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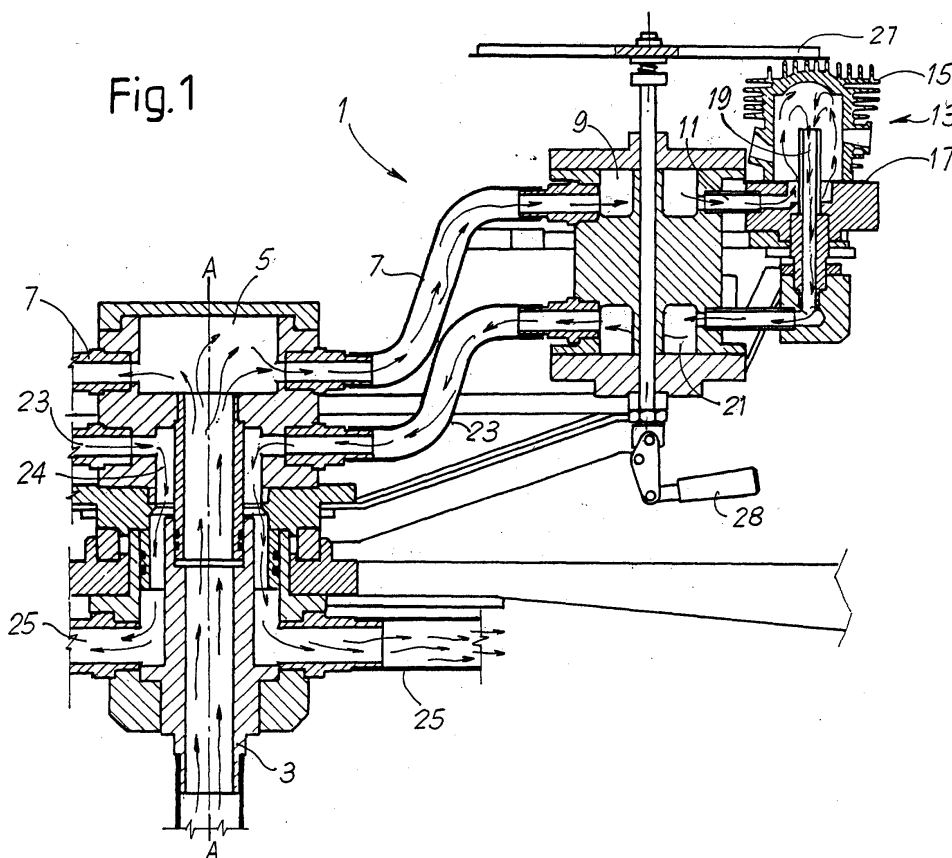
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(54) **An installation for the application of a coating to metal parts and method therefor**

(57) A description is given of an installation for the galvanic application of a coating to portions of parts to be treated (15) possessing an internal cavity, typically cylinders for internal-combustion engines. The installation comprises a flow circuit for a fluid; the parts to be

treated are inserted into the circuit so that the internal cavity of said parts forms part of said circuit. A suction member (31) which during the treatment maintains the internal cavity of said parts to be treated at a lower pressure than the external pressure is also provided.



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Description

Technical field

[0001] The present invention relates to an installation for the application of a coating by galvanic reaction to metal parts or components undergoing treatment.

Prior art

[0002] Especially in the automotive field it is very common to treat metal parts and components made of light alloys by codeposition of metal matrix/silicon carbide composites. In particular, such codepositions are applied to those parts of engines where particularly high heat resistance is required, in this case the inside surface of the liner of the cylinder of an internal-combustion engine.

[0003] At present, such application is performed by galvanic reaction of the chemical treatment solutions between a cathode, consisting of the actual part to be treated, and an anode. The chemical solutions come into contact with the surface to be treated by methods that can essentially be broken down into two categories: contact by total immersion of the part undergoing treatment in baths of treatment solution, and contact by circulating the liquid solution around a liquid circuit that includes the actual part to be treated. More particularly, in the first method the part is immersed in the chemical solutions and/or in the baths of the various stages that make up the codeposition treatment, the treatment substances thus being applied to the whole of the part, both on the surfaces that are to be treated and on those that are not. In the present case, that of a cylinder of an internal-combustion engine, it has been calculated that the percentage represented by the surface corresponding to the inner liner of the cylinder - that is the surface to be treated - is between 5% and 25% of the total surface area wetted by the chemical solution, which means that the consumption of treatment substances is enormous by comparison with what is actually necessary.

