensions, i.e. less than 2", it should be at least 1.2 mm larger than the internal diameter of the cylindrical part, and at least 1.5 mm larger for pipes of 2" and more. With the press fittings known hitherto, the difference in diameter was 0.6 mm. The enlargement of the opening results in the unhindered pressing path being extended thereby before the end of the end-face

section can be supported on the pipe and thus the further plastic deformation of the bead-shaped end is hindered. The third measure consists in enlarging the cord diameter of the sealing ring and hence in enlarging the cross-section which is to be deformed. In order that this sealing ring of larger diameter can be accommodated in the bead-shaped end without indentation, the chamber volume in the bead-shaped end is increased in parallel thereto by increasing the apex diameter of the convex curved section of the bead-shaped end. If the cord diameter of the sealing ring is related to the internal diameter of the cylindrical region of the fitting, this yields a ratio of at least 0.1. For instance, for a pipe of 2" external diameter which is to be connected, this means that the round sealing ring has a cord diameter of at least 6.1 mm. When arranging the sealing ring of increased diameter, it must be taken into account that the internal diameter of the sealing ring which forms a torus must be at least equal to or larger than the internal diameter of the cylindrical part. This condition can only be met if the mean diameter of the sealing ring forming a torus is also increased simultaneously with the increase in the cord diameter, i.e. the midpoint moves further radially outwards and hence the convex curved section of the bead-shaped end of the fitting also moves in parallel. Only when these conditions are met is it ensured that when the smooth-ended pipe end is pushed in the sealing ring is not forced into the gore region of the bead-shaped end and thus there is the risk of pinching.

The decisive advantage of the improvement of the known press fitting resides in that, due to a carefully matched combination of individual measures which are simple to realise, a press fitting was provided which is

very well suited for the use of internal pressures in the range of above 16 bar and in particular for connecting commercially available conduit pipes with relatively large tolerances. The effect can be increased further if, as is proposed, the ratio of wall thickness to internal diameter of the cylindrical section is increased by 10% compared with the press fittings known hitherto. For reasons of the set dimensions of the pipes to be connected, this can only be brought about by increasing the wall thickness with the aim of increasing the external dimensions. The increase in wall thickness at this height reinforces the press fitting with respect to impermissible elastic widening without adversely affecting the plastic deformation of the bead-shaped end. Thus it is also possible to fix the desired contour of the deformed bead-shaped end more accurately, since the increased inherent rigidity prevents uncontrolled flowing-away or displacement of the material.

The proposed improved press fitting can be used for a wide variety of embodiments, be it as a bushing, as a T-piece, bend, reducing piece or the like. Any plastically deformable ferrous and non-ferrous metals and alloys may be used for manufacturing the press fitting.

With the process according to the invention and the associated device and also the press fitting according to the invention, it is possible to manufacture an undetachable, hermetic connection which also withstands an internal pressure of greater than 16 bar in accordance with specifications for acceptance, and by means of which pipes having a diameter which goes beyond the dimension of 54 mm can also be connected.

The greater plastic deformation of the bead-shaped end of the fitting and the higher elastic pre-stress, evenly distributed over the periphery, of the sealing ring additionally present the possibility of also using
5 for this connection conventional conduit pipe qualities with larger production tolerances compared with the specially produced conduit pipes.

The details of the device according to the invention are explained in greater detail in the drawings.

10 Fig. 1 shows a partial section of the front elevation of the device bearing two jaws

Fig. 2 shows a partial region of the section along the line A-A in Fig. 1,

15 Fig. 3 shows the detail of the contour of the groove in Fig. 2, and

Fig. 4 shows a half longitudinal section through the press fitting according to the invention, including the pipe inserted therein.

20 Figure 1 shows a partial section of the front elevation of the device according to the invention. In this embodiment, it consists of two identical jaws 1, 2, which in the closed state form a correspondingly shaped bore 3. The two jaws 1, 2 each have a recess 5, 6
25 extending over the thickness 4 (Figure 2) of the jaws 1, 2. The details of the recess 6 are shown in Figure 2, which shows a section along the line A-A in Figure 1 and in this embodiment coincides with the plane of division 7 of the two jaws 1, 2, said recess being identical to

