(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 269 791 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.11.2023 Bulletin 2023/44

(21) Application number: **22425020.9**

(22) Date of filing: **29.04.2022**

(51) International Patent Classification (IPC):
F04B 15/02 *(2006.01)* *F04B 9/02* *(2006.01)*
F04B 17/03 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F04B 15/023; F04B 9/02; F04B 17/03

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicants:
- **CIFA SpA**
  20030 Senago (MI) (IT)
- **Politecnico di Milano**
  20133 Milano (IT)

(72) Inventors:
- **Tarsitano, Davide**
  VARESE (VA) (IT)
- **Cinquemani, Simone**
  MILANO (MI) (IT)
- **Zorzi, Emanuele**
  CESANO MADERNO (MB) (IT)
- **Calculli, Massimo**
  NOVATE MILANESE (MI) (IT)
- **Nigrelli, Andrea**
  MAZARA DEL VALLO (TP) (IT)

(74) Representative: **Petraz, Gilberto Luigi et al**
GLP S.r.l.
Viale Europa Unita, 171
33100 Udine (IT)

(54) PUMPING APPARATUS AND CORRESPONDING OPERATING METHOD

(57) Pumping apparatus (10) for pumping concrete, or similar material, comprising at least one pumping unit (11) having both a first pumping cylinder (16) and a second pumping cylinder (17), and also a first pumping piston (21) and a second pumping piston (22) both mobile with a respectively alternating motion inside respective chambers (19, 20) present in the first cylinder (16) and in the second cylinder (17), respectively. The apparatus comprises a motor (31), preferably electric, to drive the first and second piston (21, 22) with an alternating motion by means of suitable movement means (26, 27).

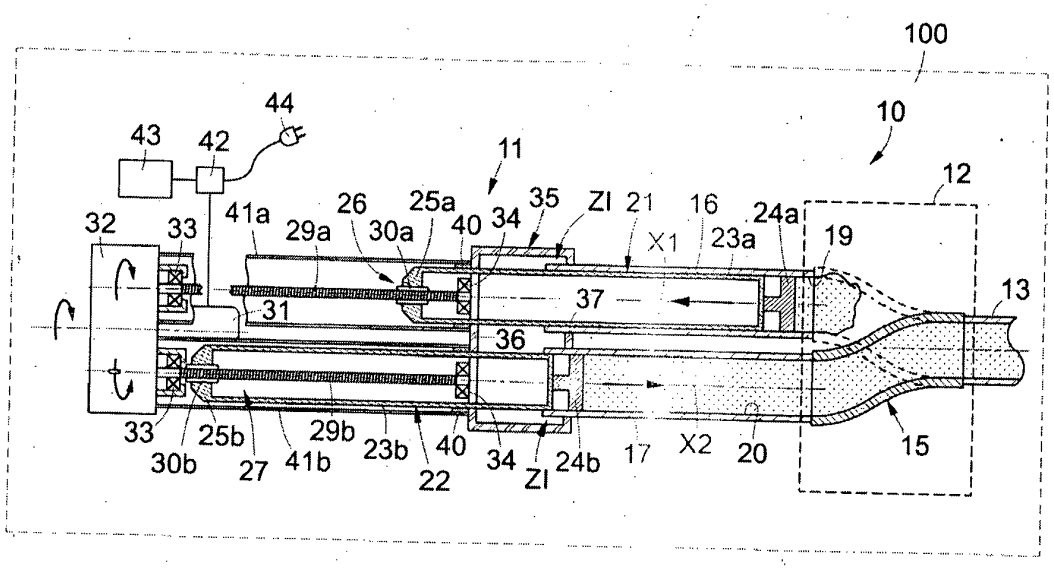

fig. 1

EP 4 269 791 A1

Description

FIELD OF THE INVENTION

[0001] The present invention concerns a pumping apparatus for pumping concrete, or similar material, from a containing compartment to a pipe for distributing the material itself. In particular, the apparatus can be installed on a mobile operating machine, such as for example a truck-mounted pump, a truck mixer pump or other operating machine suitable to distribute concrete. The present invention also concerns the operating method of the pumping apparatus as above.

BACKGROUND OF THE iNVENTION

[0002] Pumping apparatuses are known, which comprise a containing compartment; inside which there is concrete in a more or less liquid form, and a pumping unit intended to pump the concrete toward a distribution pipe.

[0003] The pumping unit normally comprises two pumping cylinders, respectively a first and a second, each having an internal chamber inside which a respective pumping piston slides.

[0004] Usually, the two pumping pistons are hydraulically driven by an oil-dynamic system which, in turn, is driven by an endothermic motor, under the control of a control unit.

[0005] In particular, the action of the two pumping pistons is synchronized by the control unit so that while a first piston sucks in the concrete present in the containing compartment, making it enter the chamber of the first pumping cylinder, a second piston thrusts the concrete present in the chamber of the second cylinder into the distribution pipe. This guarantees a continuous delivery at the distribution point.

[0006] In order to guarantee the correct operation of the two pumping pistons, inside the containing compartment there is an exchange valve, known to persons of skill in the art by the term "S" valve.

[0007] This valve has the function of guaranteeing the alternate connection between the two pistons and the containing compartment. The synchronism of the pumping pistons and the exchange valve can be obtained hydraulically or electrically.

[0008] One disadvantage of known apparatuses is that, since the two pistons are driven and synchronized by means of an oil-dynamic system, it may happen that they are not perfectly synchronized with each other. This can lead to a loss of performance of the apparatus itself, as well as possible malfunctions.

[0009] Another disadvantage is that the construction layout of known apparatuses is rather complex and, in the event of malfunctions, it can be complicated to intervene on the operating components of the pumping apparatus.

[0010] There is therefore a need to perfect a pumping apparatus that can overcome at least one of the disadvantages of the state of the art.

[0011] In particular, one purpose of the present invention is to provide a pumping apparatus in which the synchronization of the two pumping pistons is precise and not subject to possible asynchrony.

[0012] Another purpose of the present invention is to provide a pumping apparatus that is compact and has a simplified construction layout with respect to the state of the art.

[0013] Another purpose of the present invention is to provide a pumping apparatus that is highly efficient and has high operating performance.

[0014] The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0015] The present invention is set forth and characterized in the independent claims. The dependent claims describe other characteristics of the present invention or variants to the main inventive idea.

