

SPECIFICATION

Mandrel with retractable segments for shaping pipe ends

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The present invention relates to mandrels for producing connecting sockets at the end of thermoplastic pipes, particularly a mandrel with retractable segments permitting the shaping of an annular groove within a cylindrical pipe.

It is known for the connection to two ends of thermoplastic pipes to plastically shape one end of one pipe, so that the internal diameter is widened to such an extent that it corresponds to or is slightly larger than the external diameter of the other pipe. This method can advantageously be supplemented by an annular groove within the first widened end which is provided for receiving a gasket.

To this end mandrels with a shaping surface have been constructed, whose outer contours correspond to the inner surface of the pipe end to be widened and over which is firstly force-fitted a heat-softened end of a thermoplastic pipe. After cooling and hardening the thermoplastic material it is indispensable to ensure the retraction of the mandrel surfaces which have permitted the construction of the annular groove in order to permit the removal of the thus shaped pipe.

In general the known mandrels with retractable segments can be subdivided into two different categories having two rows of retractable segments which can assume an extended position in which the radially outer surface of the segments of both rows, arranged in alternating manner, form a continuous annular flange which projects radially from the shaping surfaces of the mandrel, and a retracted position in which the distance from the radially outermost surface to the mandrel axis is smaller than the radius of the shaping surfaces, the segments of both rows being axially displaceable, depending on the means used for actuating said first and second retractable segment rows.

There are firstly mandrels in which the retractable segments are pivotally mounted on a shaft which is perpendicular to the mandrel axis. In this case it is simple to move the retractable segments, leading to a simplification of the actuation means and ensuring reliable operation.

However every point on the radially outer surface of the retractable segments describes a circular arc during the extension and retraction, which makes it impossible to construct annular grooves with a rectangular or some other complicated shape.

In order to obviate the above deficiencies mandrels have been constructed in which the retractable segments are successively radially and axially moved. To retract the segments the segments of one row are radially retracted

and then axially displaced. This displacement then permits the retraction of the second row of segments. In this way it is possible to produce annular grooves with different shapes.

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However, in the case of mandrels with retractable segments of this type the actuating means are very complicated and comprise dovetail guides and cones. This often leads to faulty operation, particularly due to the thermal stressing to which the mandrel is exposed.

The problem of the present invention is to realise a mandrel with retractable segments which makes it possible to radially retract and extend segments, which has simple and space-saving means for actuating and guiding the segments making it possible to produce sockets in which the ratio of reinforcing seam depth to pipe diameter is unfavourable.

According to the invention there is provided a mandrel with at least two shaping cylindrical surfaces which are serially arranged in the direction of the longitudinal axis of the mandrel and which are axially separable on separation of a leading end of the mandrel and a mounting flange of the mandrel, the mandrel having a first series and a second series of movable segments capable of assuming a first extended position in which the segments of the two series are arranged alternately in sequence around the mandrel periphery and in which the radially outer surfaces of the segments form, around the mandrel periphery, a continuous torus which separates the two cylindrical shaping surfaces from one another, and the segments of the two series being capable of assuming a second retracted position in which the radial distance from the radially outer surface thereof to the longitudinal axis is smaller than the radius of either of the cylindrical shaping surfaces, and the segments of one series can be axially displaced with respect to those of the other series,

actuating means being provided for effecting the extension and retraction movements of the segments, wherein the actuating means comprise a first bush and a second bush which are arranged in an axially movable manner and on which the segments of the first and second series of segments are respectively mounted, with each segment being mounted on the corresponding bush by means of a pair of parallel links which are pivotally attached on the corresponding bush at axially spaced locations, support surfaces, orthogonal to the mandrel axis, being provided for the axial location of the segments during their radial movement, together with means for displacing the first bush and the second bush.

Preferably, one of the shaping cylindrical surfaces is formed on a cylindrical member fixed to the leading end of the mandrel and the other of the shaping cylindrical surfaces is movable with a slide which is displaceably

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arranged on the second bush, a spring acting between the slide and the second bush and urging the slide in a longitudinal direction towards the leading end of the mandrel.

- 5 The slide may be connected to a stop device which limits its movement in the direction towards the leading end of the mandrel. The stop device may comprise a rod extending in a longitudinal direction, the rod being
10 fixed to the slide and extending through a bore in the mounting flange, and an adjustable nut screwed on the end of the rod projecting from the flange.

