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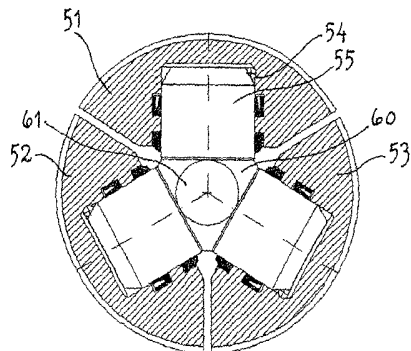
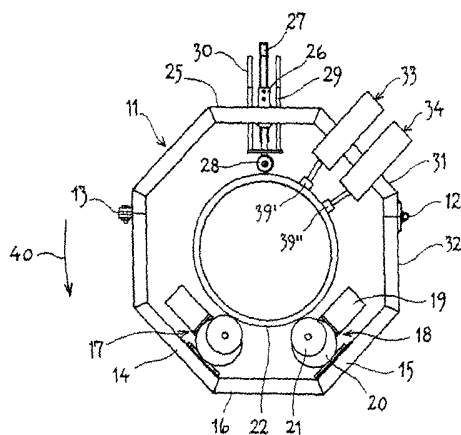
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(54) Title: WELDING MACHINE FOR PLASTIC TUBES AND DEVICE FOR HOLDING TUBE ENDS FOR JOINING BY WELDING



(57) Abstract: Apparatus for joining of plastic tubes, wherein two tubes (22) have chamfered ends which provided a groove for depositing of a joining welding seam (25), means being provided for maintaining the tube ends in place during the welding operation. It comprises an annular collar (11) provided for being mounted around two tubes ends (22). Said annular collar being dividable for being removed from a welded tube, and carries at least three double wheels, at least one of which is a driving wheel (21) for carrying the annular collar (11) around the assembly of two tube ends (22). On the collar (11) at least one assembly (33, 34) with a welding head (39) supplying welding material is provided. Inside the tube ends at the joint, means (Fig. 4-8) being provided with radially expandable pressure jaws to keep the tube ends together and provide a circular shape. It is also provided a particular device to hold the tube ends (22) during welding. It has three clamping bars (51-53) connected with an expanding means (54, 55, 60). The clamping bars are provided to cover the inside of the tube ends substantially completely, with an outer diameter corresponding to the nominal inner diameter of the tube.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Welding machine for plastic tubes and device for holding tube ends for joining by welding.

Background

5 When joining plastic tubes for demanding tasks, hand welding has not been appropriate. The reason is mainly the problem of preparing a sufficiently uniform welding seam by hand. It is previously known to weld metal tubes, particularly of steel and aluminium, by automatic equipment. But until now it has not been possible to conduct such automatic welding of plastic tubes.

10 The welding of plastic tubes with dimensions over about 100 mm is now done by heating the tube ends with heating elements. The heating elements are then removed and the tube ends are pressed together. This method is demanding space and energy (10-100 kW). At large dimensions, the cooling time may be several hours, because of the large amount of energy needed.

15 From GB-patent application 2.195.570 (British Nuclear), NO-patent specification 180157 (Atlantic Point), JP-patent application 55068197 (Hitachi) and JP-patent application 5329686 (Fujita) different devices for welding of metal are known. There is however a basic difference between welding with electrical current and metal electrodes, which has been carried out in automated machinery for decades, and welding of plastic, which requires
20 supply of energy in another way and which has a different mechanism for providing melted welding material and obtain joining.

Regarding supporting devices to hold the tube ends for welding, it is known from GB-patent application 2,156,468 (Okamoto) to utilize two diametrically arranged pistons applying pressure mainly on spots of the tube wall. It provides for non-uniform load and
25 unavailability for heat supply. From US-patent specification 5568803 (Cogsdill Tool) it is known to use a pair of arcuate clamping shoes which indeed covers a larger part of the circumference than the Okamoto-pistons, but still exerts a pressure providing bent tube ends. EP- patent application 628 378 (CRC-Evans Pipeline) shows a compound system with separate rows of clamping shoes acting on a separate tube end and a common back up
30 ring covering the joint. The separate rows of clamping shoes will never provide an accurate joining of the tube ends, because they are acting mutually independent. Heat transfer to the joint will also not be allowed.

