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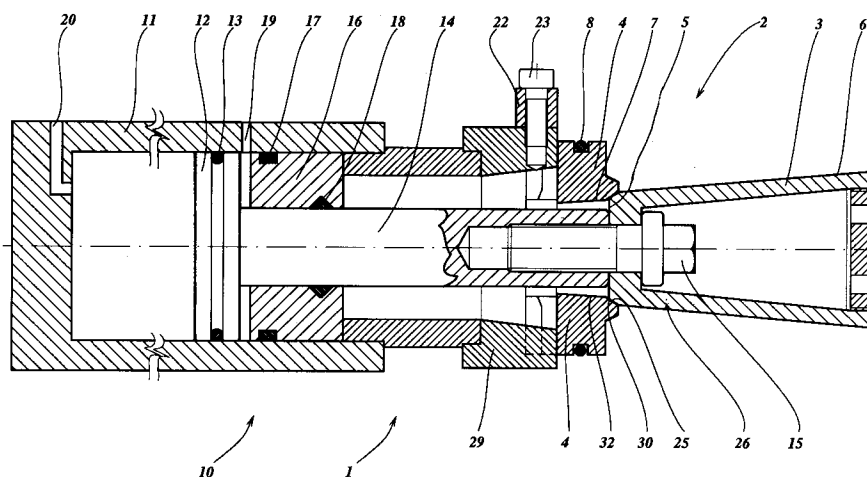
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NL-2280 GE Rijswijk (NL)**(54) **Device for mechanically expanding a pipe or pipe section.**

(57) A device for mechanically expanding a pipe or pipe section. The device comprises a housing (1) and an expansion head (2) which comprises an expansion mandrel (3) with a polygonal cross-section which increases from an end face thereof and is bounded by external faces, and expansion jaws (4) which interact with the expansion mandrel (3) and are guided in the housing (1). The device also comprises a hydraulic cylinder (10) whose cylinder wall rests against the housing (1), and the piston is connected by way of a rod to the expansion mandrel

(3). The expansion mandrel (3) can thereby be moved in its lengthwise direction relative to the expansion jaws (4), in order to move the expansion jaws (4) essentially in the radial direction. According to a first aspect of the invention, at least the expansion mandrel (3), the rod and the cylinder are made of metal in which the ratio [MPa/(kg/m³)] between the 0.2% yield limit [MPa] and the density [kg/m³] is considerably greater than that of structural steel. The ratio between the 0.2% yield limit and the density is preferably greater than 0.100.

**Fig. 1****EP 0 653 256 A1**

The present invention relates to a device for mechanically expanding a pipe or pipe section, comprising a housing and an expansion head, which expansion head comprises an expansion mandrel with a cross-section which increases from an end face thereof and is bounded by an external face, and expansion jaws which interact with the expansion mandrel and rest against the housing, and also comprising a hydraulic cylinder whose cylinder wall rests against the housing and whose piston is connected by way of a rod to the expansion mandrel, which can thereby be moved in its lengthwise direction relative to the expansion jaws, in order to move the expansion jaws essentially in the radial direction.

Such a device is generally known and is used in particular for working an end of a metal pipe or pipe section, for example a pipe bend, with a diameter lying between several tens of millimetres and hundreds of millimetres. Working the pipe means that, for example, the diameter of an end of the pipe is enlarged in such a way that an identical pipe can be connected thereto as in a spigot and socket joint. If the shape of the expansion jaws is suitably selected, the end of a pipe or pipe section can also be given a different shape at the end, for example an angular or in fact a conical shape. Such a device can also be used for making a slightly deformed pipe end round again.

During the mechanical expansion of a metal pipe great force must be exerted on the expansion mandrel by the hydraulic cylinder, in order to ensure that the expansion jaws are pressed with very great force against the wall of the pipe. The pressure of the hydraulic oil, which is supplied to the cylinder by separate pressure means through a high-pressure hose, is several hundred bar in this case, and the force in the connecting rod between the cylinder and the expansion mandrel can be several tens of tonnes. As a result of these very great forces being exerted on the parts, it is essential for such devices to be made of extremely sturdy design.

The devices of the abovementioned type known until now are based on engineering principles generally applied in this sector, which means that the devices are high in weight, due to the required sturdiness. This has the disadvantage that in practice they are suitable for use only in a more or less fixed location, for example in an engineering works.

The object of the invention is to eliminate the abovementioned disadvantage and to propose measures which lead to a reduction in the weight of such a device, in order to provide a device which is portable.

This object is achieved according to a first aspect of the invention by a device of the type

mentioned in the preamble, which is characterized in that at least the expansion mandrel, the rod and the cylinder are made of metal in which the ratio $[\text{MPa}/(\text{kg}/\text{m}^3)]$ between the 0.2% yield limit $[\text{MPa}]$ and the density $[\text{kg}/\text{m}^3]$ is considerably greater than that of structural steel. The expansion jaws are also advantageously made of such a material.

The ratio between the 0.2% yield limit $[\text{MPa}]$ and the density $[\text{kg}/\text{m}^3]$ is preferably greater than 0.100 $[\text{MPa}/(\text{kg}/\text{m}^3)]$.

The invention is based on the idea that through the use of such metals it becomes possible to obtain a device whose sturdiness at least corresponds to that of known devices, while the weight of the device is such that the device can be handled by one person. Suitable metals for achieving the desired object are, for example, Ultra-High-Yield-Limit metals. The 0.2% yield limit of steels of this grade is usually greater than 1300 MPa, so that at a density of approximately 8000 kg/m^3 a ratio of 0.160 $[\text{MPa}/(\text{kg}/\text{m}^3)]$ is present. Other suitable metals are, for example, maraging steel, titanium, titanium alloys, and high-grade aluminium alloys, such as AlCuMgZn alloys. Such materials have already been in use for years in aeronautical engineering in particular, for parts which are subject to extremely high loads. The use according to the invention of such unusual metals for manufacturing a mechanical expansion device involves very high material and manufacturing costs. However, making the expansion device portable according to the invention, despite these high costs, means that great economic advantages can be achieved in the use of the device. For example, until now for the working of a lorry load of pipes the load first had to be unloaded and stored in a factory building. The pipes then had to be taken one by one to the expansion device in its fixed position and worked there. Finally, the worked pipes then had to be reloaded onto the lorry. With the portable device according to the invention, the pipes need no longer be taken off the lorry, but a single person can perform the operation on the lorry. With the device according to the invention the pipes can also be worked on the premises of the various suppliers of pipes, who in that case do not need to have such a device themselves. The portable design of the device therefore means that a great saving in time and wage costs can be obtained, with the result that the high investment costs of the device can be recouped. Another major advantage of the device according to the invention is that it can be used for working already fitted pipes or pipe sections on the spot, for example in a chemical factory, something which is impossible with known devices, on account of their great weight.

