

[54] **ANNULAR EXPANDING RING
STRUCTURE**

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[22] Filed: **Oct. 18, 1971**

[21] Appl. No.: **189,958**

[30] **Foreign Application Priority Data**

Oct. 22, 1970 Norway.....3996/70

[52] U.S. Cl.425/393, 425/469, 249/180,
249/184

[51] Int. Cl.**B29c 17/00**

[58] Field of Search.....425/392, 393, 397

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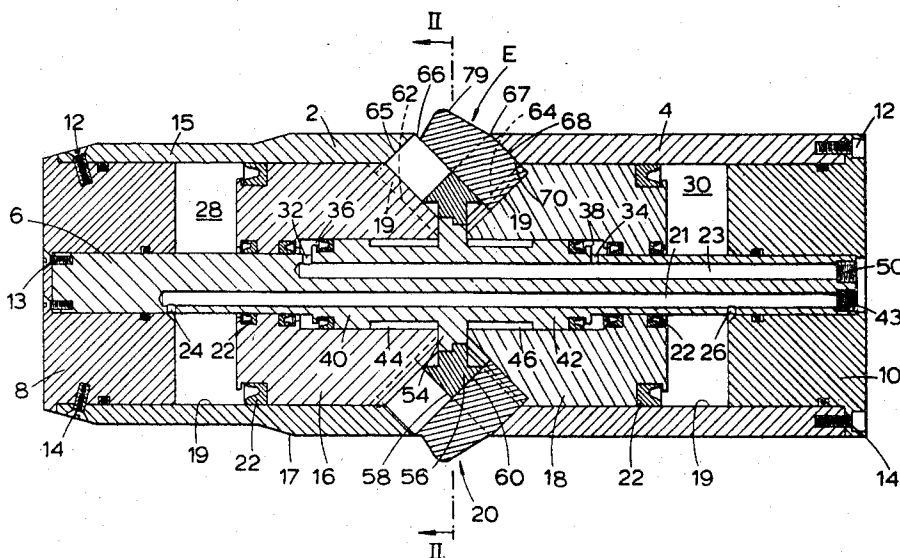
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[57] **ABSTRACT**

An annular expanding ring structure comprising a number of circumferentially arranged segments adapted to undergo partly radial movements relative to the central axis there-through. The segments are arranged in two complementary sets such that each of the segments in the ring structure is interposed with surface contact between the two adjacent segments of the other set in alternating fashion. Each of the segments is suspended in a cylindrical body constituting the support for the segments to be moveable in synchronized fashion along a straight axis lying in the respective one of two identical cones, one for each set. The cones have common axis and geometrically coinciding base circles, which circle constitutes the center plane of the ring structure. Each of the segments has two opposed plane sliding faces, and the average angle between the opposed side faces of each segment viewed in a plane normal to the central axis is $360^\circ : E$, wherein E is the total number of segments.

