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(54) **SYSTEM EQUIPPED WITH VARIABLE-PRESSURE AND LOW- FLOW-RATE PUMPING UNIT, IN PARTICULAR FOR CLEANING**

SYSTEM MIT VARIABLEM DRUCK UND NIEDRIGDURCHFLUSS-PUMPEINHEIT, INSBESONDERE ZUM REINIGEN

SYSTÈME ÉQUIPÉ D'UNE UNITÉ DE POMPAGE À PRESSION VARIABLE ET À FAIBLE DÉBIT, EN PARTICULIER POUR LE NETTOYAGE

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• **KUSCHLAN, Alberto**
I-10121 Torino (IT)

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(74) Representative: **Garavelli, Paolo**
A.BRE.MAR. S.R.L.
Consulenza in Proprietà Industriale
Via Servais 27
10146 Torino (IT)

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(73) Proprietor: **Nuove Tecnologie Applicate S.R.L.**
10121 Torino (IT)

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(72) Inventors:
• **LAMESTA, Gerardo**
I-10121 Torino (IT)

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Description

[0001] The present invention refers to a system equipped with variable-pressure and low-flow-rate pumping unit. Herein below the invention will be described with reference to a system for cleaning, but it will be able to be used, in an equally efficient way, in similar, but also different, fields, such as industrial cleaning, materials-removing activities, de-painting, etc., as described below.

[0002] Various cleaning systems are known in the art, that use variable-pressure water, for example for washing pipes, reactors, floors, machinery, painting plants, tanks and the like. The pumping units and variable-pressure systems available on the market have the purpose of exploiting the whole power provided by the variable-pressure pump, in terms both of pressure and of flow-rate. Moreover, the variable-pressure water allows not using acids or solvents for cleaning, with consequent environmental and economic benefits.

[0003] These systems however are not satisfactory and have, among other things, the problem of having to use not very high operating pressures, included between 80 and 200 bar, and high water flow-rates, included between 30 and 90 litres/minute: such conditions are serious difficulties for an operator responsible for cleaning, forced to operate with violent jets and scarcely controlled splashes of variable-pressure water.

[0004] High-pressure systems are further known, which however require exploiting the whole power supplied by the high-pressure pump, in terms both of pressure and of flow-rate.

[0005] The document DE 297 16 906 U1 is considered as being the closest prior art and discloses the features of the preamble of claim 1.

[0006] Therefore, object of the present invention is solving the above prior art problems, by providing a system equipped with variable-pressure and low-flow-rate pumping unit, that allows obtaining the following improvements:

- using the minimum water flow-rate necessary for performing industrial cleaning, materials-removing activities, paint stripping, etc. (2-4 l/min) in order to reduce to a minimum both the energetic environmental impact and the generation of wastes (water contaminated due to its use);
- using a variable pressure range, in order to make the pumping unit flexible regarding its characteristics of use (5 to 500 bar);
- be adapted to be easily transported on a van or similar small means of transport that can be easily handled;
- be able to be easily moved on the working site by using fixed or castor wheels;
- be able to be easily employed on the working site, namely not needing many connections for its operations.

[0007] The above and other objects and advantages of the invention, as will appear from the following description, are obtained with a system equipped with variable-pressure and low-flow-rate pumping unit as described in claim 1. Preferred embodiments and non-trivial variations of the present invention are the subject matter of the dependent claims.

[0008] It is intended that the claims are an integral part of the present specification.

[0009] The present invention will be better described by some preferred embodiments thereof, provided as a non-limiting example, with reference to the enclosed drawings, in which the only Figure 1 is a schematic block diagram of a preferred embodiment of the system equipped with pumping unit of the present invention.

[0010] With reference to Figure 1, a preferred embodiment of the system of the present invention is shown and described. It will be immediately obvious that numerous variations and modifications (for example related to shape, sizes, arrangements and parts with equivalent functionality) can be made to what is described, without departing from the scope of the invention as appears from the enclosed claims.

[0011] Therefore, in order to build the inventive system and to reach the above-stated objects, a series of components already available on the market have been assembled, in order to optimise performance, overall sizes, and energy and hydraulic connections.

[0012] Differently from known systems with variable-pressure pumping unit, purpose of the system according to the present invention is providing minimum performance for carrying out its working (industrial cleaning, materials-removing activities, paint stripping, etc.) in order to use the lowest amount of water possible; this is the innovation introduced by this pumping unit, that has been devised and designed in order to optimise this object.