[0016] In accordance with the above purposes, and to solve the above technical problem in a new and original way, also obtaining considerable advantages compared to the state of the prior art, a pumping apparatus according to the present invention, for pumping concrete or similar material, comprises at least one pumping unit having a first pumping cylinder and a second pumping cylinder, a first pumping piston and a second pumping piston both mobile with a respectively alternating motion inside respective chambers present in the first cylinder and in the second cylinder respectively, and a motor for driving the first and second piston with an alternating motion.

[0017] In accordance with one aspect of the present invention, the pumping apparatus also comprises movement means each having respective threaded rods which are driven in rotation by the motor with a respectively opposite and alternating sense of rotation, and on which respective bushing Cements, which are integral with the first piston and the second piston respectively, are mobile, being screwed and unscrewed in relation to the sense of rotation in order to generate the alternating motion of the first and second piston with respect to the first and second cylinder.

[0018] In accordance with another aspect of the present invention, the movement means comprise, or consist of, a first ball screw and a second ball screw.

[0019] The first and second pistons are mobile along respective axes of sliding and are provided with respective terminal ends.

[0020] In accordance with another aspect of the present invention, the threaded rods are disposed coaxial to the axes of sliding of the first and second piston, and the bushing elements are associated with the respective lower ends of the first and second piston.

[0021] In accordance with another aspect of the present invention, the motor is operatively connected to a transmission member which is associated with both of the threaded rods, and which is configured to split the motion generated by the motor, making the threaded rods rotate simultaneously with the respectively opposite sense of rotation, in order to synchronize the movement of the bushing elements and, therefore, the alternating motion of the first and second piston.

[0022] In accordance with another aspect of the present invention, the motor is an electric motor, and it is capable of inverting its drive sense in a cyclical manner and substantially continuously so that the transmission member reverses the senses of rotation of the threaded rods.

[0023] In accordance with another aspect of the present invention, the pumping apparatus also comprises a converter connected to the motor, an electric accumulator and a connection device, wherein the electric accumulator and the connection device are connected to the converter so as to supply powering and/or driving electrical energy to the motor, for a completely electric operation of the first and second piston.

[0024] In accordance with another aspect of the present invention, the connection device is configured both to connect the electric accumulator to a source of electrical energy, when the energy level of the latter is low, and also to supply driving electrical energy to the motor.

[0025] The pumping unit is configured to pump a certain quantity of material from a containing compartment to a distribution pipe by means of an exchange valve.

[0026] In accordance with another aspect of the present invention, the first or second piston, in relation to the sense of rotation of the respective threaded rod, is configured to alternatively assume a suction condition, or step, and a thrust condition.

[0027] In the suction condition, the piston, by retracting, is able to suck the material from the containing compartment, making it enter inside the chamber of the respective cylinder.

[0028] In the thrust condition, the piston, by advancing, is able to thrust the material already present in the chamber of the respective cylinder into the distribution pipe.

[0029] Furthermore, the alternating connection of the first and second piston with the distribution pipe is determined by the exchange valve.

[0030] In accordance with another aspect of the present invention, one or more oil-dynamic pumps can be associated with the transmission member, which have the function of selectively driving one or more auxiliary services of the pumping unit, which comprise the drive of the exchange valve, the drive of mixing means present in the containing compartment and the drive of a cleaning device for cleaning the containing compartment.

[0031] In accordance with a variant of the invention, the exchange valve is associated with an electric drive device, or a drive device of another type.

[0032] The present invention also concerns a method for pumping concrete, or similar material, which uses the pumping unit as above, which has a first pumping cylinder and a second pumping cylinder, a first pumping piston and a second pumping piston, both mobile in the respective cylinder, and a drive motor. The method comprises a main drive step in which the motor drives the first and second piston with alternating motion in order to move them inside respective chambers present in the first cylinder and in the second cylinder, respectively.

[0033] In the drive step, the motor drives movement means, each having respective threaded rods which are driven in rotation by the motor with a respectively opposite and alternating sense of rotation, and on which respective bushing elements, which are integral with the first piston and the second piston respectively, are screwed and unscrewed in relation to the sense of rotation, in order to generate the alternating motion of the first and second piston with respect to the first and second cylinder.

[0034] In accordance with another aspect of the present invention, in the drive step a transmission member, connected to the motor and associated with the threaded rods, splits the motion generated by the motor simultaneously making the threaded rods rotate, with a respectively opposite sense of rotation, in order to synchronize the movement of the bushing elements and, therefore, the alternating motion of the first and second piston.

[0035] In accordance with another aspect of the present invention, in the drive step it is provided that the first and second piston reciprocally alternate between a suction step, in which, by retracting, they suck the material from a containing compartment making it enter into the chamber of the respective cylinder, and a thrust step, in which, by advancing, they thrust the material already present in the chamber of the respective cylinder into a distribution pipe.

[0036] In accordance with another aspect of the present invention, the method comprises another drive step in which the motor, by means of the transmission member, drives one or more oil-dynamic pumps in order to selectively drive one or more auxiliary services of the pumping unit.

[0037] In accordance with another aspect of the present invention, the method comprises a recharging step in which, since the motor is an electric motor powered and/or driven, by means of a converter, by an electric accumulator, if the latter has a low charge level and such that if does not allow to power and/or drive the motor itself, the electric accumulator is connected to an external source of electrical energy by means of a connection device, which is also connected to the converter, so as to be recharged.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] These and other aspects, characteristics and

advantages of the present invention will become apparent from the following description of some embodiments, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a schematic representation of a pumping apparatus according to the present invention;
- fig. 2 is a simplified three-dimensional view of the pumping apparatus of fig. 1;
- fig. 3 is a schematic representation of the pumping apparatus of fig. 1 according to another embodiment;
- fig. 4 is a schematic representation of the pumping apparatus of fig. 1 according to another embodiment;
- figs. from 5 to 7 are schematic views of an operating sequence of the apparatus of fig. 1.

[0039] We must clarify that in the present description the sole function of the phraseology and terminology used, as well as the figures in the attached drawings also as described, is to better illustrate and explain the present invention, their function being to provide a non-limiting example of the invention itself, the scope of protection being defined by the claims.