9 Claims, 7 Drawing Figures



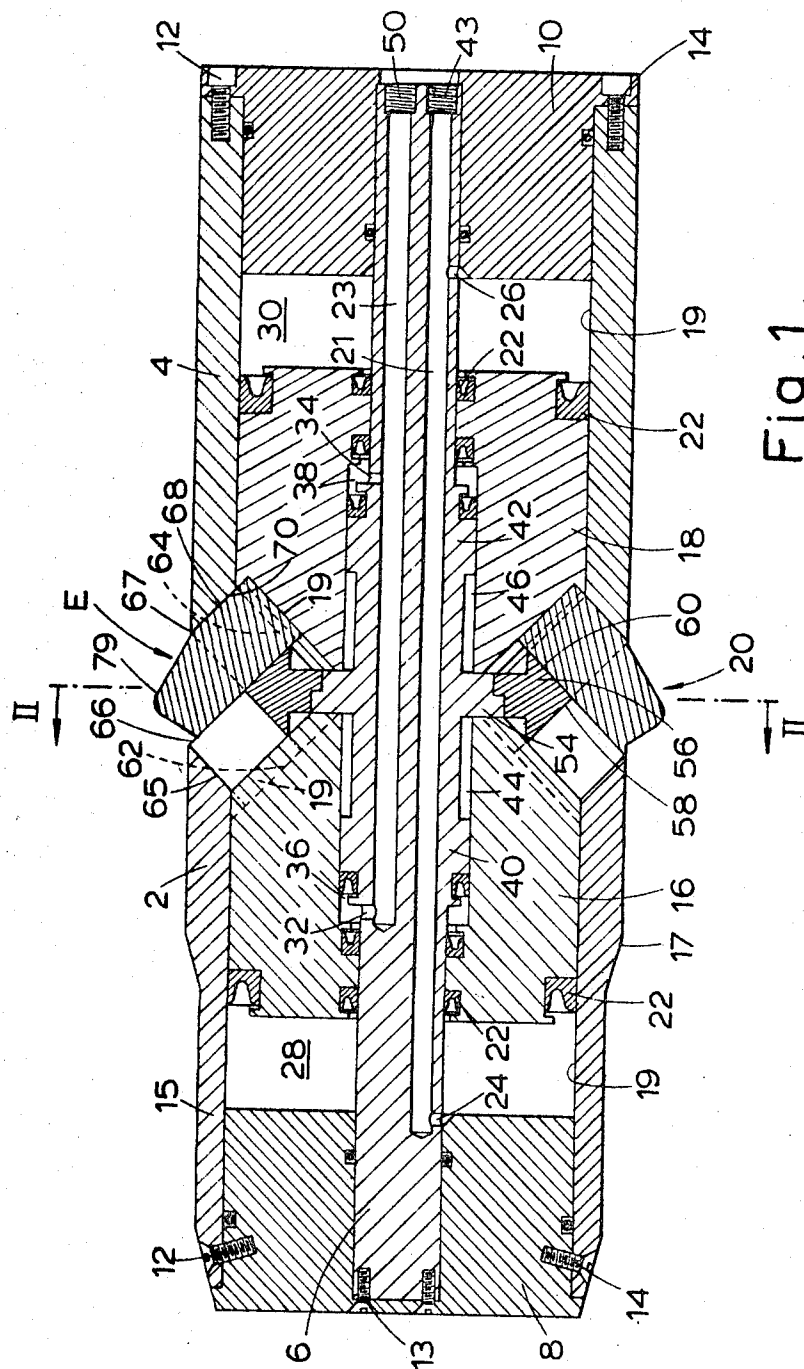


Fig. 1.

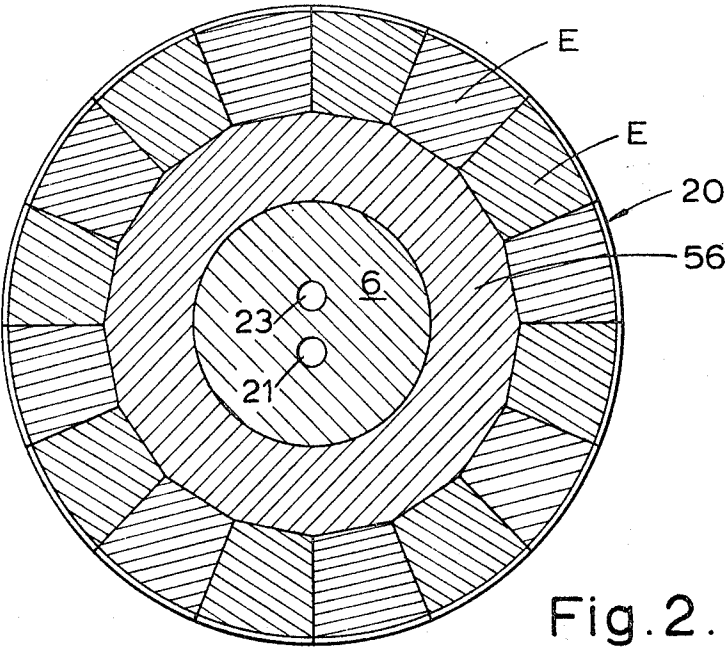


Fig. 2.