[0013] The inventive system therefore comprises:

- at least one high-pressure pumping unit (pump) 1 adapted to pump at a high output pressure water or other similar fluids;
- at least one electric motor 3 connected to the high-pressure pump 1;
- at least one device 5 for regulating the revolutions of the pump 1 (in particular an inverter), connected to the motor 3 for its control;
- at least one nozzle 15, of a special type for low flow-rate, equipped with at least one rotary head rotated by at least one pneumatic motor; and
- at least one air compressor 7 designed to provide the supply compressed air for such pneumatic motor.

[0014] As possible variations and alternatives, the pumping unit of the invention can further comprise at least one system 9 for filtering water, connected to at least one tank 11 for water, in turn connected to at least one electro-pump booster 13, connected to the high-pressure pump 1; and

[0015] The high-pressure pump 1 is connected to the electric motor 3 through a coupling system that transmits motion.

[0016] The electric motor 3 is driven through an electric panel (not shown) that includes the inverter 5 in order to be able to change the revolutions of the high-pressure pump 1 and therefore its flow-rate; the revolutions of the motor 3 are regulated by the operator depending on the pressure value to be adopted and the consumption of water to be obtained.

[0017] The supply water to the high-pressure pump 1 is made pass through a filtering system 9 and then it is stored into the accumulating tank 11; the electro-pump booster 13 allows sending water at the inlet of the high-pressure pump 1.

[0018] The high-pressure pump 1 is further equipped with a control valve (not shown) that can be actuated both electrically and pneumatically; and the air compressor 7 takes care of providing the necessary compressed air.

[0019] The high-pressure water is sent to the special nozzle 15, suitably studied for generating a low-flow-rate flow: the air compressor 7 then supplies the pneumatic motor of the rotary head of the nozzle 15. Obviously, the rotary head can have both a symmetrical and an asymmetrical arrangement of its nozzles: in addition, the system further comprises at least one second nozzle equipped with at least one rotary head rotated by the water flow going out of its nozzles.

[0020] The innovative aspect of the above-described pumping unit consists in building the high-pressure pump 1 so that it delivers the maximum possible pressure with a very low flow-rate and at a reduced size, solution that can be obtained by using the inverter 5 connected to the electric motor 3, also with small sizes.

[0021] The above-described system, in its currently preferred, but absolutely not limiting, embodiment, has the following general characteristics:

- pressure adjustable from 0 to 500 bar
- flow-rate variable from 2 to 4 l/min
- compact and light-weight structure
- electric supply compatible with portable power generating units
- no pneumatic supply
- automatic adjustment of filling of the accumulating tank.

[0022] The technical characteristics that are currently deemed optimum are as follows:

- electro-pump 1 with 11 kW (instead of the traditional 57 kW required for this type of pumps) with 450 rpm (variable through the inverter 5): such pump is preferably a pump made by the Company WOMA of the Kaercher Group with code 70M P10, of the triplex type with horizontal diving pistons and with lamellar sealing gaskets, completed with head, conversions

and stainless steel flanges, pressure by-pass, breakage disk and manometer with glycerine bath;

- electric motor 3 with 11 kW at 750 rpm, 8 poles, 400 Vac, 50 Hz, B3 shape with small feet and servo-vented;
- electric panel with 11kW, IP55 inverter;
- elastic joint for motor 3 / pump 1 transmission with protecting carter;
- suction line with related filters;
- air compressor 15 with 230 Vac, 50 Hz single-phase with 6-bar pressure switch;
- plastic tank for supply water, about 60 litres, completed with level switch for maximum level, minimum-level probe, supply solenoid valve from mains water, for a maximum of 2 bar;
- system supporting frame, made of metallic section bars with wheels, two of which are fixed and 2 are rotating with brake, whose preferred overall sizes are 180 x 78 x 120 cm (length x width x height) with a weight of about 300 kg.

[0023] As one of the possible operating variations, the above-described system with pumping unit can be installed on a van (not shown) dedicated to the system itself, namely equipped with an electric supply source and with an accumulating tank in order to guarantee some autonomous operating hours.

