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(54) FIREFIGHTING WATER SYSTEM FOR CLOSED STRUCTURES HAVING A LENGTHY EXTENSION, IN PARTICULAR ROAD TUNNELS

(57) A firefighting water system (1) for closed structures having a lengthy extension, in particular road tunnels, which comprises:
- a system of pipes (17) which supplies a plurality of water dispensing nozzles (15), the nozzles (15) being configured to dispense the water as a consequence of the detection of a fire in input to an electronic control system (50);
- a pressurization assembly, comprising a series of volumetric pumps (21), each one provided with a respective motor (41) and configured to produce in the water pumped inside the pipes a pressure adapted to generate an atomization;
- an electric filling pump (12) for filling the pipes with water (17);
- shutoff valves (13), which can be activated both electronically and manually and are adapted to cut off the circulation of water in sectors of the pipes (17);
wherein the nozzles (15) are atomizer nozzles which are configured to dispense the water that arrives from the pipes (17), creating micro-droplets with a diameter comprised between 10 μm and 80 μm when the water has a pressure adapted to generate atomization.

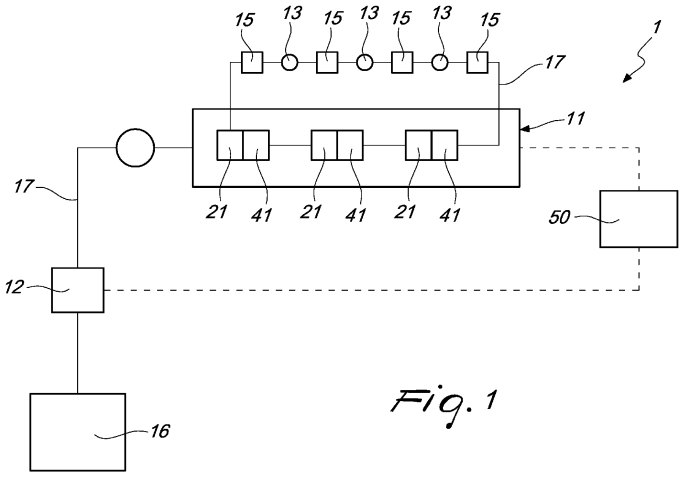

Fig. 1

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Description

[0001] The present invention relates to a firefighting water system for closed structures having a lengthy extension, which is useful in particular for extinguishing and/or mitigating fires in road tunnels.

[0002] In addition to road tunnels, the present invention can also be applied in other structures having a lengthy extension which are normally frequented by people, such as for example exhibition fairgrounds or large industrial installations.

[0003] For road tunnels, national and international regulations require tunnels (in particular those of length exceeding 500 meters) to be equipped with a firefighting water system and/or with a mitigation system (reference is made for example to international regulations UNI 12845, UNI 11292, to the European CEI 64-20 standard and, in Italy, to the ANAS guidelines).

[0004] Usually, the firefighting water system in a tunnel is constituted by a fixed network of hydrants in a closed loop proximate to the inlets, which is kept permanently under pressure and is located in a protected position behind the median barriers. This type of firefighting water system needs to be capable of ensuring uniform flow rates between the different hydrants and in any case flow rates of not less than 120 1/min for DN 45 hydrants and 300 1/min for DN 70 hydrants.

[0005] As an alternative or in addition to this type of system the use is known of systems - known as mitigation systems - of the "deluge" type. The systems of the deluge type that currently can be used in a tunnel can be categorized as:

1) fractionated water systems;
2) atomized water systems;
3) foam systems;
4) systems with automatic monitors distributed along the tunnel.

[0006] A possible low cost firefighting solution in road tunnels is obtained by implementing a deluge fire mitigation system, through a simple modification of the traditional firefighting water system.

[0007] This modification consists of installing offtakes on the water main, in sections of preset length, using valves that feed dispenser nozzles positioned on a secondary network.

[0008] The length and the positioning of the secondary networks, with corresponding nozzles, is determined so that the jet generated by the nozzles ensures the design flow rate and the uniformity of distribution of the extinguishing agent.

[0009] Activation of the system is automatic, by means of interaction with the linear system for temperature detection via sensors, which precisely identifies the location of the fire inside the tunnel.

[0010] These systems, although useful and practical, have some aspects that show room for improvement, which include the efficacy of extinguishing and mitigation and the simplicity of installation and possibility of adaptation to pre-existing structures.

[0011] Other aspects that can be improved are water consumption, simplicity of operation, and the installation and running costs.