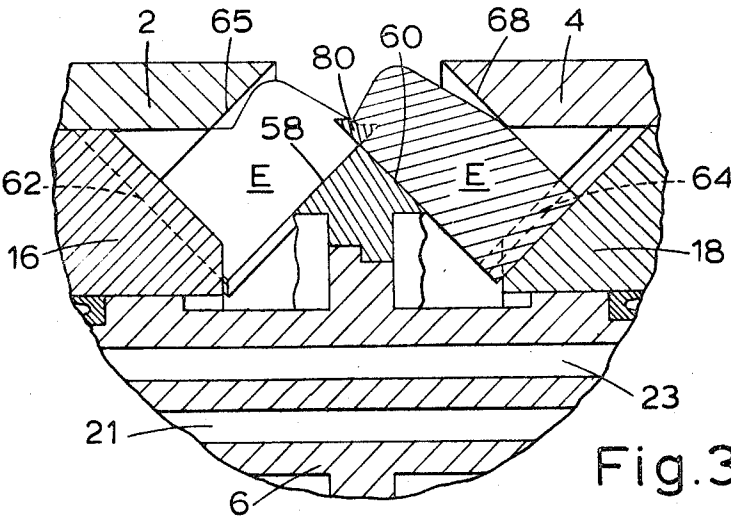


Fig. 3.

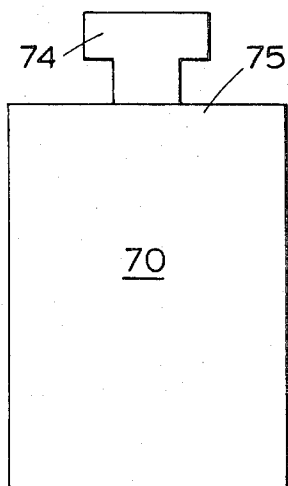


Fig. 4a.

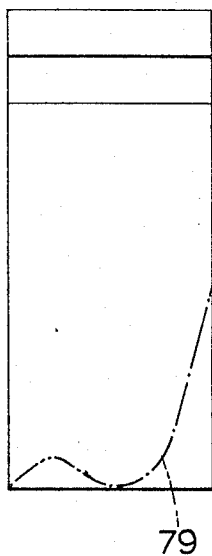


Fig. 4b.

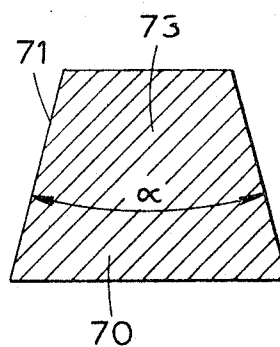


Fig. 4c.

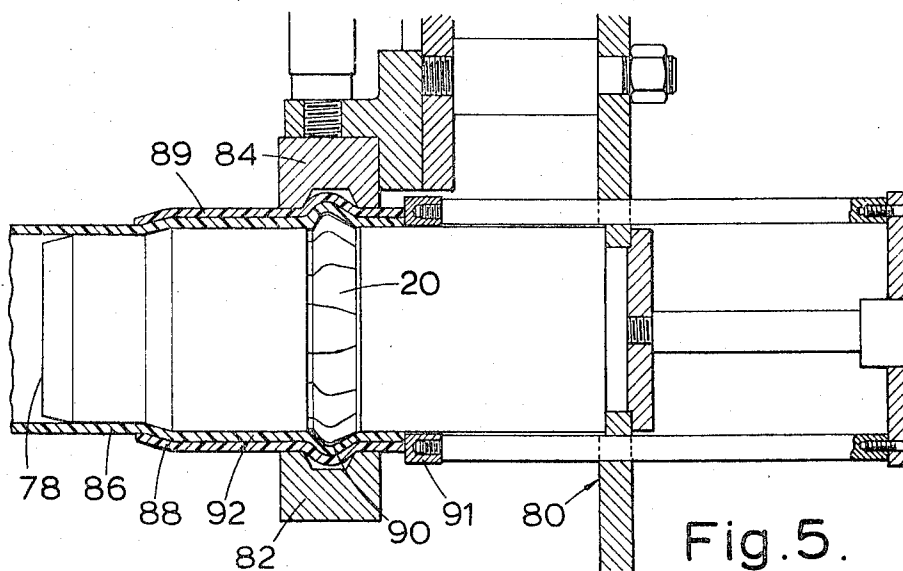


Fig. 5.