Object

The main object of the invention is to provide a welding apparatus for welding plastic tubes, enabling an automated process. Such an apparatus should be space saving, enabling the transfer to and use on sites, e.g. in public water supply systems and hydroelectric power plants, where the space may be limited. It should be light in weight, to be easy to transport.

A further object is to provide a device for use at tube welding, to maintain the tube ends in place during the welding operation. Such a device should keep the tubes circular, without eccentricity. It should be easy to handle, i.e. easy to mount and to remove after use.

10 The Invention

The invention is stated in claims 1 and 5, with particular advantageous features in claims 2-4 and 6-8.

Central parts of the invention are

- an annular collar provided for being mounted around two tube ends, said annular collar being devised for being removed from a welded tube,
- that the annular collar carries at least three double wheels, at least one of which is a driving wheel for carrying the the annular collar around the assembly of two tube ends ,
- that at least one assembly with a welding head supplying welding string is provided,
- that dispersed means for providing heat to welding string and tube material, and
- that the clamping jaws are arranged to provide uniform pressure around the circumference of the tubes, to maintaining the tube ends closely together and adjust a perfect circular form, and additionally providing heat to the tube ends.

Examples

The invention is described in the following with reference to the drawings, wherein

Fig. 1 shows an end view of a welding apparatus according to the invention, for carrying two welding assemblies during the welding of a plastic tube,

Fig. 2 shows a side view of a welding assembly for use with the welding apparatus of Fig. 1,

Fig. 3A and 3B shows a section through a nozzle head for the two welding assemblies of Fig. 1,

Fig. 4 shows a partly sectioned side view of a first embodiment of a device to maintain tube ends in place during welding,

Fig. 5 shows a section through the device of Fig. 4,

Fig. 6 shows a partly sectioned side view of a second embodiment of a device for maintaining

tube ends in place during welding,

5 Fig. 7 shows a section through the device of Fig. 6, while

Fig. 8 shows an end view of a third embodiment of a device for maintaining the tube ends in place during welding.

In Fig. 1 an annular collar 11 which is welded to an octagonal shape from rectilinear pieces
10 is shown. To open the collar 11 for removal from a welded tube, a hinge 12 is arranged at one corner and at an opposite corner a openable screw connection 13 at the opposite side. At two sides 14 and 15 at different sides of the lower side 16 in the Figure, a drive unit 17 and 18 respectively, is arranged. The drive unit 17 and 18 comprises a motor 19 with a stepless control, a gear 20 with a passing shaft and on each end of this shaft a driving wheel
15 21 with a rubber or plastic track provided to engage with and drive a tube end 22.

Previous to the welding, the tube ends 22 are chamfered with a bevel edge 23 (Fig. 3a, 3b) which leaves a narrow inner edge 24. The purpose is to admit a welding seam provided by a welding assembly as described in the following. The welding assembly may be furnished with additional equipment for cutting and chamfering.

20 At the upper edge 25 of the collar 11, a radial guide bushing 26 for a tube 27 with a pair of wheels 28 at the inner end is attached by welding, said pair of wheels engaging the tube 22. The tube 27 encloses a spring (not shown) for pressing the wheels against the tube 22. The design of this spring mechanism may be made conveniently according to known principles. This carrying structure additionally has two guiding rods 29, 30 extending
25 parallel to the carrying tube 27 to ensure stability.

On a side 31 of the collar 11, which in Fig. 1 is between the upper side 25 and the hinge 19 on a side 32, two welding assemblies 33, 34, which will be described more in detail in the following, are mounted.

In Fig. 2 a welding assembly 33, which can be used on the collar 11 and which can be
30 one of the assemblies 33 and 34, is shown, with the necessary individual adaptations as described below.

The welding assembly 33 comprises a heating and drive unit 35, which is arranged in a housing and which comprises heating elements for heating of air and a driving motor with

driving wheels for feeding of welding string 36 from a wheel 37. From the heating and driving unit 35 a carrying arm 38 with a welding head 39 is protruding for providing the welding string. The design of the welding head will appear from Fig. 3a, 3b, The heating and driving assembly 35 may be based on prior art technology regarding plastic welding, providing a preheating of the welding string, a preheating of the welding area with hot air and melting of the welding string in the welding head 39.

