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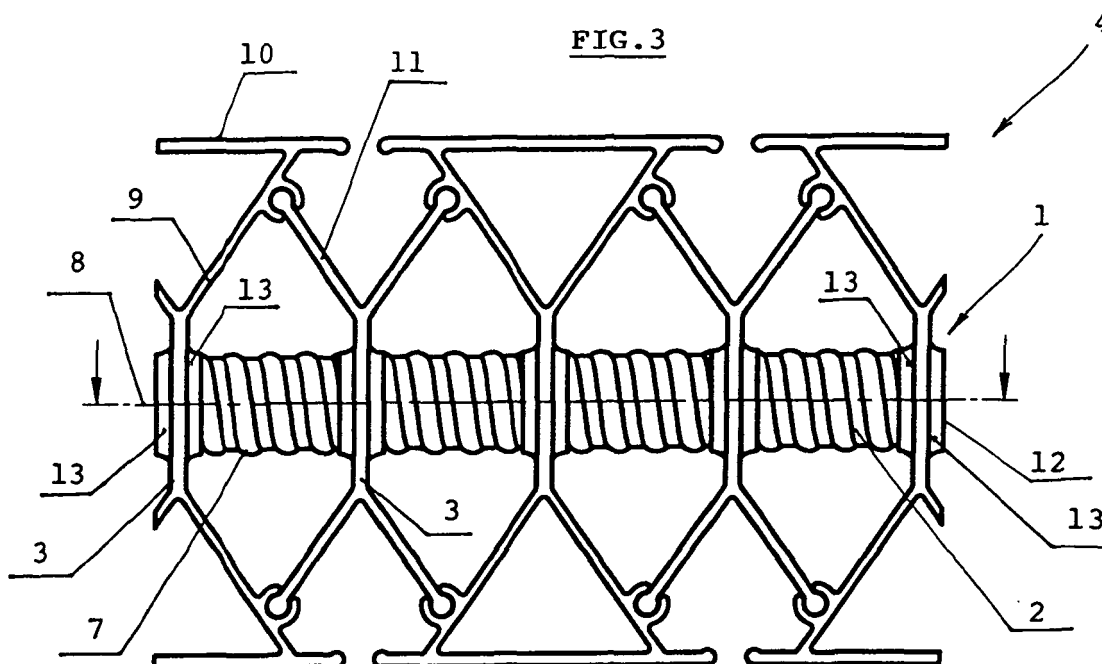
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(54) **A pressed-in joint of a pipe and a vane of a heater, its production method and the device used for performing the method**

(57) A pressed-in joint (1) of a pipe (2) and a vane (3) of a heater (4) is created by means of an inner spiral groove (6) protruding to the outside surface of the pipe (2) as an outer spiral protrusion (7) imbedded with overlap in a hole (12) in the vane (3) or in a mouth (5) or a fringe (13) of the vane (3). The pressed-in joint (1) is made by means of a rotary rolling broach (14) furnished on its surface with at least two rolling balls (15, 15') forming the inner spiral groove (6) and the outer spiral pro-

trusion (7) by rotating and sliding the broach (14) inside the pipe (2). The rotary rolling broach (14) has advantageously three rolling balls (15, 15', 15''), embedded with the possibility of adjusting their radial and axial positions. The inner spiral groove (6) causes sinuous flow of heat conducting media in the pipe (2) and better heat transfer to the pipe (2). The outer spiral protrusion (7) makes fix non-demountable connection of the pipe (2) with the vane (3) and improves the heat transfer conditions between the pipe (2) and the vanes (3).



Description

Area of the invention

[0001] The invention deals with a heater consisting of parallel heat-exchanging vanes through which at least one pipe with heat conducting medium flowing through or otherwise heated passes.

Prior art

[0002] There is a number of heaters consisting of pipes with heat conducting medium and of vanes transferring heat to a heated area.

[0003] The term "heater" means both, a heater consisting of one pipe fitted to transversal sheet vanes, or a heater in which several pipes pass in parallel through a system of parallel vanes, while the pipes are connected at their ends in bends or differently.

[0004] The term "vanes" means for the purpose of this invention profiled thin-wall vanes, particularly made of aluminium or its alloys, separate or in systems with connecting elements and cavities, then also ribs, sheet vanes and other heat exchanging elements attached to the pipe by soldering, welding, pressing or in a similar way.

[0005] Heat transfer of the heater is convective from the heat conducting medium to the pipe wall and then the heat is conducted from the pipe to the vanes, from the surface of which it is transferred by convection and radiation to the environment. The substantial factors for high efficiency of heaters are the materials used for the pipe and the vanes, the size of the heat exchanging surfaces of the pipes and vanes, the thermal gradient of the environment and also the parameters of heat transfer, i.e. the connection between the pipe and the vanes.

[0006] The file EP 0183211 presents a heater kit consisting of thin-wall vanes in which a horizontally located heat conductor pipe is integrated. The thin-wall vanes are made of one piece with the heat conductor pipe and they protrude from the pipe in radial direction up and down and to the sides. The walls of the thin-wall vanes protruding to the sides are furnished with air holes and shaped for more perfect circumfluence by ambient air. Low variability of the heater shape and high manufacturing costs are the main disadvantages.

[0007] The file GB 2146422 presents a heat exchanger consisting of a heat conductor pipe for heating medium from the walls of which thin-wall flat elements - ribs of identical shape protrude, designed for heat transfer from the heat conductor pipe to the environment. The thin-wall flat elements are finished at their free ends with V-shape lock elements. After clinching these elements together the lock elements connect tightly by means of a spring. The heat conductor pipe is integrated into the thin-wall flat element in parallel with the lock elements and is made in one piece with the flat elements to be assembled into a closed cylindrical body. The necessity to form the

closed cylindrical exchanger and the position of the heat conductor pipe that does not enable free kit assembly and shape variability, are disadvantages of this arrangement.

[0008] File EP 141 26 90 presents a heater kit with profiled aluminium vanes through which a copper pipe passes. The bearing vanes with V-shaped arms are alternated with connecting vanes with V-shaped arms whose ends are attached to the arms of the bearing vanes with the advantage of an articulated or fold joint. Copper pipes pass through holes in the vanes that might be filled with heat conducting connection substance and they are fixed in the holes by pressing by means of a common inner pull or rotation broach. The broach causes uniform increase of the inner and outer diameter of the pipe, which is thus pressed in the holes in the vanes while its wall gets thinner. The edge of the shaped hole is at the same time pulled into a fuel shape, which improves the parameters of the connection between the pipes and the vanes in term of heat transfer. The pipe might be similarly pressed into the vanes by means of liquid hydraulic pressure which blows the pipe up (its diameter increases).

