

Description

[0001] The object of the present invention relates to a coring machine comprising a coring unit for the coring of a wall, a rock face and the like.

[0002] A coring unit generally comprises a rotating tubular utensil with a diamond tip on one of its free ends, which also rotates to cut the material and consequently carry out the coring.

[0003] As a result of the great friction and resistance between the tip and the stonework, the tip reaches elevated operating temperatures, which compromise its efficiency and cause structural damage.

[0004] It is in fact known that when perforating and coring rock faces, if the diamond tip is not adequately cooled, it rapidly reaches temperatures in the order of 700-800 °C; at these temperatures the tip does not work efficiently and runs the risk of breaking and damaging the tip and the coring machine.

[0005] It is also known that the operating temperature of the diamond tip must not exceed 60-70 °C, preferably about 25-30°C.

[0006] Coring devices are known, for example from document EP1193026A1, wherein a device is exhibited for perforating a rock face comprising means for transmitting a cooling fluid, such as water, to cool the coring tip.

[0007] However, this device, which is known in the sector, presents the disadvantage of losing much of the cooling fluid through the wall it is resting on and therefore almost 60-70% of the water used impregnates the wall that is being worked and damages it, also without achieving the thermal exchange with the perforating tip.

[0008] For example, for a perforation of five metres, 700-800 litres of water are needed in the prior art and only 30-40% of this is actually used to cool the diamond tip.

[0009] Clearly in the case of coring to restore and consolidate buildings of archaeological and artistic interest, with perforations of up to 15, 20, 25 metres, the dispersion of hundreds of litres of water into the stonework is harmful as well as being anti-economical and certainly does not safeguard the working environment.

[0010] It is the object of the present invention to make a coring machine comprising a coring unit for coring a wall, a rock face and the like, which overcomes the above disadvantages with reference to the prior art.

[0011] Said object is achieved with a device made in accordance with the following claim 1. The claims depending on this describe embodiment variations.

[0012] The features and advantages of the device according to the present invention will be appreciated from the following description, which is given by way of example and not limiting, according to the accompanying drawings, wherein:

[0013] - figure 1 represents a diagram of the cooling circuit of a machine according to the present invention;

[0014] - figure 2 shows an end portion of a coring tip;

[0015] - figure 3 represents an enlarged detail of just

the tip in figure 2;

[0016] — figure 4 shows a front view of the detail in figure 3;

[0017] — figure 5 shows a side section view of a coring unit;

[0018] — figure 6 represents a side section view of a part of the coring unit in figure 5;

[0019] - figure 7 represents a rear section view of the coring unit in figure 5; and

[0020] - figure 8 shows a detail of the coring unit in figure 5.

[0021] In accordance with the accompanying drawings, a coring machine for coring or perforating a wall 17, a rock face, stones, reinforced concrete and the like is globally indicated with reference numeral 1.

[0022] The coring machine comprises means for cooling with an incoming and outgoing flow system for a cooling fluid 3 through at least one internal tube 11 and at least one cylindrical interspace 13.

[0023] Said incoming flow is substantially achieved co-axially and counter current in relation to said outgoing flow.

[0024] The machine 1 comprises a coring unit 2, which produces coring scraps 15 or manufacturing waste, such as semi-solid residues, core, building scraps, stones, mud and the like during said coring and needs to be cooled by the cooling fluid 3.

[0025] The coring unit 2 comprises a perforating battery 26 with a mandrel system 27 (figure 6) set along an X axis.

[0026] Furthermore, the coring unit 2 comprises a hydraulic engine 22 with offset movement transmission in relation to said perforating battery 26, such as a hydraulic or oleo-dynamic or electric engine, which preferably allows the revs of the engine to be manually and/or automatically adjusted (figure 5).

[0027] Advantageously, the engine 22 exhibits a driving shaft 52 that is set along a Y axis and rotates around the same Y axis.

[0028] In other words then, the X axis of said mandrel 27 is substantially parallel to the Y axis of the driving shaft 52, which means that the X axis and the Y axis do not coincide, in other words the engine 22 is offset in relation to the perforating battery 26.

[0029] Advantageously then, the rotation of the driving shaft 52 is transmitted to the mandrel 27 by special gear transmission means 53.

[0030] Advantageously, the engine 22 is a hydraulic engine with elevated torque with offset movement transmission to the mandrel 27, by means of a gear assembly 53 suitable for preventing engine 22 power energy losses.

[0031] The perforating battery 26 is suitable for being connected to a coring tip 10, such as a tubular tip that extends along the X axis.

[0032] Advantageously in fact, the coring tip 10 is keyed onto the mandrel 27 of the battery 26 and receives the rotating movement from the mandrel 27 for coring

and perforating (figure 2, 5 and 6), for example in the direction indicated by the arrow R.

[0033] Furthermore, said coring tip 10 comprises said at least one internal tube 11 and said at least one external tube 12.

[0034] Advantageously, the diameter of the external tube 12 is greater than the diameter of said internal tube 11.

[0035] Furthermore, the external tube 12 is coaxial to said internal tube 11, defining said at least one cylindrical interspace 13, or annular interspace substantially coaxial to said internal tube 11 (figure 2 and 8).

[0036] In other words, the external tube 12 and the internal tube 11 form an internal chamber that is defined by the cylindrical interspace 13, which extends longitudinally through the coring tip 10 and is suitable for receiving a cooling fluid 3 from an inlet flange 29 set on the perforating battery 26, as we shall discuss later on.

[0037] The coring tip 10 also comprises a perforating head 14 (figure 2 and 3), which rotates integrally with the tip 10, in the direction for example indicated by the R arrow in figure 2.

[0038] According to a preferred embodiment of the present invention, the perforating head 14 comprises at least one micro-perforated, diamond tip, set at one end of the coring tip 10, thus leaving the other end of the tip 10 free.

[0039] A cooling fluid 3 is preferably prepared to cool and lubricate said perforating head 14 and the diamond tip 48 during the coring operation.

[0040] Advantageously, the cooling fluid is water, such as well water, at a temperature of between 12°C and 25°C inclusive, preferably between 15°C and 20°C.

[0041] So the water is sucked in, for example from a well (not shown in the figure) and subsequently stored in a feed tank 4.

[0042] Advantageously, some abrasive powder is added to the cooling fluid 3 to increase the perforating performance of the tip 48.

[0043] Furthermore the coring tip is coupled to at least one perforation extension 30 to extend the length of the perforation or coring in the wall 17.

[0044] Each perforation extension 30 is preferably structured with an internal tube and an external tube, which are coaxial and define a cylindrical interspace that is substantially equal to the structure of the coring tip 10, as described previously.

[0045] In other words, the perforation extension 30 comprises an internal extension tube 31 and an external extension tube 32, which are set coaxially and suitable for defining an extension interspace 33 and making a hydraulic connection between the interspace 13 and the interspace 33 when the extension 30 is screwed to the coring tip 10.

[0046] According to a preferred embodiment, centring splits 51 or axial guides are made longitudinally along the outer edge of the internal tube 11 and the internal extension tube 31; these are set alternately to allow the

cooling fluid 3 to pass and are also suitable for acting as a centring guide during the preliminary assembly of the internal tube 11 in the external tube 12, and the internal extension tube 31 in the external extension tube 32 respectively.

[0047] According to a preferred embodiment of the present invention the perforation extension 30 is screwed to the coring tip 10 by means of a thread system 59, such as, for example a square thread (figure 8).