Figs. 3a and 3b are showing two embodiments of the welding heads for the welding assemblies 33, 34, linked to the direction of rotation 40 for the collar with welding assemblies 33, 34 shown with an arrow. With this direction of rotation, the welding assembly 33 will run first along the joint and deposit an inner part 25a of the welding seam. To have appropriate thickness, the welding head 39' in Fig. 3a is conical against an end face 41 with an outlet opening, which has a width about half of the maximum seam width. The sides adjoining the end face 41 are chamfered corresponding to the chamfering of the tube ends, to provide a sealing engagement.

In Fig. 3b the welding head 39" is ended with an even end face 43 which is provided to engage sealingly at the outer side of the tube for filling the welding seam with an outer part 25b. the welding heads 39' and 39" may be of heat proof plastic.

In this manner, it is possible with mechanically operated equipment to join two tube ends with welding, leaving an inner and outer even welding seam. To achieve this, a balance between velocity of rotation, ambient temperature, and welding string temperature to give the best result in each case should be aimed. Thus it is possible to weld tubes automatically with substantially lower energy and time consumption than with known methods of welding. The welding can be done on tubes with the diameter in the order of magnitude from 5 dm til 5 m, practically from about 3 dm and larger.

To provide this welding, it is necessary to hold the tube ends 22 together and with the correct form during the movement of the collar 11 with the welding assemblies 33, 34 circumferentially. This can be done with a clamping device as described in the following examples.

In Fig. 4 and 5 a first embodiment of a clamping device to hold the tube ends 11 during welding. This device has three clamping bars 51, 52, 53, each covering slightly less than 120° of the circumference, with a face being curved corresponding to the inner diameter of the tube ends to be welded. The clamping bars 51-53 can be cut from a cylindrical bar with suitable outer diameter. To make the clamping bars suitable for tubes with different

diameters, the clamping bars can be provided with holes (not shown) for attaching lining shoes with screws.

Each clamping bar 51-53 has on the inner side a cylindrical bore 54 with a piston 55, at the bottom of each bore 54 a channel 56 (Fig. 4) is arranged with connection to a hydraulic hose 57 over a coupling. The hydraulic hoses 57 are connected for supply from a not shown hydraulic pump. Each piston 55 carries a sealing ring 58 and a wiping ring 59. The pistons 55 are engaging a three faced core 60 with their free end, the core being attached on a rod 61 for lifting and moving the equipment, in the following denoted "tube clamp".

For contracting of each clamping bar 51-53 at pressure release, each clamping bar is attached to the core with two head bolts 62, 63 with a helical spring 64, 65 arranged under the head, to act against an inner flange 66. The head bolts 62, 63, which are screwed into the core 60, provides a compacted neutral position for the tube clamp.

In Fig. 6 and 7 an alternative embodiment of a tube clamp is shown, wherein a generally cylindrical bushing 71 is carrying an annular, protruding flange 72, 73 at each end, the bushing being attached by means of screw bolts. The bushing 71 is enclosed by a tubular rubber or plastic membrane 74. Radially through the wall of the bushing 71, a threaded bore 75 for a pressure hose (not shown) for supply of compressed air to the space 76 inside the membrane 74, is arranged. The membrane 74 is surrounded by three clamping bars 77, 78, 79 which are overlapping and which together define a cylindrical outer face.

Each annular flange 72, 73 carries a protruding sealing ring 80 in a groove in the flange. Between the sealing rings 80 a closed chamber 81 is provided, which do not release gas from the inner area of welding. The chamber 81 may be supplied with a protecting gas and/or hot air to improve the quality of the welding. This may be done through an opening 87 in the edge of one of the annular flanges 72, 73.