[0024] The above-described system thereby allows obtaining the following results:

- compactness: the sizes are such as to allow the system to pass through normal doors
- light weight: the weight is reduced to a maximum, in order to be able to be transported on a van
- absence of vibrations: the assembly structure is made in order to reduce the motor and pump vibrations to a minimum and the rubber wheels do not transmit the possible vibrations on the ground
- mobility: the assembly is equipped with steering wheels that allow its movements through a person's thrust
- minimum supply couplings: the assembly has to be supplied with water and three-phase and single-phase electric energy, in order to reduce to a minimum the necessary couplings (air compressor, pump booster and water-filtering system are integrated in the assembly)
- working flexibility: the pressure adjustable from 0 to 500 bar makes this assembly unique in the current high pressure field and allows a high working flexibility, allowing to perform several works
- low flow-rate: the low water flow-rate used (from 2 to 4 l/min) allows minimising the ecologic impact and reducing the waste of necessary water for performing the works
- no wastes: there are no water wastes during the use, since unused water is made re-circulate in the accumulating tank integrated in the assembly

- low energetic impact: the use of a high-efficiency electric motor, together with the latest generation speed-changing device, allows good energy savings during its use
- easy adjustments: the electric panel is equipped with all necessary warning lights for the correct operation of the unit; moreover, there is a panel for managing the speed-changing device, in order to provide all information about the operation in a simple and immediate way
- exclusive accessories: in order to manage the low water flow-rate being generated, an exclusive nozzle is used, which is able to operate till 500 bar.

[0025] With the inventive system, the following can for example be easily removed: graffiti on walls, chewing gums on the ground, debris from tramway tracks and the like; other application fields of such system are, as a non-limiting example:

- in the building sector, as hydro-demolition, concrete cutting and scarification, removal of deteriorated coatings, surface cleaning of containing basins and cleaning of facades and flooring;
- in the environmental sector, as cleaning of tanks, filter-presses, cold-cutting of tanks (hydro-cutting) and decontamination and cleaning of industrial plants; and
- in the industrial sector, as cleaning of painting cabins and ovens and cleaning of plants and machinery.

Claims

1. System, in particular for cleaning, comprising:

- at least one high-pressure pumping unit (1) designed to pump water or other similar fluids with a high output pressure;
- at least one electric motor (3) connected to the high-pressure pump (1) for its actuation;
- at least one device (5) for regulating the revolutions of the pump (1), connected to the motor (3) for its control and for regulating the pump (1) in order to deliver water at a variable pressure, preferably from 0 to 500 bar, and at a very low flow-rate, preferably from 2 to 4 l/min;
- at least one nozzle (15)

characterised in that the nozzle is equipped with at least one rotary head rotated by at least one pneumatic motor; and

- at least one air compressor (7) designed to provide the supply compressed air to said pneumatic motor.

2. System according to claim 1, **characterised in that**

it comprises at least one second nozzle equipped with at least one rotary head rotated by a water flow going out of the nozzles.

3. System according to claim 1, **characterised in that** said regulating device (5) is an inverter.

4. System according to claim 1, **characterised in that** it further comprises at least one water-filtering system (9), connected to at least one tank (11) for water, in turn connected to at least one electro-pump booster (13), connected to the high-pressure pump (1).

5. System according to claim 1, **characterised in that** the high-pressure pump (1) is connected to the electric motor (3) through a coupling system than transmits motion.

6. System according to claim 1, **characterised in that** the electric motor (3) is driven through an electric panel that includes the regulating device (5) in order to change the revolutions of the high-pressure pump (1) and therefore its flow-rate, the motor (3) revolutions being regulated by an operator depending on a pressure value to be adopted and on a water consumption to be obtained.

7. System according to claim 1, **characterised in that** it further comprises a control valve that is electrically or pneumatically actuated.

8. System according to claim 1, adapted to be installed on a van dedicated to the system itself, said van being equipped with an electric supply source and with an accumulating tank in order to guarantee a few autonomous operating hours.

Patentansprüche

1. System, insbesondere für Reinigungen, das folgendes einschließt:

- mindestens eine Hochdruckpumpeinheit (1), die dazu entwickelt wurde, mit hohem Austrittsdruck Wasser oder andere gleichartige Flüssigkeiten zu pumpen;
- mindestens einen Elektromotor (3), der für die Aktivierung der Hochdruckpumpe (1) mit dieser verbunden ist;
- mindestens eine Drehzahlstellvorrichtung (5) der Pumpe (1), die für die Motorsteuerung und für die Einstellung der Pumpe (1) mit dem Motor (3) verbunden ist, um Wasser mit einem variablen Druck, vorzugsweise von 0 bis 500 bar, mit einer sehr niedrigen Förderleistung, vorzugsweise von 2 bis 4 l/min, auszugeben;
- mindestens eine Düse (15);