[0004] The second method involves circulating the solution around a liquid circuit that includes the part. The surface to be treated, which is on the inside of the fluid circuit, is in contact with the circulating solution. As before, a galvanic reaction takes place between an anode and the part which acts as the cathode in order to promote the coating codeposition. In the liquid circuit a pump is used to maintain the pressure necessary to circulate the chemical solutions used for the various stages of the treatment. The part to be treated is fixed by means of flanges to the circuit and the solutions travel through the circuit and through the part to be treated. This avoids wetting the portion of the part that has no need to be treated, i.e. the outer surface. Clearly, though, the flanges responsible for sealing the liquid circuit are subjected to a cycle of closing and opening for each part fitted, and, because said parts succeed each

other on the circuit at the speed of the production line, these continual stresses can reduce the efficiency of the seal and result in leakages of liquid from the circuit, with both financial and environmental repercussions, as the treatment substances may be toxic. Still worse problems are due to the fact that before the treatment is carried out it is necessary to seal all ports present in the part to be treated, such as the spark plug housing holes and the fuel admission pipes. These seals must be perfect to prevent leaks of the liquid which is under pressure as it circulates through the internal cavity of the parts during the treatment.

Objects and summary of the invention

[0005] It is an object of the present invention to provide an installation that overcomes the limits of the prior art.

[0006] This and other objects and advantages, which will be clear to those skilled in the art on perusing the text which follows, are achieved in essence by using an installation of the type in which the part to be treated is used to form part of the fluid circuit. However, in contrast to conventional installations, the flow is controlled in such a way that the pressure inside the cavity of the parts to be treated is lower than the ambient pressure around the parts. Typically the circuit and the internal cavity of each part are maintained at an absolute pressure of about 500 mbar, although this value should not be understood in a restrictive sense.

[0007] All the problems relating to the efficiency of the seals are by this means eliminated. Specifically, even if the seals that insulate the internal cavity of the part from the external environment are not perfect, there is still no leakage of the treatment liquids toward the exterior; at the very most, ambient air would pass into the circuit.

[0008] The installation may comprise one or more stations for clamping one or more parts to be treated. An outward-flow pipe and a return-flow pipe for the treatment fluid may be connected to each of said stations.

[0009] Advantageously, in one possible embodiment each of the various treatment stations comprises a seal on which the part to be treated is stood and clamped. In one possible embodiment the seal surrounds the fluid return-flow pipe and the outlet of the fluid outward-flow pipe.

[0010] In a different aspect, the invention relates to a method for the galvanic treatment of parts having an internal cavity (especially but not exclusively cylinders of internal-combustion engines), in which a part to be treated is inserted into a circuit carrying a treatment fluid and the fluid is circulated through said part, an electric potential being applied between two electrodes, one of said electrodes being said part. Characteristically, according to the invention, the treatment is carried out by maintaining the pressure of the fluid in the cavity of the part to be treated at a lower value than the pressure of the external environment.

[0011] Other advantageous features and embodiments of the invention are indicated in the accompanying claims.

Brief description of the drawings

[0012] The invention will be understood more clearly from the description and attached drawing, the latter showing a practical, non-restrictive example of an embodiment of the invention.

Fig. 1 is a schematic view in cross section of a portion of the installation according to the invention;
Fig. 2 is a block diagram of the installation according to the invention; and
Fig. 3 is a perspective view of the treatment stations of the installation according to the invention.

Detailed description of the preferred embodiments of the invention

[0013] Fig. 2 shows a general block diagram of the installation. Reference 1 denotes the section of the installation containing the treatment stations, where the parts to be treated are fixed and where the actual treatment takes place. Fig. 1 shows a portion of this treatment section, the complete layout of which is visible in Fig. 3. As can be seen in Fig. 3, in the example illustrated the section 1 has a polygonal configuration, with a distribution of six work zones symmetrically arranged around a vertical axis. Each work zone has a distribution of five treatment stations in a star arrangement. However, it should be understood that the distribution of the treatment stations may differ from that illustrated, and indeed that the installation could have only a single workstation.