The present invention will be explained in greater detail hereinafter by way of example and with reference to the drawings, wherein show:

Figure 1 a section along the line I-I of Fig. 2 showing the mandrel with retractable segments in the extended position,

Figure 2 a section along the line II-II of Fig. 1,

Figure 3 a section along the line III-III of Fig. 4 showing the mandrel of Fig. 1 with retractable segments in the retracted position,

Figure 4 a section along the line IV-IV of Fig. 3.

Figure 5 the mandrel according to Figs. 1 and 2 in section along the line V-V of Fig. 4.

- 30 The mandrel according to the invention firstly contains a mounting flange 16 provided for mounting the mandrel on the socket machine and a hollow central shaft 25 fixed to the flange. A mounting plate 5 to which is
35 screwed by means of screws 31 a fixed cylinder 6 is located at the free end of the central shaft. The mandrel end comprises a guide sleeve 2 connected to fixed cylinder 6 by means of a screw 17 and whose outer cylindrical surface 80 has a radius corresponding
40 to the internal radius of the pipe to be shaped. The termination is formed by a cover 1, which is bevelled at 33 in order to facilitate the sliding of the pipe onto the mandrel.

45 The fixed cylinder 6 carries a first shaping surface 34, which is fixed and cylindrical and whose external diameter corresponds to the desired internal diameter for the shaped zone of the pipe end to be socketed.

- 50 The mandrel according to the present invention also has two rows of retractable segments 11 and 20. The radially outer surface 82 or 83 of said retractable segments corresponds to the desired reinforcing seam configuration
55 and in the extended position shown in Fig. 1 the segments of the first row 11 are arranged around the mandrel, alternating with the segments of the second row 20, as is apparent from Fig. 2, so that a continuous torus is
60 formed which bounds the first shaping surface 34.

Preferably to facilitate the positioning of the segments of the different rows lateral surfaces 35 are provided thereon which converge to
65 wards the inside of the mandrel for the seg-

ments of the first row 11 and diverge for the segments of the second row 20. Two joints 12 and 36, displaced in parallel and axial manner, are pivotably mounted on the one
70 hand on each retractable segment 11 and 20 by means of pins 10 and 37 and on the other on a first or second actuating bush 9 and 27 by means of pins 38 and 39.

- The actuating bush 9 is actuated by means
75 of a central actuating rod 19 which can move axially in the bore 40 of the hollow central shaft 25 and the flange 16, the end 84 opposite to the end projecting from flange 16 is connected by means of a disc 3 to one of
80 the ends of at least one transmission rod 4, whose secured end 85 is screwed into the first actuating bush 9. The second actuating bush 27 is actuated by at least one offset rod 15, which can be axially displaced in a bore
85 86 of flange 16. One end of rod 15 projects from flange 16, whilst the other end with a shoulder 42 is connected in fixed manner to the second actuating bush 27 by means of a screw 43.

- 90 A slide 30 which can be moved on the actuating bush 27 carries a second shaping surface 44 which, in the embodiment of Fig. 1, is connected in fixed manner to slide 30. The outer periphery of the second shaping
95 surface is cylindrical and has the same diameter as the shaping surface 34. A spring 14, fitted under pressure between slide 30 and actuating bush 27 forces the slide 30 in the direction of the first shaping surface 34 and
100 the second actuating bush 27 in the opposite direction.

A rod 21 parallel to the mandrel axis and whose one end 45 is screwed into slide 30 and whose other end passes freely through a
105 bore 46 of flange 16 and carries a nut 87 with lock nuts 88 for adjustment purposes serves to limit the movement of slide 30 in the direction of the first shaping surface 34.

- Preferably the compression spring 14 is
110 located in a bore 89 of slide 30 formed in the extension of the fastening screw 43 of the offset rod 15 on shoulder 42 of the second actuating bush 27, an axial extension 90 of said screw serving to guide and hold the coils
115 of spring 14.

In the extended position of the retractable segments shown in Fig. 1 the second shaping surface 44 is arranged in the extension of the outer periphery of the retractable segments.
120 The said periphery forms a continuous sleeve with the shaping surfaces 34 and 44 of the mandrel.

The opposite surfaces of the fixed cylinder 6 and the slide 30 carry the support surfaces
125 22 and 23, which are positioned orthogonally to the mandrel axis and which are provided for the axial retaining of segments 11 and 20 during their radial movement, as will be apparent from the subsequent description.

