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

(11) **EP 1 806 215 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.07.2007 Bulletin 2007/28

(51) Int Cl.:
B28C 5/12 *(2006.01)* ***B28C 7/04*** *(2006.01)*

(21) Application number: **06126813.2**

(22) Date of filing: **21.12.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **06.01.2006 IT MO20060177**

(71) Applicant: **O. Cuoghi di Cuoghi Manuela, Paola E.C.-S.A.S.**
41100 Modena (IT)

(72) Inventor: **Cadore, Roberto**
40014, CREVALCORE BO (IT)

(74) Representative: **Modiano, Micaela Nadia**
Modiano Gardi Patents SAS
Via Meravigli 16
20123 Milano (IT)

(54) **Mixing assembly for concrete preparation systems and associated method**

(57) A mixing assembly (100) for systems for preparing concrete, comprising a mixing tank (2) provided with mixing elements (3), at least one loading inlet (4) for introducing binders in powder form, at least one loading inlet (5) for introducing dosage water, a mixing pump (10) for mixing the content of the mixing tank, and a management and control unit which comprises memory means programmed to check the loading and unloading of the concrete components.

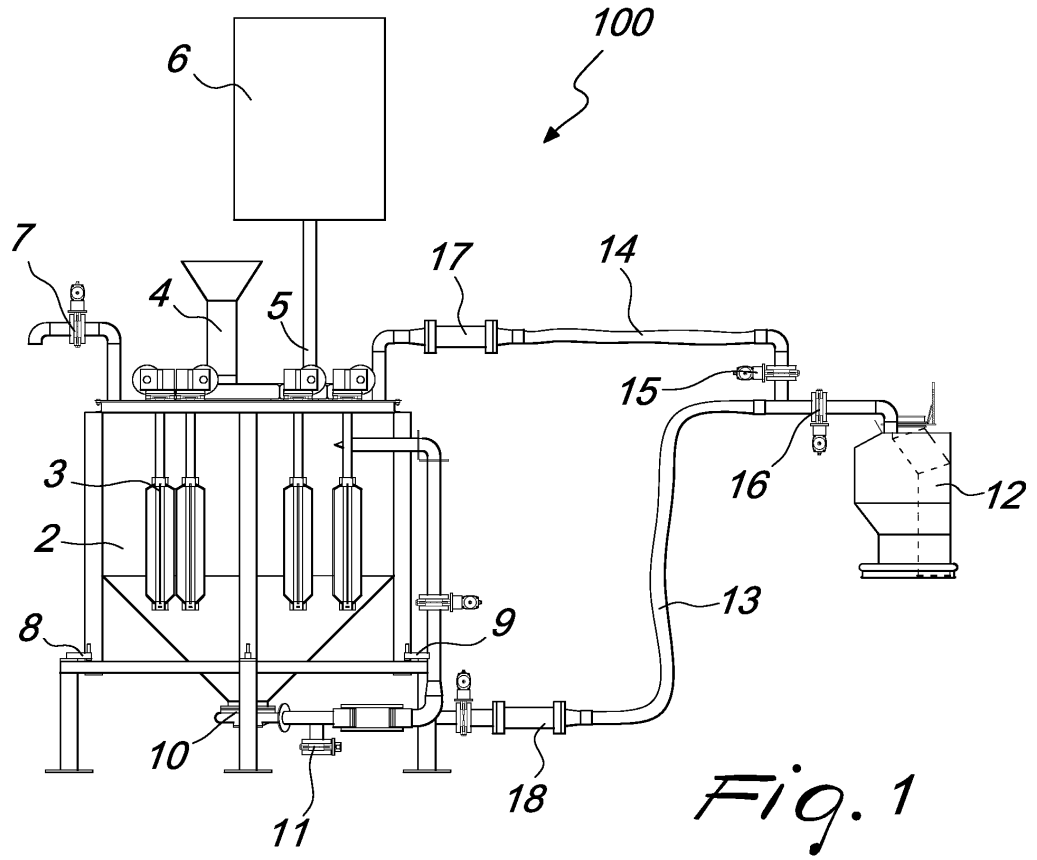

Fig. 1

EP 1 806 215 A2

Description

[0001] The present invention relates to a mixing assembly for concrete preparation systems and to the associated method. More particularly, the invention relates to a mixing assembly for concrete preparation systems and to a method which allow to prepare concrete regardless of the ratio between residual water and the binder during the preparation of the cement paste.