To keep the clamping bars 77-79 together during transport and handling and to provide contraction at air release, a rubber ring 83 is arranged at each end in a groove 82. Between the clamping bars 77-79, profiled bars 84, 85, 86 (Fig. 7) are arranged at each joint. The bars 84-86 can be of triangular cross section and be manufactured of metal or plastic. The clamping bars 77-79 are provided with circumferential grooves 88, 89, 90, e.g. for saving weight,

In Fig. 8 a third embodiment of a tube clamp provided for tube welding according to the invention is shown. Corresponding to the above embodiments, three clamping bars 91, 92, 93, in the example tubular segments with a pair of bracings 94 at each end. The bracings 94

can be attached by welding and provide attachment for three air power cylinders 95, 96, 97 extending between various pairs of the clamping bars 91-93 with a central attachment. On supply of pressurized air to the pneumatic power cylinders 95-97, these will expand and provide the clamping of the tube ends 22 required.

- 5 The edges of the clamping bars 91-93 may overlap to provide a smooth outer face, leaving no inner welding seam.

The use of the tube clamp to provide evenly curved tube ends to be welded is essential to achieve good welding.

10 Modifications

The collar 11 may carry more drive assemblies. This is particularly important at large tube diameters.

- The design of the collar 11 can be reversed for welding the inner side of the tube, e.g. tubes with large diameter for hydroelectric power plants. At such welding, the tube clamp

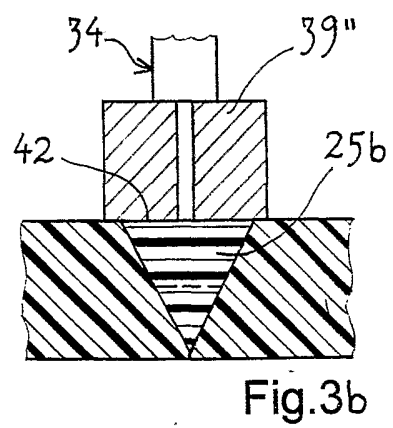
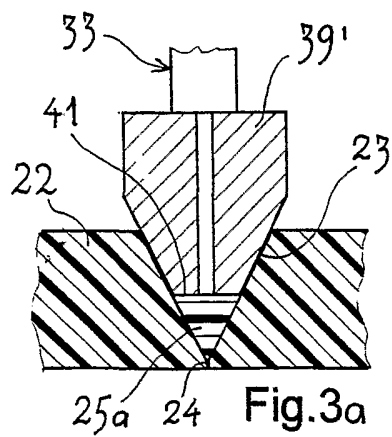
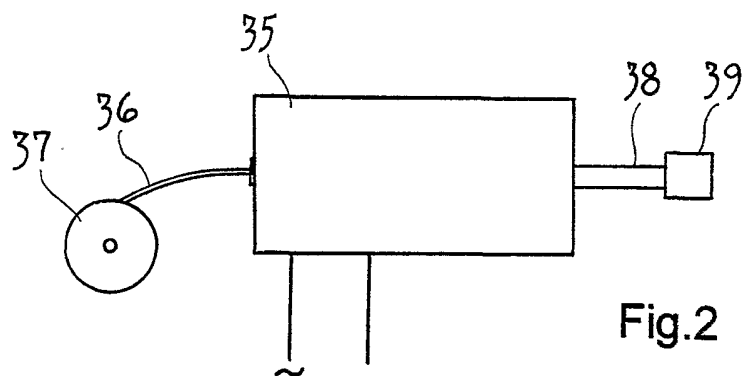
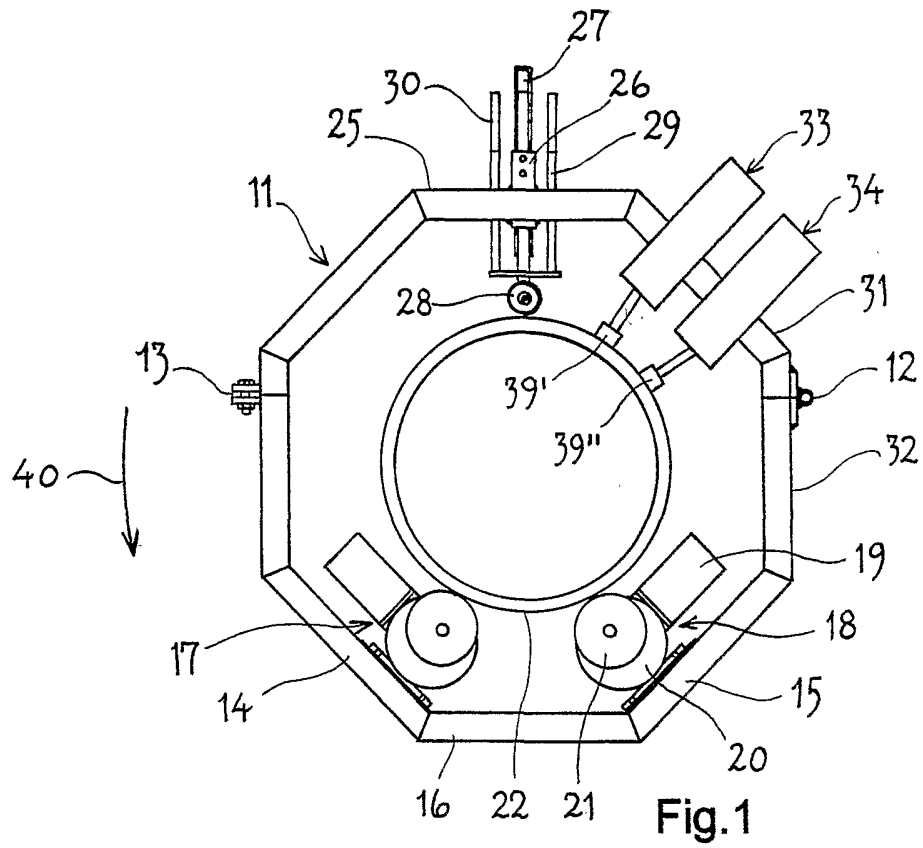
15 has to be provided with separated or divided clamping bars, to make room for the welding assemblies. An outer clamping may also be necessary to provide circular shape and an even joint.