ANNULAR EXPANDING RING STRUCTURE

The present invention relates primarily to a so-called expansion head, more particularly an expanding ring structure which may be used for forming ringshaped grooves or recesses on the inside surface of pipes and the like, particularly plastic pipes, possibly in connection with simultaneous forming of a socket on the pipe.

The invention shall in the following be described in connection with the forming of grooves on the inside of plastic pipes or the like, but it shall be understood that the invention can be utilized for other objects and in connection with other kinds of materials, par example in the technique of moulding tube-shaped objects in plastics or metal.

In order to join plastic pipes it is desirable that, one of the pipe parts is provided with an internal groove for positioning a packing ring. The groove is usually provided on the inside of a socket formed on one of the pipe ends or on a particular transition socket having two grooves and which is threaded onto and thus joining the meeting ends of two complementary plastic pipe members whereby it is in a simple fashion provided a tight joint.

In connection with the present invention one utilizes the expansion head for providing said inside ringshaped groove at the end section of the pipe element A. A such expansion head comprises a cylindrically shaped body which is externally calibrated to the inside diametrical dimension of the socket element of the joint which is pressed into the pipe end subsequent to heating same. At a certain cross-sectional plane the expansion head is provided with expandable ring means which is utilized to form the desired ringshaped groove on the inside surface of the pipe or socket, usually in co-operation with an externally positioned complementary biasing means in the shape of clamping jaws or the like. The present invention relates more particularly the type of expansion heads wherein the ring means on same is constituted by a number of circumferentially arranged segments which form part of a mechanism housed in the cylindrical expansion head and may be moved radially outwards through a peripheral opening in the cylindrical surface in order to form a protruding ringshaped bead which during the expansion forms the groove by deforming the pipe wall material. When the groove or recess has been formed on the pipe, the external biasing means is removed, the expanded segments are retracted into the cylindrical body, whereafter the pipe — now provided with the desired groove — may be withdrawn from the head and cooled, if necessary.

In known expansion heads of this type the segments are usually supported such that they may be imparted the necessary radially directed movements, either by supporting the segments in sliding guides or the like, or by supporting the segments as pivotal lever arms, the segments otherwise forming parts in a synchronized powerdriven mechanism, frequently an hydraulic mechanism.

A severe drawback with known expansion heads of this type is that the expanded ring formed by the segments when these are moved out to their radially outermost position does not constitute a contiguous ring with an even surface, but are presenting smaller or greater spacings, steps, etc. there-between and/or the

adjacent parts of the cylindrical head body. This fact involves several drawbacks. Firstly, the groove formed in the pipe material will neither be even nor uniform. Furthermore, during the forming operation, fragments of the pipe material will protrude in between the separate segments and thereby into the inside space of the expansion head, a fact which involves several drawbacks, among others the various parts of the expansion head will sooner or later be clogged and thus will not be suitable to be used in a repeating production cycle since the expansion head, the segments etc. must repeatedly be cleaned, frequently in connection with disassembling the various parts constituting the expansion head. And as mentioned the groove formed in the pipe will necessarily present a more or less uneven surface. This involves that the groove must be subjected to a subsequent machining, grinding etc. in order to present a sufficient smooth surface. The surface will, however, frequently be uneven to a such degree that it is difficult to assure a liquid tight joint in connection with a packing ring, even through the groove is subjected to special finishing treatment. Known expansion heads furthermore have not satisfactory mechanisms such that the segments are imparted more or less uneven movement patterns resulting in corresponding inaccuracies simultaneously as the expansion head is subjected for large mechanical wear.

The principal object of the invention has thus been to provide an improved expansion head of this type and with a particular aim to provide an expansion ring which when expanded presents a uniform contiguous surface about the entire circumference.