[0048] In fact, the coring tip 10 includes a free end, in other words an end opposite the end bearing the diamond tip 48, wherein the internal tube 11 and the external tube 12 are offset, in other words then a hooking portion 60 of the internal tube 11 extends, or rather protrudes, beyond the end part of the external tube 12.

[0049] The hooking portion 60 preferably has a thickness that is greater than the thickness of the rest of the internal tube 11 and exhibits micro-holes 61 made longitudinally in said greater thickness for the cooling fluid 3 to pass (figure 8).

[0050] Moreover, the thread system 59 is made on the outer surface of the hooking portion 60.

[0051] Advantageously in fact, the perforation extension 30 comprises a first end, which is engaged by the mandrel 27 and the inlet flange 29, and a second end that is suitable for coupling to the hooking portion 60, in other words the perforation extension 30 exhibits one end with a diameter slot suitable for receiving the hooking portion 60, also bearing thread means 63 made on the internal surface of the external extension tube 32 that are suitable for receiving the thread system 59 by screwing.

[0052] So by joining the hooking portion 60 of the coring tip 10 to the perforation extension 30, it is possible to extend the range of the perforation and coring operation, reaching perforation depths of 15, 20, 25 metres.

[0053] Moreover, the presence of the micro-holes 61 makes it possible to maintain the hydraulic connection between the interspace 13 of the coring tip 10 and the interspace 33 of the perforation extension 30.

[0054] Furthermore, sealing means 62, such as O-rings are included to make the hydraulic seal between the internal tube 11 and the external tube 12 in the union region respectively between the coring tip 10 and the perforation extension 30 (figure 8) and between the mandrel 27 and the coring tip 10 or rather the perforation extension 30.

[0055] Advantageously, union surfaces 64 are provided between the internal tube 11 and the internal extension tube 31 made like a cone or inclined plane, which preferably have a reciprocal inclination of 45 hexagesimal degrees to further increase the sealing effect and facilitate the centring and coupling between the coring tip 10 and perforation extension 30.

[0056] Moreover, like the union system between said tip 10 and said extension 30, the end of the perforation extension 30 engaged by the mandrel 27 and the flange 29 exhibits a thread system 159, for example a square thread, to join said extension 30 to the perforating battery

26, in other words to the mandrel 27 and to the flange 29.

[0057] In fact, the perforating battery 26 is provided with a cavity comprising thread means 163, which are suitable for screwing to the thread system 159.

[0058] Also advantageously, the coring tip 10 is keyed onto the mandrel 27, by coupling the thread means 63 to the thread system 59 of the hooking portion 60.

[0059] Advantageously then, a rough seal is achieved with the square thread to prevent grains of sand or wet dust leaking out, whilst the fine seal is achieved with the sealing means 62.

[0060] So, the coring tip 10 is joined to the mandrel or to one or more perforation extensions 30, depending on the depth of the perforation to be carried out, also creating the hydraulic connection between the region of the diamond tip 48 that is constantly cooled by the water and the outlet 36 and inlet 29 flanges.

[0061] So the water stored in the feed tank 4 is sent to the inlet flange 29 by an injection system.

[0062] Advantageously, the injection system comprises an injection pump 5, which is suitable for sending the cooling fluid 3 to said coring unit 2, as we shall explain in detail later on.

[0063] The cooling water is preferably pumped to the entrance of the coring unit 2 at a pressure of between 40 and 150 atmospheres inclusive, preferably between 50 and 70 atmospheres.

[0064] The injection pump 5 preferably comprises at least one first pressure indicator 37 for said incoming cooling fluid 3.

[0065] Furthermore, the injection pump 5 comprises at least one water softening filter (not shown in the figure).

[0066] Moreover, the injection pump 5 comprises at least one first device for measuring the temperature 38, and at least one first device for measuring the flow 39 of said incoming cooling fluid 3, such as a litre-gauge flow-meter.

[0067] According to a preferred embodiment, the injection system also comprises an inlet tube 28, which is suitable for directing the cooling fluid 3 from the feed tank 4 to the perforating battery 26, preferably a flexible inlet tube 28.

[0068] Advantageously, the injection system comprises the floating inlet flange 29 keyed onto said mandrel 27 bearing an intake connector 54, which is suitable for receiving the inlet tube 28 and directing the cooling fluid 3 inside the interspace 13, 33.

[0069] According to a preferred embodiment, the inlet flange 29 comprises a return channel 66, which is suitable for directing any leaked cooling fluid 3 into a tubular portion 67.

[0070] So the cooling fluid 3 is pumped by the injection pump 5 into the inlet tube 28 and enters the intake connector 54 through the inlet flange 29.

[0071] The injection system is also preferably fluidically connected to the perforating head 14, which means that the cooling water 3 pumped by the injection pump 5 passes through the interspace 13, 33 and flows over the

perforating head 14 cooling it.

[0072] Advantageously in fact, the perforating head 14 bears the diamond tip 48

[0073] The tip 48 is micro-perforated, which means that the tip 48 exhibits a plurality of outlet nozzles 34 for the cooling fluid 3, to send the cooling water onto the tip 48 and cool and lubricate it.

[0074] According to a preferred embodiment, the tip 48 comprises a plurality of diamond teeth 65, which are set symmetrically around the X axis, consequently defining the nozzles 34 and creating a micro-perforated, diamond crown (figure 4).

[0075] Therefore, the nozzles 34 are consequently fluidically connected to the interspace 13.

[0076] Advantageously then, the pressurised water coming from the interspace 13 is projected from the nozzles 34 between each of the diamond teeth and the other, towards the outside, to cool and lubricate the diamond tip 48 and it is sucked up inside the internal tube 11 immediately afterwards by the depression created by the suction engine 35.

[0077] Consequently, the diamond tip 48 is a tip suitable for perforating rock faces, stonework and the like and has a substantially annular shape, bearing radial splits and diamond teeth 65 defining the nozzles 34.

[0078] The tip 48 is also preferably set at one end of the coring tip 10, or rather on the perforating head 14.

[0079] According to a further feature of the invention, the coring machine 1 also comprises suction means or a suction system.

[0080] The suction system comprises a suction engine 35, which is suitable for creating a constant negative suction pressure in an interval of between 10 and 20 atmospheres inclusive, preferably between 18 and 22 atmospheres, to suck up coring scraps 15, material resulting from the coring or cutting, mud and cooling water through the internal tube 11, and the optional internal extension tube 31.

[0081] Preferably then, the pressurised flow of cooling water 3 coming in through the interspace 13, 33 is counter current in relation to the outgoing flow being sucked through the internal tube 11, and the optional internal extension tube 31 (figure 2).

[0082] In other words, the flow of water (represented in figure 2 by the I arrows) coming in along the interspace 13, in other words 33, is parallel and coaxial to the flow of water being sucked out (represented in figure 2 by the O arrow) along the internal tube 11, and the optional internal extension tube 31, but with an opposite direction, as shown by the arrows in figure 2, both being the incoming and outgoing flows comprised in one single portion of the coring unit 2, in other words the coring tip 10 or rather the perforation extension 30.

[0083] So the coring machine 1 comprises said coring tip 10 that exhibits at least two separate paths for delivery (I arrows) and suction (O arrow), which are fluidically connected to said delivery means for sending said cooling fluid 3 to said perforating head 14 and to said suction

means for sucking at least said cooling fluid 3 respectively.

[0084] According to an aspect of the invention, said two separate delivery and suction paths are in reciprocal fluidic communication through an outside area.

