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(54) Benevnelse **HYDRAULIC DEVICE FOR GENERATING SNOW**

(56) Anførte publikasjoner WO-A1-2009/145771, JP-A- H09 210 525, JP-A- H04 116 362

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[0001] The invention relates to a hydraulic device for producing snow from water, as defined by the preamble to claim 1.

[0002] Current methods and devices, particularly for producing snow or ice, have been designed differently, depending on what type of water source they have: a natural lake, an artificial lake, a river, a reservoir, a spring, and the like. These resources have advantages, but also disadvantages. When artificial lakes form, they put limits on use in terms of both time and volume. The actual production of artificial snow is done by a combination of suitably disposed water and air nozzles on the snow device (snow cannon or other snowmaking devices). Production methods that cool or chemically treat the water used for producing snow or that chemically enrich it by means of micromaterials are also known. Snow and ice pellets form faster when coated with water. A number of exemplary embodiments of snow cannon or other snowmaking devices exist, but the feature they have in common is adjustability in the horizontal and vertical directions; at least one motion can be controlled automatically. The snow cannon or the other snowmaking devices have a number of nozzles, which are either fixed or rotatable and are preferably disposed upstream of an airflow source in a directional transit chamber.

[0003] The disadvantage of these known devices for producing snow or ice is that they are especially dependent on the temperature and the humidity, as well as on the temperature and quantity of the water used service water for producing snow. The snow produced at below-freezing temperatures and at 0ºC is wet, and this cannot be improved by existing means such as a higher elevation, using less water, changing the pressure, or cooling the water. Under such conditions, either the production of artificial snow has to be stopped, or snowmaking has to be done repeatedly at night, when the conditions for producing snow are more favorable.

[0004] In WO 2007/045467, a device is described in which the medium is circulated and its temperature is increased in the process. This leads to increased energy consumption.

[0005] From Japanese Patent Reference JP H04 116362 A, a device for producing snow from water is known which has a low-pressure hydraulic device with a pump

device, a high-pressure device to which a snow cannon and/or some other snowmaking device is connected, and a distributor device, the at least one high-pressure pump of which has the low-pressure hydraulic device separated from the high-pressure device. Furthermore, the device has a triggering device, in order to subject the water, used for producing snow, to an ionization and/or polarization with simultaneous action of an electromagnetic alternating field, as a result of which it is attained that the power energy bond of the water molecules in the supermolecular water structure of the water used is changed, or in other words decreases. However, no pressure excitation device is connected to the high-pressure device upstream of the snow cannon and/or of the other snowmaking device, and the low-pressure hydraulic device has no main excitation device disposed downstream of the cleaning device and on which an excitation device is disposed, which has an adverse effect on the properties of the water used for snowmaking with regard to its heat/cold consumption and output.

[0006] From WO 2009/145771 A1, a device for producing snow from water is known which has a low-pressure hydraulic device with a pump device, to which a cleaning device is connected, a high-pressure device to which a snow cannon and/or some other snowmaking device is connected, and a distributor device, at least one high-pressure pump of which separates the low-pressure hydraulic device from the high-pressure device. What is disadvantageous is the lack of a triggering device, in order to expose the water used for producing snow to an ionization and/or polarization process with simultaneous action by an electromagnetic alternating field.

[0007] It is the object of the invention to develop a device for producing snow in which the bond of the water molecules in a supermolecular water structure of the water used changes and thereafter improves the production of snow.

[0008] The stated object is attained by the features of claim 1.

[0009] The essence of the novel device is that the water used for producing snow is exposed to an ionization and/or polarization field with simultaneous action of an alternating electromagnetic field; what is achieved thereby is that the force energy

bond of the water molecules in the supermolecular water structure of the water used changes; that is, it decreases.

[0010] Advantageous embodiments of a device for performing the method can be learned from the dependent claims.

[0011] The low-pressure and/or high-pressure part of the hydraulic circuit has a primary excitation device and/or a pressure excitation device connected directly, fixedly, and/or indirectly in their circuit by way of a bypass, and with the excitation device the flow of liquid can be interrupted. The primary excitation device is preferably disposed downstream of the cleaning device. It can also, with less-pronounced advantages, be installed at any arbitrary point of the hydraulic course or at the water source upstream of the pumping device. The pressure excitation device is preferably connected to the high-pressure device upstream of the snow cannon and/or some other snowmaking device.

[0012] The primary excitation device has a hydraulic inlet branch with a second controlled opening and closing mechanism, which in a distribution branch with at least one thermometer and/or one pressure gauge discharges in the vicinity of the controlled main opening and closing mechanism. Between the inlet and the hydraulic outlet branches, excitation devices are secured fixedly and/or detachably. The hydraulic outlet branch discharges into an intermediate branch, which is disposed between a third controlled opening and closing mechanism and a main opening and closing mechanism.

[0013] The pressure excitation device comprises a common chamber, in which at least one control electrode is secured at the inlet either fixedly, detachably, and/or flexibly. In the flow direction at the outlet of the body of the common chamber, at least one polarization electrode is secured fixedly flexibly. The body of the common chamber is formed by a fixed and/or flexible sheath (film).

[0014] In the case of the excitation devices at the primary excitation device, the common body predominantly comprises a sheath (film), which has a coating at least partially on its circumference.