[0012] The aim of the present invention consists in providing a firefighting water system for closed structures having a lengthy extension that is capable of solving the above mentioned problems and overcoming the above mentioned limitations of the background art.

[0013] Within this aim, an object of the present invention is to provide a firefighting water system for closed structures having a lengthy extension that has an improved extinguishing and/or mitigation efficacy.

[0014] Another object of the invention consists in providing a firefighting water system for closed structures having a lengthy extension that is simple to install and easily adaptable to pre-existing structures.

[0015] Another object of the invention consists in providing a firefighting water system for closed structures having a lengthy extension that offers great simplicity of operation.

[0016] Another object of the invention is to provide a firefighting water system for closed structures having a lengthy extension that is easy to implement and maintain and at low cost when compared to the known art.

[0017] This aim and these and other objects which will become better apparent hereinafter are achieved by a firefighting water system according to claim 1.

[0018] Further characteristics and advantages of the invention will become better apparent from the detailed description of a preferred, but not exclusive, embodiment of some embodiments, which are illustrated by way of non-limiting example with the aid of the accompanying drawings wherein:

Figure 1 is a block diagram of the structure of a firefighting water system according to the invention;
Figure 2 is a hydraulic diagram of a possible embodiment of the firefighting water system according to the invention;
Figure 3 is a detail of part of a possible embodiment of the firefighting water system according to the invention.

[0019] It should be noted that in Figures 2 and 3, the symbols used have the conventional meaning, known to the person skilled in the art, that is assumed by those symbols in plumbing diagrams.

[0020] With reference to the figures, the firefighting water system, generally designated by the reference numeral 1, is adapted to be installed in closed structures having a lengthy extension, in particular road tunnels (but also exhibition fairgrounds or large industrial structures).

[0021] In general the term "closed structures having a lengthy extension" is used to mean any civil or industrial architectural work that extends in at least one direction

for in the order of 100 meters or longer.

[0022] According to the invention, the system 1 comprises a system of pipes 17 which supplies a plurality of water dispensing nozzles 15, the nozzles 15 being configured to dispense the water as a consequence of the detection of a fire in input to an electronic control system 50.

[0023] The electronic control system 50 comprises adapted sensors (for detecting smoke and/or temperature or other sensors known to the person skilled in the art for detecting the outbreak of fires) and the electronics for controlling valves and motors which will be described below. Furthermore the electronic control system 50 preferably comprises a monitoring interface for controlling the operating parameters of the system which are detected via adapted detectors (for example gauges).

[0024] In the preferred embodiments which are described below, the electronic control system comprises a PLC (Programmable Logic Controller).

[0025] The system 1 also comprises a pressurization assembly 11 which comprises in turn a series of volumetric pumps 21, each one equipped with a respective motor 41. These pumps 21 are configured to produce, in the water pumped inside the pipes, a pressure adapted to generate nebulization, for example of at least 20 bar.

[0026] Preferably, such volumetric pumps 21 are piston pumps with axial pistons.

[0027] In the preferred embodiments, each one of the volumetric pumps 21 of the pressurization assembly 11 is fixed on a respective supporting tank which is configured to support that pump 21 and to contain water for supplying that pump 21.

[0028] The system 1 also comprises an electric filling pump 12, preferably of the centrifugal type, for filling the pipes 17 with water.

[0029] In the system there are also shutoff valves 13, which can be activated both electronically and manually and are adapted to cut off the circulation of water in sectors of the pipes 17.

[0030] Preferably, the system 1 comprises an accumulation cistern 16 which acts as a water tank.

[0031] Optionally, the accumulation cistern 16 comprises an internal heater provided with a thermostat and configured to heat the water so as to prevent the freezing thereof.

[0032] According to the invention, the above mentioned nozzles 15 are atomizer nozzles which are configured to dispense the water that arrives from the pipes 17, creating micro-droplets with a diameter comprised between 10 μm and 80 μm when the water has a pressure adapted to generate atomization, for example at least 20 bar.

[0033] By virtue of this peculiarity, the system 1 according to the invention provides a high pressure atomized water system that uses, substantially, a combination of effects: cooling, inertization of the oxygen present, and blocking the transmission of radiant heat.

[0034] The micro-droplets that are created by the nozzles 15 enable a rapid evaporation of the water, thus making it available in its most effective form for firefighting. The high pressure of the system, higher for example than 20 bar, enables the atomized water to penetrate into the fire where the change of state from fluid to gas takes place via evaporation of the water.