[0009] A solution is provided by a satisfactory kit system with a long range of shaped variations of heaters of unified construction elements, mainly of aluminium and copper with high temperature drop over and under the heater. The pressed-in joint of the pipes and vanes is a disadvantage. If the pipe is pressed by hydraulic pressure, the pipe extension is not uniform, as even the thickness of the pipe wall is not ideally uniform, so defects and pipe destruction occur at the thinnest points of the pipe or on the other hand in some points the pipe is not sufficiently pressed in the vane hole, which reduces the heat transfer parameters.

[0010] Mechanical expansion of the pipe by means of a mechanical pull broach or a rotation broach produces considerable friction forces. Insufficient lubrication might cause deformation of the pipe inner wall and thinning of the pipe wall in the vane holes, which causes occurrence of micro cracks that might lead to defects. The pipe may also crack when formed in the future as a consequence of the micro cracks, particularly in bending of the heater into an arch when forming arch shapes.

[0011] Application of the above described pressed-in joint between the pipe and the vane might apart from the above defects also cause insufficient connection of the pipe with the vanes, both in manufacturing and in operation of the heater, when the connection might get loosen as a consequence of thermal changes and different values of thermal expansion of materials, which worsens the heat exchange parameters between the pipe and the vanes and thus reduces the efficiency of the heater as a whole. Removal of these disadvantages is the first task of the invention.

[0012] The heat transfer from the heat ducting media to the pipe should also be improved to improve the efficiency of the heater, which is the second task of the invention herein presented.

[0013] We know that if the inner wall of a pipe is smooth, i.e. it passes as cylindrical area axially with the pipe axis, there is still stratified flow of the heat conducting medium inside such a pipe in normal flow, when the outer layers of the medium get cooler and the central section remains unmixed, which leads to lower efficiency of the heat transfer from the medium to the pipe. This drawback is usually compensated by larger diameter of pipes in practice, to achieve larger heat exchanging surface of the pipe inside wall. However this solution represents higher material demand, higher weight etc. Patent Application WO 2006/056189 presents a pipe solution with inner longitudinal fins for heat exchange improvement, which nevertheless keep the stratified flow character.

[0014] Another known method of solution of heat transfer efficiency improvement between the heat conducting medium to the pipe is based on modification of stratified flow inside the pipe to sinuous flow. File BG 1083 67U presents a smoke pipe, for example for greenhouse heating, through which hot flue gases leave a heating facility. There are vanes attached to the pipe surfaces and a resistance body is located inside the pipe causing turbulent movement of hot gas. The body may have a spiral shape or may consist of a set of cones or disks with holes. This solution is not suitable for small diameter pipes used in heaters.

[0015] File JP 2002 350082 presents a condensation pipe welded of a copper sheet strip, on which strips with transversal and longitudinal corrugation are alternately pressed in. The disadvantage is that a welded pipe itself is not suitable for heaters as it cannot be pressed into the holes in vanes.

[0016] Finally we know pipes whose inner wall is furnished with a spiral groove causing rotation of flowing liquid around the pipe longitudinal axis.

[0017] File JP 9070612 for example describes a method of manufacturing a pipe for heat transfer serving for increase of the boiling point of non-constant-boiling coolant. The pipe has a double spiral groove on the inner surface. The grooves are made by a couple of inner pins having teeth around them and are adjusted one after another inside the pipe. There are balls pressed against the pins from the outside of the pipe, arranged in two rows in a holder and in flanges. The balls move in planetary rotation and the pins form the double spiral groove inside the pipe.

[0018] A similar solution is described in document JP 2001 347311, where a single inner pin and a single external row of balls are used to make the inner grooves in the pipe, like for example in documents US 5724 844 and EP 0795 363.

[0019] The devices used for manufacturing pipes with inner grooves consist of inner toothed or slotted pins acting on the pipe inner wall, and an external set of supporting balls acting as a rest against the pressure of the pins at the outside wall of the pipe. Disadvantage of these pipes with the inner spiral groove when used for heaters is based on the fact that their outer wall remains smooth,

so the heat transfer from the pipe to the vane remains unimproved and the existing drawbacks remain unsolved. The above manufacturing methods are moreover unsuitable or applicable to pressed-in joints of pipes and vanes of heaters that are made on the pipes that were inserted in the holes of the vanes before.

Principle of the invention

[0020] The above drawbacks are removed to considerable extent by pressed-in joint of a pipe and a vane of a heater according to the invention.

[0021] It is based on the principle that the inner wall of the pipe is provided with a thread shaped spiral groove with constant pitch, protruding from the outside surface of the pipe as an outer spiral protrusion placed with overlap in the vane hole. The inner spiral groove causes sinuous flow; the outer spiral protrusion serves for attachment and connection. No local micro cracks are produced in the pipe material in manufacturing of the pressed-in joint and the joint between the pipe and the vane show tight contact with larger contact surface, which does not get loosened in time.

[0022] From technological point of view it is advantageous, if the inner spiral groove and the external spiral protrusion have semicircle profile created by rolling technology (rolling balls).

[0023] In another advantageous embodiment of the invention the radius of the semicircular profile of the inner spiral groove and the outer spiral protrusion is between 1.5 mm and 5 mm for common pipe diameters used for heater manufacturing. The radius is given by the diameter of the rolling ball, which is determined in relation to the pipe diameter, vane thickness, thread pitch of the groove and the height of the inner spiral groove.

[0024] In an advantageous embodiment of the invention the heater consists of profiled thin-wall vanes arranged in parallel and made of aluminium or its alloys, which are provided with holes, through which at least one copper pipe passes, while the outer spiral protrusion created on the pipe extend to the holes and fringes with overlap and form a non-demountable joint with them. The pressed-in joint according to the invention is particularly advantageous in this embodiment with aluminium vanes and copper pipes. From the point of view of optimal design structure it is advantageous if the pitch of the inner spiral groove and the outer spiral protrusion is between 2 and 30 mm, which basically corresponds to 30 through 100 % of the pipe diameter, while the depth of the groove is between 0.5 and 3 mm.

[0025] The invention subject also involves the method of manufacturing the pressed-in joint of the heater pipe and vane. It is based on the principle that the inner spiral groove is made in the pipe in the shape of thread with constant pitch, protruding on the outer surface of the pipe as an outer spiral protrusion, which fills the hole in the vane with overlap with a fringe or mouth. This manufacturing method has a number of advantages compared

to the known state of technology, as it enables a technology with minimum friction to be used.