[0040] To facilitate comprehension, the same reference numbers have been used, where possible, to identify identical common elements in the drawings. It is understood that elements and characteristics of one embodiment can be conveniently combined or incorporated into other embodiments without further clarifications.

DESCRIPTION OF SOME EMBODIMENTS OF THE PRESENT INVENTION

[0041] With reference to fig. 1, a pumping apparatus 10 according to the present invention is suitable and usable to pump and distribute building material, intended here as concrete but not limited thereto, used to make residential constructions or components.

[0042] Advantageously, the pumping apparatus 10 can be installed, or mounted, on a mobile operating machine 100, such as a truck-mounted pump, a truck mixer pump, or similar operating machines.

[0043] The pumping apparatus 10 essentially comprises a pumping unit 11 to pump the concrete from a containing compartment 12, which is associated, in the example representation of fig. 1, at the rear part with the pumping unit 11 and into which the concrete to be pumped is introduced, to a distribution pipe 13 in order to distribute and convey the concrete toward a determinate destination zone. The distribution pipe 13 is associated at the rear part with the containing compartment 12 and can be supported by an articulated arm, of a known type and not shown in the drawings.

[0044] Briefly, the containing compartment 12 is substantially of a known type and it can have the shape of a hopper into which the concrete is introduced, in a more or less liquid form, by means of another mobile operating machine 100, for example a truck mixer. Inside the containing compartment 12, the concrete is mixed by suitable mixing means, not shown in the drawings, which have the function of maintaining a correct fluidity of the concrete, thus preventing it from solidifying.

[0045] Furthermore, in the lower part of the containing compartment 12 there is an exchange valve 15, also known by the term "S valve", which allows to correctly pump the concrete from the containing compartment 12 to the distribution pipe 13, as will be described in detail below.

[0046] The pumping unit 11 comprises a pair of cylindrical tubular elements, respectively a first pumping cylinder 16 and a second pumping cylinder 17, which are disposed side by side, parallel to each other and operatively connected to the exchange valve 15 and, therefore, to the containing compartment 12.

[0047] The two pumping cylinders 16 and 17 comprise respective chambers 19, 20 inside which a respective pumping piston 21, 22 can slide along a corresponding axis of sliding X1, X2. Specifically, a first pumping piston 21 is able to slide, along the first axis of sliding X1, inside the chamber 19 of the first cylinder 16, and a second pumping piston 22 is able to slide, along the second axis of sliding X2, inside the chamber 20 of the second cylinder 17.

[0048] As shown in figs. 1 and from 3 to 7, both the first piston 21 and also the second piston 22 each comprise a cylindrical tubular body 23a, 23b with which there is associated a head, or initial, portion 24a, 24b which is configured to come in contact with the concrete. Furthermore, each tubular body 23a, 23b comprises a lower end 25a, 25b.

[0049] The two pistons 21 and 22 have a continuous alternating motion, or operation, and they are each configured to alternately pass from a suction condition, or step, to a thrust condition, or step (figs. from 5 to 7). Specifically, while one of the two pistons 21 or 22 is in the suction condition, in which by retracting it is able to suck the concrete from the containing compartment 12, making it enter into the chamber 19 or 20 of the respective cylinder 16 or 17, the other piston 22 or 21 is in the thrust condition, in which by advancing it is able to thrust the concrete already present in the chamber 20 or 19 of the respective cylinder 17 or 16 into the distribution pipe 13.

[0050] It should be noted that each piston 21, 22, at least in correspondence with the respective head portion 24a, 24b, can be provided with suitable sealing means, not shown in the drawings, to prevent the concrete from escaping from the chamber 19, 20 of the respective cylinder 16, 17 in an uncontrolled manner.

[0051] In the continuous alternating motion, the exchange valve 15 is configured to allow the selective and alternating connection between the piston 21 or 22 which is in the thrust condition and the distribution pipe 13.

[0052] In particular, the pumping apparatus 10 comprises a motor 31 (figs. 1 and from 3 to 7) which is provided to drive the first and second piston 21 and 22 with the alternating motion described above.

[0053] In accordance with one aspect of the present invention, the pumping apparatus 10 also comprises movement means 26 and 27 each having respective threaded rods 29a and 29b which are driven in rotation by the motor 31 with a respectively opposite and alternating sense of rotation, and on which respective bushing elements 30a and 30b, which are integral with the first piston 21 and with the second piston 22 respectively, are mobile, being screwed and unscrewed in relation to the sense of rotation, so as to genarate the continuous alternating motion.

[0054] In particular, the threaded rods 29a and 29b are disposed coaxial to the first axis of sliding X1 and to the second axis of sliding X2 respectively, and the bushing elements 30a and 30b are rigidly constrained to a respective terminal end 25a, 25b of the first and second piston 21 and 22.

[0055] In accordance with one aspect of the present invention, the movement means comprise, or consist of, a first ball screw 26 and a second ball screw 27. In this case, the bushing elements 30a, 30b are internally threaded and can perform the function of a "nut screw", known to the people of skill in the art.

[0056] It should be noted that, since the tubular body 23a and 23b is integral with the corresponding bushing element 30a, 30b, the term "nut screw" can also be understood to mean the combination of the tubular body 23a, 23b with the respective bushing element 30a, 30b.

[0057] Specifically, between the threading of the threaded rods 29a and 29b and that of the bushing elements 30a and 30b there is a plurality of balls or suitable elements, not shown in the drawings, which have the function of transforming the rotary motion of each threaded rod 29a, 29b into a translational motion for the bushing element 30a, 30b.

[0058] Therefore, in relation to the sense of rotation of the threaded rod 29a, 29b, the bushing element 30a, 30b is able to advance, or alternatively retract, along the respective axis of sliding X1, X2. Each piston 21, 22 can therefore pass from a retracted position, in which it is almost entirely outside the chamber 19, 20 of the respective cylinder 16, 17, to an advanced position, in which it is substantially inside the chamber 19, 20 of the respective cylinder 16, 17, and vice versa (figs. from 5 to 7).

[0059] In accordance with another aspect of the present invention, as shown in the attached drawings, the motor 31 is operatively connected to a transmission member 32 of the mechanical type, which is associated with the threaded rods 29a and 29b and which is configured at least to split the motion generated by the motor 31, simultaneously making the threaded rods 29a and 29b rotate, with a respectively opposite sense of rotation, in such a way as to synchronize the alternating motion of the first and second piston 21, 22. In particular, one of the two senses of rotation is concordant with the sense of drive, or of rotation, of the electric motor 31, while the other is discordant.