the recess 5 of the overlying jaw 1. In the axial centre of the recess 6 of the jaw 2, there is located a groove 8 which has an arcuate contour and extends across the entire periphery of the recess 6. One cylindrical region 9, 10 adjoins either side of the groove 8 in the axial direction, the internal diameters of which regions are always smaller than the internal diameter located in the vertex of the groove 8. Said cylindrical region 9, 10 is adjoined by an end region 11, 12, the internal diameter of which is likewise smaller than the internal diameter located in the vertex of the groove 8. The contour of this end region 11, 12 can be seen in Figure 1. An arcuate section 13, 14, the radius 15 of which is smaller than that 16 of the adjacent cylindrical region 9, 10, extends symmetrically outwards on both sides from the centre of the recess 5, 6. One straight section 17, 17', 18, 18', which forms the tangent, in each case adjoins this arcuate section 13, 14. The maximum radial extent of the two end regions 11, 12 in this embodiment is located in the plane of division of the two jaws 1, 2 and is equal to the diameter of the adjacent cylindrical region 9, 10. The extent 19 of the arcuate section 13, 14 in this example is 130 degrees, and hence the extent 20, 20' of the two straight sections 18, 18' is 25 degrees in each case. The axial extension 21 of the end region 11, 12 should be at least 3 mm, the axial extent of the cylindrical regions 9, 10 being selected such that the end region 11, 12 during the pressing operation is always located in the cylindrical region of the fitting. The arrangement of a second end region is not necessary per se for the function of the pressing, but this additional end region has been provided for reasons of foolproofness of handling of the jaw by the fitter.

The detail Z of the contour of the groove 8 is illustrated in Figure 3 on an enlarged scale. This contour is composed of an arcuate section 23 which runs symmetrically from the vertex 22 of the groove 8 and a
 5 straight section 24, 24' adjacent thereto which forms the tangent and which merges via another section 25, 25', which is arcuate but has an opposed curvature, into the cylindrical region 9, 10. The extent 26 of the first arcuate section 23 in this example is 150 degrees, and that 27, 27' of the second arcuate section 25, 25' is 75 degrees. The line 31 connecting the two midpoints 28, 28' of the two arcuate sections 25, 25' intersects the plane passing through the vertex 22 of the groove 8 at a point 29 which is located within the radius
 10 extending from the vertex 22 to the midpoint 30 of the first arcuate section 23.
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Fig. 4 shows a half longitudinal section through the press fitting 41 according to the invention together with the inserted pipe 410. In this case, said partial
 20 part of the press fitting 41 illustrated may be an element of a bend, a T-piece, a bushing or a reducing piece. The press fitting 41 has an end 42 which is hook-shaped and bead-shaped in cross-section, and which is adjoined by a cylindrical region 43 extending in the
 25 longitudinal direction. The bead-shaped end 42 has an end-face straight section 44 in cross-section which lies virtually perpendicular to the longitudinal axis 45 of the fitting and the radial extent end of which forms a circular opening 46. The diameter 47 of said opening
 30 46 is at least 1.2 mm larger than the internal diameter 48 of the cylindrical region 43. For pipe dimensions of 2" and more, the diameter of this opening 46 is at least 1.5 mm. At the end of the longitudinal extent of the

cylindrical region 43 there is formed a crimped recess extending radially inwards, which acts as a stop for the pipe 410 being inserted.

5 An arcuate convex curved section 411 adjoins the end-face straight section 44 of the bead-shaped end 42, the internal contour 412 of which curved section is matched to the outer contour 413 of the sealing ring 414. An oblique straight section 415 adjoins said curved section 411, and then merges in rounded-off manner into 10 the cylindrical region 43. Said oblique section has an inclination 416 of 37 to 43 degrees, preferably 40 degrees. This achieves surrounding of the non-deformed sealing ring 414 by the internal contour 412 of the bead-shaped end 42 of 130 degrees. The cord diameter 15 417 of the sealing ring 414 is set as large as possible, and is at least 6.1 mm for pipe dimensions of 2" and more. Independently of this, the ratio of cord diameter 417 to internal diameter 48 of the cylindrical region 43 should be at least 0.1.

20 For assembly, it is necessary for the tolerance zone of the external diameter 418 of the pipe 410 being connected to be matched to that of the internal diameter 48 [of] the cylindrical pipe 43 such that even in the event of unfavourable minimum and maximum values 25 coinciding a clearance 419 remains between the pipe 410 and fitting 41. If in the most unfavourable case the tolerance zones were to overlap, the pipe 410 could not be inserted into the fitting 41. Appropriately for this, the radial dimensions of the sealing ring 414 are 30 to be selected such that the internal diameter 420 of the sealing ring 414 which forms a torus is at least identical to or somewhat larger than the internal diameter 48 of the cylindrical region 43. In the event

of too small an internal diameter 420 of the sealing ring 414, there is the risk that when the pipe 410 is inserted the sealing ring 414 will be pushed into the gore region of the bead-shaped end 42 and the sealing
5 ring 414 will then be pinched during pressing.