According to the measure described in the characterizing part of claim 3, a reduction in weight

compared with known devices can also be achieved. According to claim 3, a device of the type mentioned in the preamble of claim 3 is provided, which device is characterized in that the expansion mandrel in succession comprises a first region and a second region, viewed from its end face, and in the first region the external face forms a larger angle with the longitudinal axis of the expansion mandrel than in the longer second region, while each expansion jaw comprises a slide face which interacts with the expansion mandrel and has, viewed in the direction towards the cylinder, a first region and a second region, in the first and in the second region the slide face forming an angle with the longitudinal axis of the expansion mandrel which corresponds to the angle of the external face in the first and the second region of the expansion mandrel respectively. This means that at the beginning of the expansion process the expansion jaws are moved outwards relatively more quickly than thereafter. This is possible because in the first instance the play required for placing the expansion head in the pipe must be bridged, and because the deformation work subsequently to be carried out when beginning the expansion of the metal pipe section is still relatively small. Through this measure, the total length of the expansion mandrel required is less than if it had been provided with an external face with a single, constant angle. This thus leads to a reduction in the weight of the device, in particular because this measure makes it possible for the stroke of the hydraulic cylinder, and thereby the length of the cylinder, to be shorter than in the case of known devices with a constant angle. It is clear that the measures according to claim 1 and/or 2 and claim 3 each individually lead to the weight reduction envisaged according to the inventive idea, but that a further weight reduction can be obtained through combination of the measures.

The expansion mandrel is preferably made hollow. As regards volume, the expansion mandrel is a large part of the device, and a considerable further reduction in the weight of the entire device is thus achieved by making it hollow. It is pointed out here that a hollow design is possible in particular through the use of the abovementioned materials of very high strength. The wall forming the generally polygonal external face of the expansion mandrel would otherwise be unable to withstand the forces exerted thereon, in particular in the case of thick-walled pipes, and the expansion mandrel would then have to be solid in design, as in the case of the known devices.

In another embodiment the end face of the expansion mandrel is provided with a bore through which a screw bolt projects, which screw bolt is screwed into an internally threaded bore in the end

of the rod of the cylinder. The length of the rod, and therefore its contribution to the weight of the device, can thereby be kept to a minimum. By means of the screw bolt, the expansion mandrel can be replaced by another expansion mandrel if desired. The expansion jaws are preferably made hollow. This measure achieves the same object as that achieved by making the expansion mandrel hollow.

In yet another embodiment the housing and the expansion jaws are provided with interacting guide projections and guide recesses for guiding the expansion jaws radially relative to the longitudinal axis of the device. Since the movement of the expansion jaws relative to the housing is less than the movement relative to the expansion mandrel, the guide can consequently be small in size and thus light. Moreover, due to the absence of guides for the expansion jaws on the expansion mandrel, a simple design of the expansion mandrel is possible.

The guide recesses and guide projections are preferably formed in such a way that the play present between an expansion jaw and the housing increases in at least part of the movement path of the expansion jaw during the radial outward movement of the expansion jaw. In this way the expansion jaw is prevented from jamming or running with difficulty, with the result that the guide can be of light design.

In addition, it is advantageous if the external face of the expansion mandrel is provided with a hard-wearing coating, preferably a titanium carbide layer. This also leads to a reduction in the friction between the expansion jaws and the expansion mandrel, with the result that the forces to be applied, and thus the weight of the entire device, are reduced.

The invention also provides a device according to the preamble of claim 10, which is characterized in that at the side facing the mandrel movable by the cylinder the housing is provided with a fixed mandrel, which fixed mandrel extends in the opposite direction to the movable mandrel, and the mandrels are designed in such a way that they can engage in each other in a sliding manner, each expansion jaw having a slide face, a first part of which interacts with the movable mandrel, and a second part of which interacts with the fixed mandrel. Through this measure, a reduction in weight relative to known devices can be obtained. This is due to the fact that the friction losses which occur in the case of the expansion jaws are low in this design. The force to be exerted by the cylinder can be smaller as a result of this, and the parts of the device can consequently be made lighter than in the case of known devices. The measure according to claim 10, alone or combined with one or more of

the above-described measures, also leads to realization of the inventive idea.

Preferably the device according to the invention comprises four expansion jaws. It has been found that a larger number of jaws results in larger friction losses.

The invention will be explained in greater detail below with reference to exemplary embodiments of the device according to the invention shown in the drawing, in which:

Fig. 1 shows a diagrammatic longitudinal section of an example of a first embodiment of the device according to the invention;

Fig. 2 shows a view from the end face of the housing of the device in Fig. 1;

Fig. 3 shows a side view of an expansion jaw of the device in Fig. 1;

Fig. 4 shows a bottom view of the expansion jaw in Fig. 3;

Fig. 5 shows a view corresponding to Fig. 1 of a second embodiment of the device according to the invention; and

Fig. 6 shows a diagrammatic longitudinal section of a third embodiment of the device according to the invention,

Fig. 7 shows a diagrammatic radial section of the expansion head of a fourth embodiment of the device according to the invention.