[0002] Systems for producing cement conglomerates to be transported, generally by means of mixer trucks, to building yards for subsequent pouring are known.

[0003] These systems substantially consist of independent units for taking and feeding the individual components (water, cement and aggregates) and optionally additives toward a discharge front, at which the loading inlet of a mixer truck is positioned.

[0004] The components are introduced in the mixer truck, where they are mixed according to preset stoichiometric quantities.

[0005] These systems have problems due mainly to the leakage of dust during the transfer and discharge of the cement and therefore require the presence of powerful suction and air treatment systems in order to reduce atmospheric pollution in the neighboring areas.

[0006] In order to obviate these problems, systems are further known which provide for the preliminary preparation of a cement grout or paste within mixers provided with mixing chambers which are fed with stoichiometric quantities of water, cement and any additives.

[0007] Assemblies for weighing the water and the cement are provided upstream of said mixers and allow to introduce preset doses of the various components within the mixing chamber.

[0008] The grout and the aggregates are sent separately to the discharge front, at which they are released into mixer trucks or the like, inside which they are mixed in order to form concrete.

[0009] Moreover, the operation of these systems is discontinuous; the working cycle of the mixer is in fact composed of an initial step for weighing the components to be introduced, a subsequent step for feeding the chamber and for mixing water, cement and additives, and a final step for discharging said chamber.

[0010] These systems are susceptible of improvements, since they have rather long cycle times and therefore allow to achieve a relatively low hourly production rate.

[0011] A system is also known which provides for a mixer which comprises an assembly for weighing the liquid vehicle, the binding material and the grout, which is included in the mixer itself and is associated with the loading inlets of the mixer.

[0012] The method that can be implemented in known types of system entails a step for the dosage of aggregates and the detection of the humidity that is present, a step for the dosage of the residual water to be sent to the mixer, where the expression "residual water" references the water which is set in the concrete preparation formula, minus the water contained in the aggregates; this is then followed by the step for dosing additives in the mixer, dosing the binder, mixing, and finally controlled feeding of the cement paste to the loading point of the mixer truck.

[0013] However, with the operating method described above it is not possible to ensure that it will be possible to mix the cement paste if the ratio between the residual water (understood as the difference between the water set in the concrete preparation formula and the water contained in the aggregates) and the binder provided in the formula is lower than a given value, in general on the order of 0.3. Therefore, there is an alarm which is capable of warning the operator that the system, in the presence of a ratio which is lower than the set value, is unable to mix and therefore the operator should add the missing water until the preset ratio is reached in order to achieve correct operation of the system in this condition. Accordingly, the technical characteristics of the resulting concrete would of course be penalized. As an alternative, since it is not possible to premix the water and the binder in such conditions of inadequate ratio within the mixer, the operator should load the mixer truck in a conventional manner, i.e., by sending all the components, aggregates, binder, water, additives, directly to the mixer truck.

[0014] The aim of the present invention is to provide a mixing assembly for systems for producing concrete which allows to produce concrete in an automated manner, in any condition of ratio between residual water and binder provided in the concrete preparation formula.

[0015] Within this aim, an object of the present invention is to provide a mixing assembly for systems for preparing concrete which uses recycled water together with clean water.

[0016] Another object of the present invention is to provide a method for providing concrete which allows to obtain the concrete from the system cited above, regardless of the ratio between residual water and binder provided in the concrete preparation formula.

[0017] Another object of the present invention is to provide a mixing assembly and a method which are highly reliable, relatively simple to provide and at competitive costs.

[0018] This aim and these and other objects, which will become better apparent hereinafter, are achieved by a method for preparing concrete which comprises the steps of:

dosing aggregates and detecting humidity that is present in said aggregates;

dosing residual water to be sent to the mixing tank of a mixing assembly for systems for preparing concrete, said residual water being determined by the water set in the concrete preparation formula minus the water contained in said aggregates;

dosing additives in said mixing tank;

dosing binders in said mixing tank;

mixing; and

sending in a controlled manner the resulting cement paste to a loading point of a mixer truck, characterized in that it comprises, before the step for dosing aggregates and detecting the humidity that is present, a step of introducing, for each concrete preparation formula, a residual water/binder ratio in order to achieve correct mixing in the mixing tank.