[0014] The detail of Fig. 1 shows, in a longitudinal section, one of the six work zones with one of the corresponding treatment stations. The other treatment stations and the other work zones are essentially the same. Fig. 1 shows that the treatment zone 1 comprises a first section of outward-flow line 3 carrying the treatment liquids to a first chamber 5. The chamber 5 and the line 3 are common to the various work zones and treatment stations. From the chamber 5 a second section of outward-flow line 7 branches off to each work zone. This line leads to a second chamber 9 from where a third section of outward-flow line 11 branches off to each of the five treatment stations 13.

[0015] A part 15 undergoing treatment and positioned on the work station 13 illustrated in Fig. 1 is pressed down on a seal or gasket 17. From here a first section of return-flow line 19 leads off from each treatment station 13.

[0016] The pipes 19 of each treatment station 13 extend vertically above the surface defined by the seal 17, thus extending into the cavity of the respective part 15 undergoing treatment. The corresponding section of

outward-flow pipe 11 ends at the flat surface of the seal 17 and the outlet end of this pipe 11 surrounds the pipe 19.

[0017] The sections of return-flow line 19 of the five stations 13 belonging to a single work zone lead to a third chamber 21. From here, for each of the six work zones of the installation, a second section of return-flow line 23 branches off, the various sections of line 23 being brought together in a manifold 24 leading to a final section of return-flow line 25.

[0018] Each work zone has a clamping device 27 with a star configuration. This is used to simultaneously clamp the five parts 15 undergoing treatment in each work zone. The clamping device 27 is clamped by a toggle mechanism 28, although mechanisms of e.g. hydraulic type are also possible. The device 27 presses the parts 15 down on the upper surface of the respective seal 17 to prevent leaks. For each part undergoing treatment, a fluid path is thus defined, formed by the pipes and chambers 3, 5, 7, 9, 11, 19, 23, 24, 25 and by the internal cavity of the part 15.

[0019] The parts are cylinders of internal-combustion engines, the ports of which are closed at the appropriate time in a manner not shown in the drawing.

[0020] As far as the electrical part of the installation is concerned, the section of pipe 19 forms the anode for the galvanic treatment, and is connected to a voltage source (not shown in Fig. 1). The cathode is formed by the part 15 itself, which is electrically connected to the other terminal of the voltage source through the clamping mechanism 27.

[0021] The installation according to the invention also includes (Fig. 2) a pumping system comprising at least one circulation pump 31 and a control device 33 for controlling said circulation pump. These are located downstream of the various treatment stations 13 with respect to the direction of flow. There are also tanks 35, 47, 39, 41, their number and capacity being adequate to contain all the substances used in carrying out the process of application of the coating. Depending on the nature of the substances used during the treatment, there may be systems 43, 45 for cooling the solutions and known per se, systems 47 for injecting controlled amounts of the solutions into the installation, tanks 49 containing demineralized water or other substances - and associated feeder systems 51 - effective in removing from the lines of the installation any residues of substances not wanted in certain stages of the treatment.

[0022] Each tank 35, 37, 39, 41, 49 is equipped with valves to control access to and release from each of said tanks 35, 37, 39, 41, 49. In the present case, solenoid valves 235, 237, 239, 241, 249 and 335, 337, 339, 341, 349 are used. There is also an automatic system 53 for controlling and monitoring the stages of the process, and at least one energy source, in the present case an electricity generator 55 for driving the galvanic reaction of application and for driving all the systems involved in the treatment. The sections of pipe 19 that form the an-

odes and the various clamping systems 27 which are in electrical contact with the parts 15 that form the cathodes are electrically connected to this generator.

[0023] A discharge 57 with a valve 59 for the exit of the liquids from the installation can be reached by lines from the treatment station 13 or directly from some of the tanks 37, 39 containing the solutions utilized. Also provided is an additional valve 61 for the controlled admission of air to the installation.

[0024] In practice, an operator places on each treatment station 13 the part to be treated 15 in such a way that the part 15 presents a surface of adhesion to the gasket 17.

[0025] The part must be prepared in such a way that once on its station it forms a part of the treatment liquid circuit. For this purpose it must be sealed. Any holes or ports must first be closed up. Nonetheless, because the liquid circuit into which the part is integrated is at a lower pressure than atmospheric pressure, the seal does not need to be perfect since there is never any risk of liquid escaping from the part 15. Besides, from a practical point of view, the fact that the part to be sealed up is at low pressure facilitates the making of the seal because the external atmospheric pressure contributes to the clamping of the flanges, which after all must ensure the seal at a theoretical maximum pressure of 1 bar. For these reasons the clamping of the part to be treated to the installation may be achieved by vacuum only and the clamping system 27 may be there purely in order to supply the electrical voltage to the part.