The portable device shown in Fig. 1 is intended for the mechanical expansion of an end of a pipe or pipe section, in particular made of metal. The device has a housing 1, which is essentially formed by a hollow cylindrical element. The device also has an expansion head 2, consisting of a hollow expansion mandrel 3 and six expansion jaws 4. The expansion mandrel 3 has a hexagonal cross-section bounded by an external face 6 and increasing from one end face 5 thereof towards the other end. The expansion mandrel 3 could also be another polygonal or even a conical shape. The expansion jaws 4 each rest with a slide face 7 against a corresponding part of the external face 6 of the expansion mandrel 3. For this purpose, an elastic O-ring 8 lies around the common circular outer periphery of the expansion jaws 4. Each expansion jaw 4 is guided in the radial direction relative to the housing 1 in a manner to be described later. The expansion jaws 4 shown in Fig. 1 are suitable for working a pipe or pipe section with an internal diameter between 70 and 90 mm. The device can be adapted for working a pipe with a larger internal diameter by replacing the set of expansion jaws 4 by a set of expansion jaws with larger radial dimensions. The O-ring 8 must also be replaced then by a larger version.

The device also comprises a double-acting hydraulic cylinder 10 with a cylinder wall 11 and piston 12. The piston 12 is provided with a seal 13

which slides along the cylinder wall. The cylinder is supported against the housing through the cylinder wall 11 being screwed firmly to the housing 1. The piston 12 is connected by means of a rod 14, which is integral with the piston 12, and a screw bolt 15 to the expansion mandrel 3. The rod 14 in this case projects through an end wall 16 of the cylinder 10, the end wall being provided with seals 17 and 18. In order to move the piston 12 to the left in Fig. 1, hydraulic oil under pressure is supplied through a connection 19. If the piston 12 has to be moved to the right, hydraulic oil is supplied to the connection 20. During mechanical expansion of a pipe with the device shown, oil under pressure is supplied to the connection 19, for example at a pressure of 700 bar. This causes the expansion mandrel 3 to move in the direction of its longitudinal axis along the slide faces 7 of the expansion jaws 4. As a result of this, the expansion jaws 4 will move outwards in the radial direction and be pressed with force against the wall of the pipe to be worked.

The device also comprises three stops 22 placed at regular intervals around the housing 1, for determining the position of the expansion head 2 relative to the pipe to be worked. Each stop 22 is detachably fixed on the housing 1 by means of a bolt 23 and, depending on the diameter of the pipe to be worked, can be replaced by a stop adapted thereto.

For the manufacture of the device shown, according to the inventive idea a number of metals which are unusual for such a device are used. The result of this is that a device of such low weight can be obtained that the device can be considered as portable. For instance, it is preferable for the housing 1, with the exception of the guide of the expansion jaws 4, and the cylinder 10 to be made of a high-grade aluminium alloy, in particular an AlCuMgZn or AlCuMg alloy. The cylindrical part of the housing 1 and the cylinder 10 of the device shown are made of an AlZnMgCu alloy, "Werkstoffnummer" 3.4365 (DIN), the 0.2% yield limit of which is 450 MPa, and the density of which is 2800 kg/m³. The ratio between these two values is then 0.161. The hollow expansion mandrel 3 is made of hardened steel, "Werkstoffnummer" 1.2379 (DIN), which has undergone a thermal treatment in order to reach a hardness of 60 Rc. The expansion jaws 4 are made of the same metal as the expansion mandrel 3. The screw bolt 15 is made of maraging steel, "Werkstoffnummer" 1.6358 or 1.2709 (DIN). If steel of "Werkstoffnummer" 1.2709 (DIN) is used, the 0.2% yield limit is 1900 MPa, at a density of 8100 kg/m³.

In order to be able to reduce the weight of the device even further, provision is made according to the invention for the expansion mandrel 3 to have

in the direction from its end face 5 in succession a first region 25 and a second region 26, in the first region 25 the external face 6 forming a larger angle with the longitudinal axis of the expansion mandrel 3 than the angle formed in the longer second region 26. Each expansion jaw 4 also has a slide face 7 which interacts with the expansion mandrel 3 and in the direction towards the cylinder 10 has a first region 30 and a second region 32, the slide face 7 in the first and in the second region forming an angle with the longitudinal axis of the expansion mandrel 3 which corresponds to the angle of the external face 6 in the first region 25 and the second region 26 respectively of the expansion mandrel 3. This ensures that at the beginning of the expansion the expansion jaws 4 are moved outwards relatively more quickly than thereafter. This is possible because in the first instance the play required for placing the expansion head 2 in the pipe must be bridged, and because subsequently the deformation work to be carried out at the beginning of the expansion of the metal pipe section is still relatively little. Through this measure, the total required length of the expansion mandrel 3 is less than if the latter had been provided with an external face 6 with a single, constant angle. This therefore also leads to a reduction in the weight of the device, in particular because this measure means that the stroke of the hydraulic cylinder 10, and consequently the length of the cylinder, can be shorter than in the case of known devices with a constant angle.

Another measure according to the invention which is aimed at a saving in weight is the radial guide of the expansion jaws 4, which will be explained in greater detail with reference to Figs. 1 - 4. The housing 1 shown in Fig. 1 has at its end face a ring 29 on which six T-shaped guide projections 33 are formed. The ring 29 is made of a high-grade steel with tough breaking behaviour. The axes of the T-shaped guide projections 33 run radially relative to the longitudinal axis of the housing and form a mutual angle of 60 degrees. As can be seen from Fig. 3, each expansion jaw 4 is provided with a T-shaped recess 34, into which a T-shaped projection 33 of the ring 29 fits with some play. According to the invention, the side edges 35 of a projection 33 do not run parallel to each other, but run slightly towards each other. Since the wall parts 36 of an expansion jaw 4 interacting therewith do run parallel to each other, when the expansion jaw 4 moves outwards the play will gradually increase. This ensures that the expansion jaw 4 does not become jammed on the guide due to torsion as a result of the forces exerted thereon. In this way the guide can be made relatively light. Fig. 2 also shows threaded holes 39 for the accommodation of the bolts of the stops 22

(see Fig. 1).