The annular expanding ring structure in accordance with the present invention comprises a number of circumferential arranged segments adapted to undergo radial movements relative to the central axis therethrough, said segments arranged in two complementary sets, one and each of the segments in the ring structure interposed with surface contact between two adjacent segments of the other set in alternating fashion, one and each of the segments suspended to be moveable in synchronized fashion along a straight axis lying in the respective one of two identical cones having common axis and geometrically coinciding base circles, which circle constitutes the center plane of the ring structure, one and each of the segments having two opposed plane sliding faces, the average angle between the opposed side faces of each segment viewed in a plane normal to the central axis being $360^\circ : E$, wherein E is the total number of segments, operative to maintain one and each of the segments in mutual surface contact in all positions of the movement.

The invention comprises also a number of other new features which will appear from the following specification in connection with the accompanying drawings, wherein:

FIG. 1 is showing a central cross-sectional view along the line I—I in FIG. 2, and including the entire expansion head with all parts assembled.

FIG. 2 is showing a cross-sectional view along the plane II—II in FIG. 1, the segments in the expansion ring being in their expanded position. FIG. 3 is showing a view of a detailed section similar to FIG. 1 and which illustrates the segments in the retracted position.

FIGS. 4a, 4b and 4c show a plan view, a lateral view and an end view, respectively, of one separate segment as used in the shown embodiment for the invention, and

FIG. 5 illustrates the entire expansion head assembly the same being mounted in a clamp jaw tool with a plastic pipe in position in order to be worked with.

In all the Figures same reference numbers designate the same parts.

In FIG. 1, reference numbers 2 and 4 designate two along the center line S axially spaced cylinders or bushings which are supported on a centrally positioned piston rod 6 by means of bosses 8 and 10 provided in respective ends of the rod and fixed by means of screws 12, 13, 14. The left bushing 2 is made with a section 15, having a reduced diameter which corresponds with the normal inside diameter of the plastic pipe dimension in question such that same, when it in heated state is pressed onto the expansion head from the left, is expanded along the sloping zone 15a and formed with a calibrated socket corresponding to the diameter of the bushing from the point designated with the number 17.

In the bushings are mounted two displaceable, fluid operated pistons 16 and 18 which as shown encompass the piston rod 6 and is sealed against same and the bushing inside surface 19 by means of packing rings 22.

The piston rod is further provided with two axially extending passages 21 and 23 whereof the one has ports 24 and 26 which open into the cylinder spaces 28 and 30, respectively, while the other passage has ports 32 and 34 which open into the inside spaces 36 and 38, respectively, the piston rod on the inside of each of the pistons provided with cylindrically shaped flanges 40 and 42, respectively, which are biased against complementary bores 44 and 46 in the pistons.

The passages 21 and 23 have inlet/outlet ports 48 and 50 in the right boss 10 in order to be connected to a source for pressurized fluid (not shown). It will be understood that the pistons may move towards each other when pressurized fluid (liquid or gas) is supplied through the passage 21 and into the cylinder spaces 28 and 30 and they may be moved in direction away from each other when pressurized fluid is supplied into the spaces 36, 38 via the passage 23. The displacement power will naturally in the latter case be relatively small due to the small cylinder bore in the spaces 36, 38, but this movement represents only the retracting-or return movement and requires only little force.

The meeting sides 19 and 21 of the pistons 16 and 18, respectively, are adapted to support and guide a number of segments E which together form the structure of the expansion ring 20 and they form as shown, geometrically speaking, two generally conically shaped opposed bodies. In the shown embodiment the expansion head is designed to comprise altogether sixteen segments, i.e. eight segments in each set and which is controlled by each respective piston, and as cone angle is selected 90° such that the conical surfaces intersect each other at an angle of 90° and slope at 45° relative to the center line S. At the transverse mid-plane the piston rod is provided with a ringshaped stepped shoulder 54 on which is mounted guide flange 56 configured with generally conical guide surfaces 58 and 60 which supports and guides each of the segments. Each of the complementary cone surfaces 19 and 21 on the pistons

is provided with eight guide seats, respectively, designated 62 and 64, in order to receive the altogether sixteen segments used in the shown embodiments. Through the fact that the pistons carry sixteen segments, i.e. eight segments on each piston, the angle between each guide and each segment on each of the guide surfaces will be 45° such that the angle between each segment will be 22.5° ($360:16 = 22.5^\circ$). In other words, the guides on the opposing pistons are alternately and mutually angularly displaced 22.5°.