[0035] In this step it can be considered that one liter of water absorbs, in the fluid-to-gas change of state, approximately 500 Kcal, considering that 1 kW corresponds to 860 Kcal/h and the flow of water of one nozzle is approximately 33 lt/min (1,980 lt/h) and therefore it can be seen that, theoretically, assuming the complete evaporation of the water and that all the water is dispensed directly onto the fire, a single nozzle could be capable of fighting a fire of magnitude in the order of 1.5 MW.

[0036] During this step the system acts on the fire triangle (i.e. on the three factors that feed the fire: oxygen, heat, fuel), by reducing the percentage of oxygen present and the heat of the fire itself. Another advantage of the system consists of its capacity to block the radiant heat by creating a "water barrier" that impedes both the propagation of the fire and the dispersion of the smoke.

[0037] The system entails the use of dispenser nozzles 15 that are capable of high efficiency and excellent performance. These nozzles are designed to operate at high pressure, creating micro-droplets of water (10μm-80μm), making their distribution inside the tunnel to be protected more effective.

[0038] The substantial difference between a high pressure system and a traditional "sprinkler" system consists of the size of the water particles which, in traditional sprinklers, are in the form of droplets of large dimensions, therefore requiring a high consumption of water, which further translates to a high volume of water to be disposed of after activation of the system.

[0039] With respect to a traditional system, the average size of the droplets is very small, the amount of droplets produced is much higher (approximately 800 times higher) and the overall heat exchange surface, for the same quantity of water dispensed, is therefore much greater (approximately 400 times greater than a traditional sprinkler nozzle).

[0040] Preferably, the system of pipes 17 is subdivided into autonomous sectors, each one of which comprises at least two dispensing nozzles 15 and two shutoff valves 12, the nozzles 15 and the shutoff valves 12 of each sector being activateable by the electronic control system 50 independently of the other sectors, so as to allow the dispensing of water selectively only in a region of the structure (for example of the tunnel) where a fire is detected.

[0041] In the preferred embodiments, the system is provided by joining together modular elements, of length equal to 6 m, forming hydraulically autonomous sectors of approximately 75 m.

[0042] Each element is basically constituted by a stainless steel pipe 17 and fixing supports, also made of steel.

[0043] The main characteristic of these embodiments

is, in addition to the extremely low energy consumption, the ease of mounting which renders the installation of the system 1 rapid and independent of the progress in construction of the civil works.

[0044] With reference now to a first particularly advantageous embodiment, shown in Figure 3, the system 1 comprises:

- a pressurization assembly 11 composed of service pumps of the volumetric type 21 with axial pistons, made of AISI316 stainless steel, self-lubricating, with a constant flow rate independent of the delivery pressure, mounted on a footing of metallic profiles and coupled, via a flexible joint with spacer and provided with accident-prevention shelter;
- a piston-driven volumetric electric pilot pump 30 with the main body made of brass and oil-lubricated, with a reduced flow rate, designed to maintain a pilot pressure comprised between 15 and 25 bar (preferably equal to 20 bar) on the delivery line of the fire-fighting network, compensating for any losses, equipped with an on-off valve and a control pressure switch and assembled with the necessary flexible tubes for connection to the main pumping assembly.

[0045] Also in this embodiment, each pump 21/electric motor 41 pair is assembled on a special footing which acts as a tank made of stainless steel and which has the twofold purpose of providing support for those pumps 21 and of being the water buffer tank for those pumps 21, with a volume of approximately 220 lt.

[0046] Each pump 21/electric motor 41 pair is provided with:

- pipes in AISI 316 stainless steel for plumbing connections to the pressurization assembly;
- a control panel inside which is the PLC for managing the sensors present on the pumping unit, for acting as an interface with the fire detection system and for interfacing with the monitoring system by way of transmission via Ethernet or by way of clean contacts;
- control instrumentation;
- two bag filters (main and reserve) which have a degree of filtration managed autonomously by the control panel by way of two solenoid valves;
- two recirculation circuit diaphragm kits for cooling the service pumps during zero flow rate operation;
- a pump intake kit made of stainless steel.

[0047] In an alternative embodiment, the pressurization assembly 11 of the system 1 comprises:

- a pressurization assembly composed of service pumps 21 of the volumetric type with axial pistons, made of brass, lubricated with oil baths, mounted on an uncoupled frame by way of vibration-damping joints;
- a control panel inside which the PLC for managing the sensors present on the pumping unit is provided, for acting as an interface with the fire detection system and for interfacing with the monitoring system by way of transmission via Ethernet or by way of clean contacts;
- control instrumentation;
- two Y-filters with a degree of filtration compatible with the specifications of the piston pumps 21, which are installed on the main supply line.