[0060] By way of example, the threaded rod 29a of the first ball screw 26 is made to rotate clockwise in order to make the respective bushing element 30a and therefore also the first piston 21 advance along the respective axis of rotation X1, thus determining the thrust condition described above, while the threaded rod 29b of the second ball screw 27 is made to rotate counterclockwise in order to make the respective bushing element 30b and therefore also the second piston 22 retract along the respective axis of rotation X2, thus determining the suction condition described above (figs. from 5 to 7).

[0061] In accordance with another aspect of the present invention, the motor 31 is an electric motor, and is capable of reversing its sense of drive in a cyclical manner and substantially continuously, so that the transmission member 32 reverses the senses of rotation of the threaded rods 29a, 29b so as to cause the two pistons 21 and 22 to cyclically pass from the suction condition to the thrust condition, and vice versa.

[0062] As shown in fig. 1, each threaded rod 29a, 29b is provided with a first pair of start-of-travel bearings 33, disposed in correspondence with the initial part of the respective threaded rod 29a, 29b, and with a second pair of end-of-travel bearings 34, disposed in correspondence with the terminal part of the respective threaded rod 29a, 29b.

[0063] In accordance with possible embodiments of the present invention, a hollow connection member 35, disposed transversely to the axes of sliding X1 and X2, is associated in correspondence with respective inlet zones ZI of the two cylinders 16 and 17. The connection member 35 defines a piston-cylinder connection interface and has the function of supporting the movement of the two pistons 21 and 22, in particular of the two tubular bodies 23a and 23b.

[0064] Specifically, the connection member 35 comprises: a first wall 36 facing toward the motor 31 and provided with special apertures for the passage of the first and second cylinder 21 and 22; a second wall 37 facing toward the containing compartment 12 and provided with suitable apertures in which the two cylinders 16 and 17 are attached; and an upper wall 38 provided with an access door 39 for possible maintenance operations, for example to replace the head portion 24a and 24b. Furthermore, sealing elements 40 are disposed in correspondence with the apertures of the first wall 36 to guarantee a hermetic seal of the connection member 35.

[0065] Preferably, in order to protect the ball screws 26 and 27, respective tubular protection members 41a and 41b can be disposed externally thereto, which are associated on one side with the transmission member 32 and on the other with the connection member 35.

[0066] In accordance with one aspect of the present invention, the pumping apparatus 10 also comprises a converter 42 (figs. 1, 3 and 4) connected to the electric motor 31, an electric accumulator 43 and a connection device 44 both connected to the converter 42 so as to supply powering and/or driving electrical energy to the motor 31, for a completely electric operation of the first

and second piston 21, 22.

[0067] In particular, the electric accumulator 43 comprises one or more electric batteries to electrically drive the motor 31, and the connection device 44 for a connection to an external source of electrical energy, for example a normal electrical network.

[0068] In particular, the connection device 44 is configured both to connect the electric accumulator 43 to the source of electrical energy when the energy level of the latter is low, and also to supply powering and/or driving electrical energy to the motor 31 itself. In this regard, the presence of the converter 42 has the function of an inverter and allows to guarantee a correct management of the direct DC and/or alternating AC electrical energy and a correct electrical operation of the motor 31.

[0069] According to other embodiments of the present invention, not shown in the drawings, the electric accumulator 43 can be connected to a power take-off of the endothermic motor that drives the mobile operating machine 100; in this case, it is provided that the operative connection between the power take-off and the electric accumulator 43 occurs by means of an electric generator associated with the converter 42.

[0070] The pumping apparatus 10 has the advantage that the pumping of concrete and, therefore, the drive of the pistons 21 and 22 occurs without the use of an oil-dynamic system; moreover, thanks to the use of the movement means 26 and 27 and of the transmission member 32, the movements of the first and second pistons 21 and 22 are not independent from each other, but they are synchronized with each other in a mechanical manner. This allows to have an optimized and highly performing alternating motion of the two pistons 21 and 22.

[0071] In accordance with possible embodiments of the present invention, shown in figs. 3 and 4, the transmission member 32 can also be used with a coupler function for keying other drive elements, or components, configured to drive one or more auxiliary systems of the pumping apparatus 10. Specifically, it is possible to key, in a rear part of the transmission member 32, one or more oil-dynamic pumps 45 capable of driving the auxiliary systems of the pumping unit 11.

[0072] As shown in the embodiment of fig. 3, provided by way of example only, there are several oil-dynamic pumps 45, respectively:

- a first pump 45a to drive and command the exchange valve 15;
- a second pump 45b to drive the mixing means present in the containing compartment 12; and
- a third pump 45c to pump water under pressure toward a cleaning device 46 for cleaning the containing compartment 12.

[0073] In order to maintain a simpler construction layout and configuration of the pumping apparatus 10, as shown, by way of example, in the embodiment of fig. 4, it is possible to provide a single oil-dynamic pump 45 with which there is associated a distribution member 47 configured to manage the oil-dynamic flows toward the auxiliary services, defined by the correct drive of the exchange valve 15, of the mixing means and of the cleaning device 46.

[0074] The construction layout of the pumping apparatus 10 is therefore very compact and allows to optimize the efficiency of the pumping unit 11, since the use of oil-dynamic pumps 45 is limited to the auxiliary services only.

[0075] Within the scope of the invention, it is understood that the exchange valve 15 can be associated with an electric drive device, or a drive device of another type, not shown in the drawings.

[0076] The operating method of the pumping apparatus 10 comprises the following steps.

[0077] In a main drive step (figs. from 5 to 7) the motor 31 is powered by means of the electric accumulator 43, or possibly by means of the connection device 44, when the electric accumulator 43 has a low energy level, and by means of the transmission member 32 it drives the movement means, which in the example provided here consist of the first and second hall screw 26, 27. Therefore, the threaded rods 29a, 29b rotate with a respectively opposite sense of rotation, consequently moving the bushing elements 30a, 30b so that while one of them is screwed, the other is unscrewed, generating the forward and backward alternating motion of the two pistons 21 and 22 described above.