[0015] The advantage of the device for producing snow is that high-quality snow can already be produced at 0ºC. The snow produced is drier, and because it has a multiple coating, water does not escape from it. Hence the quality of the snow is maintained despite the need for the snow to be scattered by machines for the purpose; these machines compress the layers of snow but do not force the water out. Thus a layer of ice cannot form. Similarly, there is no prerequisite for making so-called snow pellets in the spring. The artificial snow produced thaws more slowly, so snowmaking does not have to be repeated frequently. The result is reduced costs, especially electrical costs, for operating snow cannons, since there is no need to increase the already generous snow production. At the same time, the amount of water used is reduced, which has a positive effect environmentally. As a result, the ski season can be extended, or shifted to lower-lying regions, with better-quality artificial snow. This is achieved because of the treatment according to the invention, in which the water or other medium used acquires unforeseen, unexpected, newly discovered properties in terms of heat/cold consumption and output. This is also documented physically.

[0016] The invention will be described in further detail in conjunction with the drawings. In the drawings:

Fig. 1 is a hydraulic, electronic and pneumatic block diagram of a device;

Fig. 2 shows a concrete exemplary embodiment of a hydraulic device with a concrete exemplary embodiment of a primary excitation device for producing snow, with a suitably controlled main opening and closing mechanism;

Fig. 3 shows an excitation device at the primary excitation device, showing a high-power source which is supported in its own control device and in an equivalent exemplary embodiment is connected directly to the excitation device;

Fig. 4 shows a pressure excitation device, the part of which between the inlet and the outlet has a flexible sheath;

Fig. 5 shows a concrete exemplary embodiment of a pressure excitation device or its equivalent, comprising two devices in succession that are supported in an

air chamber by heat insulation, which has a controlled heating element in the interior of the hydraulic portion and/or in the air chamber;

Fig. 6 shows a simplified embodiment of temperature and/or motion control for the medium; and

Fig. 7 shows variants of the electromagnetic signal.

[0017] The device, particularly for producing snow, comprises a hydraulic distributor device 2.4 with at least one high-pressure pump. A high-pressure device 3 comprises a pressure line 3.1, which has a number of exemplary embodiments. They can be fixed and/or flexible and can comprise steel, polyethylene, polypropylene, textile, or rubber, with distributor devices 3.2. A snow cannon 3.3 and/or other snowmaking devices 3.4 can be connected as needed to the high-pressure device 3 in such a way that upstream of it, pressure excitation blocks 3.5 with at least one pressure excitation device 3.51 are connected to the pressure line 3.1. The snow cannon 3.3 has a distributor device 3.31, which communicates hydraulically with a nozzle device 3.32 disposed in the interstice or on its end, preferably on the inside. The nozzle device 3.32 is disposed in the direction of the airflow out of an air module 3.33. The distributor device 3.31 is connected to pressure, temperature, flow and moisture sensors and the like, each of which has its own control module and algorithm of physical variables.

[0018] Similarly, rod-type snow blocks 3.4 have a second technological distributor device 3.41, which is connected to a second nozzle device 3.42. The snow cannons 3.3 and the rod-type snow blocks 3.4 are placed in a manner that suits the type of terrain.

[0019] The low-pressure device 2 of the hydraulic device 1 includes a pumping device, to which a cleaning device is connected that is connected fixedly or detachably to the primary excitation device 2.3. A distributor device 2.4, whose at least one high-pressure pump 23 separates the low-pressure device 2 from the high-pressure device 3, is connected downstream of the primary excitation device 2.3.

[0020] The pumping device 2.1 comprises a reservoir 2.11, which is a spring, river, lake, or reservoir with a suction pipeline let into it. Downstream of the suction device, a

filter 2.13 is disposed upstream of the pump 2.12. The pumping device 2.1 has a number of exemplary embodiments with measuring instruments for measuring the inflow, temperature, pressure, level, and the like, which are preferably, like the pump 2.12 as well, connected electrically to the primary excitation device 9.

[0021] The cleaning device 2.2 includes a technological branch, on which a first opening and closing mechanism 2.21 is disposed, downstream of which a filter 2.22 is preferably connected. Downstream of the filter 2.22, there is a second opening and closing mechanism 2.23. The connecting branch includes a third opening and closing mechanism 2.24. The technological branch communicates with the connection branch both downstream of the pumping device 2.12 and downstream of the second opening and closing mechanism 2.23. Downstream of the technological branch is a first controlled opening and closing mechanism 4, and downstream of it is a connection branch, which includes a pressure gauge 5, a venting device 6, and a flow meter 7 upstream of the inlet into the distributor device 2.4.

[0022] At the hydraulic inlet branch, the primary excitation device 2.3 has a second controlled opening and closing mechanism 2.31, which discharges into a distribution branch with at least one thermometer 2.32 and one pressure gauge 2.33. The distribution branch is located upstream of the main opening and closing mechanism 2.34. Between the distribution branch and the output hydraulic branch, at least one excitation device 2.35 is secured fixedly or detachably. The hydraulic inlet branch discharges into an intermediate branch, which connects the third controlled opening and closing mechanism 2.34 to a main opening and closing mechanism 2.36 and at which intermediate branch an outlet pressure gauge 2.37 is preferably disposed. It is advantageous if at least one venting excitation device 6.1 is connected to the hydraulic outlet branch.