[0085] Furthermore, said two separate delivery and suction paths are in reciprocal fluidic communication near said perforating head 14 through said outside area.

[0086] Moreover, said two separate delivery and suction paths are in reciprocal fluidic communication through said outside area, near the diamond tip 48 comprised in said perforating head 14 and by means of the outlet nozzles 34 for said cooling fluid 3 made in said perforating head 14.

[0087] Preferably then, said coring tip 10 exhibits at least said interspace 13 suitable for directing said cooling fluid 3 from said delivery means to said perforating head 14, and said internal tube 11 spatially defining said interspace 13, suitable for collecting at least said cooling fluid 3 from said perforating head 14 to said suction means.

[0088] Advantageously, said delivery path exhibits said interspace 13, and said suction path comprises said internal tube 11, in fluidic communication with said interspace 13.

[0089] Furthermore, the suction system comprises a floating outlet flange 36 set in said perforating battery 26, preferably aligned along the X axis.

[0090] The perforating battery 26 is, in fact, hollow cylindrical, in other words it exhibits the internal tubular portion 67 set along the X axis, suitable for putting the internal tube 11, and the optional internal extension tube 31, in hydraulic connection with the suction engine 35, through the outlet flange 36.

[0091] Advantageously, the suction system also comprises a recovery apparatus 7 for recovering the cooling fluid 3.

[0092] In fact, the cooling fluid 3 is sent by said injection pump 5 into the cylindrical interspace 13 to cool the perforating head 14, and it is sucked inside the internal tube 11 by the suction system to discharge the cooling fluid 3 into the recovery apparatus 7.

[0093] According to a preferred embodiment, a portion of the recovery apparatus 7 comprises at least one container 43 for recovering said coring scraps 15.

[0094] Moreover, a further portion of the recovery apparatus 7 comprises at least one mud or liquid residue tank 44.

[0095] In a further embodiment, the recovery apparatus 7 is suitable for roughly decanting the sucked in fluid, allowing clarification of the mud and/or liquid residues from the coring scraps 15.

[0096] Furthermore, the suction system comprises an outlet tube 42 connected to the outlet flange 36 that is suitable for directing said cooling fluid 3 from said outlet flange 36 to said recovery apparatus, preferably a flexible outlet tube 42.

[0097] The suction engine 35 is designed to suck the coring scraps 15 mixed with the cooling water, in other

words water, mud and semi-solid residues, such as the core up through the internal tube 11 and outlet tube 42.

[0098] In other words then, the cooling water and scraps are sucked up from said perforating battery 26, through the outlet flange 36 by the suction engine 35, and directed into the outlet tube 42, in other words the coring scraps 15 are sucked up by the suction means or suction system into said internal tube 11, subsequently discharging said coring scraps 15 into said recovery apparatus 7.

[0099] According to a preferred embodiment, the outlet flange comprises a second device for measuring the temperature 40, and at least a second device for measuring the flow 41 of said outgoing cooling fluid 3, such as a litre-gauge flow-meter.

[0100] Then the water that has been sucked up is directed from the outlet tube 42 into the recovery apparatus 7 and accumulates in the mud or liquid residue tank 44 (figure 1).

[0101] Advantageously, the liquid residue tank 44 comprises at least one saturation sensor 45, which is suitable for indicating when said mud or liquid residue tank 44 is "too full".

[0102] Furthermore, the coring machine 1 exhibits a closed re-circulating system 6, comprising a plurality of tubes suitable for hydraulically interconnecting the coring unit 2, the suction system, the recovery apparatus 7, the feed tank 4 and the injection system.

[0103] Advantageously, the suction system also comprises a re-circulating tube 47 for re-circulating said sucked in cooling fluid 3 to the injection pump 5.

[0104] Furthermore, the recovery apparatus comprises a draining means 55, such as a tube fitted with a valve, for example a gate valve, to allow draining of the heavy and solid residues, such as the larger scraps 15, and cleaning of the solid residue container 43.

[0105] According to a preferred embodiment, the recovery apparatus 7 comprises at least one filtering means 8 suitable for filtering said mud or liquid residues and scraps 15, consequently obtaining said outgoing cooling fluid 3 that has been cleaned.

[0106] The filter 8 is preferably connected upstream to said recovery system 7 and downstream to said injection pump 5.

[0107] In other words the mud and/or liquid residues are sent by the re-circulating tube 47 to the filtering means 8 for filtering, obtaining a clean outcoming permeate, or rather a treatment fluid 3 that is substantially suitable for being reused to cool the coring tip 14.

[0108] The permeate obtained is in fact sent to the injection pump 5 by a portion of tube from the closed re-circulating system 6, and from here it is pumped to the inlet flange 29 and then into the interspace 13 and the optional extension interspace 33.

[0109] According to a further embodiment, the suction engine 35 sucks part of the liquid residue from the recovery apparatus 7 by means of a draining system 46 and then drains the roughly clarified cooling fluid 3, for exam-

ple into the sewer system.

[0110] Therefore, according to a preferred embodiment the re-circulating system 6 comprises at least said internal tube 11 and at least said external tube 12 defining the interspace 33, at least said inlet tube 28, at least said outlet tube 42 and at least said re-circulating tube 47.

[0111] According to a preferred embodiment the coring unit 2 comprises a frame 25 that is suitable for supporting the coring unit 2 (figure 5 and 7).

[0112] Advantageously, the frame 25 comprises an adjustable, fastening counter-plate 16, which is suitable for a first rough alignment of said coring unit 2 with said wall 17.

[0113] In other words the counter-plate 16 allows the coring unit 2 to be positioned so that the X axis is substantially perpendicular to the wall or face 17.

[0114] The counter-plate 16 is fastened to the wall on small plates with fastening means, such as expansion bolts with mechanical or chemical tie rod, allowing the counter-plate 16 to adapt to the wall 17 (figure 5 and 7).

[0115] Furthermore, the frame 25 comprises a rack shaft 18, which is suitable for acting as a supporting guide for the oleo-dynamic engine 22 and for the whole coring unit 2 (figure 5).

[0116] In fact, the rack shaft 18 is engaged with a guiding housing 23 for said engine 22, which allows the sliding support of the coring unit 2 along the shaft 18, in other words along the Y axis.

[0117] In other words, since the coring unit moves increasingly closer to the wall 17 during perforation and coring, penetrating the perforating head 14 inside the wall substantially along the X axis, the engine 22 also moves along the rack shaft 18, substantially along the Y axis, parallel to the X axis.

[0118] According to a further preferred feature of the present invention, the frame 25 comprises a supporting plate 19, which is suitable for finely aligning said coring unit 2 with said wall 17 thanks to the action on fine regulating means 56 for adjustment (figure 5).

[0119] Advantageously, the supporting plate 19 comprises a centring pin 21 suitable for the correct axial positioning of the rack shaft 18 onto the plate 19.

[0120] Furthermore, the frame 25 comprises an anti-flexion support 20 suitable for reducing the movements of said coring tip 10 during said coring (figure 7).

[0121] In other words, during the coring operation, the coring unit 2 transmits flexion stress to the frame 25, which is advantageously absorbed by the support 20.

[0122] The anti-flexion support 20 preferably also comprises an internal tube 57 and an external tube, which are coupled telescopically so they can extend and contract, following and supporting the movement of the coring unit 2 along the X axis (figure 5).

[0123] Furthermore, to increase the flexural stiffness of the frame 25, the anti-flexion support 20 comprises a plurality of supporting rods 24, which are suitable for absorbing stress during said coring (figure 7).