[0078] In particular, in the main drive step it is provided that the two pistons 21 and 22 alternate reciprocally between the suction step and the thrust step, as previously defined.

[0079] The method comprises a secondary drive step, in which the motor 31, by means of the transmission member 32, drives one or more oil-dynamic pumps 45 in order to selectively drive the one or more auxiliary services of the pumping unit 11.

[0080] Furthermore, the method also comprises a recharging step in which, if the electric accumulator 43 has a low charge level and such that it does not allow to power and/or drive the motor 31, the same electric accumulator 43 is connected to an external source of electrical energy by means of the converter 42 and the connection device 44, so as to be recharged.

[0081] It should be noted that both during the main and secondary drive steps, and also during the recharging step, the converter 42 manages the conversion of the direct DC and/or alternating AC electrical energy in relation to the specific operating needs of the apparatus 10.

[0082] It is clear that modifications and/or additions of parts may be made to the pumping apparatus 10 and to its operating method as described heretofore, without departing from the field and scope of the present invention as defined by the claims.

[0083] It is also clear that, although the present invention has been described with reference to some specific examples, a person of skill in the art shall certainly be able to achieve other equivalent forms of pumping appa-

ratuses, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

[0084] In the following claims, the sole purpose of the references in brackets is to facilitate reading and they must not be considered as restrictive factors with regard to the field of protection defined by the claims.

Claims

1. Pumping apparatus (10) for pumping concrete, or similar material, comprising at least one pumping unit (11) having a first pumping cylinder (16) and a second pumping cylinder (17), a first pumping piston (21) and a second pumping piston (22) both mobile with a respectively alternating motion inside respective chambers (19, 20) present in said first cylinder (16) and in said second cylinder (17) respectively, a motor (31) being provided to drive said first and second piston (21, 22) with alternating motion, **characterized in that** it also comprises movement means (26, 27) each having respective threaded rods (29a, 29b) which are driven in rotation by said motor (31) with a respectively opposite and alternating sense of rotation, and on which respective bushing elements (30a, 30b), which are integral with said first piston (21) and said second piston (22) respectively, are mobile, being screwed and unscrewed in relation to said sense of rotation, in order to generate said alternating motion of said first and second piston (21, 22) with respect to said first and second cylinder (16, 17).

2. Pumping apparatus (10) as in claim 1, **characterized in that** said movement means comprise, or consist of, a first ball screw (26) and a second ball screw (27).

3. Pumping apparatus (10) as in claim 1 or 2. in which said first and second pistons (21, 22) are mobile along respective axes of sliding (X1, X2) and are provided with respective terminal ends (25a, 25b), **characterized in that** said threaded rods (29a, 29b) are disposed coaxial to said axes of sliding (X1, X2), **and in that** said bushing elements (30a, 30b) are associated with the respective lower ends (25a, 25b) of said first and second piston (21, 22).

4. Pumping apparatus (10) as in any claim hereinbefore, **characterized in that** said motor (31) is operatively connected to a transmission member (32) which is associated with said threaded rods (29a, 29b) and which is configured to split the motion generated by said motor (31), making said threaded rods (29a, 29b) rotate simultaneously with said respectively opposite sense of rotation, in order to synchronize the movement of said bushing elements (30a, 30b) and, therefore, said alternating motion of said first and second piston (21, 22).

5. Pumping apparatus (10) as in claim 4, **characterized in that** said motor (31) is an electric motor and it is capable inverting its sense of drive in a cyclical manner and substantially continuously, so that said transmission member (32) reverses the senses of rotation of said threaded rods (29a, 29b).

6. Pumping apparatus (10) as in claim 5, **characterized in that** it also comprises a converter (42) connected to said motor (31), an electric accumulator (43) and a connection device (44), wherein said electric accumulator (43) and said connection device (44) are both connected to said converter (42) so as to supply powering and/or driving electrical energy to said motor (31), for a completely electric operation of said first and second piston (21, 22).

7. Pumping apparatus (10) as in claim 6, **characterized in that** said connection device (44) is configured both to connect said electric accumulator (43) to a source of electrical energy when the energy level of the latter is low, and also to supply driving electrical energy to said motor (31).

8. Pumping apparatus (10) as in any claim hereinbefore, in which said pumping unit (11) is configured to pump a certain quantity of material from a containing compartment (12) to a distribution pipe (13) by means of an exchange valve (15), **characterized in that** said first or second piston (21, 22), in relation to said sense of rotation of the respective threaded rod (29a, 29b), is configured to alternatively assume a suction condition, in which by retracting it is able to suck said material from said containing compartment (12) into the chamber (19, 20) of the respective cylinder (16, 17), and a thrust condition, in which by advancing it is able to thrust said material already present in the chamber (19, 20) of the respective cylinder (16, 17) into said distribution pipe (13), **and in that** the alternating connection of said first and second piston (21, 22) with said distribution pipe (13) is determined by said exchange valve (15).

9. Pumping apparatus (10) as in claim 8, **characterized in that** one or more oil-dynamic pumps (45) can be associated with said transmission member (32), which have the function of selectively driving one or more auxiliary services of said pumping unit (11), said services comprising the drive of said exchange valve (15), the drive of mixing means present in said containing compartment (12) and the drive of a cleaning device (46) for cleaning said containing compartment (12).

10. Pumping apparatus (10) as in claim 8, **character-**

ized in that at least said exchange valve (15) is associated with an electric drive.

11. Operating method of a pumping apparatus (10) for pumping concrete or similar material, comprising at least one pumping unit (11) having both a first pumping cylinder (16) and a second pumping cylinder (17), and also a first mobile pumping piston (21) and a second mobile pumping piston (22), said method comprising a main drive step in which a motor (31) drives said first and second piston (21, 22) with an alternating motion in order to move them inside respective chambers (19, 20) present in said first cylinder (16) and said second cylinder (17) respectively, **characterized in that** in said main drive step said motor (31), in order to move said first and second piston (21, 22), drives movement means (26, 27) each having respective threaded rods (29a, 29b) which are driven in rotation by said motor (31) with a respectively opposite and alternating sense of rotation, and on which respective bushing elements (30a, 30b), which are integral with said first piston (21) and said second piston (22) respectively, are screwed and unscrewed in relation to said sense of rotation, in order to generate said alternating motion of said first and second piston (21, 22) with respect to said first and second cylinder (16, 17).