[0023] The pressure excitation device 3.5 comprises at least one pressure excitation device 3.51 with a common chamber 3.42, which has at least one control electrode 3.43 in the vicinity of the inlet opening 3.45 and a polarization electrode 3.44 in the vicinity of the outlet opening 3.46. The control electrode 3.43 is supported flexibly and/or fixedly and in watertight fashion in a holder 3.401. This holder 3.401 is connected in watertight fashion to an inlet sheath (film) 3.490. The input sheath 3.490 includes an inlet opening 3.45. The polarization electrode 3.44 is supported flexibly

and/or fixedly and in watertight fashion in the holder 3.401. This holder 3.401 is connected in watertight fashion to an outlet sheath (film) 3.491 and includes an outlet opening 3.46. It is advantageous if the inlet sheath (film) 3.490 and the outlet sheath (film) 3.491 are connected to one another via a deformation sheath (film) 3.47 of flexible, bendable pressure material. A concrete exemplary embodiment of the connection provides a coupling 3.48. For example, this is a hydraulic hose of synthetic rubber. The synthetic rubber has high resistance to wear and environmental factors. It is advantageous if at least a portion of the common chamber 3.42 comprises a material with negative electrochemical potential and/or is disposed outside the deformation sheath (film) 3.47. The control electrode 3.43 has a sheath 3.41 in the form of a test tube, which is a tube of silicate, ceramic and the like, in which a rodlike and/or spiral antenna 3.432 is disposed. The polarization electrode 3.44 is embodied similarly, but in its interior it has a fixed, liquid or gaseous polarization material 3.441. The sheath 3.41 of the control electrode 3.43 and the sheath of the polarization electrode 3.44 have a number of versions, depending on the load and on the type of excitation water (medium) used. For the lowest load, the sheath comprises technical glass with a predominant proportion of SiO_2. This is a homogeneous, amorphous, isotropic, solid and fragile substance, which in the metastable state has a tensile strength of 30 MPa and a density of approximately 2.53 $g.cm^{-3}$. This is an insulating material with dielectric properties that has polarization capabilities. An oxidic sintered ceramic with an Al_2O_3 content of at least 99.7%, or a microstructured ceramic of oxygen with a modulus of elasticity in tension of 380-400 GPa, a breaking strength of at least 300 MPa and a density of 3.8 g cm^3, is suitable. What is best is a composite ceramic C/SiC, which is in the category of nontoxic technical ceramics and has short carbon fibers, which improve the excellent mechanical and thermal properties of K/SiC. Its density is 2.65 $g.cm^{-3}$; the modulus of elasticity is 250-350 GPa and the bending strength is at least 160-200 MPa. The composite ceramic C/SiC includes short carbon fibers with a length of 3-6 mm and a Rovince thickness of 12 k (1k = 10^3 filaments), which can be oriented volumetrically randomly, as a result of which the material then has isotropic properties. Under an extreme load on the polarization electrode 3.44 or control electrode 3.43, the short carbon fibers can preferably be oriented in a targeted way, for instance perpendicularly to the axis, as a result of which the material gains anti-isotropic properties. The spiral or rod antenna 3.432 is connected detachably or fixedly to a high-power source 8, which is connected to a power supply 81. The high-power source 8, if the excitation device is located in water, feeds an alternating

electromagnetic signal of 100-500 MHz with an intensity of 0.1-2.0 W into the rodlike and/or spiral antenna 3.432. The power supply 81 is understood to be a 230 V source, which is converted into 12 V (24 V and the like). It can also be a technical equivalent, such as a battery, solar or photoelectric element, and the like. In an alternative version, the high-power source 8 can also be disposed outside the pressure excitation device 3.51.

[0024] An excitation device 2.35, which corresponds to the elastic pressure excitation device 3.51, is disposed on the primary excitation device 2.3 and has a common chamber 3.42, in which at least one control electrode is secured in watertight fashion, fixedly or detachably, in the vicinity of the inlet opening 2.45. In the vicinity of the outlet opening 2.46, a polarization electrode 2.44 is secured fixedly or detachably and in watertight fashion. On the circumference of the common chamber 2.42 or on at least a portion thereof, there is a coating, film or sheath 2.421 of positive electrochemical material (C, Cu, etc.) or negative electrochemical material (Al, Fe, etc.), depending on the composition of the water (or medium). In the exemplary embodiment described, a storage housing 2.47 comprises nonconductive plastic (dielectric) insulating material. In the concrete exemplary embodiment, this is polypropylene. The control electrode 2.43 and the polarization electrode 2.44 are supported in the holder 2.40. The control electrode 2.43 has a closed sheath 2.431 of tubular shape, in which a rodlike or spiral antenna 2.432 is disposed. The polarization electrode 2.44 is constructed similarly and in its interior, it has a solid, liquid or gaseous content 2.441 with a positive and/or negative electrochemical potential. It is advantageous if, as in a further exemplary embodiment, it has an openable and closeable ventilation and sludge removal opening. Some elements and nodes, which form a novel device for producing snow or ice, are connected electronically to a primary control device 9 and a pneumatic device 11. These are for example a pump 2.12, high-pressure pump 23, flow meter 7, temperature and pressure gauges, and measuring instruments for other physical variables. The primary excitation node 2.3 has its own control device 10 and pneumatic device 11, both of which are connected to a first controlled opening and closing mechanism 4, a second controlled opening and closing mechanism 2.31, a controlled main opening and closing mechanism 2.34, and a third opening and closing mechanism 2.36. The control device 10 itself is connected to a thermometer 2.32, a pressure gauge 2.33, and an outlet pressure gauge 2.37, or to an external thermometer (not shown in the drawing). It is advantageous if the low-pressure

hydraulic device 2, downstream of the excitation device, has at least one ventilation node 15, or if the primary excitation device 23 has its own ventilation device 6.1. The phrase “material with positive or negative electrochemical potential” is understood to mean an electrode potential E^0. Only the electromotive voltages of the member that are generated by the defined electrode and comparison electrode are measured. The standard comparison electrode has an electrode potential equal to zero, $E^0 = 0$, which is equivalent to a platinum electrode prepared in a standard way. The values of standard electrode potentials range from -3.04 V (lithium) to +1.52 V (gold). Especially good outcomes are achieved by a polarization electrode of silver, even if the chamber sheath either entirely or only partially comprises stainless steel. This process is analyzed continuously by a device according to Slovakian Patent 279 429 of Polakovič-Polakovičová. With the Po process, it is documented and proven that the water molecules prepared in the excitation devices are bound more weakly to one another than in untreated water. The method can be defined as a passage of a liquid medium, water, or at least a portion of its volume, through a polarization and/or ionization chamber under the influence of an alternating electromagnetic signal. As a result, it is attained that the molecules of the medium, the water molecules in the supermolecular structure, have a weaker bond. The force energy of the bonds in the molecular and supermolecular water structure vary, but only to such an extent that its fluidity varies; however, the liquid properties are preserved (the aggregate status remains unchanged).