- 130 The fixed cylinder 6, which carries the first

shaping surface 34 is provided with an annular passage 18 in order to receive a heat-transferring liquid which is supplied or removed by two lines 24. These lines run

- 5 parallel to the mandrel axis, pass between the retractable segments and also through bores 50, 51 and 52 which are provided in the fixed cylinder 6, slide 30 and flange 16, as is apparent from Figs. 4 and 5.
- 10 A guide rod also shown in Figs. 4 and 5 runs parallel to the mandrel axis and one of its ends 91 is connected to cylinder 6 and its other end is connected to the flange 16, being freely received by a bore 53 of slide

- 15 30.
- Fig. 3 shows a mandrel with the segments in the retracted position in which, with respect to the position of Fig. 1, the first actuating bush 9 has been positioned internally with
- 20 respect to the first shaping surface 34 in the direction of the cover plate 1 of the mandrel. This first actuating bush 9 is received internally in a bore 92 provided in the fixed cylinder 6 and the second actuating bush 27
- 25 has been moved in the opposite direction until its shoulder 42 engages with the surface 55 of flange 16. A joint 8, which is on the one hand pivotably mounted on the pin 56 on each segment 11, on the other on the pin 28
- 30 on the fixed cylinder 6 pivotable on the plane of the two parallel joints 12 and in a direction parallel to the mandrel axis, ensures the axial maintenance of the retractable segments 11 in the retracted position.

- 35 According to the present embodiment of the invention joints 12 and 36 comprise fork members, whose arms 98 (Figs. 2 and 4) are arranged on either side of tongues 99 formed by the opposite ends of the actuating bushes
- 40 9 and 27 and mounted by means of pins 38 and 39. The end 100 thereof receives a pin 10 or 37.

- The surface 97 (Fig. 3) at the junction of arms 98 is constructed in such a way that an abutment which limits the radial retraction of segments 11 and 20 is formed by the mounting on the radial surface of the tongues 99.

- In order to bring about the movement of the retractable segments from the position
- 50 shown in Fig. 3 the central actuating rod is firstly actuated in the direction opposite to guide sleeve 2, as indicated by arrow 65. The first actuating bush 9 then moves in the same direction, which leads to the extension of
- 55 segments 11, which together with the first actuating bush 9 and the two parallel joints 36 form a deformable parallelogram and are axially retained by the joints 8.

- In a second phase a force is exerted in the
- 60 direction of guide sleeve 2 in accordance with arrow 60 on the offset rod 15, which brings about the displacement of the second actuating bush 27 in the direction of mandrel end 1. The slide 30 then accompanies this move-
- 65 ment due to the action of compression spring

14. When nuts 87 of the stroke limiting rod 21 abut against the wall 93 of flange 16, stops 59 and 61 of segments 11 and 20 engage gently with the support surface 22 or
- 70 23. The force in the direction of arrow 60 on rod 15 then acts further and spring 14 is compressed, which permits the second actuating bush 27 to move further in the direction of arrow 60, leading to the radial extension of
- 75 segments 20 which are held axially by support surfaces 22 and 23.

- The retraction of the mandrel segments according to the present invention from the position shown in Fig. 1 is also performed in
- 80 two phases.

- Firstly a force is exerted on rod 15 in accordance with arrow 66 in the opposite direction to the guide sleeve and this leads to the relaxing of spring 14 which holds the
- 85 slide 30 in position, whilst the second actuating bush 27 moves in the direction of arrow 66, which initially leads to the radial retraction of the retractable segments 20. When spring 14 is relaxed the slide 30 is in turn
- 90 brought against flange 16 and is carried along by the axial movement of segments 20 which are supported on the surface 23 of slide 30.

- It is then merely necessary to move the central actuating rod 19 in the direction of
- 95 guide sleeve 2, i.e. in the direction of arrow 70 in order to bring about the radial retraction of segments 11.

- It is readily apparent that the joints 8 could be replaced by equivalent means, e.g. springs
- 100 arranged in such a way that the retractable segments 11 are axially retained.

- Furthermore the second shaping surface 44 has been described as "fixed with the slide 30", but said members could also be constructed so as to slide on one another and be separately actuated. For example the second
- 105 shaping surface 44 can be connected in fixed manner with flange 16, whilst slide 30 is displaceably arranged within said surface. The
- 110 retractable segments 20 in the retracted position are then located inside the second shaping surface 44 during the axial return. In a similar manner the second shaping surface 44 could move freely on slide 30 in order to
- 115 cover the segments in the retracted position and in order in this position to form a direct extension of the first shaping surface 34.