[0026] The mechanical clamping device 27 fixes the position of the part 15 in the station 13. The automatic system 53 for controlling and monitoring the treatment stages activates the circulation pump 31 via the control device 33 to produce inside the fluid circuit, which includes the various parts 15 clamped in their positions, a vacuum which may if wished also contribute to the leaktight adhesion of the part 15 to the gasket 17. Said vacuum draws the liquid from one or other of the various tanks (depending on the treatment program) and is sufficient to fill the lines of the circuit and circulate the solutions or liquids necessary to carry out the various stages of the treatment. The installation according to the invention may be equipped with a vacuum switch that enables starting up of the process only below a defined pressure. In this way there is immediate and automatic verification that the system is sufficiently sealed.

[0027] In particular, the process of applying the coating involves wetting the surface to be treated with all the liquid solutions present in the tanks 35, 37, 39, 41, 49, in an order controlled by the automatic system 53. The process involves opening the valve corresponding to the tank containing the required solution at one or more stages of the treatment and sucking this solution into the lines of the circuit by vacuum. As the part 15 is integrated into the circuit the flow wets the surface undergoing the treatment, and the mechanical clamping component 27 - also acting as an electrical contact - supplies energy

to the part 15 so that a galvanic reaction is produced between the part 15 and the first section of return-flow line 19, causing the coating to be deposited.

[0028] When the circuit needs draining, for example in order to replace one treatment liquid with another, air enters through the valve 61, allowing the liquid to flow either toward tanks for recovery - if the valve 59 is closed and the valve corresponding to the tank is open - or toward the discharge 57 with valve 59 open. Discharge is by gravity.

[0029] It will be understood that the drawing shows only an example provided purely as a practical demonstration of the invention, it being possible to vary the shapes and arrangements of said invention without thereby departing from the scope of the concept on which the invention is based.

Claims

1. An installation for the galvanic application of a coating to portions of parts to be treated (15) possessing an internal cavity, said installation comprising a flow circuit for a fluid, the parts to be treated being inserted into said circuit so that the internal cavity of said parts forms part of said circuit, **characterized by** a suction member (31) which during the treatment maintains the internal cavity of said parts to be treated at a lower pressure than the external pressure.
2. An installation according to Claim 1, **characterized in that** said circuit is a liquid circuit.
3. An installation according to Claim 1 or 2, **characterized in that** it comprises one or more stations (13) for clamping the parts to be treated, an outward-flow pipe (11) and a return-flow pipe (19) for the treatment fluid being connected to each of said stations.
4. An installation according to Claim 3, **characterized in that** each of said stations comprises a seal (17) on which the part to be treated is stood and clamped.
5. An installation according to Claim 4, **characterized in that** said seal surrounds the fluid return-flow pipe (19) and the outlet of the fluid outward-flow pipe (11).
6. An installation according to Claim 5, **characterized in that** said return-flow pipe (19) extends above the seal (17).
7. An installation according to Claim 3, 4, 5 or 6, **characterized in that** each of said stations comprises clamping means (27) for clamping the parts to be

treated.

8. An installation according to Claim 7, **characterized in that** said clamping means include one closing and opening mechanism (28) for a plurality of treatment stations (13).
9. An installation according to at least one of the previous claims, **characterized in that** said parts are cylinders for internal-combustion engines.
10. An installation according to at least one of the previous claims, **characterized in that** said portion of a part is the cavity forming the liner of said internal-combustion engine cylinder.
11. An installation according to at least one of the previous claims, **characterized in that** it comprises at least one tank containing a chemical solution useful for the application process.
12. An installation according to at least one of the previous claims, **characterized in that** said cathode consists of the part to be treated.
13. An installation according to at least Claim 3, **characterized in that** said return-flow pipe (19) constitutes an anode.
14. An installation according to one or more of the previous claims, **characterized in that** it comprises a distribution of work stations about an essentially vertical central axis.
15. An installation according to one or more of the previous claims, **characterized in that** said circuit comprises a first section of outward-flow pipe (3), leading to a distribution chamber (5), and a plurality of feeder pipes (7) going to a plurality of stations (13) for the simultaneous treatment of a plurality of parts.
16. An installation according to Claim 15, **characterized in that** it comprises a first section of outward-flow pipe (3) common to all the workstations and branches (7, 11) going to individual workstations distributed about said central axis.
17. An installation according to Claim 15 or 16, **characterized in that** it comprises a plurality of return-flow pipes (23) coming from said stations (13) and a discharge manifold (24).
18. An installation according to Claim 17, **characterized in that** said manifold and said first outward-flow pipe (3) are coaxial with each other.
19. An installation according to at least one of the pre-

vious claims, **characterized in that** it comprises a vacuum switch that enables the process to start only below a defined pressure.