[0048] Below we refer in more detail to the preferred, but non-limiting, characteristics of the individual elements present in the system 1, irrespective of the embodiment.

[0049] Preferably, the electric filling pump 12 is of the vertical centrifugal type with intake and delivery in line with EN1092-2 flange couplings. The operating temperature of the pump is in the range -20°C ÷ +140°C.

[0050] The input and output water pipes on the electric filling pump 12 are made of stainless steel and optionally are protected with special insulating or hollow material that is heated in order to keep the water inside the line from freezing.

[0051] Preferably, the shutoff valves are activated electrically by way of a solenoid coil powered with a power supply voltage equal to 24 V CC.

[0052] Optionally, each shutoff valve 13 is provided with a gauge positioned on the body of the valve itself, the purpose of which is to give a visual indication of the operation of the system.

[0053] The valve 13 can be activated manually if its operation is required under emergency conditions. Alternatively, the shutoff valve is activated electrically via a rotary actuator with a 90° travel, powered by 230VAC, complete with stroke limiter in order to monitor the "completely open" and "completely closed" state. The valve can be activated manually in the event of emergency if its operation is required under emergency conditions.

[0054] The shutoff valves 13 are managed by the electronic control system 50 which controls the opening, closing and state thereof.

[0055] The system 1 conveniently also comprises one or more system on-off valves.

[0056] Such on-off valves are preferably manually-operated quarter-turn ball valves suitable for use with potable water in the temperature range comprised between -30°C and 100°C.

[0057] These valves are preferably made of AISI316 stainless steel with an operating pressure of 250 bar.

[0058] Preferably, the dispensing nozzles 15 are made of AISI304 stainless steel with bronze components provided with an internal filter for protection against any impurities present in the feeder line.

[0059] Optionally each nozzle 15 is provided with a cap made of plastic or silicone rubber with a retention cord, for protecting the component against the particulate present in the tunnel.

[0060] Preferably, the accumulation cistern 16 is cylindrical in conformance with the UNI EN 12845/09 standard and UNI 11292.

[0061] The useful capacity of the accumulation cistern is at least 7.5 cubic meters.

[0062] Optionally the accumulation cistern 16 is provided with one or more of the following apparatuses:

- level transmitter for indicating low water level to the PLC of the pumping assembly;
- internal heater provided with integrated thermostat, the purpose of which is to keep the water inside the tank from freezing.

[0063] Preferably, the pipes 17 are made of AISI316 stainless steel with a nominal DN80/DN40 diameter in accordance with the EN10217-7:2014 standard, with manufacturing tolerances in accordance with the EN ISO 1127 D4/T3 standard, which are adapted for use under a nominal operating pressure of 100 bar.

[0064] Supports for the pipes of the firefighting plumbing system 1 will be made of steel, conveniently shaped.

[0065] The system of pipes 17 also comprises: vibration-damping joints adapted to absorb vibrations, oscillations, shifts, usable for cold water, hot water, superheated water and steam up to 300°C, PN120, constituted by steel bellows, flanged couplings complete with complementary flanges, bolts and gaskets.

[0066] Conveniently, the system 1 also comprises a fire alarm system that comprises preferably an incorporated optical/acoustic/flash alarm panel, a siren with acoustic pressure of 110dB at 1m, self-powered, complete with internal backup battery and installation accessories.

[0067] Below is a detailed description of an example of application of a possible embodiment of the system 1 in a road tunnel, from which the operation will also be clear.

[0068] Activation is automatic and independent of each zone, in such a manner that, wherever a fire breaks out, only the zone closest to the fire is opened, thus creating a thermal shielding, in this manner the spraying of water occurs effectively only in the zone affected by the event and not in all the rest of the tunnel.

[0069] Sections of secondary piping 17, complete with distributors, manifolds and multi-nozzle dispensers 15 are branched off from the distribution network of the main firefighting water system, through the use of solenoid valves located at the emergency stations. The dimensions of the components and their height positioning and their horizontal position depend on the geometric characteristics of the tunnel.

[0070] In considering the protection of the tunnel, it has been considered to divide the tunnel into sections of length equal to 75 mt in which to activate the system. In other embodiments the sections can be of different length according to requirements.

[0071] Activation of the system is performed via the alert received by the electronic control system 50 via the fire detection system.

[0072] Each section of tunnel has an overlapping of the zones via the use of two dispenser nozzles 15, as shown in Figure 3, so as to enable the total protection of the tunnel.

[0073] Each section of tunnel is provided with two electric shutoff valves 13 the purpose of which is to leave the last part of the pipe 17 up until the open dispensing nozzles 15 without water.