It can be seen from Fig. 4 that the expansion jaws 4 are made hollow as far as possible. For this purpose, each expansion jaw 4 is provided with a recessed part 38.

Taking the above-described measures produces a mechanical expansion device whose total weight is less than 19 kg, including the hydraulic oil present in the cylinder 10. With this device it is possible to carry out operations which until now were possible only with devices whose weight was approximately 150 kg. The device shown can be used by a single person, with the result that the investment costs on the expensive materials used can be recouped. On account of the very low weight, the device according to the invention can also be used in many more cases than the known devices, for example in places where access is difficult.

Fig. 5 shows an embodiment in which an important difference from the embodiment described with reference to Figs. 1 - 4 is that for expanding the expansion jaws the mandrel is forced away relative to the housing by the hydraulic cylinder. Since the parts used here correspond essentially to the above-described embodiment, they are given the same reference numbers. The embodiment in Fig. 5 has the advantage compared with the above-described embodiment that a greater working surface area of the piston is available for exerting the force required for the mechanical expansion. For moving the expansion jaws apart during the expansion, oil under high pressure is supplied here to the connection 20 of the cylinder 10. The forces acting upon the parts of the device shown can be absorbed by this embodiment with even lighter measures as regards design.

Fig. 6 shows an embodiment in which a hydraulic cylinder 50 is connected by way of a rod 51 to a movable mandrel 52. The mandrel 52 is screwed onto the rod with a bolt 53. The cylinder 50 rests against a housing 54, which bounds a fixed mandrel-shaped part 55 at its free end. The mandrel 52 and the mandrel-shaped part 55 are designed in such a way that they engage with each other in a sliding manner. The device shown also has expansion jaws 56 which are each held with a guide face 57 against the two mandrels by a spring element 58 lying around the expansion jaws 56. Each expansion jaw 56 consists of two parts 58, 59. In this case the slide face part 61 formed by part 58 interacts with the fixed mandrel 55, and the slide face part 60 formed by part 59 interacts with movable mandrel 52. This division of the expansion jaws in a radial plane of the device means that the expansion jaws are prevented from jamming during the expansion. When the cylinder 50 is being operated the expansion jaws will remain lying at the

level of the intersecting line of the two mandrels 52, 55 and will be forced radially outwards. Through this embodiment, it is ensured that the friction losses of the expansion jaws are minimal, with the result that the force to be exerted by the cylinder is less than in the case of known devices, and the parts can thus be made lighter. The choice of the materials used in this example corresponds to the choice of material described with reference to the device shown in Fig. 1. The weight of the device shown in Fig. 6 is consequently also so low that said device is portable.

In Fig. 7 an expansion mandrel 70 has an essentially rectangular and hollow cross-section. Around the mandrel 70 two pairs of opposed expansion jaws are placed. The first pair of jaws comprises jaws 71 and 72, which jaws are lying against a first pair of opposed slide faces 73, 74 of the mandrel 70, respectively. The second pair of jaws comprises jaws 75 and 76, which jaws are lying against a second pair of opposed slide faces 77, 78 of the mandrel 70, respectively. Not visible in Fig. 7 is that the angle between each of the faces 73, 74 and the longitudinal axis 80 of the mandrel is larger than the angle between said axis 80 and the faces 77, 78. The neighbouring side edges of the jaws have a particular form which will be explained below referring to the jaws 71 and 75. Jaw 71 has a left-hand side edge which is defined by an essentially flat surface 82. The neighbouring side edge of jaw 75 is also defined by an essentially flat surface 83. As can be seen in Fig. 7 the surfaces 82 and 83 are essentially parallel and spaced apart. To maintain the spacing between both surfaces 82, 83, when the jaws are moved radially outwards during expansion of a pipe, the surfaces 82, 83 have to extend in a specific direction, i.e. there is an angle between the surfaces 82, 83 and the extension of the slide face 77 of the mandrel 70. This angle depends on the ratio between the sloping angles of the first pair of slide faces 73, 74 and the second pair of slide faces 77, 78. It is preferred that no contact takes place between the side edges of the jaws to reduce the amount of friction.

Claims

1. Device for mechanically expanding a pipe or pipe section, comprising a housing and an expansion head, which expansion head comprises an expansion mandrel with a cross-section which increases from an end face thereof and is bounded by an external face, and expansion jaws which interact with the expansion mandrel and rest against the housing, and also comprising a hydraulic cylinder whose cylinder wall rests against the housing

and whose piston is connected by way of a rod to the expansion mandrel, which can thereby be moved in its lengthwise direction relative to the expansion jaws, in order to move the expansion jaws essentially in the radial direction, **characterized in that** at least the expansion mandrel (3; 52, 55), the rod (14; 51) and the cylinder (10, 50) are made of metal in which the ratio $[\text{MPa}/(\text{kg}/\text{m}^3)]$ between the 0.2% yield limit $[\text{MPa}]$ and the density $[\text{kg}/\text{m}^3]$ is considerably greater than that of structural steel.