[0019] This aim and these and other objects which will become better apparent hereinafter are also achieved by a mixing assembly for systems for preparing concrete, which comprises a mixing tank provided with mixing elements, at least one loading inlet for introducing binders in powder form, at least one loading inlet for introducing dosage water, a mixing pump for mixing the content of said mixing tank, characterized in that it comprises a management and control unit which comprises memory means programmed to perform the steps of the method described above.

[0020] Further characteristics and advantages of the invention will become better apparent from the following detailed description of a preferred but not exclusive embodiment of the mixing assembly according to the present invention and of the corresponding method, illustrated by way of nonlimiting example in the accompanying drawings, wherein:

Figure 1 is a side elevation view of the mixing assembly for systems for producing concrete according to the present invention;

Figure 2 is a top plan view of the mixing assembly shown in Figure 1;

Figure 3 is a flowchart of the method for preparing concrete according to the present invention;

Figure 3a is a flowchart of the continuation of the method shown in Figure 3;

Figure 4 is a top plan view of a system for producing concrete which uses a mixing assembly according to the present invention.

[0021] With reference to the figures, a mixing assembly for systems for preparing concrete according to the present invention, generally designated by the reference numeral 100, comprises a mixing tank 2 which is provided with mixing elements 3, which are arranged within the tank in order to mix components introduced in said tank so as to obtain cement paste or grout. The mixing tank is provided with at least one first inlet 4 for introducing cement, at least one second inlet 5 for clean water which arrives from a clean water tank 6, and optionally a third inlet 7 for introducing recycled water.

[0022] The tank is conveniently supported on load cells 8 and 9, which allow to detect the weight of the material contained within the tank, taking into account the weight of the tank itself.

[0023] A mixing pump 10 is provided in order to mix the content of the tank, and conveniently the pump is of the type with a variable rotation rate; the rotation rate of the pump is selected for each type of concrete preparation formula that can be chosen.

[0024] The reference numeral 11 instead designates a discharge valve for the washing water at the end of the work shift, i.e., after the tank has been washed after preparing the cement paste.

[0025] The cement paste thus prepared is sent to a hopper 12 for loading a mixer truck, not shown.

[0026] The cement paste is then sent by means of the line 13 to the loading hopper 12 of the mixer truck and can be returned to the mixing tank 2 by means of the line 14, after opening an opening/closure return valve 15, in case of clogging or suspension of the loading process.

[0027] The reference numeral 16 instead designates a proportional valve for discharging the cement paste to the hopper 12. Accordingly, the cement paste is discharged proportionally and in case of clogging or suspension of the loading process the valve 15 is opened and the valve 16 is closed in order to allow to return the cement paste, by means of the line 14, into the mixing tank 2.

[0028] The reference numerals 17 and 18 designate two concertina sleeves, arranged respectively at the line 13 and at the line 14, for rendering the weighing system obtained by the load cells 8 and 9, which weigh the mixing tank 2, independent of the amount of any cement paste in the lines 13 and 14 and of the weight of the lines themselves.

[0029] The reference numeral 20 designates the motor drive of the mixing pump 10 and the reference numeral 21 designates a washing system for the mixing tank 2.

[0030] Conveniently, the mixing assembly 100 can be installed in an existing system for preparing concrete or in a newly provided one.

[0031] In any case, as shown schematically in Figure 4, the system, generally designated by the reference numeral 200, provides a first assembly 201 for storing aggregates, which is provided with a system for weighing the amount of aggregates discharged into a collecting tank and a first assembly 202 for feeding the discharged aggregates toward a discharge front 203, which is arranged at the loading inlet of a mixer truck, which is not shown since it is of a known type. The tank for collecting the discharged and weighed aggregates is provided generally with conventional sensors for detecting the residual humidity.

[0032] The system 200 further has a second assembly 204 for storing the binder in powder form (cement), a second assembly 205 for feeding the binder in powder form toward the discharge front 202, along which a weighing assembly 206, such as a balance, is arranged, and a third assembly 207 for feeding the binder toward the first inlet 4 of the mixing assembly 100. In an alternative embodiment, the first portion 205a of the second feeding assembly, interposed between the second storage assembly and the balance, and the third feeding assembly 207 might be integrated.