[0124] Advantageously, the coring machine 1 comprises

es input/output control means (not shown in the figure), such as a remote control multi-function push-button panel and a diagnostic digital monitor, which makes it possible to continuously control the optimum working level of all of the components during perforation, for automatic control, for example retro-action control, of the pressure, temperature and capacity of the cooling fluid 3 coming into the coring unit 2.

[0125] During normal use of the coring machine 1, as described, after aligning and fastening the coring unit 2 to the wall 17 with the counter-plate and plate system, and after making the due connections for the electrical wires, hydraulic pipes, oil tubes and the like, you turn on a special hydraulic power unit and the suction system in sequence.

[0126] Then you start the injection pump 5 for the cooling fluid 3 or water and subsequently proceed with perforation, starting the engine 22 and inserting a special rotation gear for the coring tip 10.

[0127] During perforation, the diagnostic display indicates the temperature of the water coming in and going out of the suction system, maintaining the differential between the values read in an automatic working interval.

[0128] Advantageously in fact, if the outgoing temperature is excessive, the flow of water is increased and, if necessary, the perforation pressure is reduced, acting manually on the perforating battery to allow the machine 1 to operate in optimum conditions.

[0129] An advantageous feature of the machine 1, as described, is surely related to the fact that this system allows perforations to be made through rock faces, homogenous or non homogenous stonework and wall faces of particular value, without causing damage as a result of vibrations or infiltrations of water or dust, which are instead advantageously sucked up through the central internal tube 11.

[0130] Advantageously, substantially there is no dispersion of water or any kind of mud or dust material either inside the wall or on the connecting perforation wall, with consequent cleaning of the site in the area of the perforation, creating advantages in terms of cleaning and safety for both the customers and operators using the described coring system, without dust or liquids that constitute a health hazard.

[0131] Surprisingly, the central suction of the building scraps advantageously eliminates the need to store the material resulting from the perforation, which would otherwise accumulate on the site of the perforation; the material resulting from the cutting and the cooling water are in fact sucked into the central tube 11 and collected by the recovery apparatus 7, also without the disadvantage of having to stop the coring unit 2 to clean the tip.

[0132] Advantageously then, with the machine 1 and the recovery apparatus 7 herein included, the solid part, such as the core, stones and the like are accumulated in the solid residue container and separated from the liquid part, which is then cleaned and stored to be used again in the re-circulating system for the cooling fluid or drained

into the sewer system or dump.

[0133] Also surprisingly, since the whole machine is made with a seal, disadvantageous leaks of water or mud material from the wall affected by the cutting are avoided, consequently resulting in reduced maintenance costs for the parts of the machine 1 most subject to wear and tear, keeping the stone surfaces being worked integral and clean.

[0134] In other words, the machine 1 advantageously allows operations to be carried out in the field of static-structural consolidation for damaged stonework, and also in the field of conservative restoration building, which requires precision and prompt intervention, whilst at the same time not compromising the homogeneity of the wall face and altering its chemical-physical characteristics, preventing water from entering.

[0135] Advantageously in fact, during the coring, it is not necessary to extract the coring tip 10 from the stonework to remove the core produced; the core and the scraps 15 resulting from the cutting are, in fact, sucked up with the cooling water through the internal tube 11.

[0136] In fact, since the diameter of the external tube 12 is slightly smaller than the diameter of the diamond tip 48, the space that is created during the coring as a result of this difference means that the core does not take up all of the space and so when it is detached it is sucked back up leaving the tip free to carry on perforating, avoiding time being wasted in dismantling the tip and extensions.

[0137] Unusually, in fact, the suction path made in the coring tip 10 allows both the cooling fluid 3 and the coring scraps 15 to be sucked up continuously, at the same time, with the same tool, in other words the coring tip 10, also without stopping coring.

[0138] In other words, the working times of the coring unit are advantageously shortened by operating in this way; it is, in fact, only stopped to add extensions to the perforating tip, such as for example extensions each 5 metres long, for in-depth coring, whilst the interruptions to remove perforation residues and core are avoided thanks to the central suction of the scraps 15, consequently reducing idle time.

[0139] According to a further advantageous feature of the present invention, thanks to the constant lubrication and continuous cooling of the diamond tip 48 with the water, there is a consequent reduction in the wear and tear of the tip, the diamond crown and also the extension battery.

[0140] Surprisingly too, the tip and extension battery are subject to less wear and tear because the perforation times are reduced.

[0141] Advantageously then, the reduced working times and cleaning of the site mean reduced labour costs and greater control over the progress of the perforation.

[0142] Unusually, with the coring machine 1, profound perforations can be made without dispersing water onto wall faces of a homogenous nature, wherein the dispersion of water is synergically prevented by the homoge-

nous structure of the stonework itself and by the central suction, and of a non-homogenous nature, comprising stones, rocks and the like.

[0143] In fact, in the case of non-homogenous stonework, the central suction of the cooling water advantageously prevents an otherwise rapid and harmful dispersion and infiltration of hundreds of litres of water through the non-homogenous stonework.

[0144] Also advantageously, with the counter-plate and plate adjustment system, the coring unit is also stably connected and aligned with stonework that is particularly irregular and has protrusions or that is not perpendicular to the perforation X axis.

[0145] Advantageously, the rack shaft and sliding guide and the diagonal anti-flexion support eliminate the possibility of plays and movements of the coring tip, allowing precise perforation.

[0146] Advantageously, the coring unit 2 is very easy to assemble, disassemble and install thanks to the plate and counter-plate adjustment system and thanks to the modular structure of the tip, the perforation extensions and the engine system and rack shaft with the sliding guide.

[0147] Surprisingly too, there is an advantageous reduction in the amount of cooling water used, because all of the water is projected selectively by the nozzles 34 onto the diamond teeth, and used to cool the diamond crown, consequently maximising the thermal exchange effect.

[0148] Advantageously then, with the coring unit 2 used at about 300 revs/minute, substantially 90% of the well water at 15-20 °C pumped under pressure is used in the thermal exchange, bringing the coring tip from 600-800 °C, without cooling, to the operative temperature of 25-40 °C; the temperature of the water going out is, in fact, about 30 °C, proving the efficiency of the thermal exchange.

[0149] Clearly, to satisfy specific, contingent needs, an expert skilled in the art can make several variations and modifications to the coring machine according to the present invention, all of which are contained within the scope of protection as defined by the following claims.

Claims

1. Coring machine (1) for carrying out the coring of a wall (17), a rock face, stones and the like, comprising:

- a coring tip (10), extending along an axis (X) and bearing a perforating head (14) on one of its ends, which is suitable for operating on said wall (17) to carry out said coring;
- delivery means suitable for sending a cooling fluid (3) to said perforating head (14) through said coring tip (10);
- suction means suitable for sucking at least said cooling fluid (3) from said perforating head (14);

said coring machine (1) being **characterised in that** said suction means are suitable for sucking said cooling fluid (3) from said perforating head (14) through said coring tip (10).