20. A method for the galvanic treatment of parts having an internal cavity, in which a part to be treated is inserted into a flow circuit for a treatment fluid and the fluid is circulated through said part, an electric potential being applied between two electrodes, one of said electrodes being said part, **characterized in that** the pressure of the fluid in said cavity is maintained at a lower value than the pressure of the external environment.
21. Method according to Claim 20, **characterized in that** said parts are cylinders of internal-combustion engines.

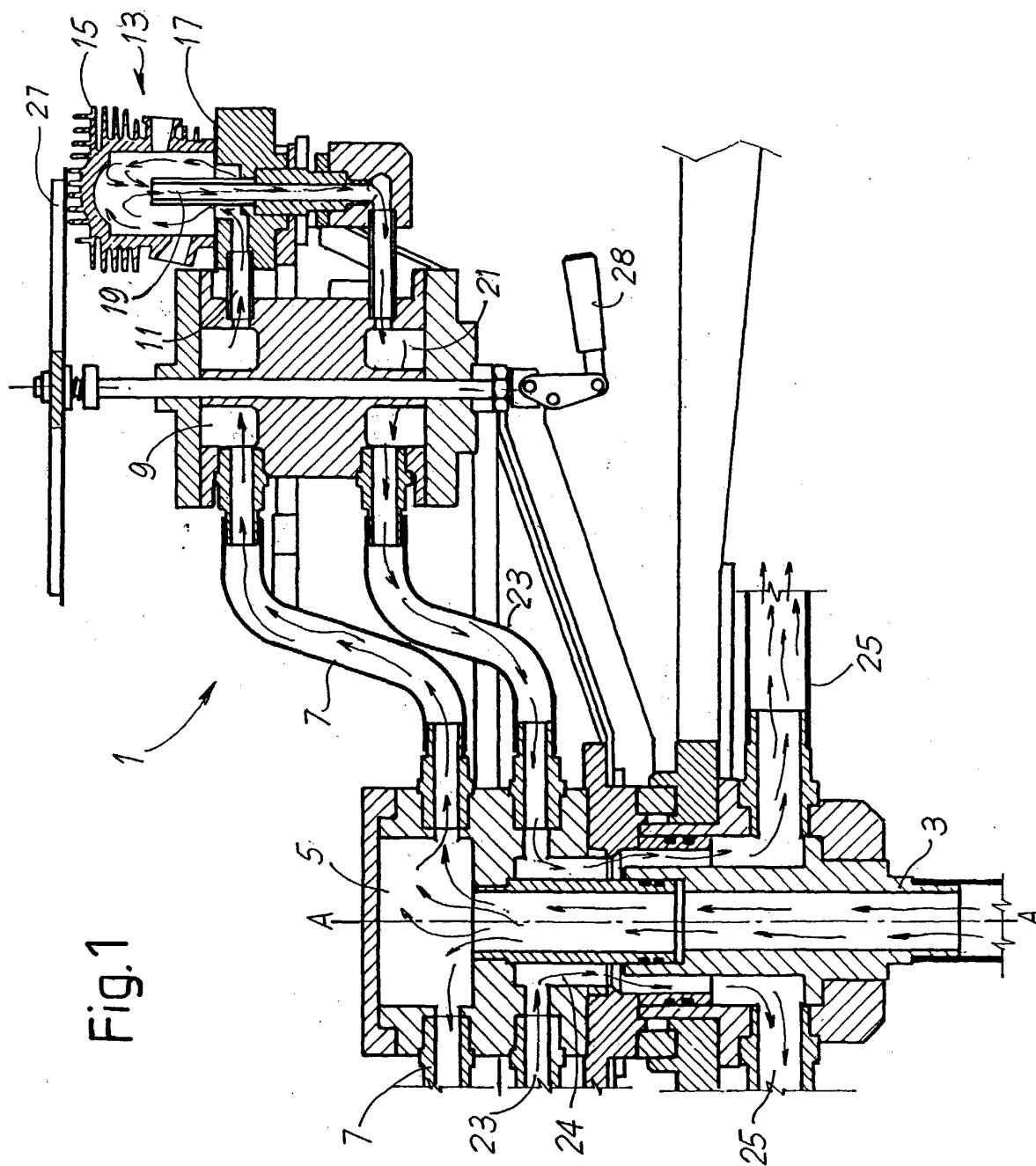
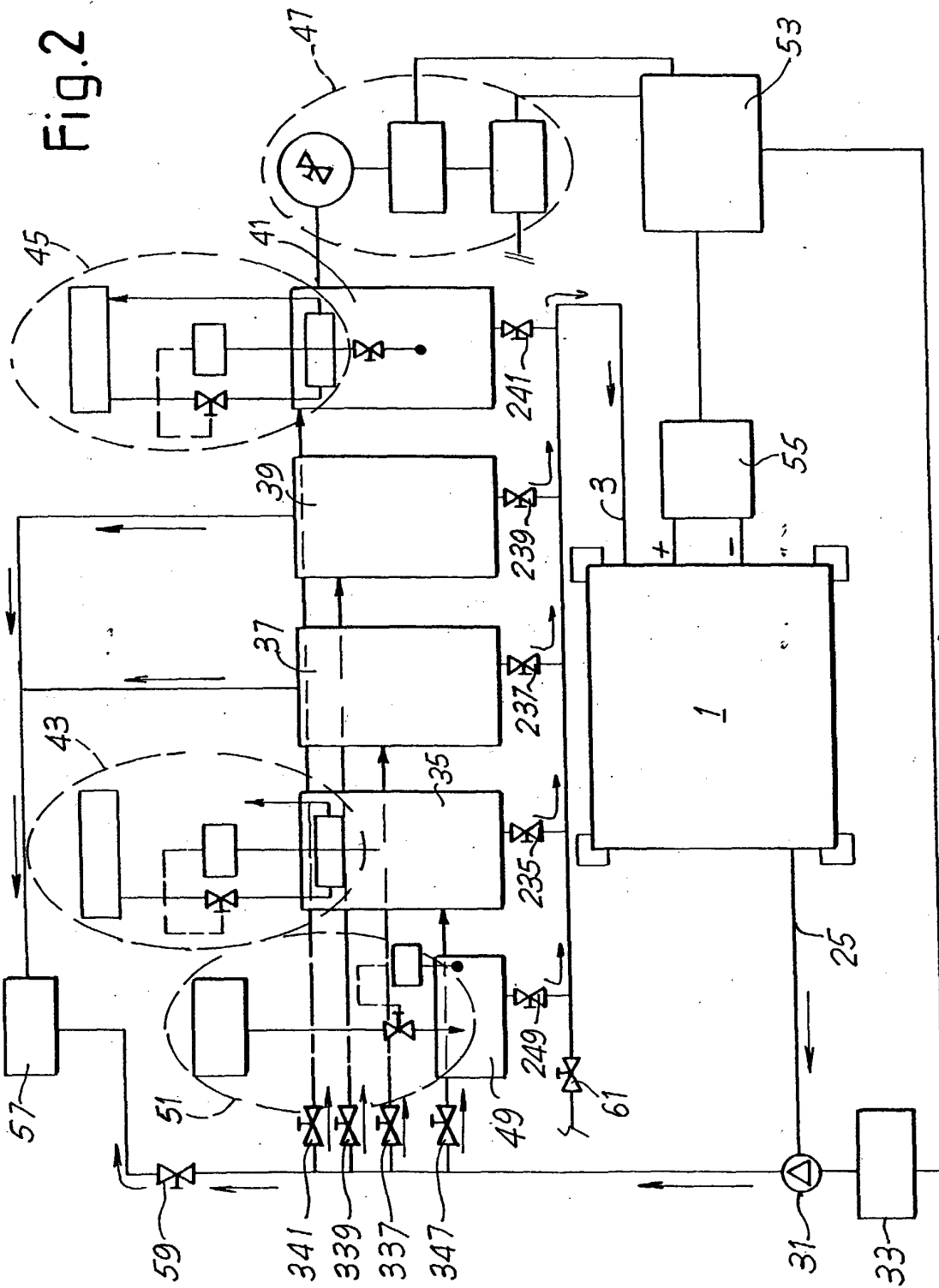
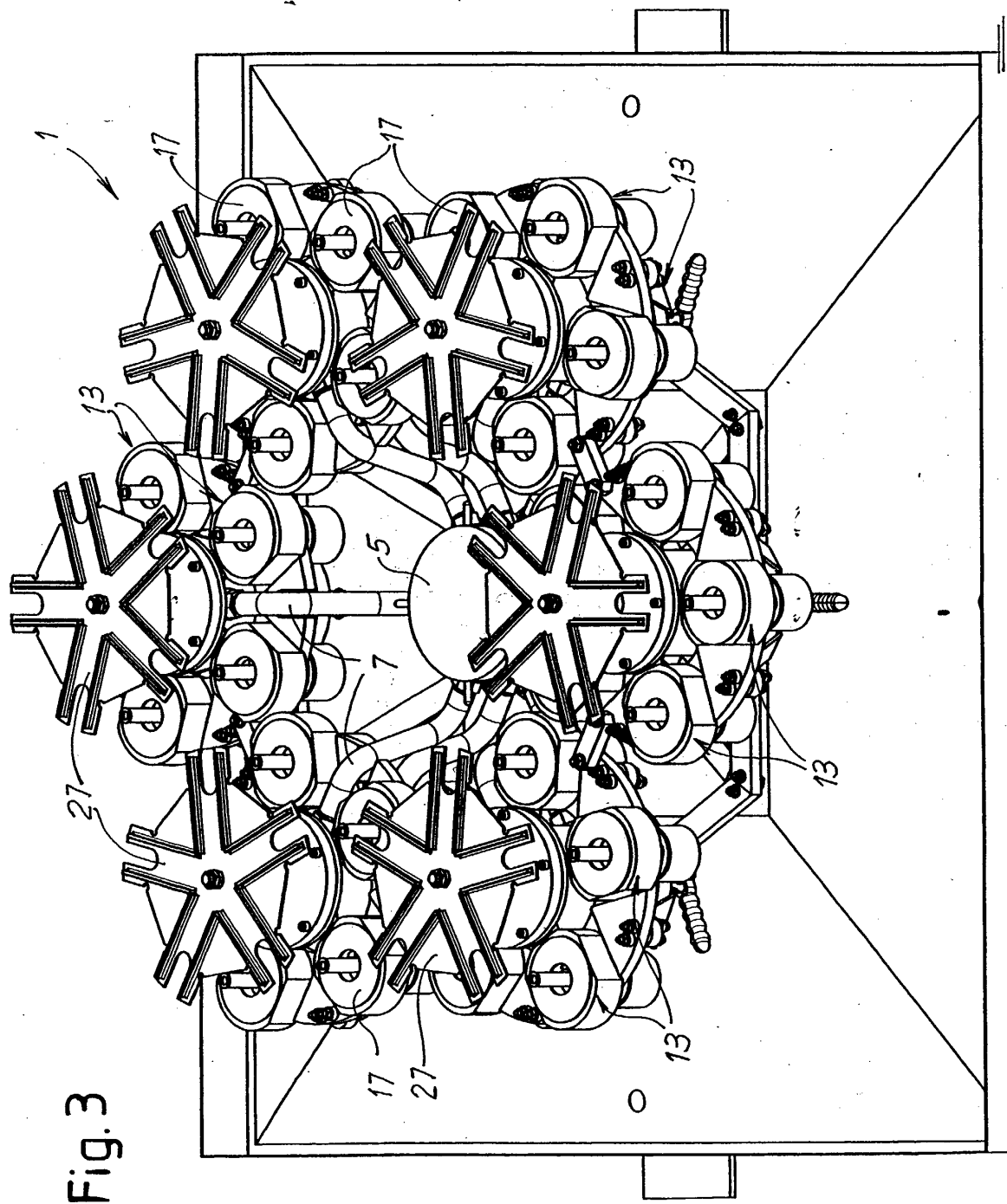


Fig.1







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Application Number
EP 03 42 5200

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Y	* figure 2 *	15-17	
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X	* column 1, line 56 - column 2, line 43 * * column 10, line 55 - column 11, line 16 * * figures 4, 5, 12-15 *	1-13, 20, 21	
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Place of search THE HAGUE		Date of completion of the search 20 August 2003	Examiner Zech, N
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