[0033] Advantageously, the mixing assembly 100 is provided with a management and control unit which comprises memory means programmed to perform the steps of the method described hereinafter. Such management and control unit, typically of the electronic type, is not shown in the figures since it is of a traditional type.

[0034] The method for using the mixing assembly, and more precisely the system in which the mixing assembly according to the present invention is installed, is as follows.

[0035] The method provides for a step 200 for starting the cycle, which is followed by a step 201 for selecting the desired formula of the concrete and the required components. This is followed by a step 202 which checks whether the volume of the required components is lower than a minimum volume of required components. If the answer is affirmative, this is followed by a step 203 in which the cycle is declared not executable by means of the mixing assembly according to the invention (indicated by the acronym CHTT in the figures) and therefore the intervention of the operator is required to cancel or change the required components or to proceed with execution without automatic mixing by means of the mixing assembly according to the invention.

[0036] If the answer is instead negative, the process moves from step 202 to a step 204 for calculating the quantities for aggregates, binders in powder form, liquid additives, and total water.

[0037] This is followed by a step 205 for dosing the aggregates, which is followed by a step 206 for detecting the humidity in the aggregates.

[0038] This step is followed by a step 207 for calculating the water that is available in the mixing tank 2, which is provided by the total water minus the sum of the water that is present in the aggregates and of the washing water, i.e., the water that is retained and reintroduced during discharge in the cement paste.

[0039] Step 207 leads to a step 208 for checking the ratio of available water with respect to binders in powder form, in order to check whether the ratio is lower than the minimum limit provided in the formula, said limit being possibly variable depending on the formula.

[0040] If the answer is affirmative, this is followed by a step 209 for calculating the amount of binder in powder form to be dosed in the balance 206 of the cement, without sending it to the mixing assembly 100, and this is followed by a step 210 for dosing the excess amount of binders in powder form in the cement balance.

[0041] In case of a negative answer to step 208, the process continues instead, as occurs following the step 210, with a step 211 for dosing water in the mixing tank 2.

[0042] Simultaneously, a step 212 branches out from step 210 in order to recalculate the amount of aggregates on the basis of the water content detected by the humidity detectors provided in the aggregates collection tank; this is followed by a step 213 for ending the dosage of the aggregates.

[0043] Step 211 then leads to step 214 for dosing and introducing liquid additives, a step 215 for dosing binders in powder form in the mixing tank, and finally a step 216 for mixing the cement paste in the mixing tank 2.

[0044] At this point, the cement paste is ready for loading in the mixer truck, step 217, followed by the step 218 for beginning the loading of the mixer truck.

[0045] This loading step occurs with a step 219 for loading aggregates by means of conveyor belts, which is followed by a step 220 for checking for clogging or emergency, which in case of an affirmative answer leads to a halting step 221, which thus returns to step 219.

[0046] If the answer is instead negative, the process proceeds with step 221a for ending the loading of the aggregates.

[0047] At the same time, a step 222 for loading cement paste which arrives from the mixing tank 2 to the mixer truck and a step 223 for checking for clogging or emergency are performed; in this last step, following a positive answer, a halting step 224 is performed which returns to step 222 (acting so as to open the valve 15 and close the valve 16).

[0048] If instead the answer is negative, the process proceeds with a step 225 for checking for uneven reduction with aggregates and binders in powder form. An affirmative answer to this step is followed by a step 226 for adjusting the speed of the delivery of the cement paste, which returns to step 222.

[0049] If instead the answer is negative, the process proceeds to a step 227 which requests whether it is necessary to perform an intermediate wash. If the answer is affirmative, this is followed by a step 228 for performing an intermediate washing cycle which returns to step 222.

[0050] If the answer is negative, one instead proceeds with a step 229 for checking the end of the loading of the cement paste. If the answer is negative, the process returns to step 222, whereas a positive answer leads to a step 230 for final washing of the mixing tank and then to a cycle end step 231, which is also reached from step 221.

[0051] Conveniently, a proportional load of aggregates and cement paste to the mixer truck is insured so that the components mix uniformly in order to obtain a concrete which has high-level chemical and physical properties.