[0026] A rotating rolling broach furnished with at least two rolling balls for forming the inner spiral groove and the outer spiral extrusion is inserted into the pipe, while the outside support during forming the pressed-in joint is only provided by the vane holes and/or vane mouths and/or vane fringe.

[0027] The subject of the invention also involves a device for making the pressed-in joint of the heater pipe and vanes. It is based on the principle that it consists of a rotary rolling broach for making the inner spiral groove of thread shape with constant pitch, protruding on the outside surface as an outer spiral protrusion. The rotary rolling broach has a working head, in which at least two rolling balls protruding from the working head surface on the opposite sides with regard to the rotary rolling broach axis, are located. The balls are mutually shifted in the direction of the rotary rolling broach axis with the distance corresponding to at least 0.5 multiple of the thread pitch of the inner spiral groove and the outer spiral protrusion.

[0028] The device for forming the pressed-in joint of the heater pipe and vanes may alternatively consist of a rotary rolling broach for forming the inner spiral groove of thread shape with constant pitch, protruding on the outside surface as an outer spiral protrusion. The rotary rolling pin has a working head, in which at least three rolling balls protruding from the working head surface and shifted in the direction of the rotary rolling broach axis with the distance corresponding to at least 1/3 of the thread pitch of the inner spiral groove and the outer spiral protrusion.

[0029] In an advantageous embodiment of the device according to the invention the pressing balls are attached in the working head with the possibility of variable radial overhang from the working head surface and/or their mutual axial distance in the direction of the rotary rolling pin axis. Such a universal tool may be used to making pressed joints with various groove sizes and for various materials and designs of vanes and pipes.

[0030] The advantages of the solution according to the invention are particularly based on the fact that it improves the parameters of heat transfer both between the heat conducting medium and the pipe and between the pipe and the vanes. The spiral thread groove in the inside wall of the pipe causes rotation movement of the heat conducting media and causes sinuous flow, which improves the heat transfer to the pipe. The outer spiral protrusion forming thread on the outside wall of the pipe pressed in the vane hole holds the pipe in the vanes better in both the axial and radial directions and improves the contact of the pipe with the vane, which improves heat transfer from the pipe to the vane. The inner and the outer surfaces of the pipe are enlarged, so the heat exchanging surface is also bigger. Another advantage is that the proposed method of pressed-in joint may be applied uniformly through the whole pipe length regardless possible reduction of the pipe diameter at any point. Min-

imum friction accompanies the pressing process and there are no micro cracks formed that might later lead to defects, destruction, leaks etc. The manufacturing method and the device for implementation of the method are designed to enable a pressed-in joint to be performed on pipes that have already been inserted through the holes in the vanes, only by means of pressing their inner wall. The solution according to the invention is also suitable for heater kits that might be deformed and shaped into arch and angular shapes without deforming and destructive actions.

Brief description of the Drawings

[0031] The invention will be detailed by means of drawings, in which Fig. 1 shows a ground plan of the pressed-in joint of the tube and the transversal vanes, Fig. 2 shows a cross-section through the pressed-in joint as in Fig. 1 by an A-A plane, Fig. 3 shows a ground plan of pressed-in joint of pipes and parallel profiled thin-wall vanes in a heater kit, Fig. 4 shows a cross-section through the pressed-in joint from Fig. 3 by a B-B plane, Fig. 5 shows a longitudinal section through a rolling broach with the second rolling ball at the distance of 1.5 of the thread pitch from the first rolling ball, fig. 6 shows a cross section through the rolling broach as in Fig. 5 by a C-C plane, Fig. 7 shows a longitudinal section through a rolling broach with the second rolling ball at the distance of 0.5 of the thread pitch from the first rolling ball, Fig. 8 shows a cross section through the rolling broach as in Fig. 7 by a D-D plane, Fig. 9 longitudinal section through a rolling broach with the uniform arrangement of the rolling balls around the perimeter, Fig. 10 shows a cross section through the rolling broach as in Fig. 9 by a E-E plane, Fig. 11 shows a longitudinal section through a rolling broach with fixing cage for the rolling balls, Fig. 12 shows a cross section through the rolling broach as in Fig. 11 by a F-F plane.

Detailed description of the preferred embodiments

[0032] The example embodiments described and depicted below are understood as illustrative and they do not represent limitation of the invention example embodiments to those herein mentioned. Experts knowing the state of technology will find or will be able to find higher or lower number of equivalents to specific implementation of the invention specifically described herein, using routine experimenting. Such equivalents will be also covered by the below claims.

[0033] The first example embodiment depicted in Fig. 1 and Fig. 2, involves a pressed-in joint 1 made on a heater 4 consisting of parallel sheet vanes 3 with holes and with mouths 5 fitted to a pipe 2 one next to another. Similarly the individual vanes 3 may be arranged directly on the pipe 2 (without the mouths 5). The inner wall of the pipe 2 is provided with an inner spiral groove 6 as a thread with constant pitch, and the outside wall of the

pipe 2 is provided with an outer spiral protrusion 7 corresponding to the inner spiral groove 6. By forming the pressed-in joint 1 the mouth 5 of the vanes 3 are also extended together with the extension of the pipe 2 at the outer spiral protrusion 7, and a fixed non-demountable joint of the pipe 2 with the vanes 3 is created, while the contact surfaces tightly lie on each other and the parameters of heat transfer from pipe 2 to the vanes 3 are much improved compared to different connection methods. The inner spiral groove 6 rotates not depicted heat conducting medium around the longitudinal axis 8 of the pipe 2, so there are turbulences created inside the pipe 2 increasing effectiveness of heat transfer from the medium to the pipe 2. The radius of the inner spiral groove 6 is between 1.5 and 5 mm, according to the type and diameter of the pipe 2 and the type of the vanes 3, the pitch of the groove 6 thread is usually from 2 mm to 30 mm, the depth of the groove 6 is usually from 0.5 mm to 3 mm.