[0025] The exemplary embodiment of Fig. 5 comprises a sheath 16, on which a heat insulator 17 is disposed on the outside or inside. A pressure excitation device 3.511 and a second pressure excitation device 3.512, or a plurality of excitation devices communicating hydraulically with one another, are located in the sheath 16. Each excitation device has its own high-power source 8, which is connected to its own or a common power supply 81. In the interior of the hydraulic device, there is at least one heating element 18, which is connected to a temperature controller 20 and/or a motion controller for the medium. In another concrete exemplary embodiment, the control device 20 is located in the sheath 16. The control device 20 includes a sensor 21, which is connected to an evaluation unit 22 (such as a thermostat), which is connected to a switch element 23. The heating element 18 is formed by a resistance wire, rodlike wire or spiral wire. If the heating element 18 is on the interior, it can also be a laser beam or an induction heating element 18, optionally a suitably powerful plasma

heating element. This is necessary to avoid freezing and the ensuing damage, or to reverse them. The primary excitation device 2.3 can also be connected without controlled opening and closing mechanisms (2.34; 2.36; 2.31 and 4), specifically with a manual control in the form of a bypass.

Patentkrav

1. Hydraulikkanordning for generering av av snø fra vann, hvilken hydraulikkanordning har en lavtrykksinnretning (2) med en pumpeinnretning (2.1), som en rengjøringsinnretning (2.2) og en hoved-eksitasjonsinnretning (2.3) som er fast eller demonterbart forbundet med denne, er koblet til, en høytrykksinnretning (3) bestående av en trykkledning (3.1) som en snøkanon (3.3) og/eller en annen snødannende innretning (3.4) er koblet til, samt en fordeleranordning (2.4) bak hoved-eksitasjonsinnretningen (2.3), hvis minst ene høytrykkspumpe kobler lavtrykksinnretningen (2) fra hovedtrykkinnretningen (3), idet minst en eksitasjonsinnretning (2.35) er anordnet til hoved-eksitasjonsinnretningen (2.3),
snøkanonen (3.3) og/eller den andre snødannende innretningen (3.4) er koblet til trykkledningen (3.1) ved hjelp av trykk-eksitasjonsblokker (3.5) med minst én trykk-eksitasjonsinnretning (3.51, 3.511, 3.512), idet den minst ene trykk-eksitasjonsinnretningen (3.51, 3.511, 3.512) og eksitasjonsinnretningen (2.35) i hvert tilfelle har et felles kammer (2.42, 3.42), som har en styreelektrode (2.43, 3.43) som er forbundet med en høyeffektkilde (8) og anordnet i nærheten av en inngangsåpning, med et hylster (2.431, 3.41), som har form av et reagensglass eller et rør av silikat eller keramikk og er anordnet i den ene stang- og/eller spiralantennen (2.432, 3.432), som er fast eller demonterbart forbundet med høyeffektkilden (8), som er koblet til en strømforsyning (81) og har en polariseringselektrode (2.44, 3.44) som er anordnet i et hylster i nærheten av utgangsåpningen og er lignende oppbygget og har et fast, flytende eller gassformet polariseringsmateriale (2.441, 3.441) innvendig, idet høyeffektkilden (8) fører et elektromagnetisk vekselsignal på 100–500 MHz med en styrke på 0,1–2,0 W inn i styreelektroden (2.43, 3.43), når trykk-eksitasjonsinnretningen (3.51, 3.511, 3.512) eller eksitasjonsinnretningen (2.35) befinner seg i vann, idet hoved-eksitasjonsinnretningen (2.3) har en inngangs- og utgangs-hydraulikkgren med en hovedåpnings- og lukkemekanisme (2.34) og en andre styrt åpnings- og lukkemekanisme (2.31), som munner ut i en fordelingsgren, som befinner seg foran hovedåpnings- og lukkemekanismen (2.34), med minst et temperaturmåleinstrument (2.32) og/eller et trykkmåleinstrument (2.33), og idet minst eksitasjonsinnretningen (2.35) er fast og/eller demonterbart festet og munner ut i den andre styrte åpnings- og lukkemekanismen (2.31) og en tredje styrt åpnings- og lukkemekanisme (2.36).

2. Anordning ifølge krav 1,
karakterisert ved at styreelektrodens (2.43, 3.43) hylster (2.431, 3.41) og polariseringselektrodens (2.44, 3.44) hylster av glass har en overveiende andel av SiO_2, som har en strekkstyrke på 30 MPa og en tetthet på 2,53 $g.cm^{-3}$.

3. Anordning ifølge krav 1,
karakterisert ved at styreelektrodens (2.43, 3.43) hylster (2.431, 3.41) og polariseringselektrodens (2.44, 3.44) hylster består av oksidisk sintret keramikk med et Al_2O_3-innhold på minst 99,7 %, som har en strekk-elastisitetsmodul på 380–400 GPa, en bøyefasthet på 300 MPa og en tetthet på 3,8 $g.cm^{-3}$.