[0074] In order to prevent any damage by pollutant agents of the components of the shutoff valves 13, these are installed inside boxes made of AISI316 stainless steel provided with a cover and having an IP55 IK10 protection rating.

[0075] Also inside each box are the manual ball valves for shutting off the lines in the event of maintenance of the fire mitigation system in the protected portion of tunnel.

[0076] The type and number to install in each individual portion are determined so that the jets generated by them ensure the design delivery and the distribution thereof with an opening angle such as to create the optimal conditions for mitigating/extinguishing the fire.

[0077] The system 1 can be integrated in a pre-existing firefighting water system without modifying the architecture thereof and the characteristics of the original intended use.

[0078] In order to combat the problems associated with pollutant agents and dust, each nozzle is protected with a silicone covering which is tied to the base of that nozzle. When pressure is applied, the protective cap is automatically expelled by the pressure of the water, but still remains located proximate to the dispenser.

[0079] Activation of the system occurs automatically via the system algorithm implemented in the electronic control system 50, which as a function of the fire scenario (fire load, location inside the tunnel, spacing of pedestrian bypasses, geometry etc.) and the detection systems present (sensor cable, CO sensors, video cameras etc.), identifies with precision the location of the fire inside the tunnel, activating the following procedure:

1) send alarm to the control center;
2) switch on safety lighting (illuminated guide);
3) shut down the fans located in the vicinity of the fire;
4) adjust the other jet fans to the critical speed;
5) activate the mitigation system, i.e. activation of the nozzles 15, in the zone of the fire by opening the valve 13 that covers the zone affected by the fire;
6) collect liquids with draining system.

[0080] In practice it has been found that the firefighting water system according to the present invention achieves the intended aim and objects in that it has an improved extinguishing and/or mitigation efficacy.

[0081] Another advantage of the firefighting water system according to the invention consists in that it is simple

to install and easily adaptable to pre-existing structures.

[0082] Another advantage of the firefighting water system, according to the invention, consists in that it has great simplicity of operation.

[0083] Another advantage of the firefighting water system, according to the invention, consists in that it is easy to implement and maintain and at low cost when compared to the known art.

[0084] The firefighting water system thus conceived is susceptible of numerous modifications and variations all of which are within the scope of the appended claims.

[0085] Moreover, all the details may be substituted by other, technically equivalent elements.

[0086] In practice the materials employed, and the contingent dimensions and shapes, may be any according to requirements and to the state of the art.

[0087] The disclosures in Italian Patent Application No. 102021000010196 from which this application claims priority are incorporated herein by reference.

[0088] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs

Claims

1. A firefighting water system (1) for closed structures having a lengthy extension, in particular road tunnels, which comprises:

   - a system of pipes (17) which supplies a plurality of water dispensing nozzles (15), said nozzles (15) being configured to dispense the water as a consequence of the detection of a fire in input to an electronic control system (50);
   - a pressurization assembly, comprising a series of volumetric pumps (21), each one provided with a respective motor (41) and configured to produce in the water pumped inside the pipes a pressure adapted to generate an atomization;
   - an electric filling pump (12) for filling the pipes with water (17);
   - shutoff valves (13), which can be activated both electronically and manually and are adapted to cut off the circulation of water in sectors of said pipes (17);

   wherein said nozzles (15) are atomizer nozzles which are configured to dispense the water that arrives from said pipes (17), creating microdroplets with a diameter comprised between 10 μm and 80 μm when said water has a pressure adapted to generate atomization.

2. The system (1) according to claim 1, **characterized in that** said volumetric pumps (21) are piston pumps with axial pistons.

3. The system (1) according to claim 1 or 2, **characterized in that** each one of said volumetric pumps (21) of the pressurization assembly is fixed on a respective supporting tank which is configured to support said pump (21) and to contain water for supplying to said pump (21).

4. The system (1) according to one or more of the preceding claims, **characterized in that** it further comprises an accumulation cistern (16).

5. The system (1) according the preceding claim, **characterized in that** said accumulation cistern (16) comprises an internal heater provided with a thermostat and configured to heat the water so as to prevent the freezing thereof.

6. The system (1) according to one or more of the preceding claims, **characterized in that** said electric filling pump is of the centrifugal type.

7. The system (1) according to one or more of the preceding claims, **characterized in that** it comprises an electric pilot pump (30) adapted to maintain a pilot pressure on a pilot delivery line, thus compensating for any losses.