- die **dadurch gekennzeichnet ist, dass** die Düse mit mindestens einem Drehkopf der Förderleistung ausgestattet ist, der von mindestens einem pneumatischen Motor gedreht wird; und
- mindestens einen Luftverdichter (7), der dazu dient, die Druckluft an den genannten pneumatischen Motor zu leiten.
2. System gemäß Patentanspruch 1, das dazu dient, mindestens eine zweite Düse einzuschließen, die mit mindestens einem Drehkopf der Förderleistung ausgestattet ist, der durch den Fluss des aus den Düsen austretenden Wassers gedreht wird.
3. System gemäß Patentanspruch 1, das **dadurch gekennzeichnet ist, dass** die genannte Einstellvorrichtung (5) ein Inverter ist.
4. System gemäß Patentanspruch 1, das **dadurch gekennzeichnet ist, dass** es außerdem mindestens ein Wasserfiltersystem (9) einschließt, das mit mindestens einem Wassertank (11) verbunden ist, welcher seinerseits mit mindestens einer Booster-Elektropumpe (13) verbunden ist, die mit der Hochdruckpumpe (1) verbunden ist.
5. System gemäß Patentanspruch 1, das **dadurch gekennzeichnet ist, dass** die Hochdruckpumpe (1) mit dem Elektromotor (3) durch ein Kraftübertragungssystem verbunden ist.
6. System gemäß Patentanspruch 1, das **dadurch gekennzeichnet ist, dass** der Elektromotor (3) durch eine Schalttafel gesteuert wird, die die Einstellvorrichtung (5) einschließt, um die Drehzahl der Hochdruckpumpe (1) und daher ihre Förderleistung zu ändern, die Motordrehzahl (3) wird durch den Bediener je nach dem zu verwendenden Druckwert und dem zu erzielenden Wasserverbrauch eingestellt.
7. System gemäß Patentanspruch 1, das **dadurch gekennzeichnet ist, dass** es außerdem ein Steuerventil einschließt, das elektrisch oder pneumatisch angetrieben wird.
8. System gemäß Patentanspruch 1, das dazu dient, auf einem LKW installiert zu werden, der für dieses System bestimmt ist, der genannte LKW ist mit einer Stromversorgungsquelle und einem Speicherbehälter ausgestattet, die die Autonomie für mehrere Betriebsstunden garantieren.

Revendications

1. Système, en particulier pour le nettoyage,

comprenant :

- au moins une unité de pompage à haute pression (1) conçue pour pomper avec une pression élevée de sortie d'eau ou d'autres fluides analogues ;
- au moins un moteur électrique (3), relié à la pompe haute pression (1), qui actionne celle-ci ;
- au moins un dispositif (5) de réglage des tours de la pompe (1) ; il est relié au moteur (3) pour commander ce dernier et régler la pompe (1) de sorte qu'elle distribue l'eau à pression variable, de préférence de 0 à 500 bars, et avec un débit très faible, de préférence de 2 à 41/min ;
- au moins un gicleur (15) ;

caractérisé en ce qu'il est doté au moins d'une tête tournante actionnée par un moteur pneumatique ; et

- au moins un compresseur à air (7) apte à fournir l'air comprimé d'alimentation nécessaire au moteur pneumatique.

2. Système, selon la revendication 1, **caractérisé en ce qu'il** comprend au moins un second gicleur doté au moins d'une tête tournante actionnée par le flux d'eau sortant des gicleurs.
3. Système, selon la revendication 1, **caractérisé en ce que** le dispositif de réglage (5) est un variateur.
4. Système, selon la revendication 1, **caractérisé en ce qu'il** comprend au moins un système (9) de filtrage de l'eau, relié au moins à un réservoir (11) pour l'eau, ce dernier étant relié à une électropompe booster (13) qui est branchée à la pompe haute pression (1).
5. Système, selon la revendication 1, **caractérisé en ce que** la pompe haute pression (1) est reliée au moteur électrique (3) à l'aide d'un système d'accouplement qui transmet le mouvement.
6. Système, selon la revendication 1, **caractérisé en ce que** le moteur électrique (3) est commandé à travers un tableau électrique qui comprend le dispositif de réglage (5) afin de varier les tours de la pompe haute (1) et donc son débit ; les tours moteur (3) sont réglés par l'opérateur en fonction de la valeur de pression à adopter et de la consommation d'eau à obtenir.
7. Système, selon la revendication 1, **caractérisé en ce qu'il** comprend aussi une vanne de contrôle qui est actionnée électriquement ou pneumatiquement.