4. Anordning ifølge krav 1,
karakterisert ved at styreelektrodens (2.43, 3.43) hylster (2.431, 3.41) og polariseringselektrodens (2.44, 3.44) hylster består av keramisk kompositt C/SiC, som har en tetthet på 2,65 $g.cm^{-3}$, en elastisitetsmodul på 250–350 GPa og en bøyefasthet på minst 160–200 MPa.

5. Anordning ifølge krav 1 til 4,
karakterisert ved at høyeffektkilden (8) har en 230V~-kilde, som er omformet til en spenning på 12 V eller 24 V.

6. Anordning ifølge krav 1 til 5,
karakterisert ved at det på en omkrets eller minst en del av eksitasjonsinnretningens (2.35) kammer (2.42) befinner seg et belegg (2.421) som består av positivt elektrokjemisk materiale (C, Cu) eller av negativt elektrokjemisk materiale (Al, Fe), alt etter vannsammensetningen, at et lagerhus (2.47) for eksitasjonsinnretningen (2.35) består av et ikke-ledende isolasjonsmateriale, f.eks. polypropylen,
at styreelektroden (2.43) og polariseringselektroden (2.44) er lagret i en bærer (2.401) for eksitasjonsinnretningen (2.35) og at styreelektroden (2.43) og polariseringselektroden (2.44) er anordnet i lukkede hylstre (2.431).

7. Anordning ifølge krav 1 til 6,
karakterisert ved at styreelektroden (2.43, 3.43) er en platinaelektrode med et elektrodepotensial på -3,04 V (litium) til +1,52 V (gull).

8. Anordning ifølge krav 1 til 7,
karakterisert ved at at trykk-eksitasjonsinnretningen (3.51, 3.511, 3.512)

befinner seg i et hylser (16) som er utstyrt med en varmeisolering (17) på innsiden eller utsiden.

9. Anordning ifølge krav 1 til 8,
karakterisert ved at trykk-eksitasjonsinnretningen (3.511) og andre trykk-eksitasjonsinnretninger (3.512), som er hydraulisk forbundet med hverandre, er anordnet i felles hylster (16) og **at** hver trykk-eksitasjonsinnretning (3.511, 3.512) har en egen høyeffektkilde (8), som er koblet til en egen eller en felles strømforsyning (81).