The tube clamps can also be used for clamping tube ends for other purposes than shown, e.g. at manual welding.

Claims:

1. Apparatus for joining of plastic tubes, wherein two tubes (22) have chamfered ends which provides a groove for depositing of a joining welding seam (25), means being provided for maintaining the tube ends in place during the welding operation, with a
 - 5 releasably introduced device with radially expandable pressure jaws extending over the tube joint, means for providing heat for melting plastic material being arranged, characterized in
 - that it comprises an annular collar (11) provided for being mounted around two tube ends, said annular collar being dividable for being removed from a welded tube,
 - 10 - that the annular collar (11) carries at least three double wheels, at least one of which is a driving wheel (21) for carrying the annular collar around the assembly of two tube ends (22),
 - that at least one assembly (33, 34) with a welding head (39) supplying welding string is provided,
 - 15 - that dispersed means for providing heat to filler rod and tube material, and
 - that the clamping jaws are arranged to provide uniform pressure around the circumference of the tubes, to maintaining the tube ends closely together and adjust a perfect circular form, and additionally providing heat to the tube ends.
- 20 2. Apparatus according to claim 1, characterized in that each pair of driving wheels (21) has a gear (20) with a through shaft and a controllable motor (19), the driving wheels being arranged at the ends of the shaft.
3. Apparatus according to claim 1 or 2, characterized in that two assemblies (33, 34) for the
 - 25 advance of welding string, the first in the direction of rotation being provided with a conical welding head (Fig. 3a) adapted to the chamfer of the joint, while the second is provided with a straight ended welding head (Fig, 3b) to provide an even external joint.
4. Apparatus according to one of the claims 1-3, characterized in that the collar carries
 - 30 equipment for cutting and/or chamfering of tube ends.

5. Device for clamping two plastic tube ends (22, 23) for welding, particularly for welding with an apparatus according to claim 1, comprising clamping bars connected with expanding means, characterized in that the clamping means (51, 53) are provided to cover the inner side of the tube ends substantially completely, with an outer diameter
- 5 corresponding to the nominal inner diameter of the tube, and that the clamping bars are subjected to the same pressure.
6. Device according to claim 5, characterized in that the clamping bars comprise three or more cylindrical sectors (51-53), each having one or more inner bores (54) for a
- 10 corresponding number hydraulically driven pistons (55) acting against a common core (60).
7. Device according to claim 6, characterized in that each of the clamping bars (51-53) is pre-tensioned against an inner end position by two or more helical springs (64, 65) arranged on head bolts (62, 63) attached to the common core (60).
- 15
8. Device according to claim 5, characterized in that the clamping bars (91, 93) are connected in pairs with hydraulic or pneumatic driving units, particularly power cylinders (95-97) expanding the clamping bars at the supply of a pressurized medium.