8. The system (1) according to one or more of the preceding claims, **characterized in that** said system of pipes (17) is subdivided into autonomous sectors, each one of which comprises at least two dispensing nozzles (15) and two shutoff valves (12), the nozzles (15) and the shutoff valves (12) of each sector being activatable by the electronic control system (50) independently of the other sectors, so as to allow the dispensing of water selectively only in a region of the structure where a fire is detected.

9. The system (1) according to one or more of the preceding claims, **characterized in that** each nozzle (15) is provided with a protective cap with a retention cord which is configured to be expelled by the pressure of the water when the nozzle (15) is activated.

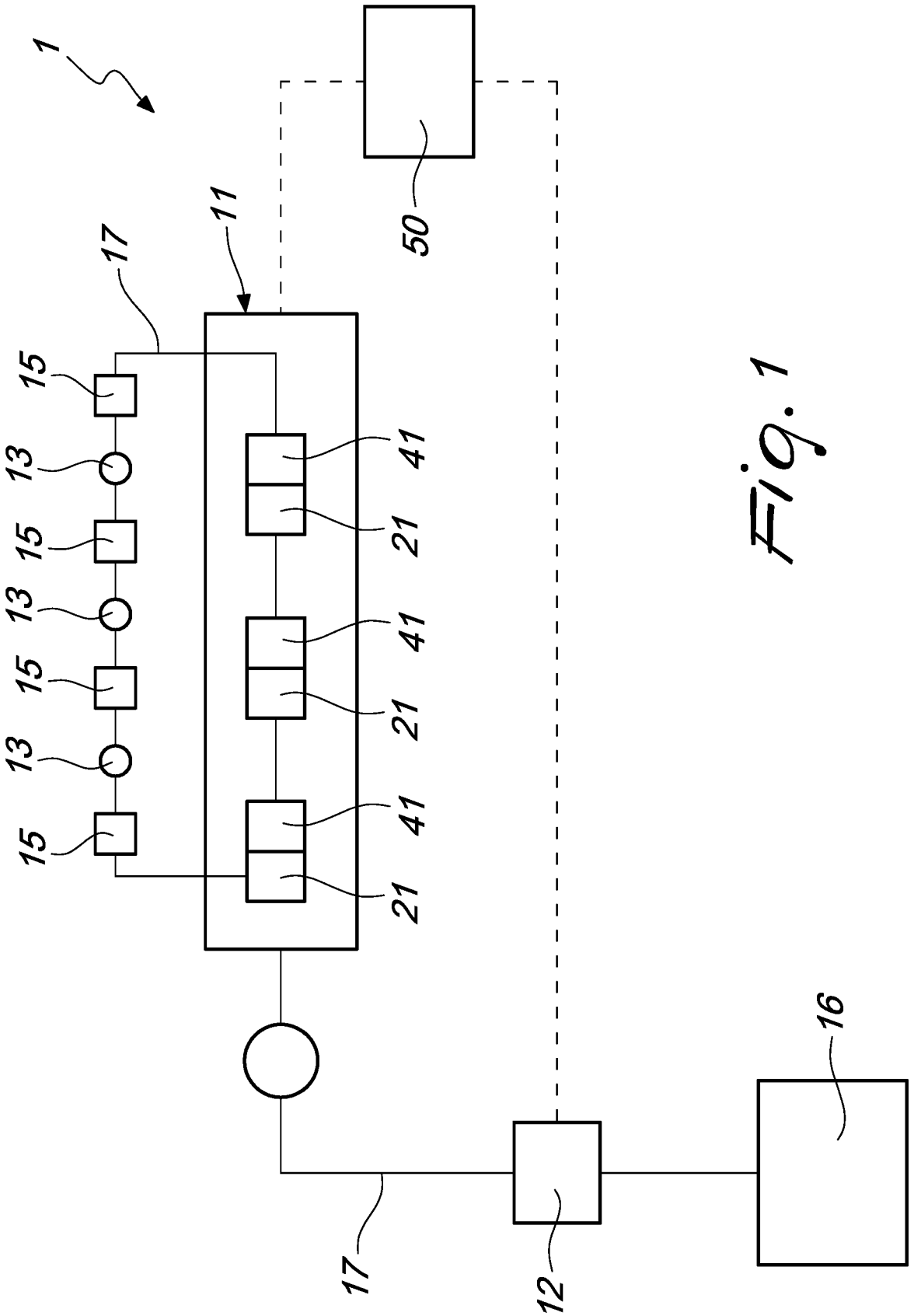