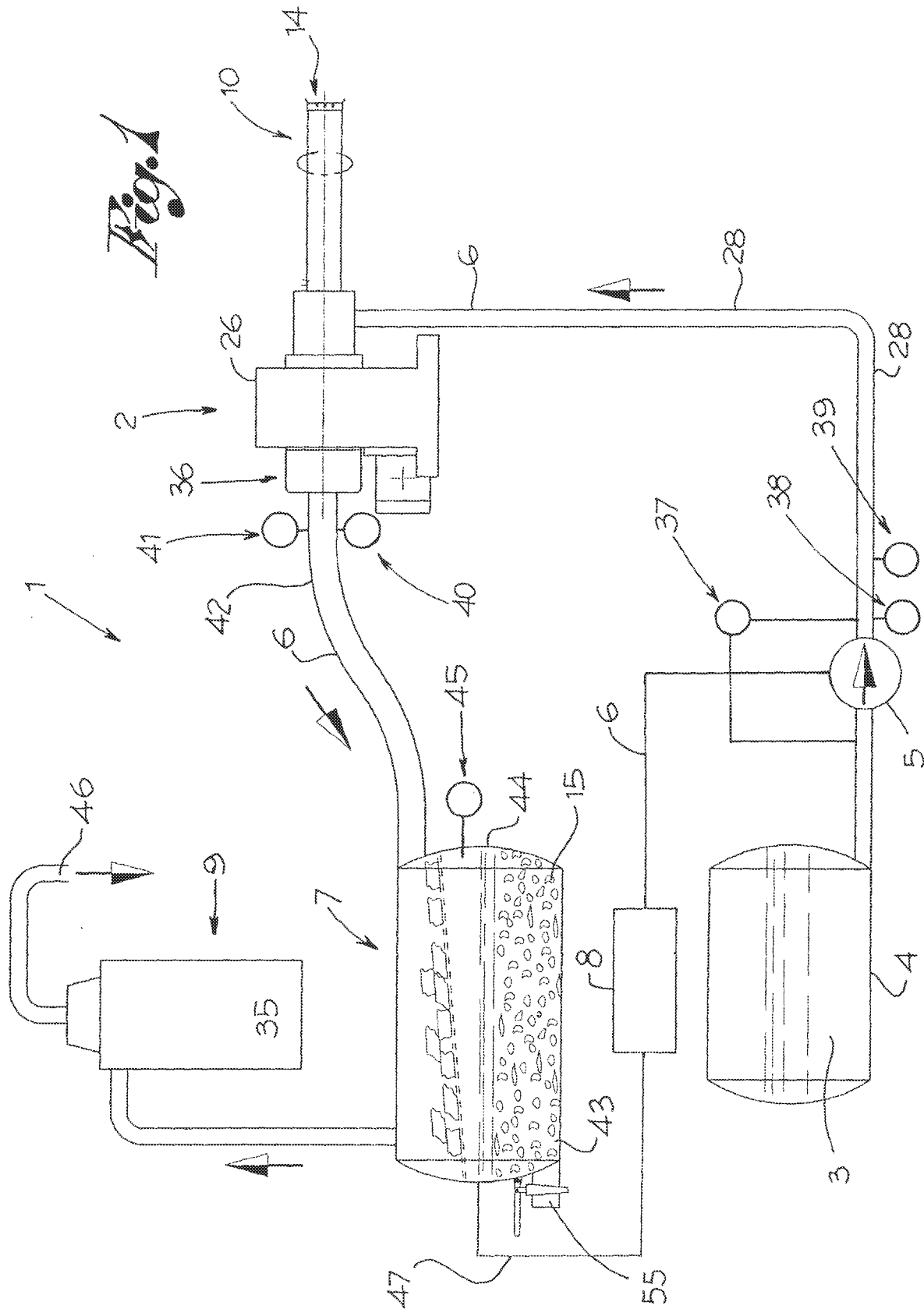
2. Coring machine (1) according to claim 1, wherein said coring tip (10) exhibits at least two separate delivery and suction paths, which are fluidically connected to said delivery means for sending said cooling fluid (3) to said perforating head (14) and to said suction means for sucking at least said cooling fluid (3) respectively.
3. Coring machine (1) according to claim 2, wherein said two separate delivery and suction paths are in reciprocal fluidic communication through an outside area.
4. Coring machine (1) according to claim 3, wherein said two separate delivery and suction paths are in reciprocal fluidic communication near said perforating head (14) through said outside area.
5. Coring machine (1) according to claim 4, wherein said perforating head comprises a diamond tip (48) and outlet nozzles (34) for said cooling fluid made in said perforating head, and wherein said two separate delivery and suction paths are in reciprocal fluidic communication through said outside area near said diamond tip (48) and by means of said nozzles (34).
6. Coring machine (1) according to any one of the previous claims, wherein said coring tip (10) exhibits at least one interspace (13) suitable for directing said cooling fluid (3) from said delivery means to said perforating head (14) and an internal tube (11) spatially defining said interspace (13) suitable for collecting at least said cooling fluid (3) from said perforating head (14) to said suction means.
7. Coring machine (1) according to claim 6, wherein said delivery path comprises said interspace (13) and wherein said suction path comprises said internal tube (11) in fluidic communication with said interspace (13).
8. Coring machine according to any one of the previous claims, wherein said coring tip comprises at least one external tube (12) whose diameter is greater than the diameter of said internal tube (11), coaxial to said internal tube (11), said two tubes defining said interspace (13) between them.
9. Coring machine (1) according to any one of the previous claims, with a coring unit (2) comprising:
 - a perforating battery (26) that is substantially hollow, comprising a tubular portion (67);

- said coring tip (10);
- a feed tank (4) for said cooling fluid (3);
- an injection system;
- a closed re-circulating system (6);
- suction means comprising recovery apparatus (7);

wherein said cooling fluid (3) is sent by said injection pump (5) inside said interspace (13) to cool said perforating head (14) and is sucked up, by said suction means, from said internal tube (11) through said tubular portion (67), to discharge said cooling fluid (3) into said recovery apparatus (7).

10. Coring machine (1) according to claim 9, wherein said suction means are suitable for sucking the coring scraps produced during coring, such as core, building scraps, stones and the like, from said internal tube (11) through said tubular portion (67).
11. Coring machine (1) according to claim 10, wherein said recovery apparatus (7) is suitable for receiving said coring scraps (15) sucked up by said suction means.
12. Coring machine (1) according to claim 10 or 11, wherein said coring unit (2) comprises a supporting frame (25) comprising an adjustable fastening counter-plate (16), which is suitable for a first rough alignment of said coring unit (2) with said wall (17).
13. Coring machine (1) according to claim 11 or 12, wherein said frame (25) comprises a rack shaft (18) for guiding and moving said coring unit (2), a supporting plate (19) suitable for finely aligning said coring unit (2) with said wall (17), and a centring pin (21) connected to said supporting plate suitable for correct positioning of said rack shaft (18).
14. Coring machine (1) according to claim 13, wherein said frame (25) comprises an anti-flexion support (20) suitable for reducing the movements of said coring tip (10) during said coring.
15. Coring machine (1) according to any one of the claims from 9 to 14, wherein said coring unit (2) comprises an engine (22) with movement transmission that is offset in relation to said perforating battery (26), such as an electric, oleo-dynamic or hydraulic engine.
16. Coring machine (1) according to any one of the claims from 8 to 15, wherein said injection system comprises an injection pump (5) connected at the entrance to the feed tank (4) and to the recovery apparatus (7) and at delivery to said perforating battery (26) through an inlet tube (28), at least one first pressure indicator (37) for said incoming cooling flu-