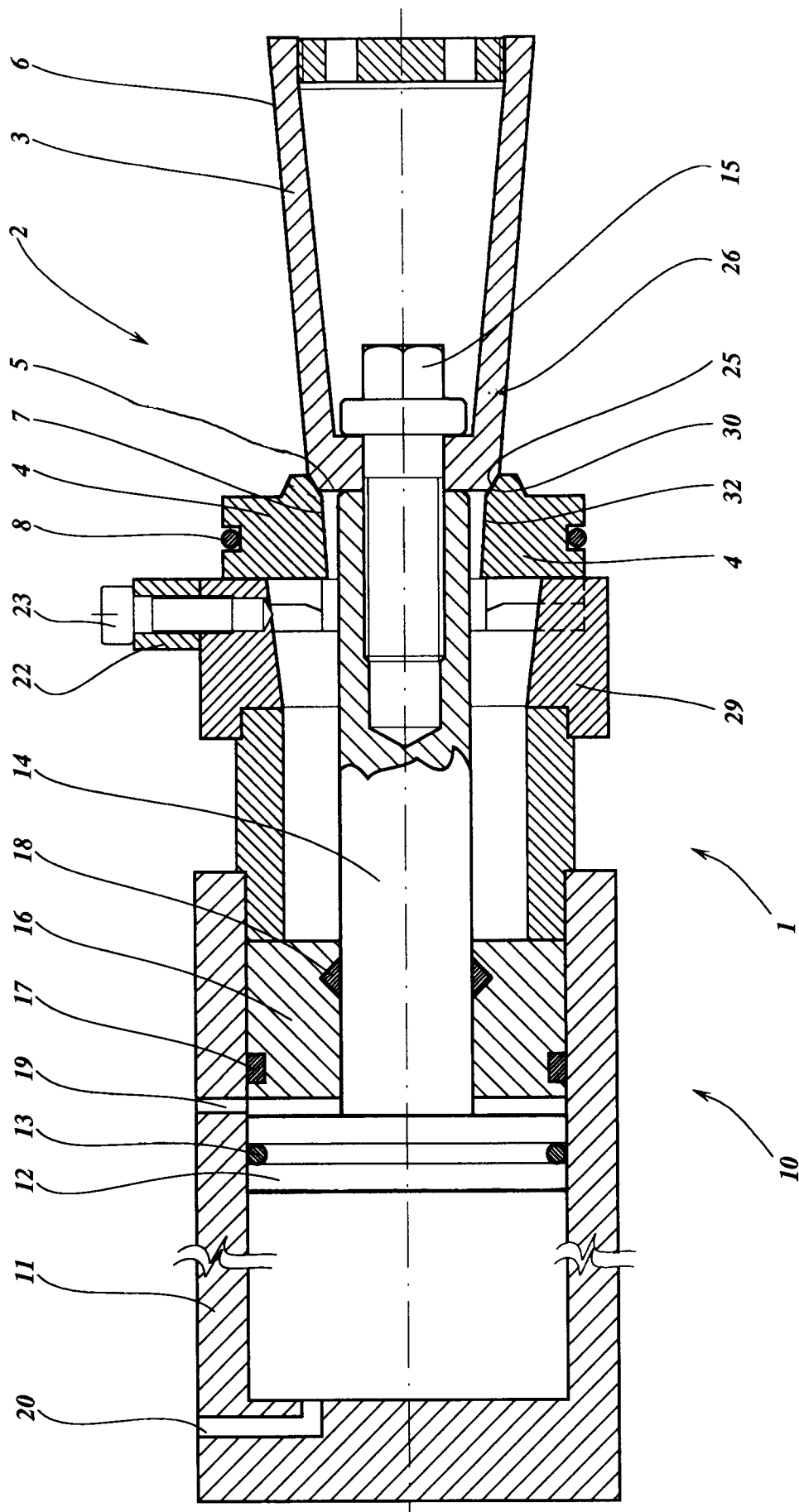
2. Device according to claim 1, **characterized in that** the ratio between the 0.2% yield limit $[\text{MPa}]$ and the density $[\text{kg}/\text{m}^3]$ is greater than $0.100 [\text{MPa}/(\text{kg}/\text{m}^3)]$.

3. Device for mechanically expanding a pipe or pipe section, comprising a housing and an expansion head, which expansion head comprises an expansion mandrel with a cross-section which increases from an end face thereof and is bounded by an external face, and expansion jaws which interact with the expansion mandrel and rest against the housing, and also comprising a hydraulic cylinder whose cylinder wall rests against the housing and whose piston is connected by way of a rod to the expansion mandrel, which can thereby be moved in its lengthwise direction relative to the expansion jaws, in order to move the expansion jaws essentially in the radial direction, **characterized in that** the expansion mandrel (3) comprises a first region (25) and a second region (26), viewed from its end face (5), and in the first region (25) the external face (6) forms a larger angle with the longitudinal axis of the expansion mandrel (3) than in the longer second region (26), and in that each expansion jaw (4) comprises a slide face (7) which interacts with the expansion mandrel (3) and has, viewed in the direction towards the cylinder (10), a first region (30) and a second region (32), in the first and in the second region (30, 32) the slide face forming an angle with the longitudinal axis of the expansion mandrel (3) which corresponds to the angle of the external face in the first and the second region (25, 26) of the expansion mandrel respectively.

4. Device according to one or more of the preceding claims, **characterized in that** the expansion mandrel (3; 52, 55) is made hollow.