[0052] The mixer truck can also be loaded in steps or by varying the speed of the binder in powder form which is dosed in the dosage unit of the cement provided with a screw feeder, step 232. This step is followed by a step 233 for checking for clogging or emergency, which is followed, in case of a positive answer, by a halting step 234 which returns to step 232.

[0053] If the answer is instead negative, the process has a step 235 for checking the end of the loading of the binder in powder form, which is followed, in case of negative answer, by a return to step 232 and, if the answer is positive, by continuation up to the cycle end step 231.

[0054] Substantially, the method according to the invention provides a step of introduction for each concrete preparation formula of a residual water/hydraulic binder

ratio for proper mixing of the mixing tank.

[0055] Further, the residual water is checked in order to determine whether said water is less than the minimum residual water/binder ratio set initially in the formula of the concrete; at this point a dosage of residual water and a dosage of binder is performed which complies with the residual water/binder ratio set in the formula, with this ratio which, as mentioned, ensures the proper operation of the system.

[0056] The cement paste obtained by the system is sent to the mixer truck simultaneously with the aggregates, and if there is an amount of binding powder which has been sent to the balance, this last amount of powder also is sent in steps to the loading of the mixer truck in order to obtain, in this case also, perfect distribution of the cement powder (or other powders) on the entire mass of the aggregates and in the cement paste.

[0057] In practice it has been found that the system and method according to the invention fully achieve the intended aim and objects, since they allow to make the residual water/binder ratio independent of a given formula and instead introduce for each formula a ratio which is adequate to obtain a good mixing in the mixing tank.

[0058] Further, the system according to the invention provides for varying the rotation rate of the mixing pump depending on the type of formula used at that given time for preparing the cement paste.

[0059] The system and method thus conceived are susceptible of numerous modifications and variations, all of which are within the scope of the appended claims; all the details may further be replaced with other technically equivalent elements.

[0060] In practice, the materials used, as well as the contingent shapes and dimensions, may be any according to requirements and to the state of the art.

[0061] The disclosures in Italian Patent Application No. M02006A000177 from which this application claims priority are incorporated herein by reference.

[0062] 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 method for preparing concrete, comprising the steps of:

   dosing aggregates and detecting the humidity that is present in said aggregates;
   dosing residual water to be sent to the mixing tank of a mixing assembly for systems for preparing concrete, said residual water being determined by the water set in the concrete preparation formula minus the water contained in said aggregates;
   dosing additives in said mixing tank;
   dosing binders in said mixing tank;
   mixing; and
   sending in a controlled manner the resulting cement paste to a loading point of a mixer truck, **characterized in that** it comprises, before the step of dosing aggregates and detecting the humidity that is present, a step of introducing, for each concrete preparation formula, a residual water/binder ratio in order to achieve correct mixing in the mixing tank.

2. The method according to claim 1, **characterized in that** it comprises, after the step of dosing the aggregates and detecting the humidity that is present, a step of verifying the residual water, in order to check whether said residual water is less than the minimum residual water/binder ratio set initially in the concrete preparation formula.

3. The method according to claim 1 or 2, **characterized in that** the step of dosing the binder in said mixing assembly is performed until the residual water/binder ratio set in the concrete preparation formula is met.

4. The method according to one or more of claims 1 to 3, **characterized in that** it comprises a step of dosing any residual binder directly in the binder balance with which the concrete production system is provided.

5. The method according to one or more of claims 1 to 4, **characterized in that** it comprises a step for sending an amount of binding powder to said balance, said amount of powder being sent in steps or at a variable rate to the loading point of the mixer truck, in order to obtain an optimum distribution of the powder on the entire mass of the aggregates and of the cement paste.

6. A mixing assembly for systems for preparing concrete, comprising said mixing tank provided with mixing elements, at least one loading port for introducing binder in powder form, at least one loading inlet for introducing dosage water, a mixing pump for mixing the content of said mixing tank, **characterized in that** it comprises a management and control unit which comprises memory means programmed to perform the steps of the method according to one or more of claims 1 to 5.

7. The mixing assembly according to claim 6, **characterized in that** said mixing pump is a mixing pump with a variable and controllable rotation rate.

8. The mixing assembly according to claim 6 or 7, **char-**

acterized in that it comprises at least one inlet for recycled water which is suitable to be dosed within said mixing tank.