- In the preceding description reference has been made to at least one offset rod 15 for
- 120 actuating the second actuating bush 27. In practice there will however preferably be a plurality of parallel rods uniformly distributed about the axis and which together with in each case one compression spring 14 permit
- 125 an optimum distribution of the forces exerted on the displaceable parts.

- It is also apparent that the construction of the mandrel with retractable segments according to the present invention permits the manu-
- 130 facture of sockets with reinforcing seams hav-

ing a considerable "reinforcing seam depth/pipe diameter" ratio, because an extension of the seam depth corresponds to an extension of the radial movement of the segments. Such an extension can be simply realised by increasing the axial movement of the actuating bushes and lengthening the parallel, axially displaced joints. Contrary to the known mandrels these changes only lead to a relatively small increase in the size of the actuating means and therefore considerably improves the above-mentioned ratio.

Furthermore, since all the actuating means, with the exception of the joints are moved in a purely axial manner it is easy to supply and remove a temperature-transferring liquid through pipes passing through bores in the fixed or only axially moving members and which pass between the joints.

The mounting flange 16 makes it possible to mount the mandrel according to the present invention on all machines equipped with means for actuating the ends of actuating rods 15 or 19 and which project from the wall 93 of flange 16, whereby this takes place in one of the sequences indicated hereinafter:

Return of the central actuating rod 19, followed by the insertion of at least one offset rod 15 to bring about the display of the retractable segments.

Return of at least one rod 15, followed by the insertion of the central actuating rod 19 to bring about the insertion of the retractable segments.

These actuating means are preferably hydraulic cylinders or compressed air cylinders.

As a variant it is possible to provide for the electrical heating of the mandrel by means of an annular heating resistor located in the passage 18 of fixed cylinder 6 and which receives the power supply through lines 24.

CLAIMS

1. A mandrel with at least two shaping cylindrical surfaces which are serially arranged in the direction of the longitudinal axis of the mandrel and which are axially separable on separation of a leading end of the mandrel and a mounting flange of the mandrel, the mandrel having a first series and a second series of movable segments capable of assuming a first extended position in which the segments of the two series are arranged alternately in sequence around the mandrel periphery and in which the radially outer surfaces of the segments form, around the mandrel periphery, a continuous torus which separates the two cylindrical shaping surfaces from one another, and the segments of the two series being capable of assuming a second retracted position in which the radial distance from the radially outer surface thereof to the longitudinal axis is smaller than the radius of either of the cylindrical shaping

surfaces, and the segments of one series can be axially displaced with respect to those of the other series, actuating means being provided for effecting the extension and retraction movements of the segments, wherein the actuating means comprise a first bush and a second bush which are arranged in an axially movable manner and on which the segments of the first and second series of segments are respectively mounted, with each segment being mounted on the corresponding bush by means of a pair of parallel links which are pivotally attached on the corresponding bush at axially spaced locations, support surfaces, orthogonal to the mandrel axis, being provided for the axial location of the segments during their radial movement, together with means for displacing the first bush and the second bush.

2. A mandrel according to Claim 1, wherein one of the shaping cylindrical surfaces is formed on a cylindrical member fixed to the leading end of the mandrel and the other of the shaping cylindrical surfaces is movable with a slide which is displaceably arranged on the second bush, a spring acting between the slide and the second bush and urging the slide in a longitudinal direction towards the leading end of the mandrel.

3. A mandrel according to Claim 2, wherein the slide is connected to a stop device which limits its movement in the direction towards the leading end of the mandrel.

4. A mandrel according to Claim 3, wherein the stop device comprises a rod extending in a longitudinal direction, the rod being fixed to the slide and extending through a bore in the mounting flange, and an adjustable nut screwed on the end of the rod projecting from the flange.

5. A mandrel according to any one of Claims 2 to 4, wherein a guide rod parallel to the mandrel longitudinal axis is fixed to the flange and extends through a bore formed in the slide.

6. A mandrel according to Claim 1, wherein a slide is axially displaceable relative to a sleeve providing said other cylindrical surface, and the sleeve is rigidly connected to the flange.

7. A mandrel substantially as herein particularly described and illustrated in the accompanying drawings.



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