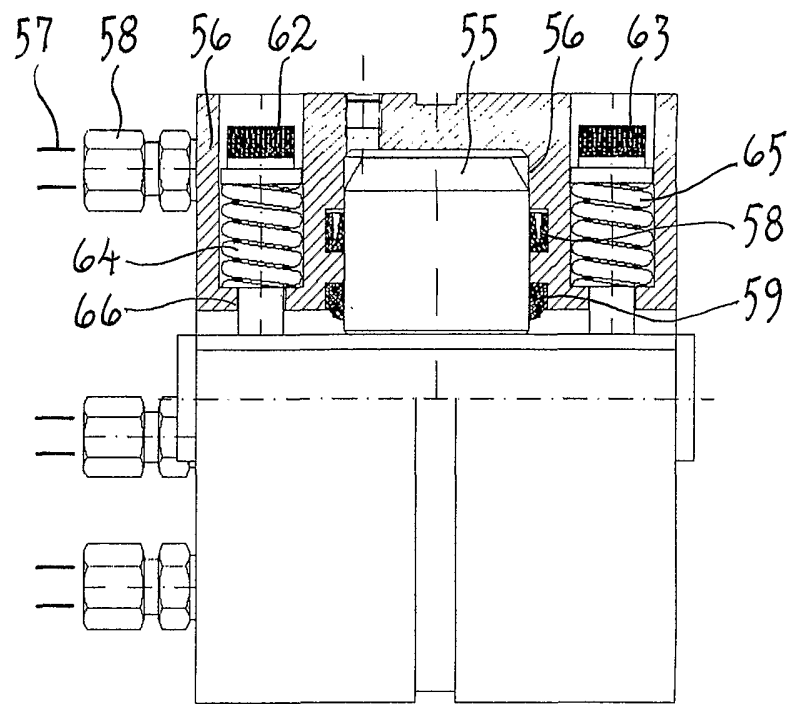


Fig.4

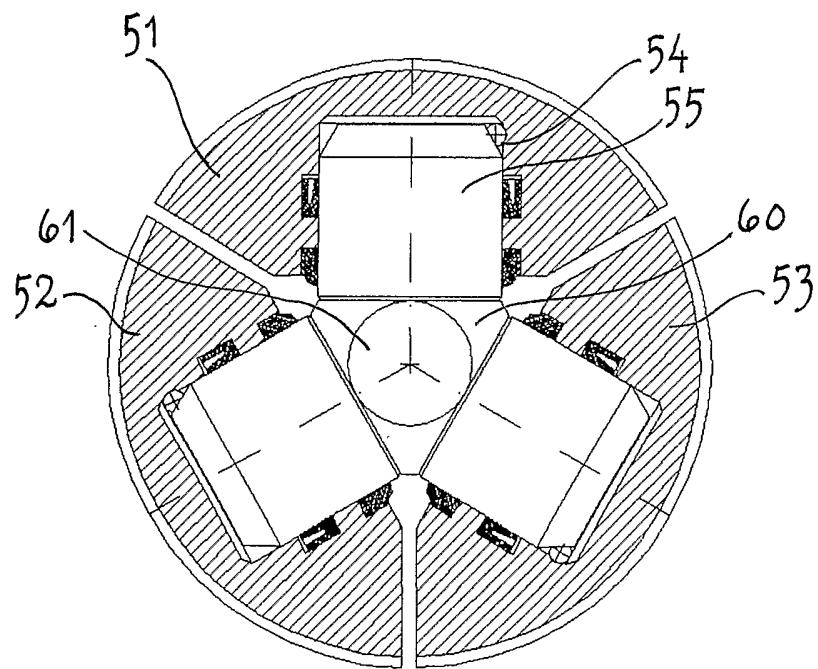


Fig.5

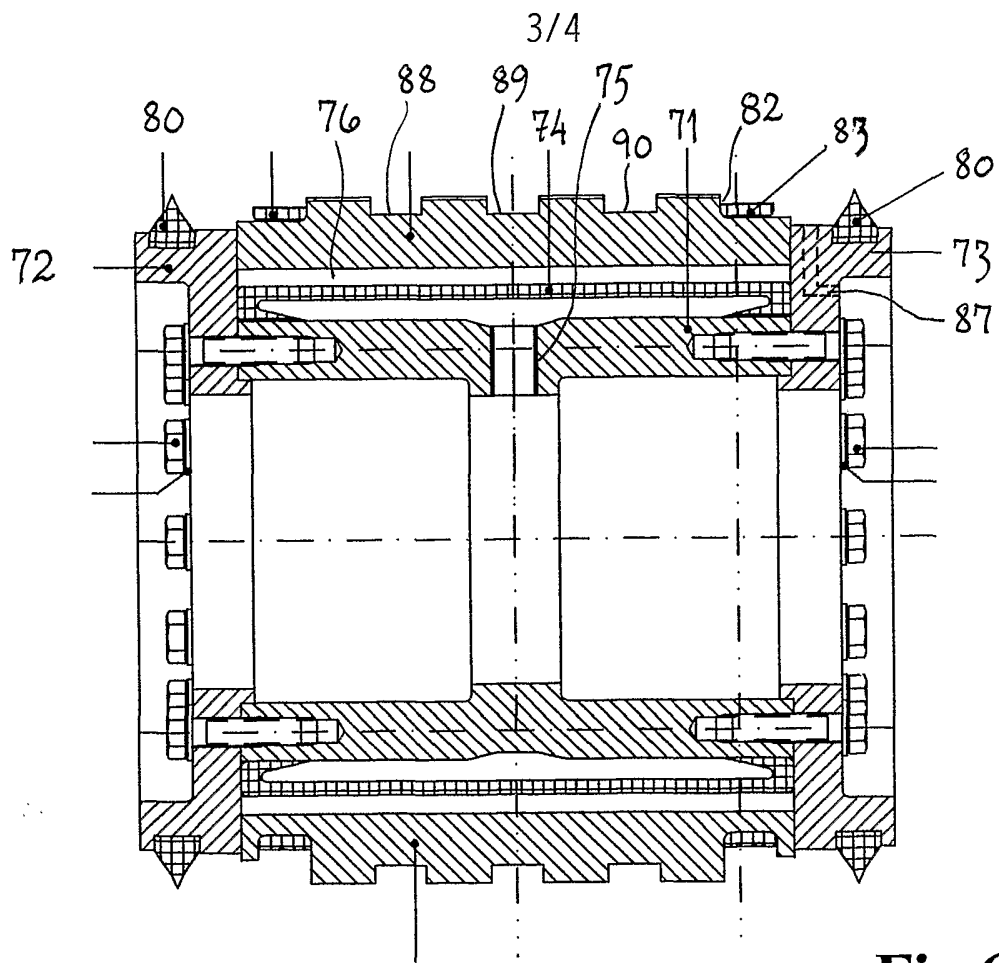


Fig.6

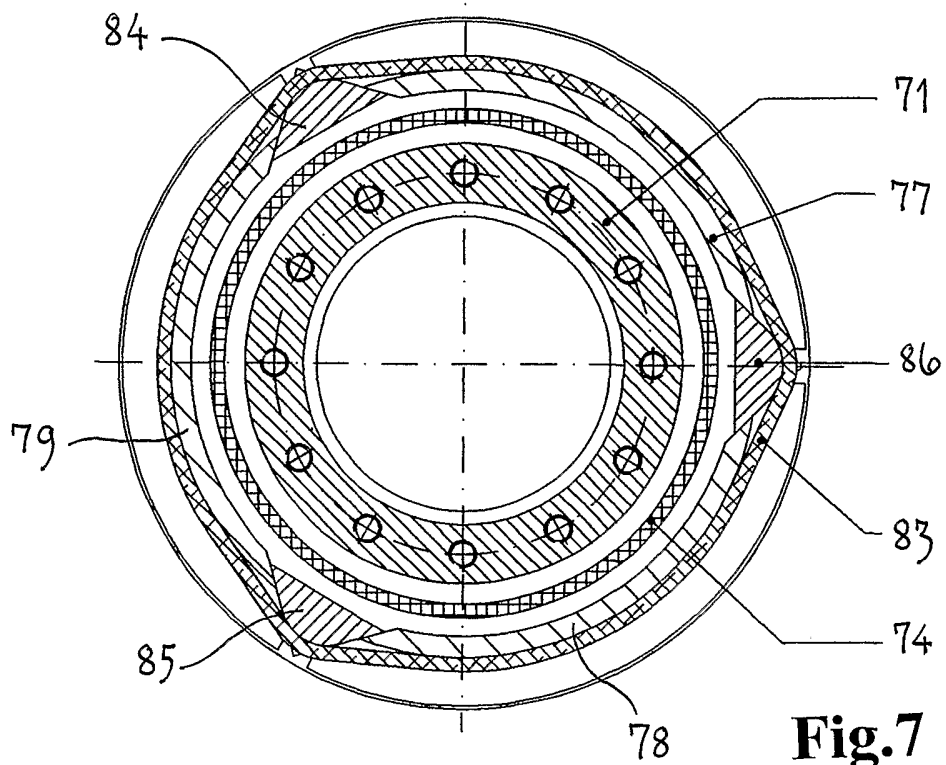


Fig.7

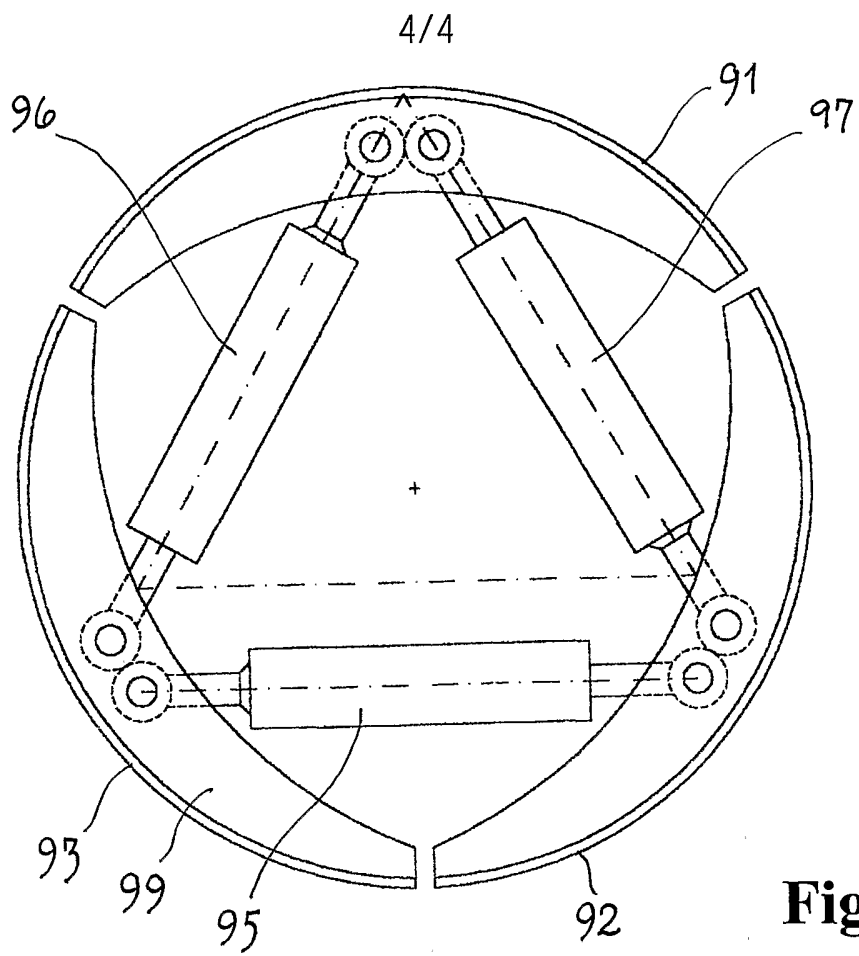


Fig.8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 01/00254

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B29C 65/02, B29C 65/78

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B29C, F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	--	1-4
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☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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"P" document published prior to the international filing date but later than the priority date claimed

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INTERNATIONAL SEARCH REPORT

International application No.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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Information on patent family members

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