Fig. 1

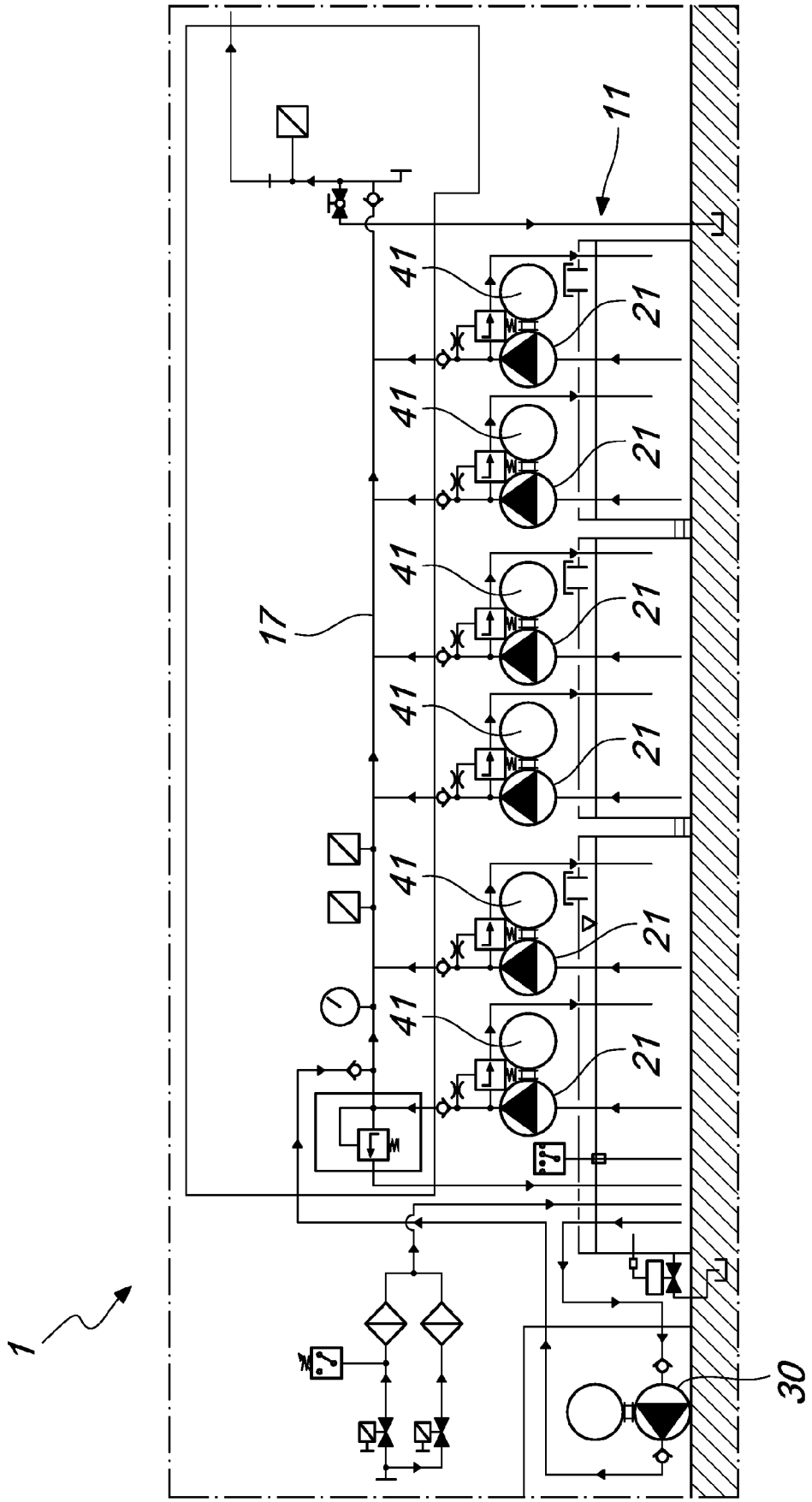

Fig. 2

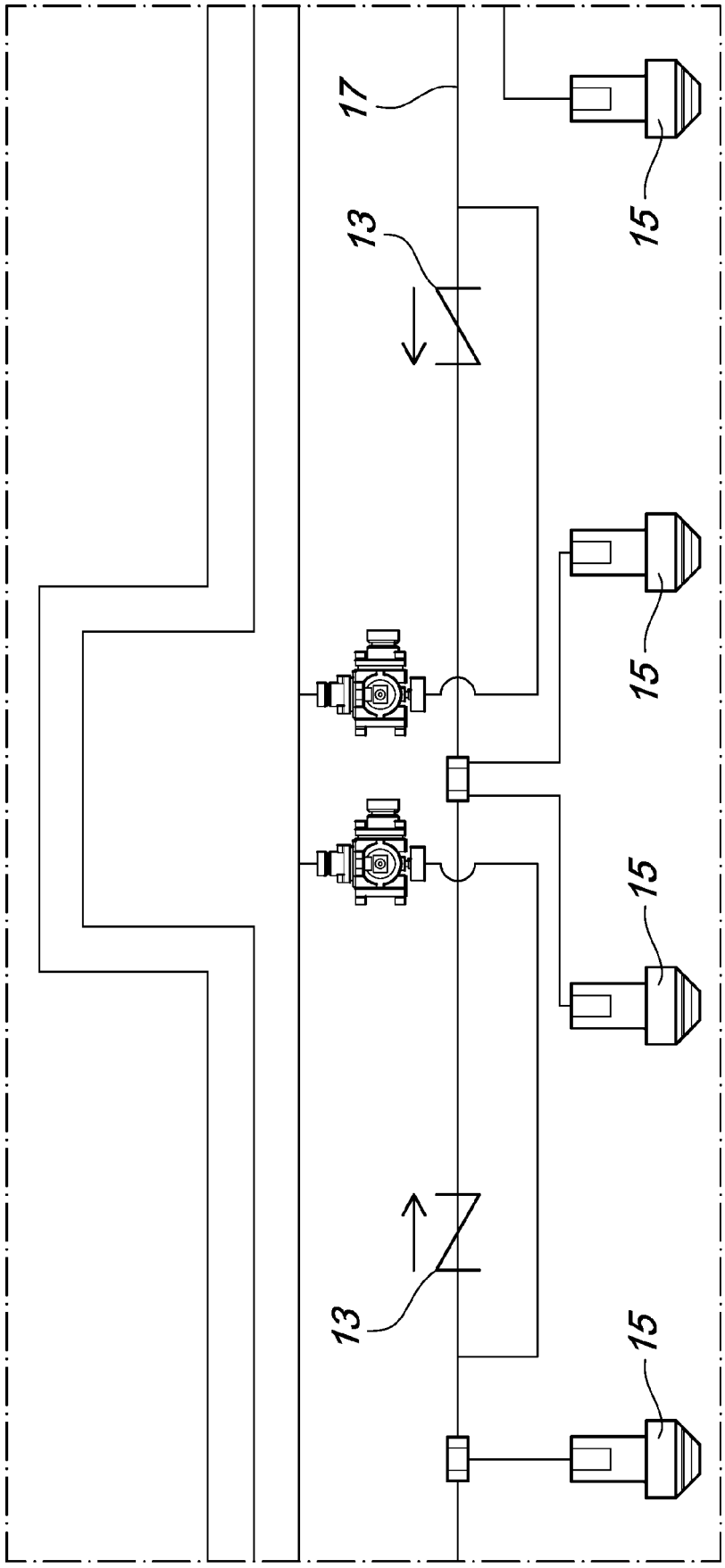

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 22 16 4538

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	CN 202 136 713 U (BEIJING URBAN ENG DESIGN & RES INST CO LTD) 8 February 2012 (2012-02-08) * the whole document * * figures *	1-9	INV. A62C3/02 A62C31/00 A62C35/58 A62C35/64
Y	IT 2018 0000 3789 A1 (MUELLER ANDREA ENRICO LEONARDO [IT]; MUELLER UGO MARIO CARLO [IT]) 20 September 2019 (2019-09-20) * figures * * the whole document *	1-9	
Y	DE 100 37 921 A1 (PLEIGER HANDEL GMBH & CO KG [DE]) 14 February 2002 (2002-02-14) * the whole document * * figures *	1-9	
Y	US 2010/218961 A1 (LADE ROBERT J [GB] ET AL) 2 September 2010 (2010-09-02) * paragraph [0002] *	1-9	
Y	US 8 291 990 B1 (MOHR JOHN A [US]) 23 October 2012 (2012-10-23) * column 1, line 17 - line 18 * * column 5, line 25 - line 38 *	1-9	TECHNICAL FIELDS SEARCHED (IPC) A62C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 August 2022	Almeida, Mariana

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 16 4538

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
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23-08-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 202136713 U	08-02-2012	NONE	
IT 201800003789 A1	20-09-2019	----------	
DE 10037921 A1	14-02-2002	NONE	
US 2010218961 A1	02-09-2010	CN 101939060 A	05-01-2011
		EP 2205327 A1	14-07-2010
		ES 2394737 T3	05-02-2013
		US 2010218961 A1	02-09-2010
		WO 2009056780 A1	07-05-2009
US 8291990 B1	23-10-2012	NONE	

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- IT 102021000010196 **[0087]**