Claims

1. A process for producing an undetachable, hermetic connection for pipes (410), with a fitting (41) surrounding the smooth-ended pipe ends, the bead-shaped ends (42) of which fitting, which have a hook-shaped cross-sectional contour, each hold a sealing ring (414), whereby by pressing by means of a holding device connected to an actuating device and having a plurality of articulated jaws (1, 2),
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- 10 - the curved apex region (411) of the bead-shaped end (42) is reduced to a smaller diameter by forces acting substantially radially and
- the virtually rectilinear regions (44, 415) of the bead-shaped end (42) which adjoin the apex region (411) are deformed such that after pressing the cross-section of the bead-shaped end (42) is approximately parabolic and the sealing ring (414) is under elastic stress without pinching and comes to bear, over a large part of the periphery of the cross-section, in
- 15
- 20 linear manner on the surface regions of the bead-shaped end (42) and of the pipe (410) which surround it and
- at the same time a cylindrical region (43) of the fitting (41) which is at an axial distance therefrom
- 25 is plastically deformed together with the pipe (410), characterised in that
- the jaws (1, 2), once they have been placed on, are moved simultaneously and centrically to one another and the regions (44, 415) of the bead-shaped end (42) adjoining the apex region (411) are pressed on to one another by the forces which act substantially axially in such a manner that the oblique region (415) of the bead-shaped end (42) which merges into the cylindrical region
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(43) of the fitting (41) is pressed more strongly in the axial direction than the opposing end-face region (44) and runs in mirror-inverted manner thereto after pressing, and the sealing ring (414) is under a high elastic stress which is distributed evenly across the periphery without pinching and in each cross-sectional plane of the periphery comes to bear in linear manner on the surface regions of the bead-shaped end (42) and of the pipe (410) which surround it via a part of the cross-sectional periphery of practically identical size and the periphery of the cylindrical region (43) of the fitting (41) which is located at an axial distance from the bead-shaped end (42) is reduced in annular manner via separately located segment-like regions of almost identical size.

2. A process according to Claim 1, characterised in that the elastic deformation of the sealing ring (414) in each cross-sectional plane is at least 10%.

3. A process according to Claim 1 or 2, characterised in that the linear contact surface of the sealing ring (414) is at least 80% of the cross-sectional periphery of the deformed sealing ring (414).

4. A process according to one of Claims 1 - 3, characterised in that the periphery of the cylindrical region (43) of the fitting (41) which is located at an axial distance from the bead-shaped end (42) is reduced in annular manner via two opposing segment-like regions of equal size.

5. A process according to one of Claims 1 - 4, characterised in that a plurality of separately located



cylindrical regions (43) are reduced to a smaller diameter in almost circular manner.

5 6. A process according to one of Claims 1 - 5, characterised in that the diameter of the annular, segment-like regions of the deformed cylindrical region is at least 5% smaller than the initial diameter of the non-deformed cylindrical region (43).

10 7. An apparatus for carrying out the process according to one of Claims 1 - 6, consisting of an actuating device which is connected to a replaceable holding device which has a plurality of articulated jaws (1, 2), the mouth-like recesses (5, 6) of which, which extend across the thickness (4) of the jaw (1, 2) and form a bore when the jaws (1, 2) are closed,

15 - are provided with one groove (8) each having an arcuate contour and extending in the peripheral direction in the axial centre of the recess (5, 6) and

20 - with one cylindrical region (9, 10) each on either side of the groove (8) adjacent thereto in the axial direction, the internal diameter of which is smaller than that located in the vertex (22) of the groove (8) and at least equal to or greater than the external diameter of the cylindrical region (43) of the fitting (41), and also

25 - with an end region (11, 12) adjoining thereon, the maximum radial extent of which is less than that of the groove (8),

30 - the internal diameter of the groove (8) located in the apex plane always being smaller than the maximum external diameter of the bead-shaped end (42) of the fitting (41) and the maximum radial extent of the end region (11, 12) of the recess (5, 6) always being



smaller than the external diameter of the adjacent cylindrical region (43) in the initial state, characterised in that