- id, at least one water softening filter, at least one first device for measuring the temperature (38) and at least one first device for measuring the flow (39) of said incoming cooling fluid (3), such as a litre-gauge flow-meter.
17. Coring machine (1) according to claim 16, wherein said perforating battery comprises a mandrel (27), and wherein said inlet tube (28) comprises a floating inlet flange (29) keyed onto said mandrel (27).
18. Coring machine (1) according to any one of the claims from 8 to 17, wherein said injection system comprises at least one perforation extension (30) with an internal extension tube (31) and an external extension tube (32) set coaxially, said tubes being suitable for defining an extension interspace (33) suitable for the passage of the cooling fluid.
19. Coring machine (1) according to any one of the claims from 8 to 18, wherein said suction means comprise a floating outlet flange (36) set in said perforating battery (26).
20. Coring machine (1) according to claim 19, wherein said outlet flange (36) comprises:
- at least one second device for measuring the temperature (40);
 - at least one second device for measuring the flow (41) of said incoming cooling fluid (3), such as a litre-gauge flow-meter.
21. Coring machine (1) according to claim 29 or 30, wherein said suction means comprise an outlet tube (42) suitable for directing said cooling fluid (3) from said outlet flange (36) to said recovery apparatus, preferably a flexible outlet tube (42).
22. Coring machine (1) according to any one of the claims from 8 to 21, wherein said recovery apparatus (7) comprises at least one mud or liquid residue tank (44).
23. Coring machine (1) according to claim 22, wherein said mud or liquid residue tank (44) comprises at least one saturation sensor (45), suitable for indicating when said mud or liquid residue tank (44) is too full.
24. Coring machine (1) according to claim 22 or 23, wherein said recovery apparatus comprises at least one filter (8), which is suitable for filtering said mud or liquid residues and obtaining said cleaned cooling fluid (3).
25. Coring machine (1) according to any one of the previous claims, wherein said suction means comprise
- at least one drainage system (46) for draining said cleaned cooling fluid (3) into the sewer system.
26. Coring machine (1) according to any one of the claims from 18 to 25, wherein said at least one perforation extension (30) is suitable for making a union with said coring tip (10), for the fluidic connection between said interspace (13) and said extension interspace (33) and between said internal tube (11) and said internal extension tube (31) respectively.
27. Coring machine (1) according to any one of the claims from 18 to 26, wherein said perforating head (14) comprises:
- at least said diamond and micro-perforated tip (48) comprising said nozzles (34);
 - said at least one micro-perforated perforation extension (30), substantially with a seal;
 - at least one micro-perforated mandrel connection (49) with a seal.
28. Coring machine (1) according to claim 27, wherein said coring tip (10) comprises an end opposite the end bearing said diamond tip (48), wherein said internal tube (11) and said external tube (12) are axially offset to define a hooking portion (60) of said internal tube (11) that protrudes from the external tube (12).
29. Coring machine (1) according to claim 28, wherein said hooking portion (60) comprises a thread system (59), such as a square thread, suitable for making a hydraulic connection between said perforating battery (26) and said coring tip (10).
30. Coring machine (1) according to claim 28 or 29, wherein said hooking portion (60) comprises a thread system (59), such as a square thread, which is suitable for making said union with said perforation extension (30).
31. Coring machine (1) according to any one of the claims from 18 to 30, wherein said internal tube (11) and said internal extension tube (31) comprise longitudinal centring splits or axial guides (51), which are set alternately to allow the cooling fluid (3) to pass (3) and which are also suitable for acting as a centring guide for said internal tube (11) in said external tube (12) and for said internal extension tube (31) in said external extension tube (32) respectively.