[0034] The second example embodiment depicted in Fig. 3 and Fig. 4, involves a pressed-in joint 1 made on a heater 4 consisting of a set of parallel profiled thin-wall vanes 3 made of aluminium or its alloys, through which a multiple of mutually connected copper pipes 2 arranged in parallel pass transversely. It is a heater 4 kit described in European patent EP 1412690, and may be bent for example into arch after assembly. V-shaped arms of the bearing vanes 9 bear front covers 10 and V-shaped arms of the connecting vanes 11 are attached on the arms of the bearing vanes 9 by means of swing joints. The individual vanes 3 have circular holes 12 with fringes 13 created during making the holes 12 by forming technology of flowdrill. Pipes 2 are inserted through the holes 12 and a pressed-in joint 1 is created by formation of an inner spiral groove 6 in the inner wall of the pipe 2 as a thread with constant pitch, and an outer spiral protrusion 7 is provided on the outer wall of the pipe 2, corresponding to the inner spiral groove 6 and copying its trajectory. When the pressed-in joint 1 is formed the pipe 2 extends its diameter at the place of the outer protrusion 7 and is pressed in the holes 12 and the fringes 13. The holes 12 and the fringes 13 serve as external support acting against the pressure extending the pipe 2 from the inside, and are slightly deformed and adapt their perimeter to the pipe 2 with the outer spiral protrusion 7. This creates a fixed non-dismountable connection of the pipe 2 with the vanes 3, while the contact surfaces tightly lie on each other and the parameters of heat transfer from pipe 2 to the vanes 3 are much improved. The inner spiral groove 6 improves efficiency of heat transfer from not depicted heat conducting media to the pipe 2, like in the first example embodiment of the invention. In another not depicted example an electric heating element may be inserted into the pipe 2 so electric heating may be used for the heater 4 instead of heat conducting medium.

[0035] The radius of the inner spiral groove 6 is between 2 and 4 mm, according to the diameter of the pipe 2, the depth of the groove 6 is usually from 0.5 mm to 1.5 mm the thread pitch of the groove 6 is usually from

2 mm to 6 mm.

[0036] When making the pressed-in joint 1 as per the first and the second example embodiments of the invention the vanes 3 are first put on the pipe 2 and the inner wall of the pipe 2 is then formed by the rolling broach 14 with rolling balls 15 arranged around the broach 14 peripheral, by which the inner spiral groove 6 and the outer spiral protrusion 7 are formed at the same time, and the pipe 2 is pressed into the holes 12 with the fringes 13 in the vanes 3.

[0037] The rotary rolling broach 14 attached to a not depicted driving rod may be in a number of concrete design variations according to the field of application and the type of the connecting pipes 2 and the vanes 3. The rotary rolling broach 14 consists of a working head 16 with rolling balls 15 and a clamping shaft 17 which is separated from the working head 16 by indent surfaces 18 for a clamping tool (wrench).

[0038] The example embodiment shown in Fig. 5 and Fig. 6 involves a rotary broach 14, suitable for forming the pressed-in joint 1 of a pipe 2 with thicker and stiffer vanes 3. The first rolling ball 15 protrudes from the peripheral of the cylindrical working head 16 at sufficient distance from the insertion part. The second rolling ball 15' is also embedded in the working head 16 and protrudes from its surface on the opposite side with regard to the axis 19 of the broach 14 in axial distance of 1.5 times the thread pitch of the inner spiral groove 6 in the pipe 2 (the peripheral length 1.5 of the thread of the groove 6). A third rolling ball 15'' is imbedded in the working head 16 behind the second rolling ball 15' and protrudes from its surface at the same side of the broach 14 as the second rolling ball 15', with regard to the axis 19, with axial distance equal to the thread pitch of the inner spiral groove 6 (peripheral length of one thread of the groove 6). All the rolling balls 15, 15', 15'' are embedded in the working head in the manner enabling regulation of their overhang from the head 16 and thus the size and depth of the inner spiral groove 6 and the outer spiral protrusion 7 in the pipe 2. The regulation is performed by positioning bolts 20, while the adjustment values of the individual rolling balls 15, 15', 15'' may differ. When the rotary rolling broach 14 is applied on the pipe 2, resistance (counterforce) occurs at the inlet of the first rolling ball 15 into the hole 12 in the vane 3, corresponding with the rigidity of the vane 3 and its material. The force of the resistance caused this way is transferred to the opposite rolling balls 15', 15'', which are already guided in the thread of the inner spiral groove 6 preformed by the first rolling ball 15. The force of the resistance of the first rolling ball 15 forms a gradual haunch of the groove 6 thread to the hole 12 in the vane 3, and is transferred to the opposite rolling balls 15', 15'', where it forms elevated protrusion of the groove 6 thread in the pipe 2, which does not cause thinning of the pipe 2 passing through the hole 12 of the vane 3. The example embodiment is suitable for smaller diameters of the pipe 2 with thread pitch smaller than the diameter of the balls 15,

15', 15". It may be used for pressing in joints 1 with thins as well as thick vanes 3. There is an advantage of the gradual haunch of the thread of the pipe 2 into the hole 12 of a thicker and stiffer vane 3, where adaptability of more flexible material is advantageously exploited, i.e. the material of the pipe 2, to which the second two balls 15', 15" apply the force created by the resistance of the first ball 15 when it penetrates to the hole 12 of the vane 3. This means that the broach 14 is partly deflected from the axis of the pipe 2 and acts eccentrically during penetration of the first ball 15 through the hole 12 of the vane 3.

[0039] In another example embodiment shown in Fig. 7 a Fig. 8, suitable for formation of the pressed-in joint 1 of a pipe 2 with thinner and less rigid vanes 3, the rotary rolling broach 14 equipped with the first rolling ball 15, which is located approximately at the same place of the working head 16, while the second rolling ball 15' is embedded on the opposite side of the head 16 with regard to the axis 19 of the broach 14 at axial distance equal to 0.5 multiple of the thread pitch of the inner spiral groove 6 in the pipe 2 (the peripheral length 0.5 of the thread of the groove 6). A third rolling ball 15" is embedded in the working head 16 behind the second rolling ball 15' and protrudes from its surface with axial distance equal to the thread pitch of the inner spiral groove 6 (peripheral length 1 of one thread of the groove 6) like in the previous example.

[0040] The rolling balls 15, 15', 15" are imbedded in the working head 16 in the manner enabling regulation of their overhang from the head 16 not individually, but all together. The overhang regulation is performed by means of a changeable shaft 21, which is inserted in central cavity 22 in the axis 19 of the working head 16, and fixed with thread 23, while the balls 15, 15', 15" are embedded in the peripheral of the shaft 21. The overhang of the balls 15, 15', 15" from the working head 16 thus depends on the diameter of the changeable shaft 21 used. This version is suitable for larger pipe 2 diameters with thread pitch of groove 6 bigger than the diameter of the balls 15, 15', 15".