5. Device according to claim 4, **characterized in that** the end face (5) of the expansion mandrel

- (3; 52) is provided with a bore through which a screw bolt (15; 53) projects, which screw bolt is screwed into an internally threaded bore in the end of the rod (14; 51) of the cylinder (10; 50).
6. Device according to one or more of the preceding claims, **characterized in that** the expansion jaws (4) are made hollow. 5
 7. Device according to one or more of the preceding claims, **characterized in that** the housing (1, 29) and the expansion jaws (4) are provided with interacting guide projections (33) and guide recesses (34) for guiding the expansion jaws (4) radially relative to the longitudinal axis. 10
 8. Device according to claim 7, **characterized in that** guide recesses (34) and guide projections (33) are formed in such a way that the play present between an expansion jaw (4) and the housing (1, 29) increases over at least a part of the movement path of the expansion jaw during the radial outward movement of the expansion jaw (4). 15
 9. Device according to one or more of the preceding claims, **characterized in that** the external face (6) of the expansion mandrel (3) is provided with a hard-wearing coating. 20
 10. Device for mechanically expanding a pipe or pipe section, comprising a housing and an expansion head, which expansion head comprises an expansion mandrel with a cross-section which increases from an end face thereof and is bounded by an external face, and expansion jaws which interact with the expansion mandrel and rest against the housing, and also comprising a hydraulic cylinder whose cylinder wall rests against the housing and whose piston is connected by way of a rod to the expansion mandrel, which can thereby be moved in its lengthwise direction relative to the expansion jaws, in order to move the expansion jaws essentially in the radial direction, **characterized in that** at the side facing the mandrel (52) movable by the cylinder (50) the housing (54) is provided with a fixed mandrel (55), the fixed mandrel (55) running in the opposite direction to the movable mandrel (52), and the mandrels (52, 55) being designed in such a way that they can engage in each other in a sliding manner, each expansion jaw (56) having a slide face (57), a first part (60) of which interacts with the movable mandrel (52), and a second part (61) of which interacts with 25
- the fixed mandrel (55).
11. Device according to claim 10, **characterized in that** each expansion jaw (56) is divided in a radial plane of the device, so that a first part (59) of the expansion jaw comprises a first part of the slide face (60), which interacts with the movable mandrel (52), and a second part (58) of the expansion jaw comprises the second part of the slide face (61), which interacts with the fixed mandrel (55). 30
 12. Device according to one or more of the preceding claims, **characterized in that** the device comprises four expansion jaws (71, 72, 75, 76). 35
 13. Device according to claim 12, **characterized in that** the expansion mandrel (70) has a first pair of opposed slide faces (73, 74) and a second pair of opposed slide faces (77, 78), cooperating with a first pair of expansion jaws (71, 72) and a second pair of expansion jaws (75, 76), respectively. 40
 14. Device according to claim 13, **characterized in that** each face (73, 74) of the first pair of slide faces forms a first angle with the longitudinal axis (80) of the expansion mandrel (70) and each face of the second pair of the slide faces (77, 78) forms a second angle, the neighbouring side edges of two expansion jaws, seen in a radial section of the expansion head, being essentially parallel flat faces (82, 82) and extending in such a direction that the distance between them is essentially invariable during the expansion movement of the jaws. 45