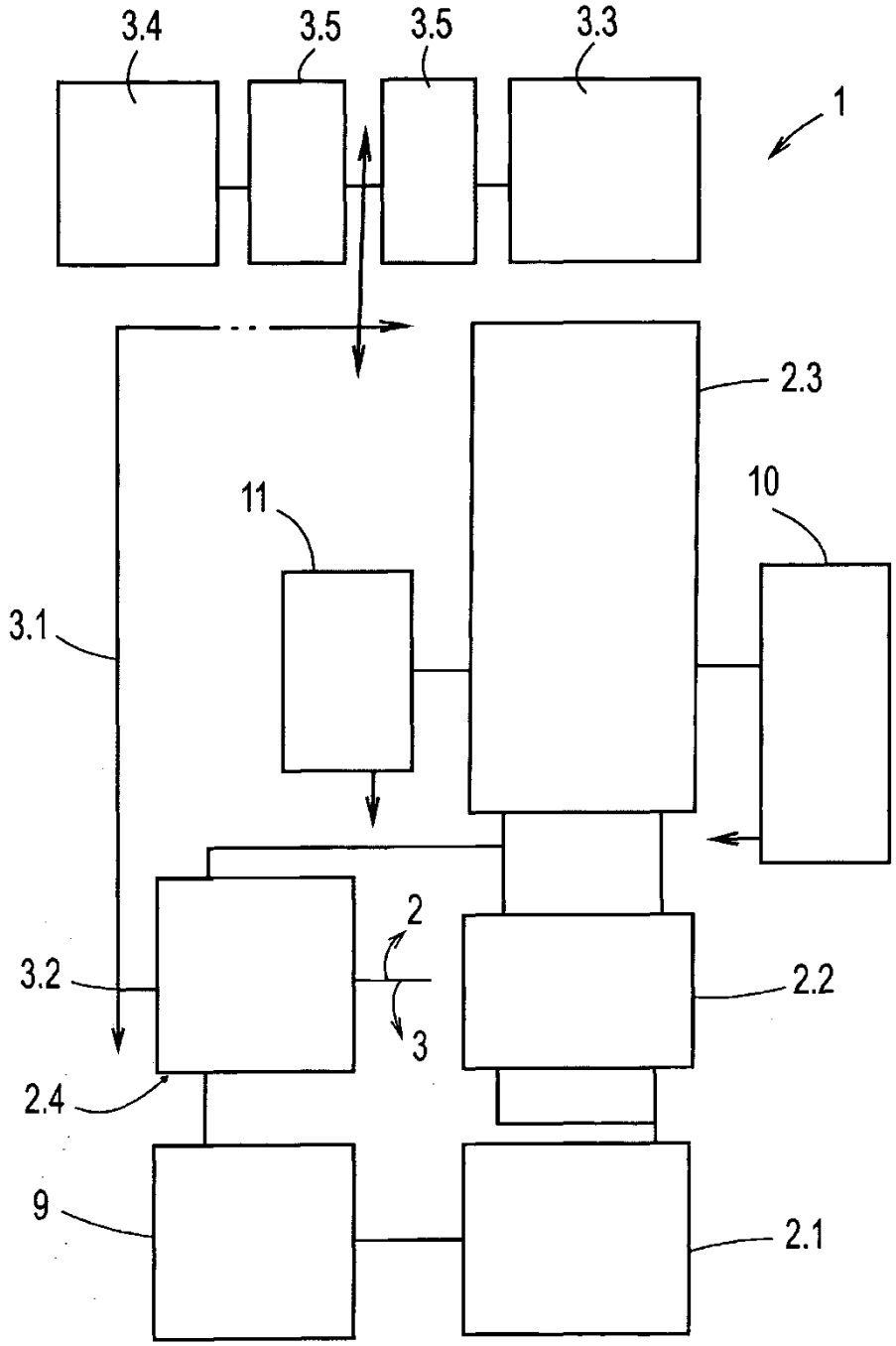

Fig. 1

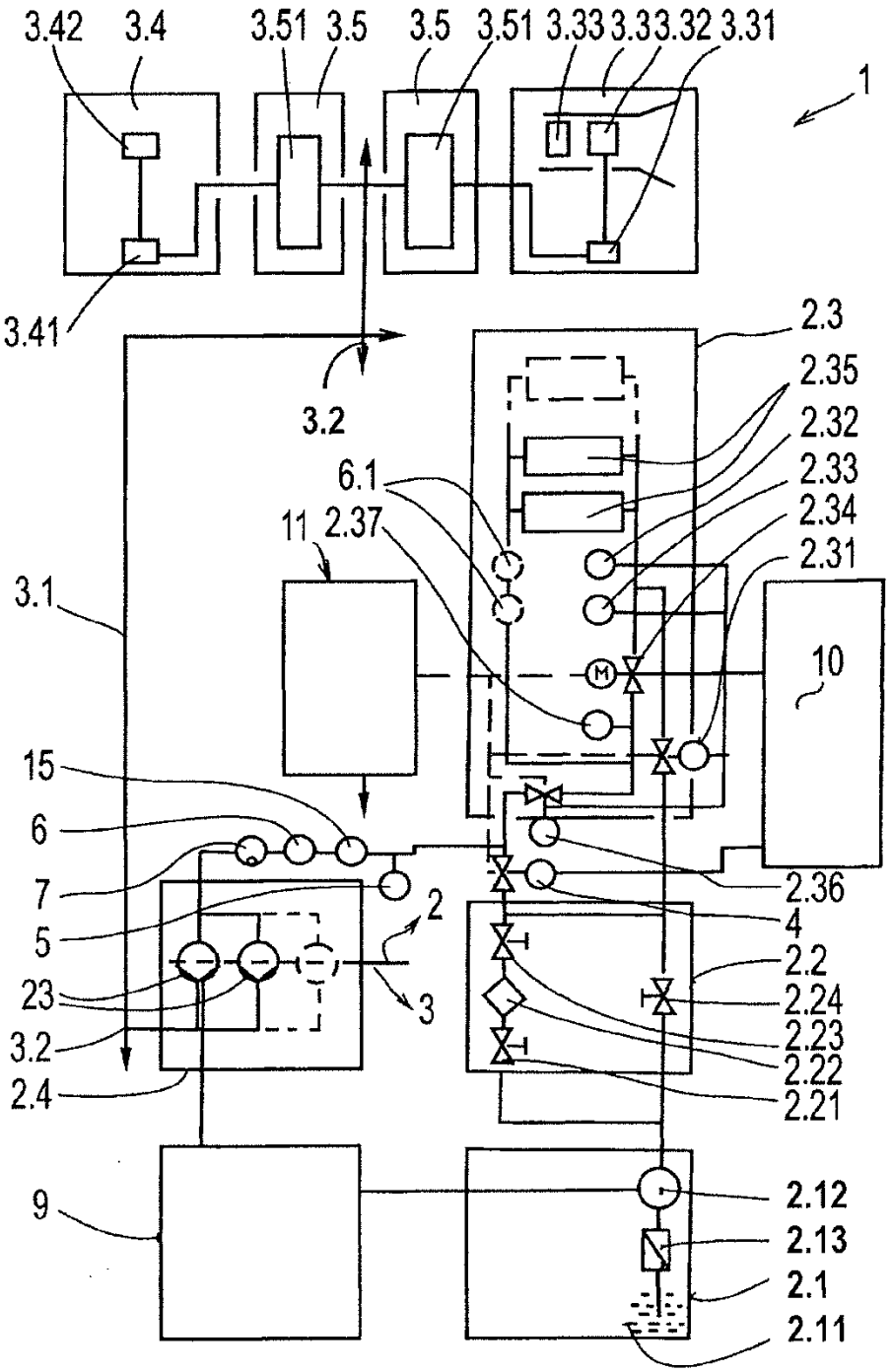
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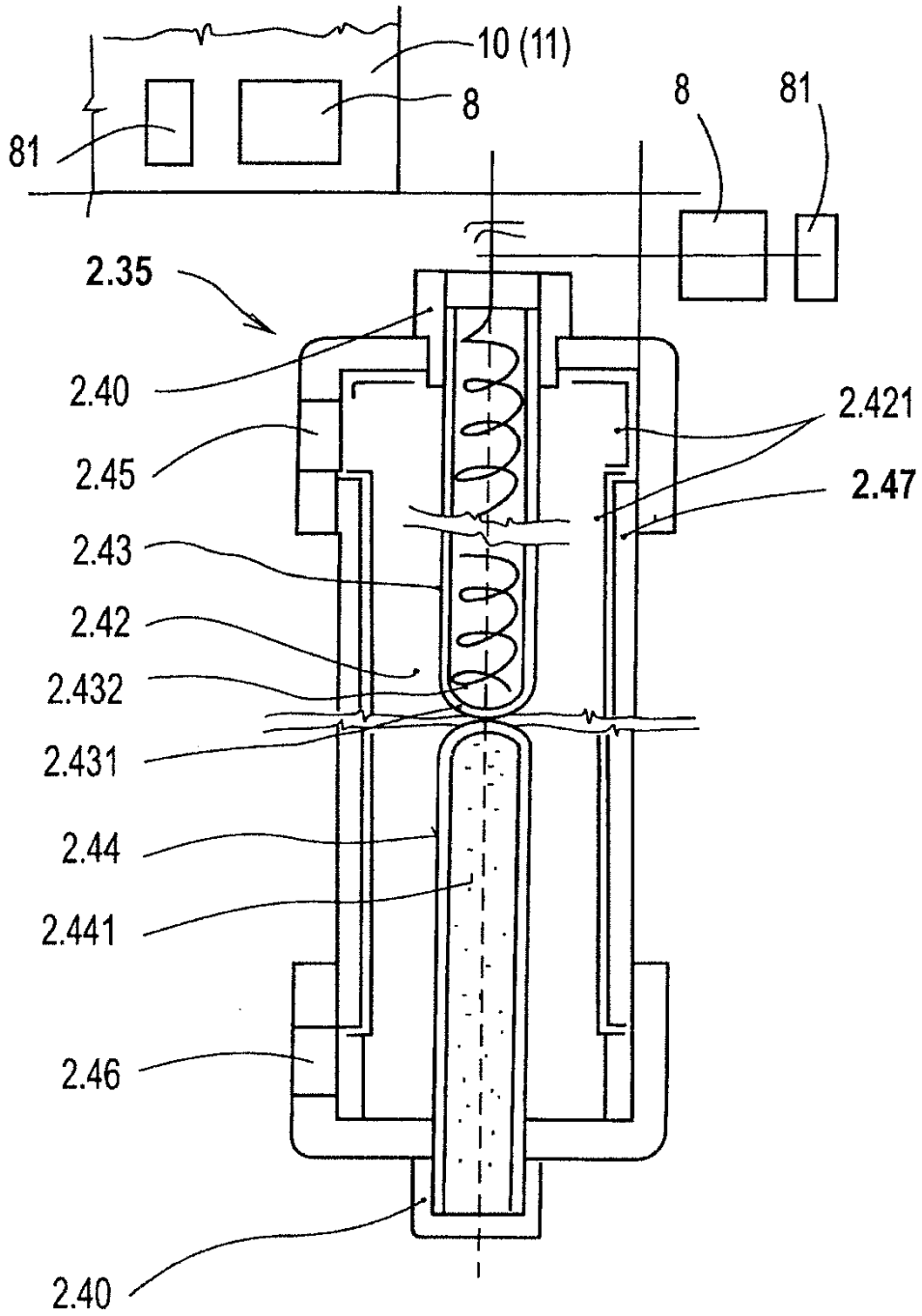