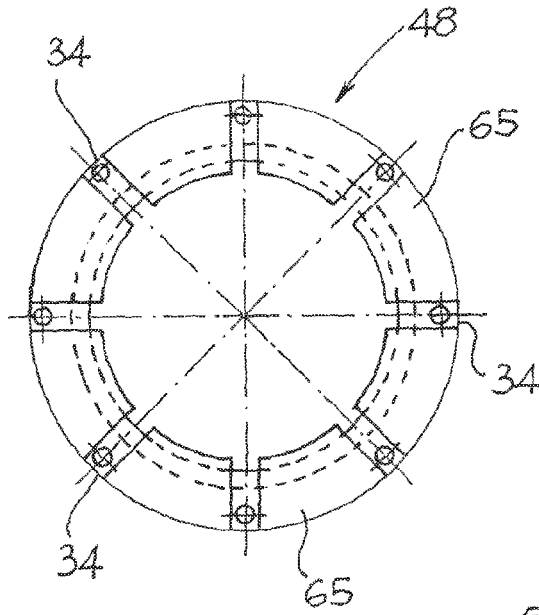


Fig. 4

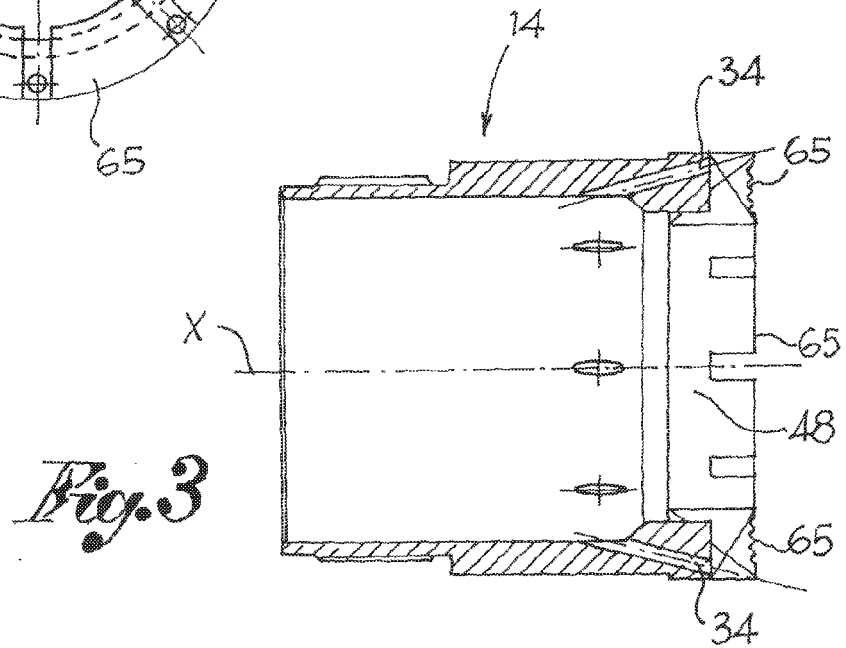


Fig. 3

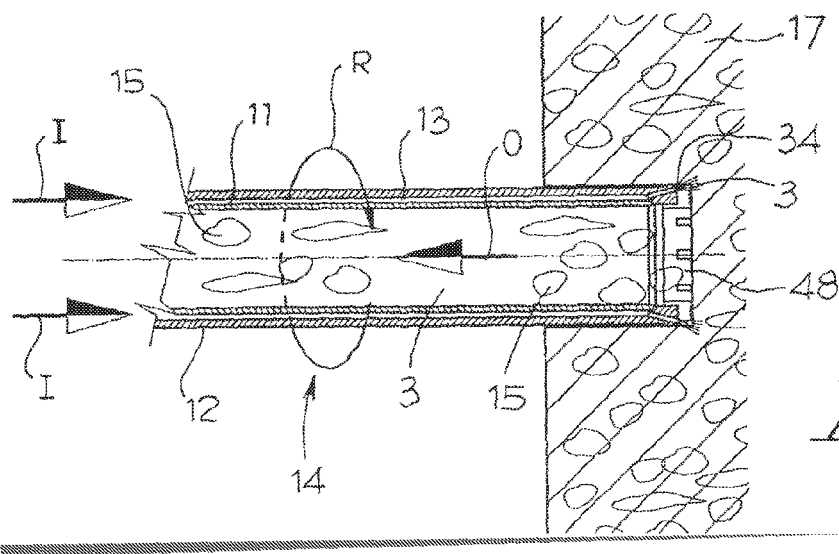
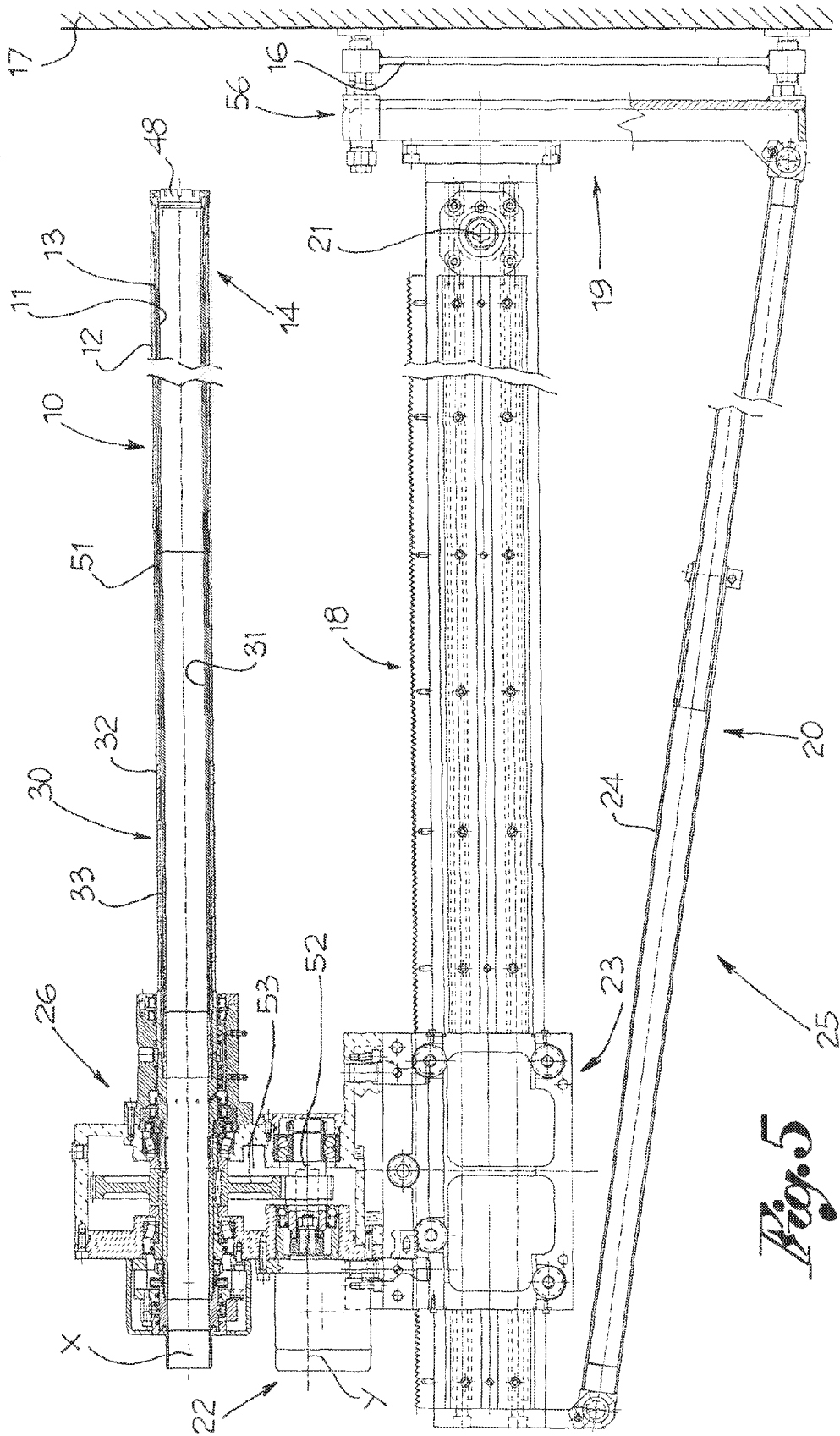
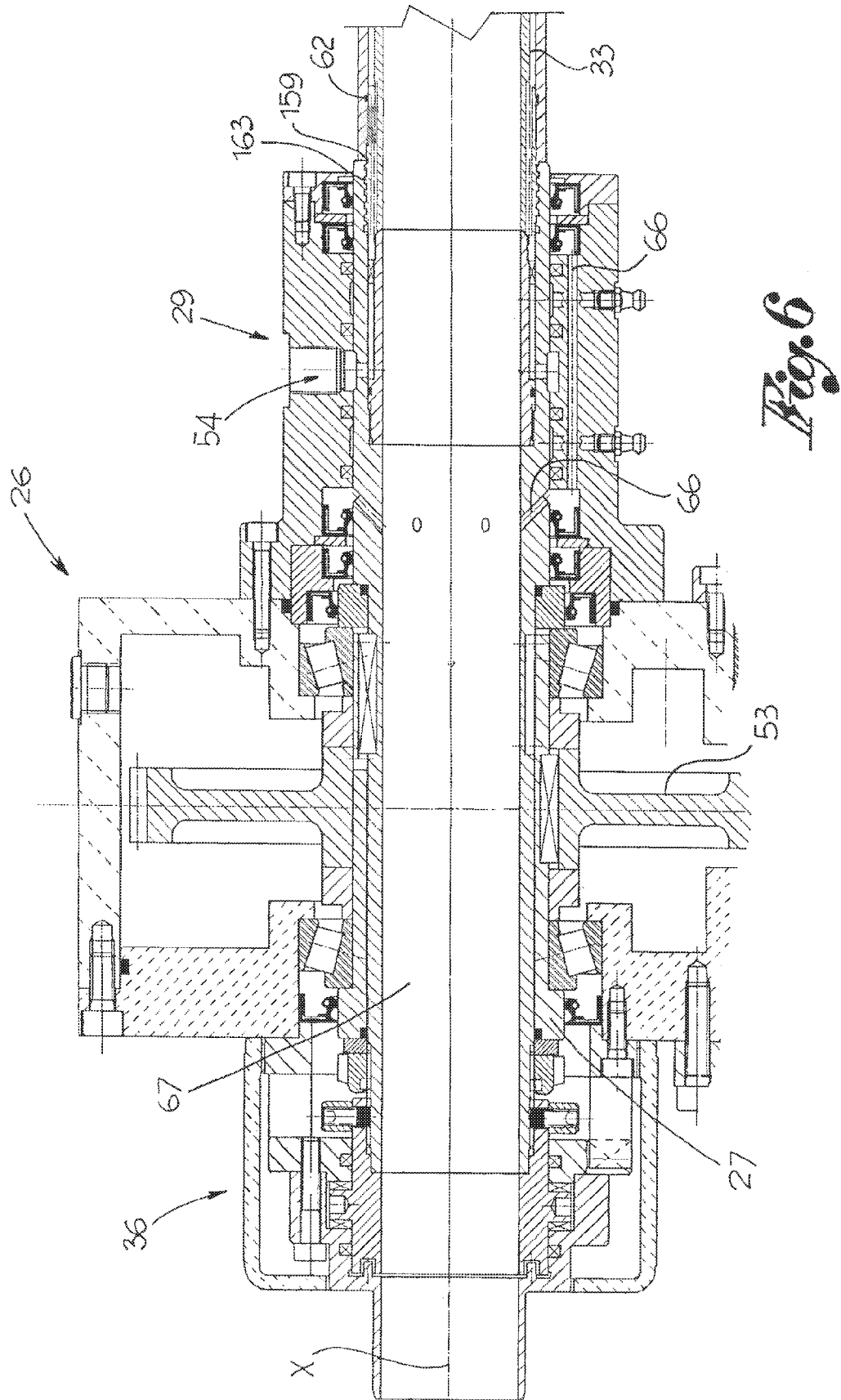
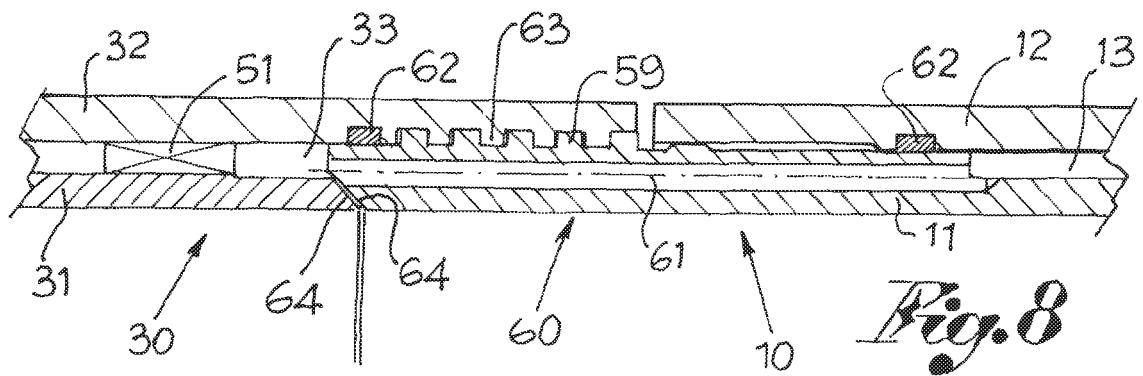
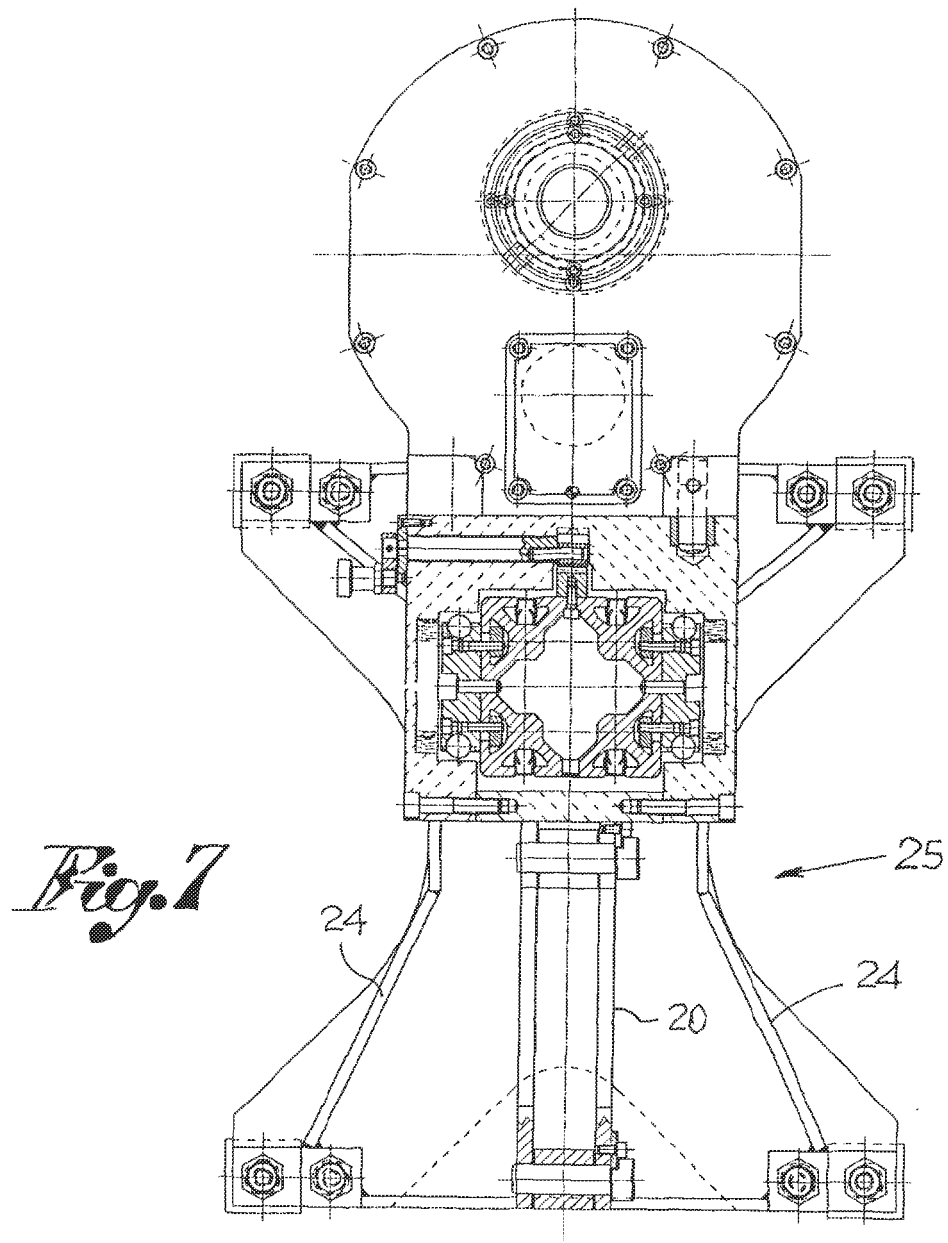