12. Operating method as in claim 11, **characterized in that** in said main drive step a transmission member (32), connected to said motor (31) and associated with said threaded rods (29a, 29b), splits the motion generated by said motor (31) simultaneously making said threaded rods (29a, 29b) rotate, with said respectively opposite senses of rotation, in order to synchronize the movement of said bushing elements (30a, 30b) and, therefore, said alternating motion of said first and second piston (21, 22), **and in that** in said main drive step it is provided that said first and second pistons (21, 22) alternate reciprocally between a suction step, in which by retracting they suck said material from a containing compartment (12) making it enter into the chamber (19, 20) of the respective cylinder (16, 17), and a thrust step, in which by advancing they thrust said material already present in the chamber (19, 20) of the respective cylinder (16, 17) into a distribution pipe (13).

13. Operating method as in claim 12, **characterized in that** it comprises a secondary drive step in which said motor (31), by means of said transmission member (32), drives one or more oil-dynamic pumps (39) in order to selectively drive one or more auxiliary services of said pumping unit (11).

14. Operating method as in any claim from 11 to 13, **characterized in that** it comprises a recharge step in which, since said motor (31) is an electric motor powered and/or driven, by means of a converter (42), by an electric accumulator (43), if the latter has a low charge level and such that it does not allow to power and/or drive the motor (31) itself, said electric accumulator (43) is connected to an external electrical energy source by means of a connection device (44), which is also connected to said converter (42), so as to be recharged.

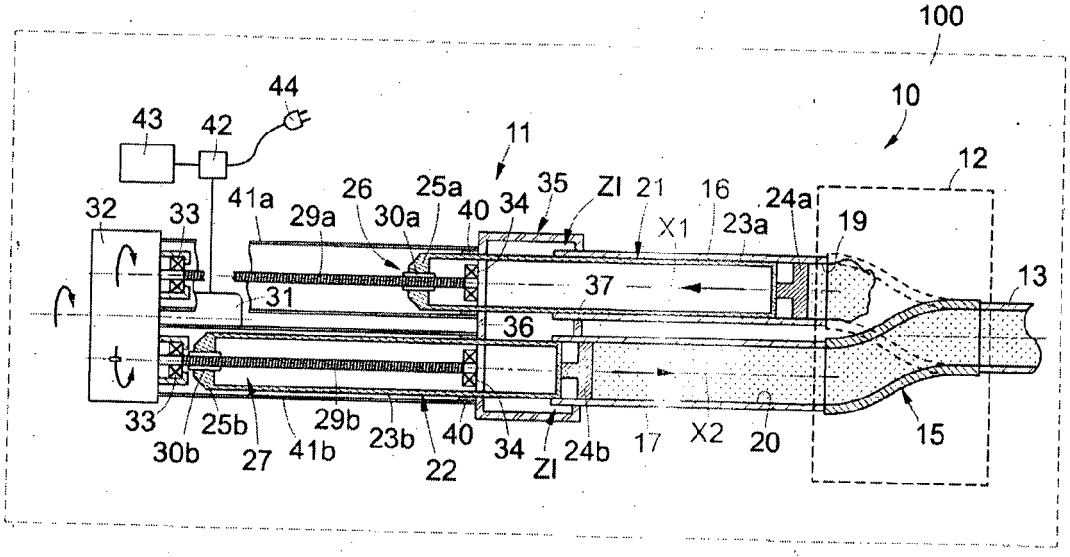
100
10
44
43
42
11
12
41a
26
25a
35
ZI
21
16
24a
32
33
29a
30a
40
34
X1
23a
19
31
37
13
36
33
25b
29b
23b
40
34
24b
17
X2
20
15
30b
27
41b
22
ZI

fig. 1

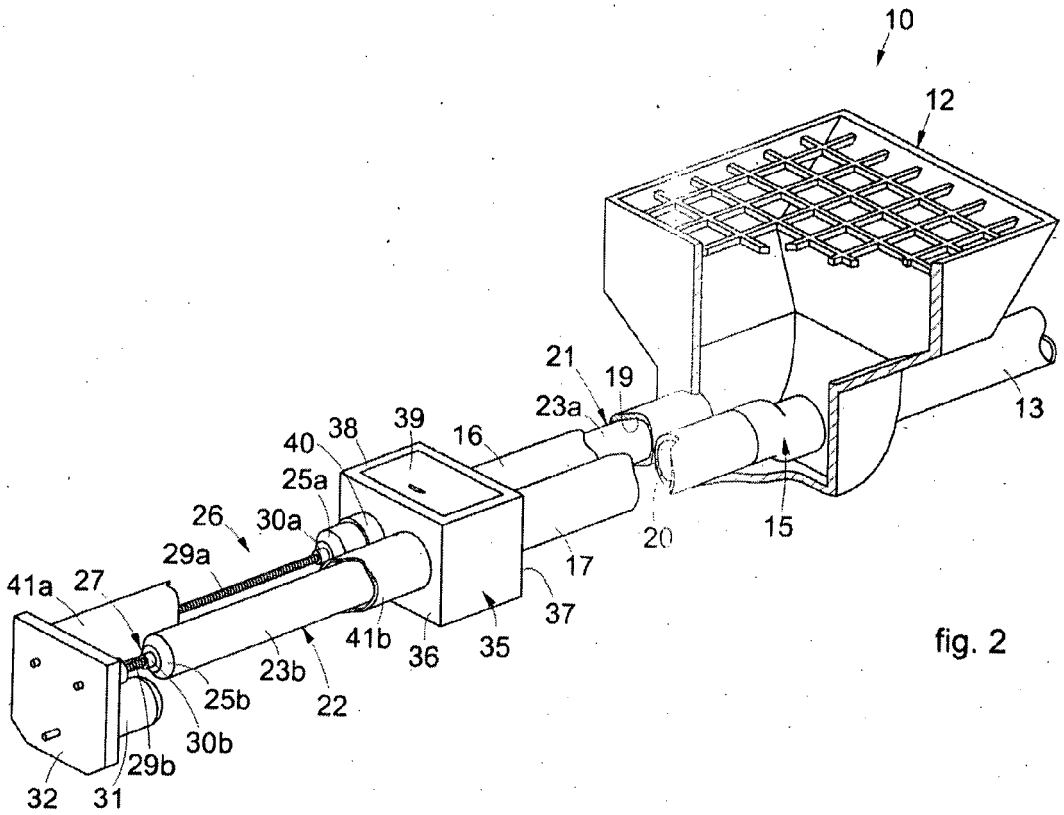
10
12
21
19
23a
13
40
38
39
16
25a
26
30a
29a
41a
27
20
15
17
37
41b
36
35
23b
22
25b
30b
29b
32
31