Between the two cylindrical bushings 2, 4 is provided a circumferential opening which opening edges 66 and 67 define the end of conically bevelled guide faces 65 and 68 machined out in the goods and presenting identical, but opposed angles corresponding to the angle of the guide faces 58, 60 on the guide flange, i.e. 45° in the shown embodiment. The segments in each set are thus displaceably supported between the guide faces 58, 65 and 60, 68, respectively.

All segments are identical and have the general configuration of a regular prism as it appears from the FIGS. 4a, 4b, 4c, which are illustrating one separate segment viewed in plan-view, lateral view and a cross-sectional view, respectively. As appears from FIG. 4a the segment has a rectangular basic surface or, more correct, top surface 70 (see also FIG. 1) and the segment has furthermore, viewed in a section as shown in FIG. 4c, the shape of an equilateral trapez as appears from FIG. 4a, having side faces 71 and 73. On the one end face 75 of the segment is provided a slide guide in the shape of a T-shaped dow tail 74 designed to be guided in the complementary dow tail guide, for instance the guide 64 in the cone surface 19 on the piston 18 shown in FIG. 1.

It should be noted that on all segments E shown in FIG. 1 the segments are given the desired final external profile shape 79 and said profile is shown in stiched lines 79 on FIG. 4b. This profile defines the curvature of the groove formed in the plastic pipe. The angle α between the plane side faces of the segment is geometrically defined by the cone angle selected, that is the angle of slope of the rectilinear movement axis of each segment, and is furthermore defined by the number of segments selected. In the shown embodiment wherein is used a cone angle of 90° and 16 segments, the angle α will not be equal to the pitch angle of 22.5°, but will due to the angular slope of the movement axis be somewhat greater and will — quite exact — be equal to 31° 27' 41". The steeper the movement axes of the segments relative to the main axis S, the greater will be the angle α . By the fact that all segments in assembled position have mutual surface contact the surface area varies in dependence upon the radial position on the cross-sectional plane laid through the segments at the mid-plane II—II (FIG. 2) will disclose one single contact line L between adjacent segments, and these lines L will always point through the center line S and in the shown embodiment said angle will always be constant and equal to 22.5°.

Upon basis of the abovementioned explanation the way of operation of the expansion ring in accordance with the invention will be easily understood. In the position shown in FIG. 1 all segments E are moved outward to their outermost position by supplying pressurized fluid into the cylinder spaces 28, 30 via the

passage 21, and the segments form a unified, contiguous crown, like ring surface as illustrated in FIGS. 2 and 5. The retracted position of the segments are illustrated in the detail view shown in FIG. 3. Pressurized fluid is then supplied into the spaces 36 and 38, and the pistons 16 and 18 are displaced in direction from each other simultaneously as the segments due to the slide guides are displaced radially inward along the conical piston surfaces simultaneously as each respective set of segments have been withdrawn rectilinearly inward between the guide faces 58, 60 and 65, 68, respectively. In this retracted position only the very little double stitched area 80 of each of the side faces of the segments will still have mutual face contact.

FIG. 5 illustrates how an expansion head in accordance with the invention in a per se known fashion will be utilized in a machine for forming a socket with a ring-shaped groove or recess of the inside surface.

The expansion head 78 in accordance with the invention is anchored horizontally in a machine-frame 80 which furthermore is provided with a couple of opposed clamp jaws 82, 84. Before the plastic pipe 86 is threaded onto the expansion head as shown it is preferably heated and it is provided with two heavy circular socket moulds 88, 89, provided with a ring-shaped bead or bulb 90 the inside configuration of which partly or entirely corresponds to the outside profile shape of the expansion ring (the segment profile), in the outermost position. The plastic pipe is then threaded onto the expansion head to face against stop-means 91, while the expansion ring means is retracted, and hereby is shaped the shown socket 92 on the end part of the pipe. Thereafter the expansion ring is expanded and thereby is formed the inside groove 94 in the socket section of the pipe simultaneously as on the outside of the pipe is formed a bead as shown. It is just this step during the process which is illustrated in FIG. 5. The socket mould part provides for that the goods in the socket is not deformed axially outside of the zone defined by the expansion ring. Thereafter the expansion ring elements are again withdrawn, the clamp jaws are removed together with the socket mould parts and the pipe may be withdrawn from the expansion head, whereafter the machine immediately is ready for handling a new pipe to be shaped as now described.