[0041] In another example embodiment of the rotary rolling broach 14 shown in Fig. 9 a Fig. 10 the rolling balls 15, 15', 15" are also placed around a changeable shaft 21 like in the previous example, but their arrangement in the surface of the working head 16 is different. The balls 15, 15', 15" are arranged around the peripheral in angular distances 120°, and their axial distance equals 1/3 of the thread pitch of the spiral groove 6 in the pipe 2 (the peripheral distance is 1/3 of the thread length of the groove 6). The overhang of all the balls 15, 15', 15" may also be regulated in this example embodiment by replacement of the changeable shaft 21. The version is suitable for rolling threads of the groove 6 with the pitch smaller than the diameter of the balls 15, 15', 15".

[0042] The last example embodiment shown in Fig. 11 and Fig. 12 represents a rotary rolling broach 14 with three rolling balls 15, 15', 15", where, unlike in the pre-

vious example embodiments the overhang of the balls 15, 15', 15" from the working head 16, cannot be regulated, but their axial arrangement (distance) on the peripheral of the working head 16 can be changed. The balls 15, 15', 15" are freely embedded in grooves 24, 25 made in the opposite sides of the working head 16 with regard to the axis 19 of the broach 14 and fixed at required distances by means of a fixation cage 26 sunk into the working head surface. The fixation cage 26 is changeable and its disassembly and assembly is performed by a fixing bolt 27 the head of which forms the front of the working head 16.

[0043] The advantage of this embodiment is in its versatility, as the rotary broach 14 with the balls 15, 15', 15" may be used in various operation applications with different requirements for the thread pitch with several changeable fixation cages.

[0044] Common advantage of all the above example embodiments of the rotary rolling broach 14 is that the arrangement of the rolling balls 15, 15', 15" and their function in rolling the inner spiral groove 6 and the outer spiral protrusion 7 enable the pressed-in joint 1 to be made with a simple source of rotary movement of the rolling broach 14 without any special demands for the size of the axial component of the force acting on the rotary rolling broach 14 in the axis 19. Another advantage is based on the feature that the individual design indications of the above described example embodiments may be mutually combined and create further possible embodiments of the rotary broach 14 for particular required parameters and applications.

Industrial Applicability

[0045] The subject of the invention may be used in manufacturing of a pressed-in joint of a pipe and a vane of a heater in numerous variations of heaters with heat conducting media flow or with another heating type.

Overview of the positions used in the drawings

[0046]

1	pressed-in joint
2	pipe
3	vane
4	heater
5	mouth
6	inner spiral groove
7	outer spiral protrusion
8	longitudinal axis of the pipe
9	bearing vane
10	face cover
11	connecting vane
12	hole
13	fringe
14	rotary rolling broach
15, 15', 15"	rolling ball

16	working head
17	clamping shaft
18	indent surfaces for attachment tool
19	broach axis
20	adjustment bolt
21	changeable shaft
22	cavity
23	thread
24	groove
25	groove
26	fixation cage
27	fixing bolt