fig. 2

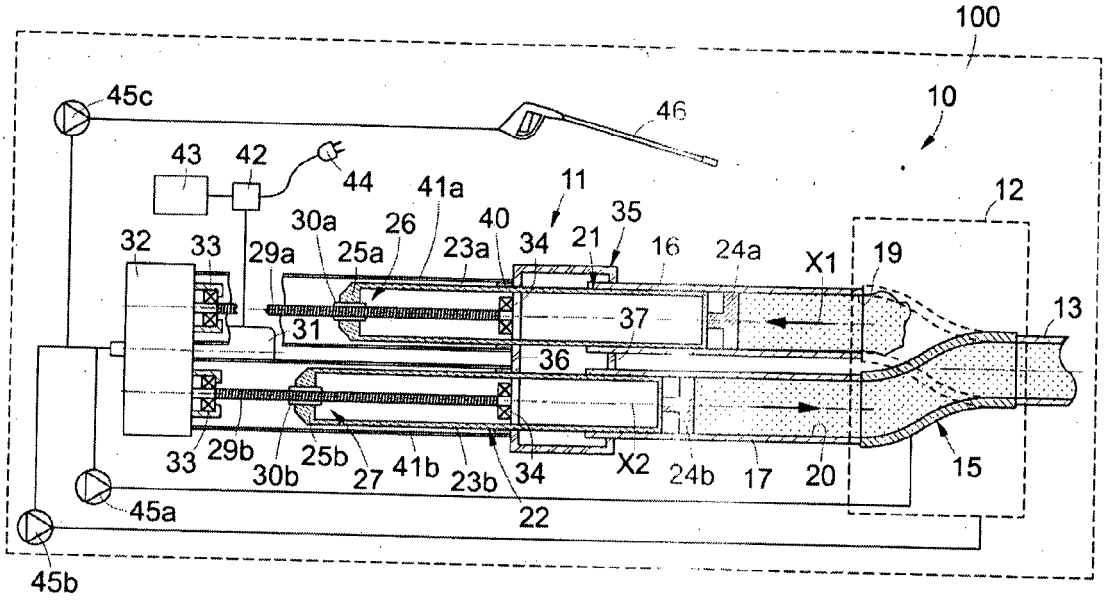
100
10
45c
46
43
42
44
41a
11
12
30a
26
40
35
32
33
29a
25a
23a
34
21
16
24a
X1
19
31
37
13
36
33
29b
30b
25b
27
41b
23b
34
X2
24b
17
20
15
45a
22
45b

fig. 3

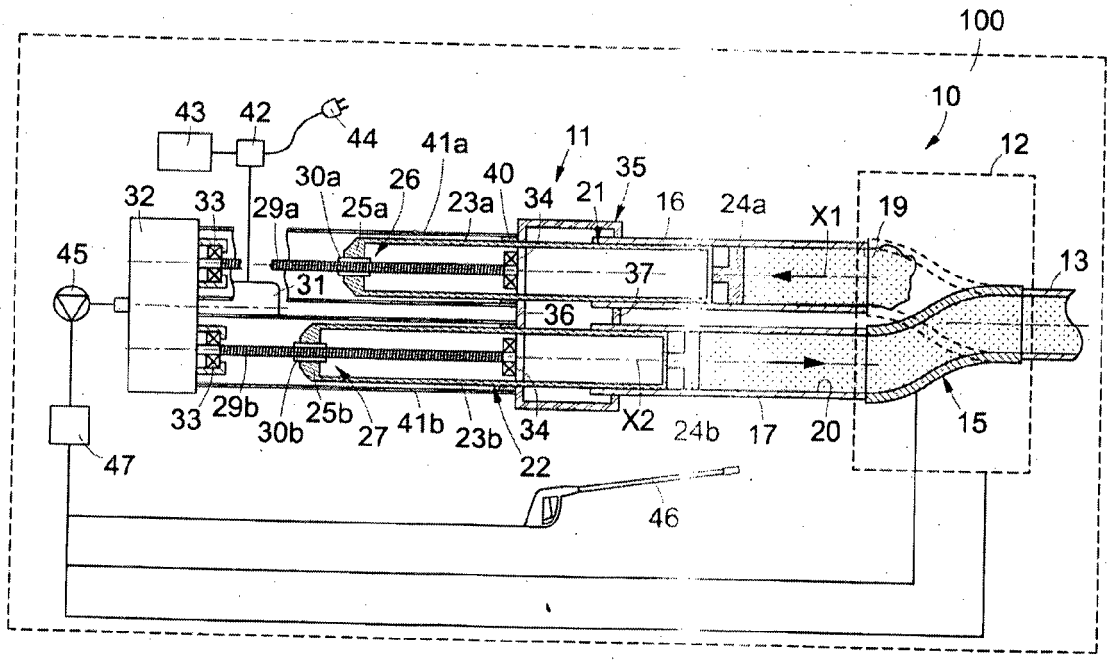
100
10
43
42
44
41a
11
12
30a
26
40
35
32
33
29a
25a
23a
34
21
16
24a
X1
19
45
31
37
13
36
33
29b
30b
25b
27
41b
23b
34
X2
24b
17
20
15
47
22
46