Fig. 2









European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 11 2173

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 505 450 B1 (LOCKE REGINALD A. J ET AL) 14 January 2003 (2003-01-14) * column 7, lines 10-19,30-62 * * figures 6,7 *	1-12,15, 18,25,26	B28D1/04 B28D1/02 B28D7/02 E21B21/12
A	-----	13,14, 16,19, 27,31	
X	US 2003/167728 A1 (MOHLENHOFF WILLIAM) 11 September 2003 (2003-09-11) * paragraphs [0053], [0065], [0066], [0084], [0085] * * claim 1 * * figures 3,5,6b,7b *	1-4,8,25	
A	-----	5,6,16	
A	US 2002/027023 A1 (BRITZ RORY) 7 March 2002 (2002-03-07) * the whole document *	9,16,22	
D,A	& EP 1 193 026 A (HILTI AKTIENGESELLSCHAFT) 3 April 2002 (2002-04-03) * the whole document *	9,16,22	
	-----		TECHNICAL FIELDS SEARCHED (IPC) B28D B23Q E21B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 10 February 2006	Examiner Chariot, D
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

2
EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 05 11 2173

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-02-2006

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 6505450	B1	14-01-2003	NONE	
US 2003167728	A1	11-09-2003	NONE	
US 2002027023	A1	07-03-2002	DE 10043418 A1 EP 1193026 A1	18-04-2002 03-04-2002
EP 1193026	A	03-04-2002	DE 10043418 A1 US 2002027023 A1	18-04-2002 07-03-2002