Fig. 2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2.441
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2.40
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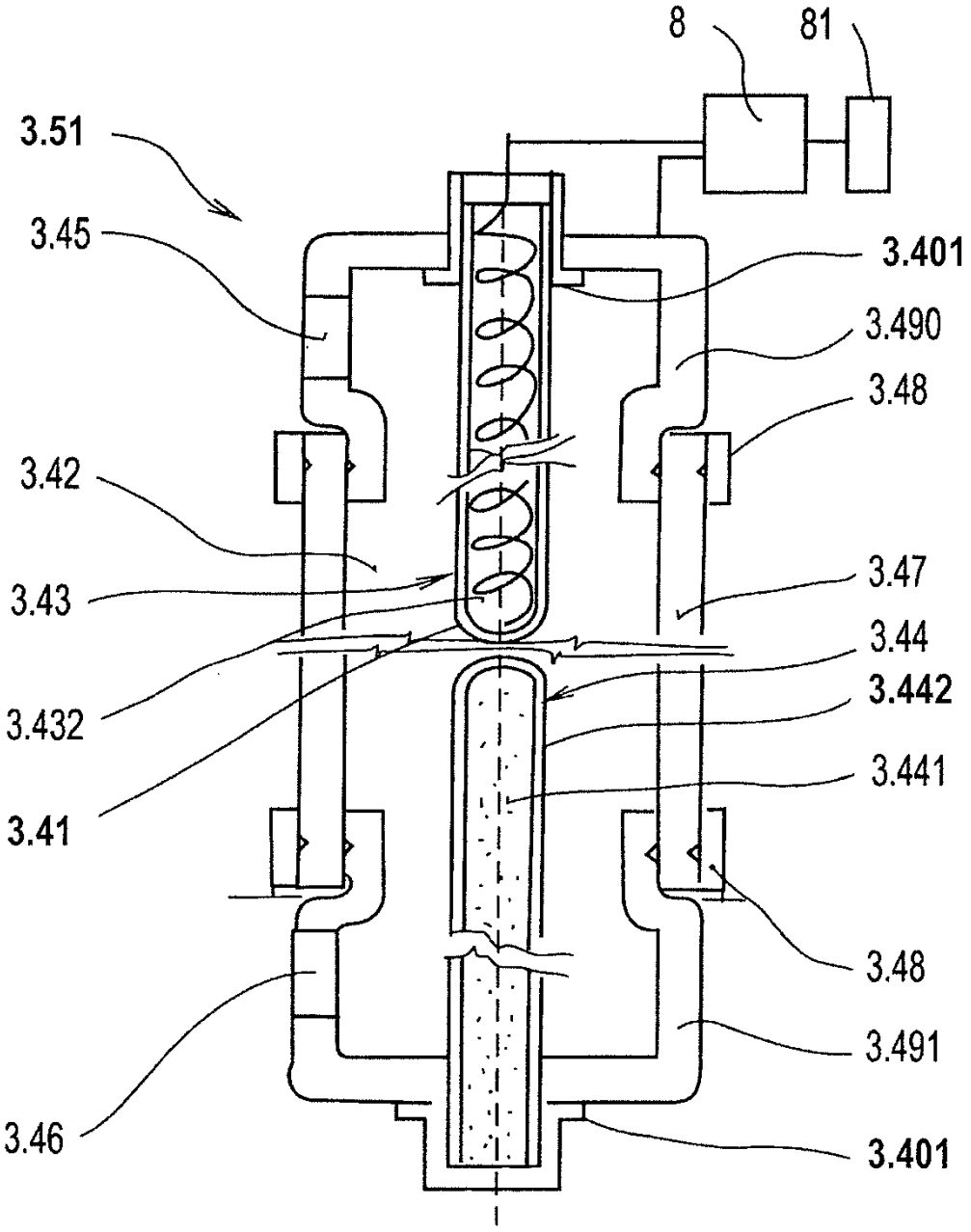
2.47