5 the jaws (1, 2) are arranged in the holding device in such a manner that they are movable simultaneously and centrically to one another and the arcuate contour (23) of the groove (8) extends symmetrically from the vertex (22) over a range of between 140 and 160 degrees and at both ends one section (24, 24') each forming the
10 tangent and projecting somewhat beyond the diametral plane adjoins thereon and an arcuate section (25, 25') designed with an opposing curvature and extending over a range of between 75 and 85 degrees adjoins thereon, which section merges into the cylindrical region (9, 10) located between the groove (8) and the end region (11, 12), whereby the radius of the second arcuate section (25, 25') is smaller than that of the groove (8) and the vertical distance from the line (31) connecting the two midpoints (28, 28') of these sections to the vertex (22)
15 of the groove (8) is smaller than the radius of the groove (8) and the two end regions (11, 12) of the recess (5, 6) of the respective jaw (1, 2) are half-shell-shaped with an arcuate section (13, 14) extending symmetrically from the centre across a large peripheral region and a straight section (17, 17', 18, 18') forming the tangent adjoins thereon and the maximum radial extent of the end region (11, 12) is equal to that of the cylindrical region (9, 10) of the recess (5, 6) between the groove (8) and the end region (11, 12) and
20 the axial extent of the cylindrical regions (9, 10) is set such that the end region (11, 12) of the recess (5, 6) always lies in the cylindrical region of the fitting (41) during the pressing operation.



8. An apparatus according to Claim 7, characterised in that the internal diameter of the groove (8) located in the vertex (22) is at least 1.5% smaller than the maximum external diameter of the bead-shaped end (42) of the fitting (41).
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9. An apparatus according to Claim 7 or 8, characterised in that the radius of the second arcuate section (25, 25') is smaller than that of the groove (8) by a factor in the range of 1.5 to 2.5.

10. An apparatus according to one of Claims 7 - 9, characterised in that the holding device has two identical jaws (1, 2).
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11. An apparatus according to one of Claims 7 - 10, characterised in that the arcuate section (13, 14) of the end region (11, 12) extends symmetrically over a range of 120 to 140 degrees.
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12. An apparatus according to one of Claims 9 - 11, characterised in that the axial extent of the end region (11, 12) is at least 3 mm.

13. An apparatus according to one of Claims 9 - 12, characterised in that the jaws (1, 2) on one side extend beyond the end region (11, 12) in the axial direction and have at least one additional identical end region at a distance from the first end region (11, 12) and the region between the two end regions is cylindrical and has an internal diameter which is at least equal to or greater than the external diameter of the cylindrical region (43) of the fitting (41).
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14. A press fitting (41) for producing an undetachable, hermetic connection in pipes (410), which has at least one bead-shaped end (42) which is hook-shaped in cross-section and holds a round sealing ring (414) and a cylindrical region (43) adjoining thereon which extends in the longitudinal direction, which is provided at the end of its extent with a crimped indentation (49) acting as a stop for the smooth-ended pipe (410) which can be inserted, whereby in cross-section the bead-shaped end (42) has a straight section (44) on the end face which extends almost perpendicular to the longitudinal axis (45) of the fitting (41) and an adjoining arcuate, convex curved section (411) which has an internal contour matched to the external cross-sectional contour of the sealing ring (414), which section is adjoined by a straight section (415) inclined towards the longitudinal axis, which section merges in rounded-off manner into the cylindrical region (43), and the end of the radial extent of the end-face straight section (44) forms a circular opening (46), the diameter (47) of which is somewhat larger than the internal diameter (48) of the cylindrical part (43), characterised by the combination of the following features:
- a) the oblique straight section (415) of the bead-shaped end (42) has an inclination (416), relative to the horizontal, in the range of 37 to 43 degrees,
 - b) the diameter (47) of the opening (46) on the end-face end (44) in each case is at least 1.2 mm larger than the internal diameter (48) of the cylindrical region (43),
 - c) the ratio of the cord diameter (417) of the non-deformed sealing ring (414) to the internal diameter (48) of the cylindrical region (43) is



5 at least 0.1 and the internal diameter (420) of the non-deformed sealing ring (414) which forms a torus is at least equal to or larger than the internal diameter (48) of the cylindrical region (43).

10 15. A press fitting according to Claim 14, characterised in that for pipes (410) which are to be connected which have a diameter of 2" or more, the diameter (47) of the opening (46) on the end-face end (44) in question is at least 1.5 mm larger than the internal diameter (48) of the cylindrical region (43).

15 16. A press fitting according to Claim 14 or 15, characterised in that for pipes (410) which are to be connected which have a diameter of 2" or more the cord diameter (417) of the non-deformed sealing ring (414) is at least 6.1 mm.

20 17. A press fitting according to one of Claims 14 to 16, characterised in that the ratio of wall thickness to internal diameter (48) of the cylindrical region (43) is 10% larger than in the press fittings known hitherto.