fig. 4

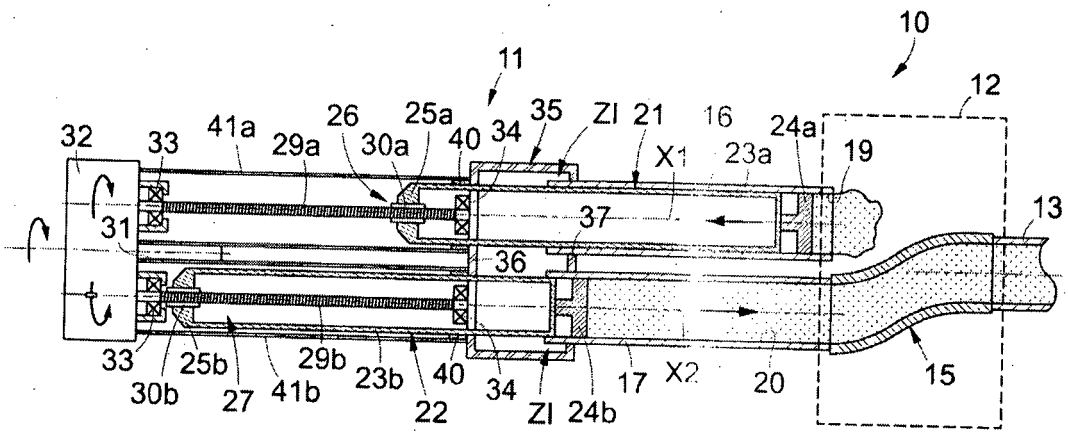

fig. 5

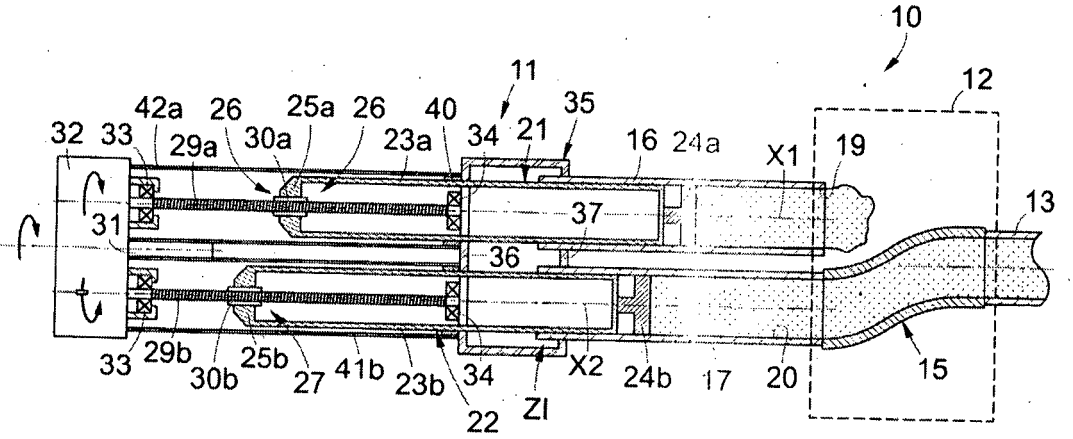

fig. 6

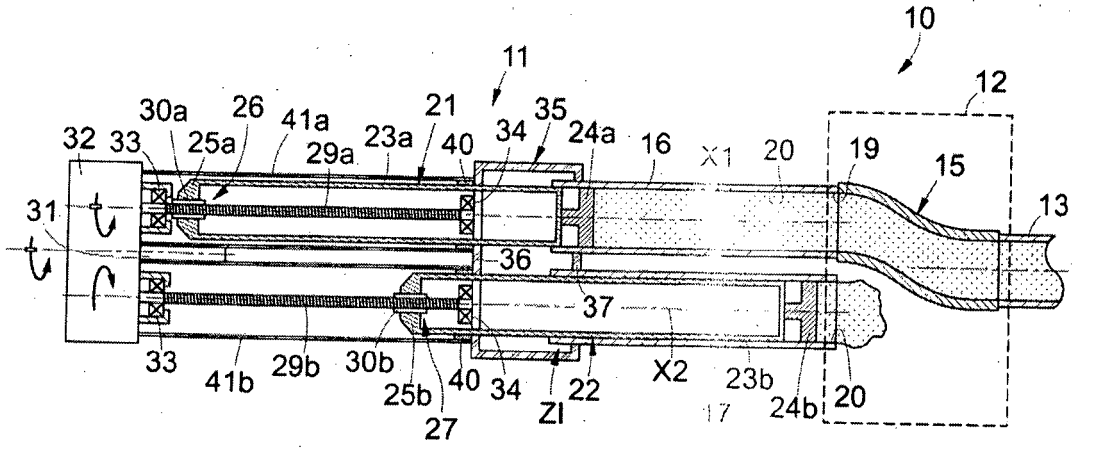

fig. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 42 5020

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	JP 2018 071386 A (FURUKAWA CO LTD) 10 May 2018 (2018-05-10) * paragraph [0001] * * paragraph [0002]; figure 5 * * paragraphs [0024] - [0045]; figure 1 * -----	1-3, 8-11,13 4,5,12	INV. F04B15/02 ADD. F04B9/02 F04B17/03
X A	JP 2003 193961 A (TAIHEIYO KIKO KK) 9 July 2003 (2003-07-09) * paragraph [0001] * * paragraphs [0004] - [0012]; figures 3,4 * * paragraphs [0028] - [0041]; figure 1 * -----	1-3, 8-11,13 4,5,12	
A	GB 1 585 482 A (RELF D; BUCKNER B) 4 March 1981 (1981-03-04) * page 1, lines 13-38 * * page 2, lines 82-124; figure 1 * * page 3, lines 10-76; figure 2 * -----	1-5,8-13	

TECHNICAL FIELDS SEARCHED (IPC)
F04B

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
Munich	21 November 2022	Homan, Peter

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
.....
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

Application Number
EP 22 42 5020

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-5, 8-13

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

Europäisches Patentamt
European Patent Office
Office européen des brevets

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 22 42 5020

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-5, 8-13

   Providing piston driving means of a pumping apparatus for pumping concrete or similar material.

   ---

2. claims: 6, 7, 14

   Providing electric power for driving a pumping apparatus for pumping concrete or similar material.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 42 5020

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

21-11-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2018071386 A	10-05-2018	NONE	
JP 2003193961 A	09-07-2003	JP 3869718 B2	17-01-2007
		JP 2003193961 A	09-07-2003
GB 1585482 A	04-03-1981	AU 3349278 A	30-08-1979
		DE 2806523 A1	24-08-1978
		FR 2381187 A1	15-09-1978
		GB 1585482 A	04-03-1981
		JP S5452306 A	24-04-1979
		NL 7801856 A	22-08-1978
		ZA 78925 B	31-01-1979
		ZM 2178 A1	21-12-1978

EPO FORM P0459

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