Fig. 3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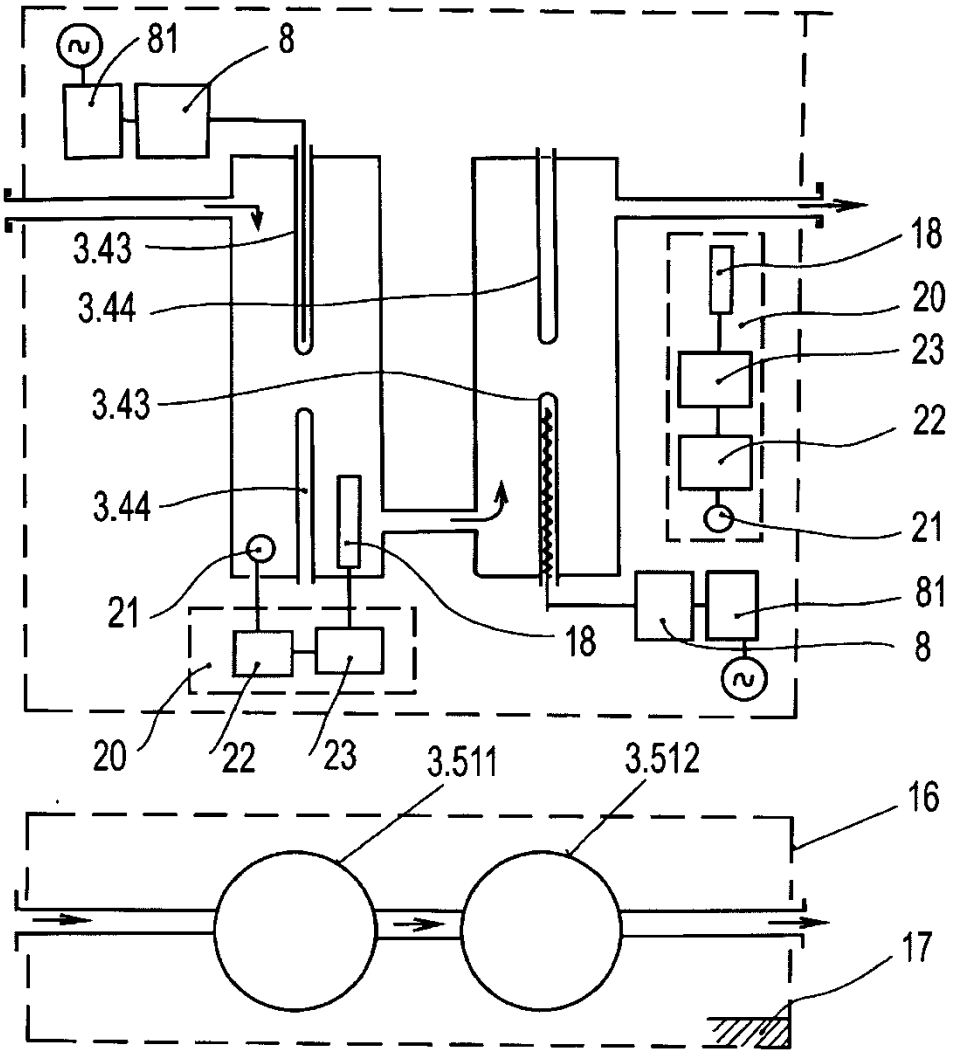
3.45
3.401
3.490
3.48
3.42
3.47
3.43
3.44
3.442
3.432
3.441
3.41
3.48
3.491
3.46
3.401

Fig. 4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8
3.43
3.44
3.43
3.44
21
20
22
23
18
18
20
23
22
21
81
8
3.511
3.512
16
17

Fig. 5

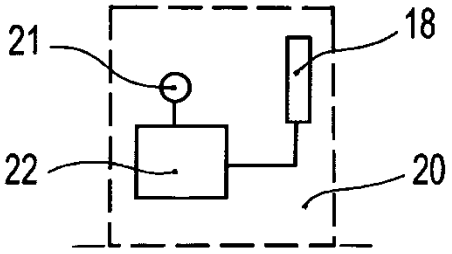

Fig. 6

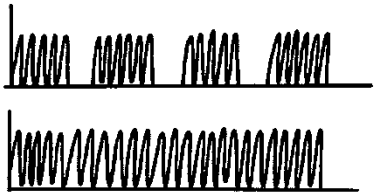

Fig. 7