It will be understood that an expansion head and an expansion ring in accordance with the invention may be given many embodiments and it will be appreciated that the external profile of the expansion ring can be given various configurations. It is for instance nothing to hinder to give the segments an outside profile in the shape of a ring-shaped right-angled flange.

It shall be added that in the shown embodiment the guide flange 56 is not configured with flush or even conical side faces, but are preferably adapted with rectilinear sliding seats in order to receive the separate segments such that these may be imparted steady and dependable movements without play or lost motion. Likewise the guide faces 65, 68 may at the opening edges on the cylindrical pipes be formed with faces or recesses to form a corresponding guiding of the separate segments. Hereby is ensured in addition to steady motions with resulting little wear that the expansion ring in expanded position will receive an absolutely contiguous surface without recesses or interstices

along any of the meeting parts forming the external surface.

It should be noted that there are no geometrical or mechanical objections to making the segments with varying sizes, i.e. having varying angular widths, for instance having alternating narrow and wide segments, but such embodiments have little practical value.

Even though the invention in the foregoing is described in connection with forming beads and/or recesses in plastic pipes by deforming the pipe goods, it will be understood that an expansion ring in accordance with the invention with corresponding advantages can be utilized for other purposes, for instance in connection with casting of pipe-shaped elements thus utilizing the expansion ring as a moulding core.

What is claimed is:

1. In a cylindrical body for forming ring-shaped grooves or recesses in tube-shaped bodies, an annular expanding ring structure comprising a number of circumferentially arranged segments adapted to undergo radial movements relative to the central axis therethrough, said segments arranged in two complementary sets, one and each of the segments in the ring structure interposed with surface contact between two adjacent segments of the other set in alternating fashion, one and each of the segments suspended to be moveable in synchronized fashion along a straight axis lying in the respective one of two identical cones having common axis and geometrically coinciding base circles, which circle constitutes the center plane of the ring structure, one and each of the segments having two opposed plane sliding faces, the average angle between the opposed side faces of each segment viewed in a plane normal to the central axis being $360^\circ : E$, wherein E is the total number of segments, operative to maintain one and each of the segments in mutual surface contact in all positions of the movement.

2. Annular expanding ring structure in accordance with claim 1, wherein one and each of the segments are identical and has an angle between the opposed slide faces which in a plane normal to the central axes is equal to $360^\circ : E$, where E is the total number of segments.

3. An annular expanding ring structure in accordance with claim 1, wherein the segments in expanded position fill out a substantially ring-shaped circumferential opening in the cylindrical body.

4. An annular expanding ring structure in accordance with claim 3, wherein said cylindrical body includes a centrally through-going piston rod (6), two to the rod at the ends of same via end bosses anchored cylinder bushings, which bushings constitute the external parts of the cylindrical body, and which bushings between themselves define said ring-shaped opening therein, and two in the cylinder around the piston rod devised axially displaceable, pressurized fluid operated pistons which constitute support for each and all of the segments in each respective set, the pistons operative to impart to each of the segments a rectilinear stroke from a retracted position to an expanded position wherein the external part of the segments constitute a contiguous annular surface profiled to requirements.

5. An annular expanding ring structure in accordance with claim 3, wherein said piston inwardly of

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the ringshaped opening in the cylinder body is provided with an axis-symmetrical guide flange having guide faces for guiding the respective segments during their movements.

6. An annular expanding ring structure in accordance with claim 4, wherein said pistons adjacent the segments are provided with conical faces complementary to said cones defining the movement axes for the segments, said conical faces provided with slide guides engaging the segments.

7. An annular ring structure in accordance with

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claim 6 wherein the apex angle of the two cones defining the axes of movements for the segments are 90°.

8. An annular expanding ring structure in accordance with claim 2, wherein one and each of the segments are generally configured as regular prisms, viewed in cross-sectional planes.

9. Annular expanding ring structure in accordance with claim 8, wherein said two sets of segments altogether comprise 16 identical segments.

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