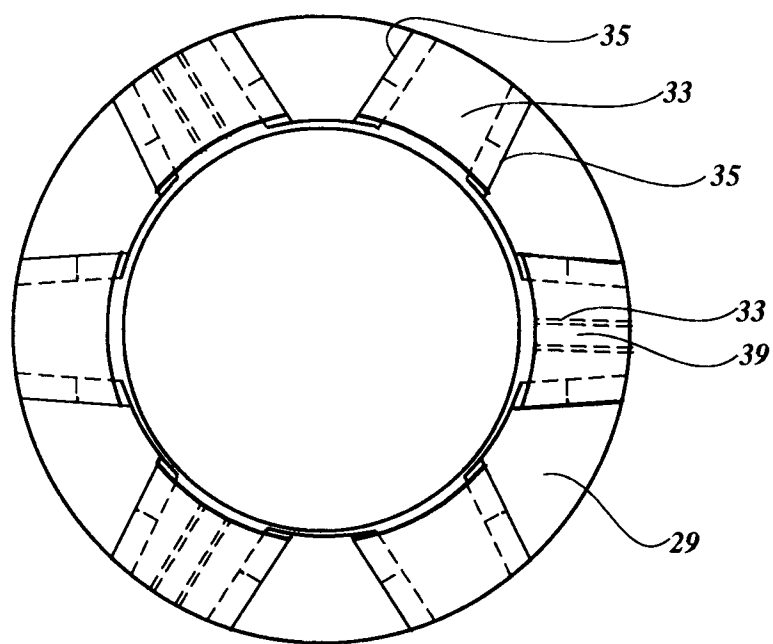


Fig. 2

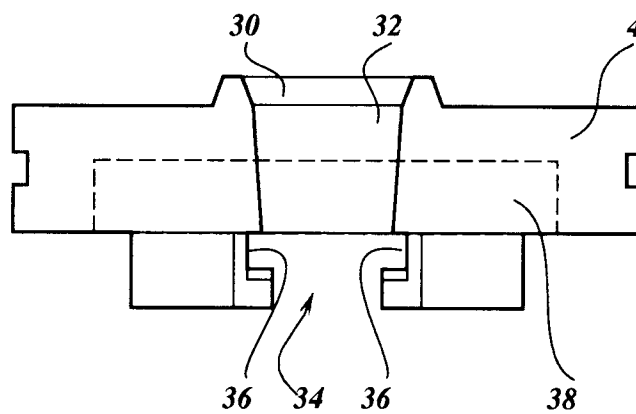


Fig. 3

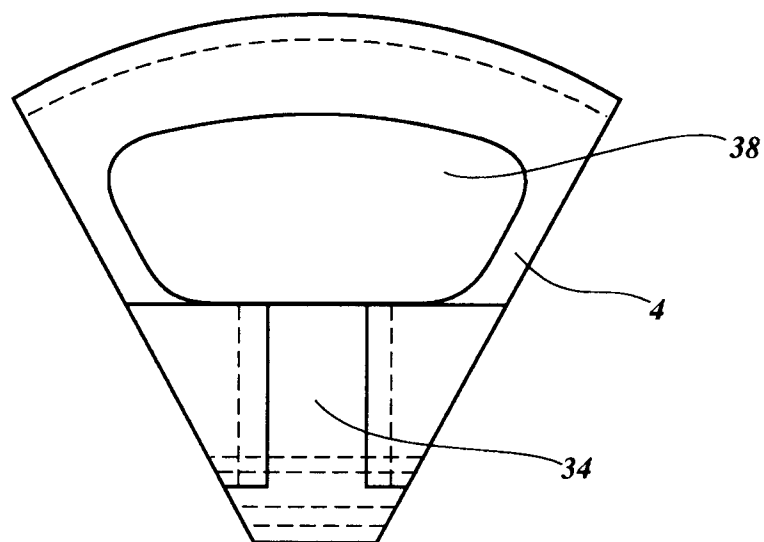


Fig. 4

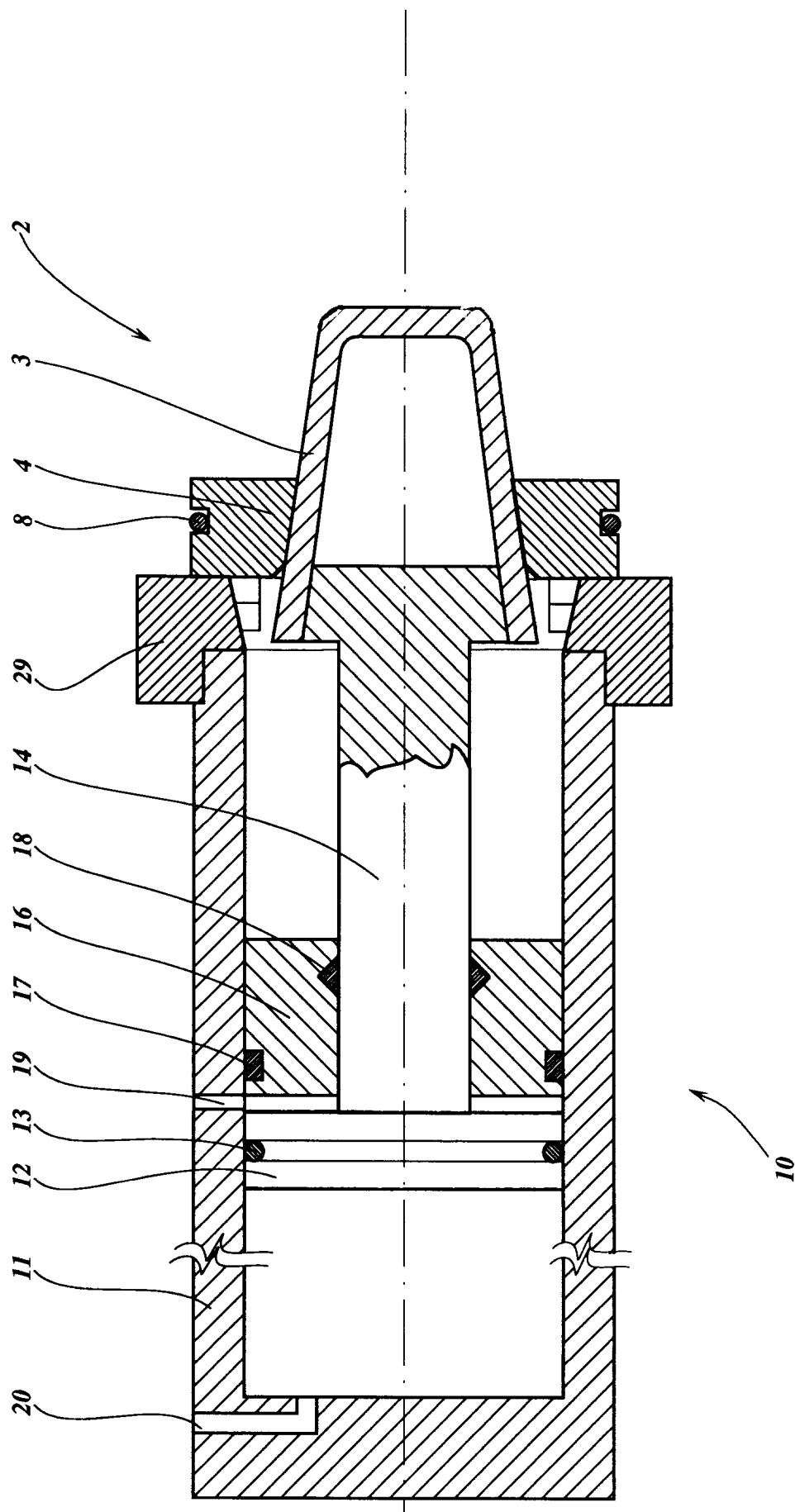
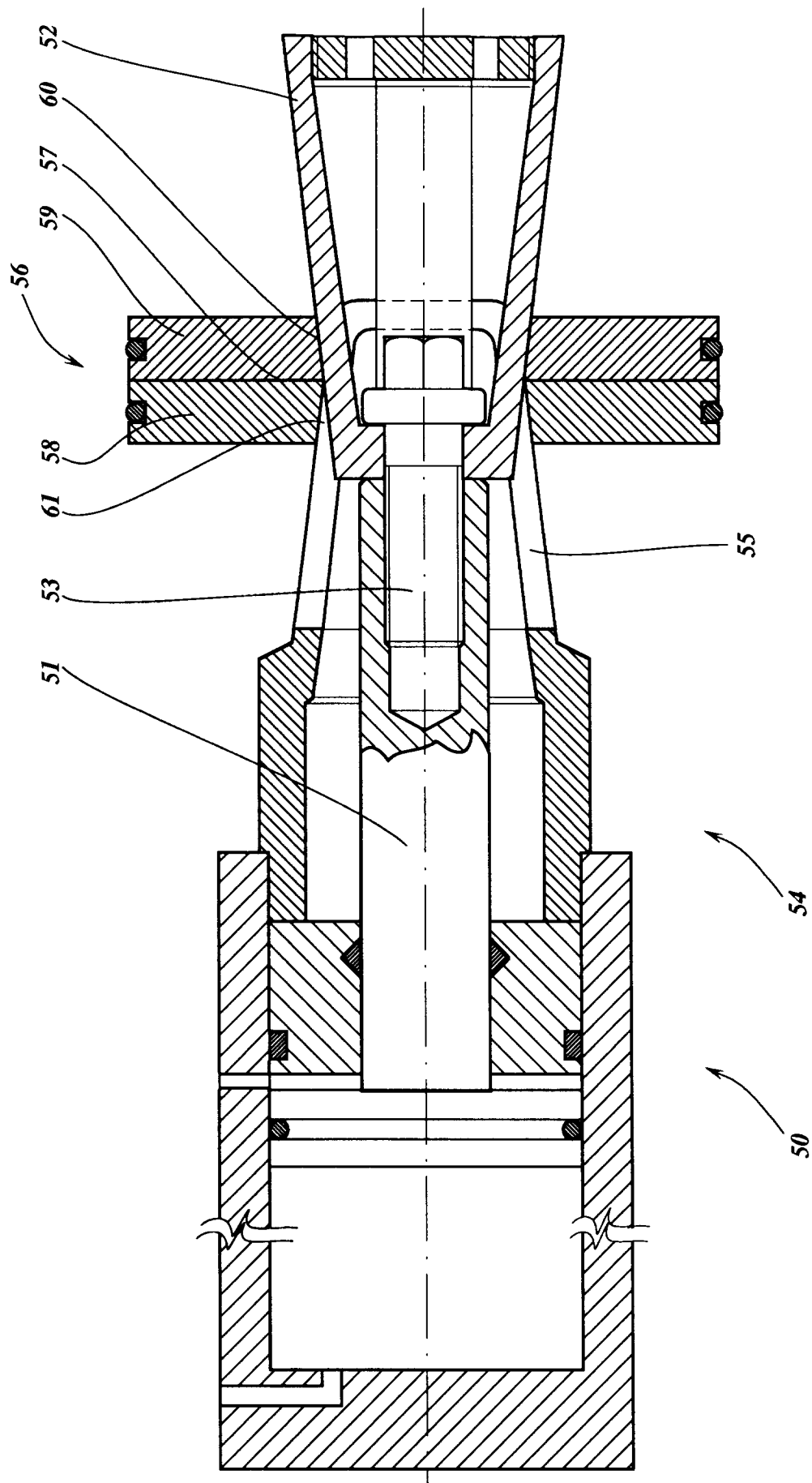
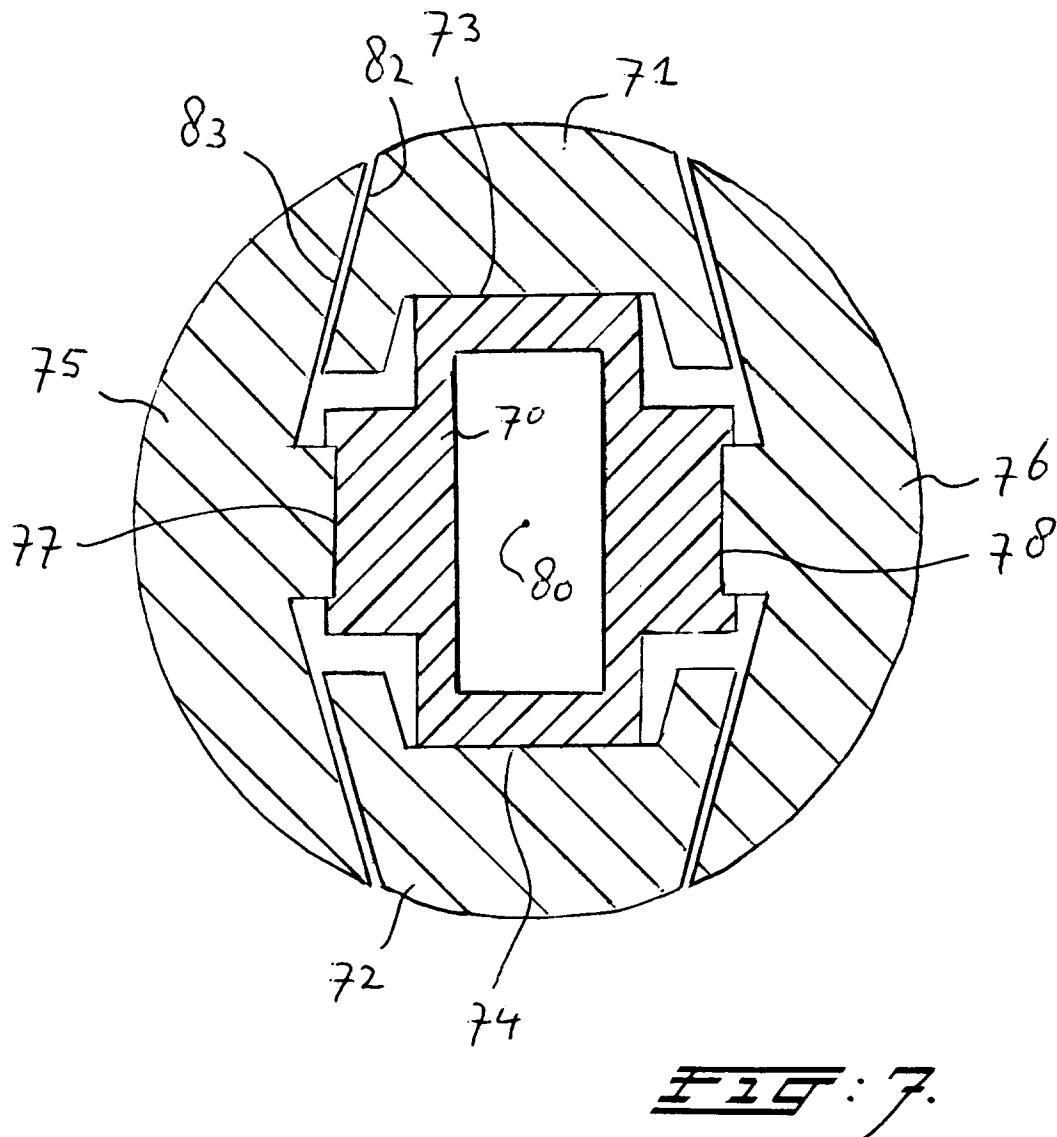


Fig. 5







European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 20 3286

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US-A-4 494 398 (MIDAS INTERNATIONAL CORPORATION) * the whole document *	1,2	B21D41/02
A	---	3,10	
X	US-A-4 934 038 (CATERPILLAR) * column 3, line 56 - column 4, line 65; claims; figures *	1,2	
A	---	3,10	
A	US-A-3 385 087 (HUTH) ---		
A	US-A-3 466 920 (PARKER) ---		
A	US-A-4 198 844 (LOWE) ---		
A	US-A-4 212 186 (BLATTNER) ---		
A	US-A-4 308 736 (LOWE) -----		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B21D
Place of search		Date of completion of the search	Examiner
THE HAGUE		7 February 1995	Peeters, L
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