8. Système, selon la revendication 1, indiqué pour être

installé sur une camionnette dédiée au système, cette camionnette est dotée d'une source d'alimentation électrique et d'un réservoir d'accumulation garantissant quelques heures de fonctionnement en autonomie.

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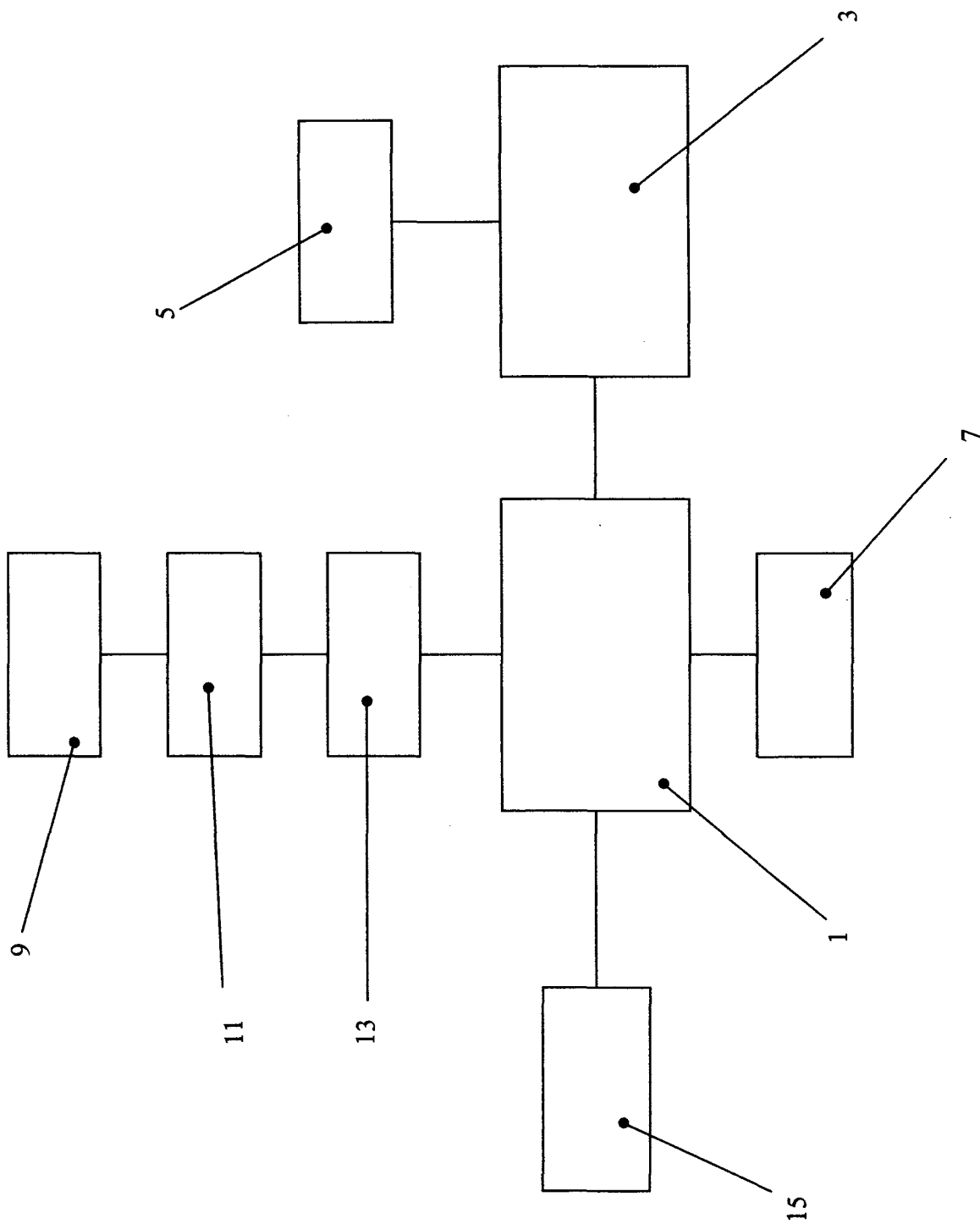


FIG. 1

REFERENCES CITED IN THE DESCRIPTION

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