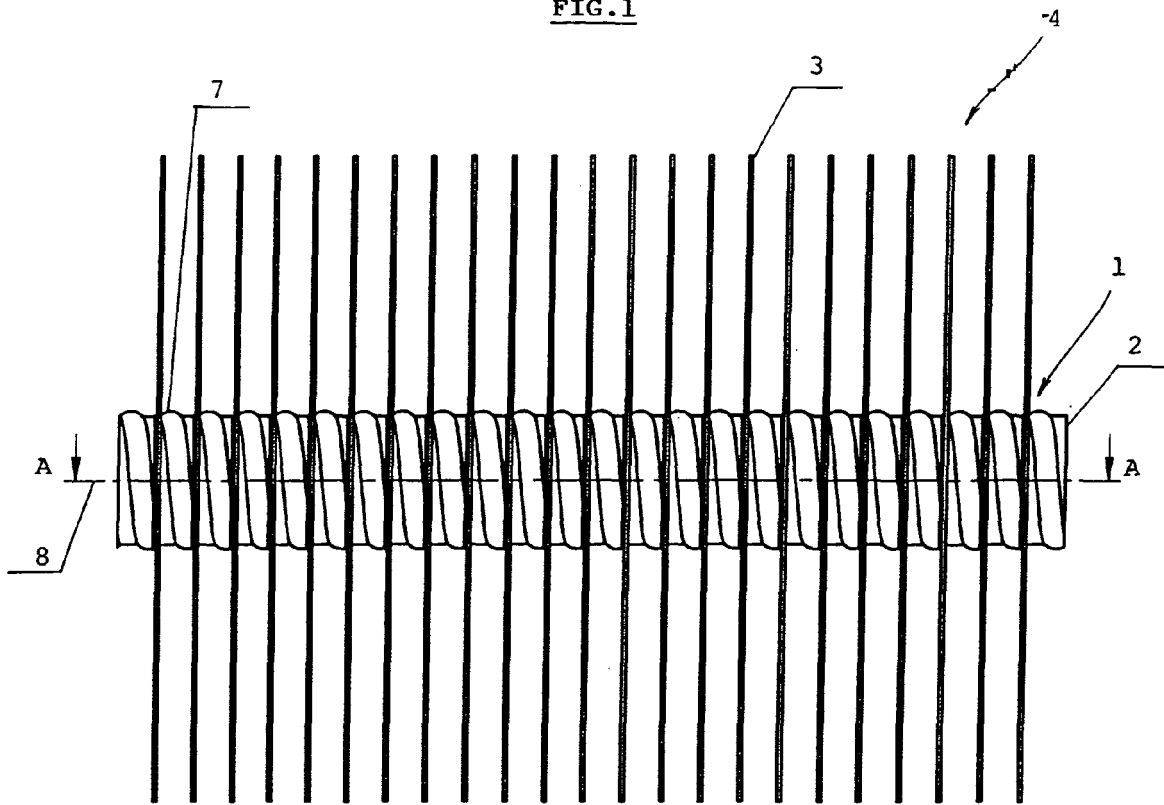
Claims

1. A pressed-in joint (1) of a pipe (2) and a vane (3) of a heater (4) with at least one vane (3) fitted on the pipe (2), **characterized by** that an inner spiral groove (6) is created on the inner wall of the pipe (2) having thread shape with constant pitch, protruding to the outside surface of the pipe (2) as an outer spiral protrusion (7) imbedded with overleap in a hole (12) in the vane (3).
2. A pressed-in joint according to Claim 1, **characterized by** that the inner spiral groove (6) and the outer spiral protrusion (7) have semicircular profile.
3. A pressed-in joint according to Claim 2, **characterized by** that the radius of the semicircular profile of the inner spiral groove (6) and the outer spiral protrusion (7) are in the range from 1.5 mm to 5 mm.
4. A pressed-in joint according to at least one of the Claims 1 to 3, **characterized by** that the heater (4) consists of profiled thin-wall vanes (3) arranged in parallel and manufactured of aluminium or its alloy, which are provided with holes (12) with fringes (13), through which at least one pipe (2) made of copper passes, while the outer spiral protrusion (7) formed on the pipe (2) reaches with overleap to the holes (12) and the fringes (13) and forms a non-dismountable connection with them.
5. A pressed-in joint according to at least one of the Claims 1 to 4, **characterized by** that the thread pitch of the inner spiral groove (6) and the outer spiral protrusion (7) is between 2 mm and 30 mm and the depth of the groove (6) is between 0.5 mm and 3 mm.
6. Method for producing a pressed-in joint (1) of a pipe (2) and a vane (3) of a heater (4), where a pipe (2) is inserted in a hole (12) in at least one vane (3) and the pipe (2) diameter is subsequently extended **characterized by** that a spiral groove (6) of thread shape with constant pitch is formed in the pipe (2), protruding to the outside surface of the pipe (2) as

an outer spiral protrusion (7) imbedded with overleap in a hole (12) in the vane (3).

7. The production method according to Claim 6, **characterized by** that a rotary rolling broach (14) furnished on the surface with at least two rolling balls (15, 15') forming the inner spiral groove (6) and the outer spiral protrusion (7) is inserted into the pipe (2), while the outer support in producing the pressed-in joint (1) is provided by the holes (12) in the vanes (3) and/or a mouth (5) of the vanes (3) and/or fringes (13) of the vanes (3).
8. A device for producing a pressed-in joint (1) of a pipe (2) and a vane (3) of a heater (4), with at least one vane (3) fitted on the pipe (2), **characterized by** that the device consists of a rotary rolling broach (14) for formation of the inner spiral groove (6) having the shape of thread with constant pitch, protruding on the outside of the pipe (2) as an outer spiral protrusion (7), while the rotary rolling broach (14) has a working head (16), in which at least two rolling balls (15, 15') are embedded, protruding from the surface of the working head (16) on the opposite sides of the working head (16) with regard to the axis (19) of the rotary rolling broach (14), in mutual distance in the direction of the axis (19), corresponding at least to 0.5 multiple of the thread pitch of the inner spiral groove (6) and the outer spiral protrusion (7).
9. A device for producing a pressed-in joint (1) of a pipe (2) and a vane (3) of a heater (4), with at least one vane (3) fitted on the pipe (2), **characterized by** that the device consists of a rotary rolling broach (14) for formation of the inner spiral groove (6) having the shape of thread with constant pitch, protruding on the outside of the pipe (2) as an outer spiral protrusion (7), while the rotary rolling broach (14) has a working head (16), in which at least three rolling balls (15, 15', 15'') are embedded, protruding from the surface of the working head (16) and with mutual distance in the direction of the axis (19) of the rotary rolling broach (14) at least 1/3 of the thread pitch of the inner spiral groove (6) and the outer spiral protrusion (7).
10. The device according to Claim 8 or 9, **characterized by** that the rolling balls (15, 15', 15'') are embedded in the working head (16) with the possibility of adjustment of their radial overhang from the working head (16) surface and/or adjustment of their mutual axial distance in the direction of the axis (19) of the rotary rolling broach (14).

FIG. 1



A-A

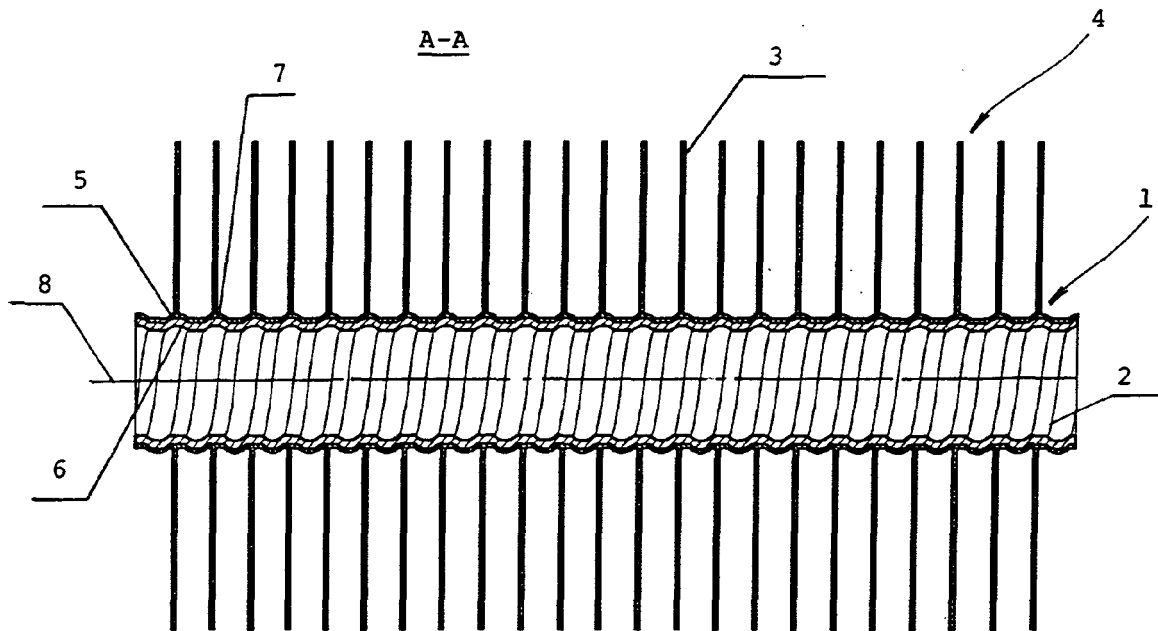


FIG. 2

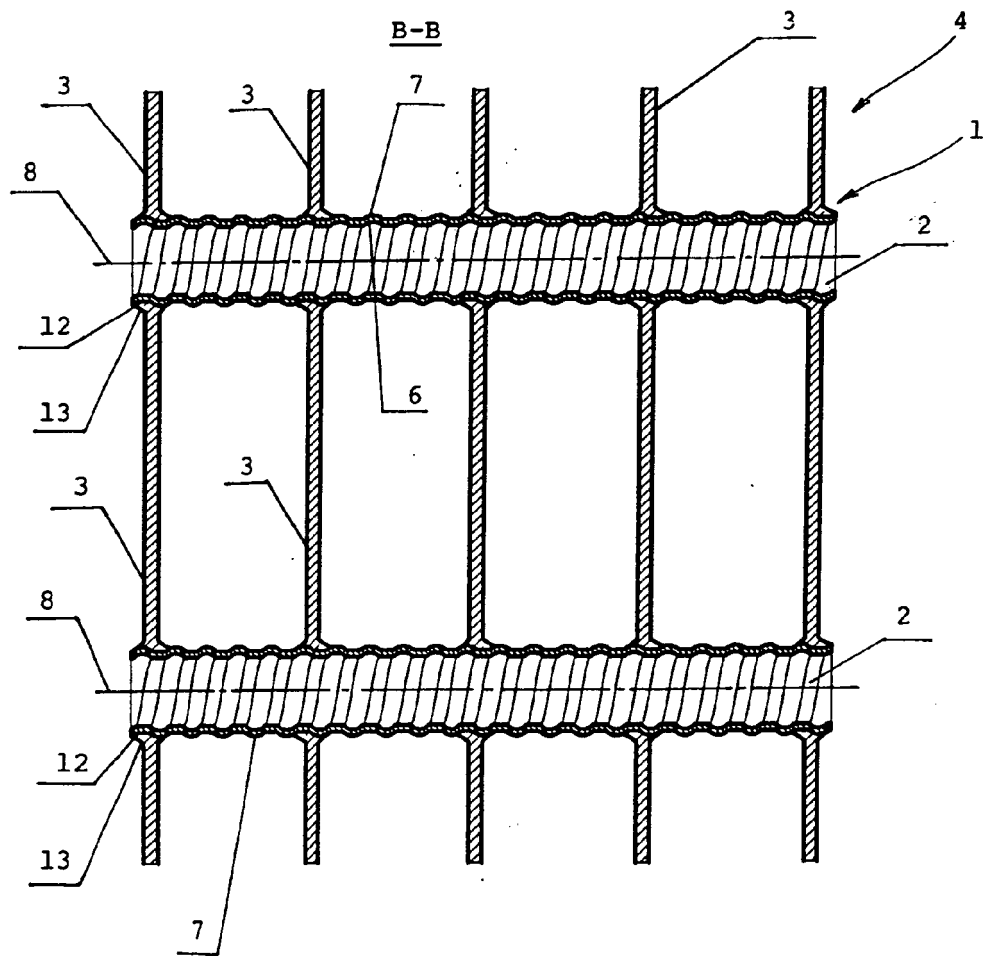
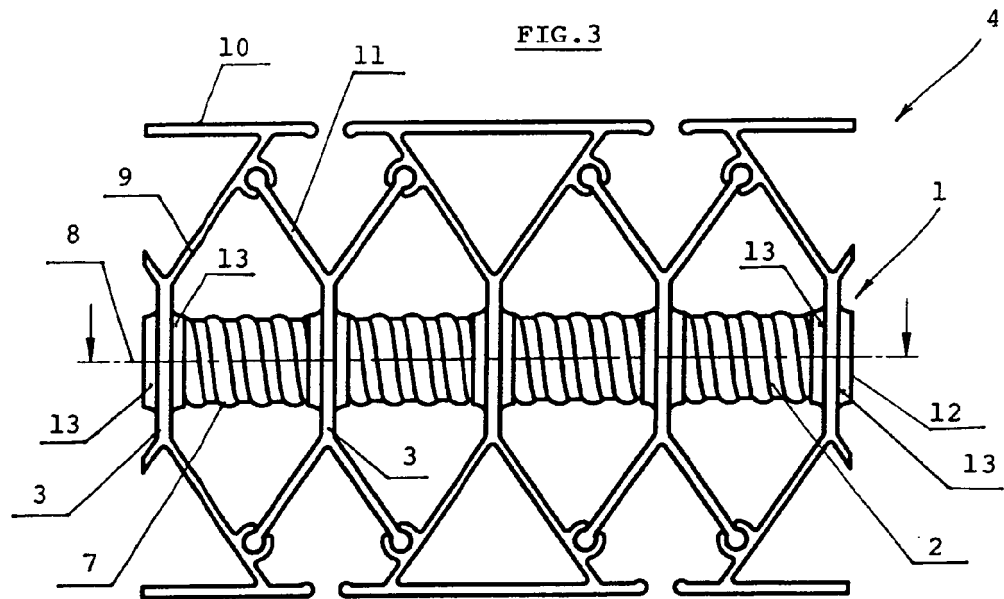


FIG. 4

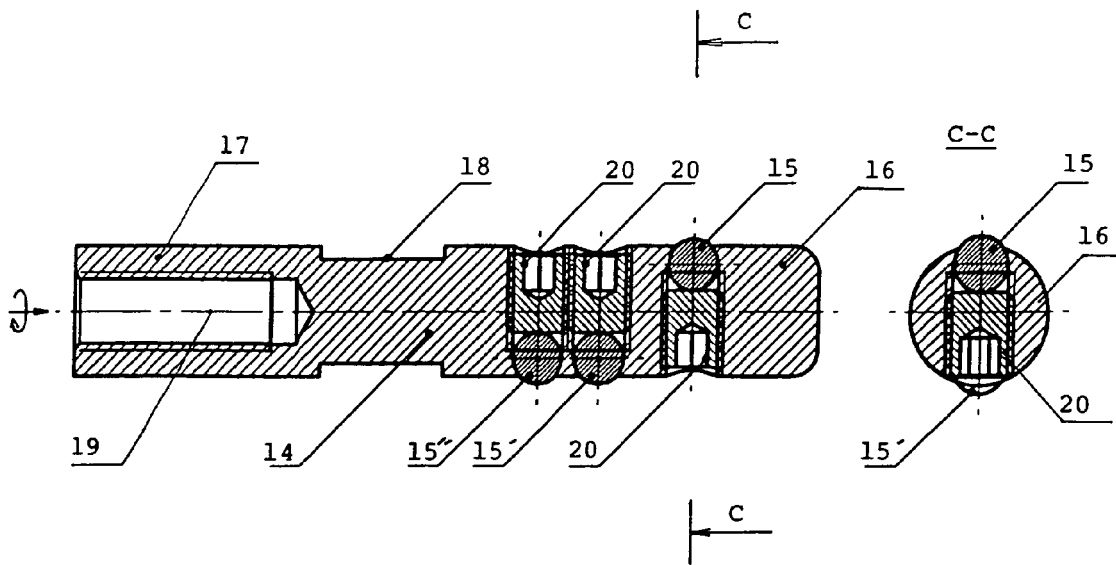


FIG. 5

FIG. 6

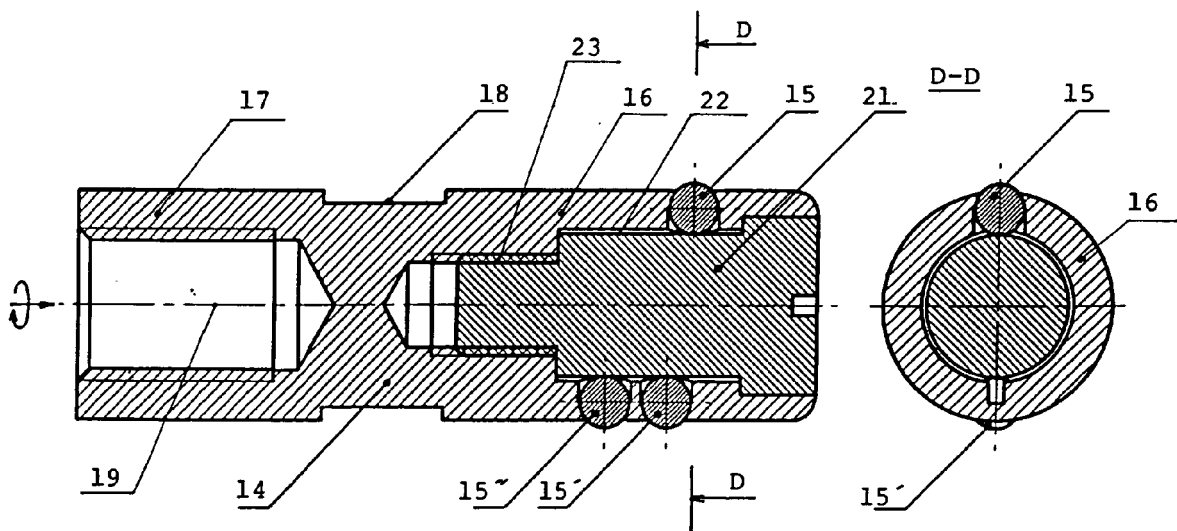


FIG. 7

FIG. 8

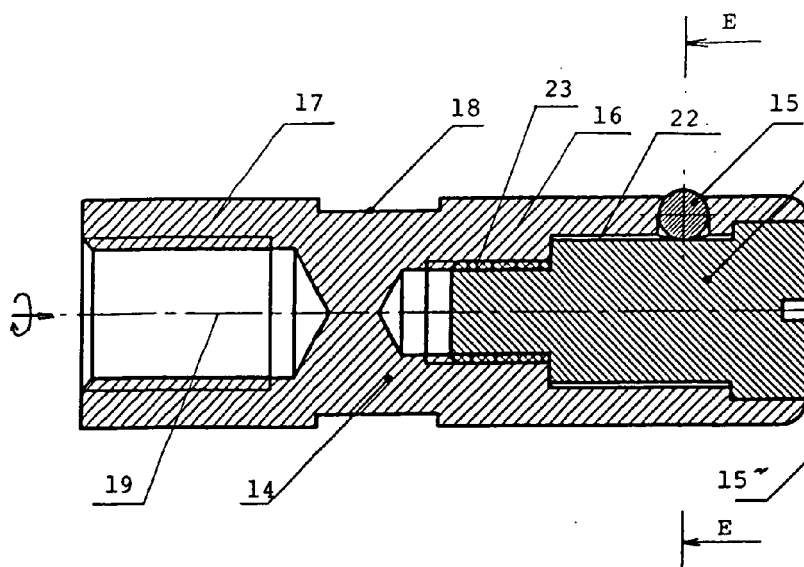


FIG. 9

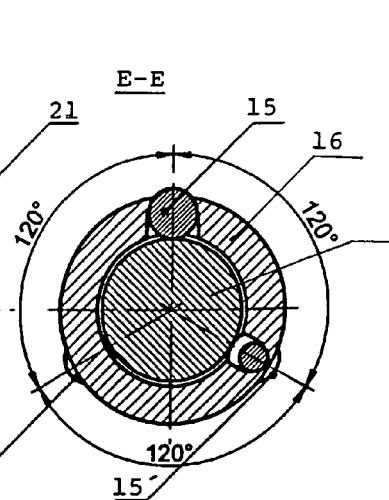


FIG. 10

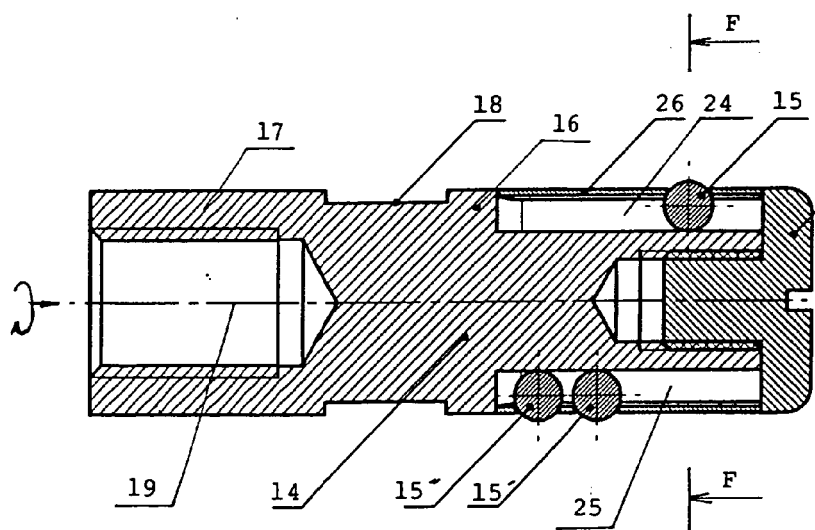


FIG. 11

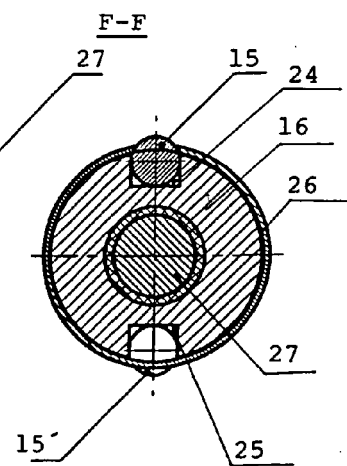


FIG. 12

REFERENCES CITED IN THE DESCRIPTION

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