9. The mixing assembly according to one or more of claims 6 to 8, **characterized in that** it comprises load cells which are suitable to allow the weighing of the content of said mixing tank.

10. The mixing assembly according to one or more of claims 6 to 9, **characterized in that** it comprises a system for washing said mixing tank.

11. The mixing assembly according to one or more of claims 6 to 10, **characterized in that** it comprises a clean water tank which is suitable to be dosed into said clean water inlet in said mixing tank.

12. A system for preparing concrete, **characterized in that** it comprises at least one mixing assembly according to one or more of claims 6 to 11.

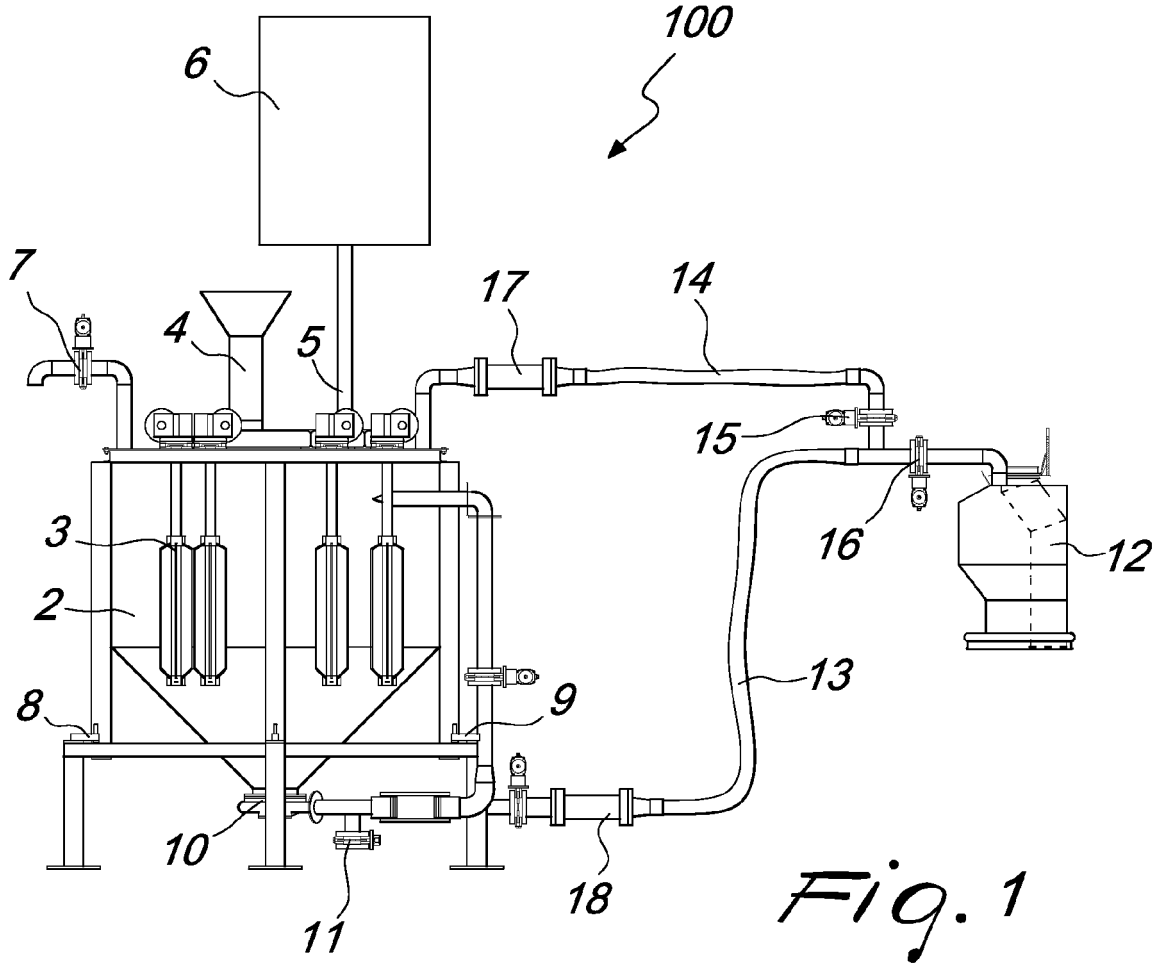
100
6
7
4
5
17
14
15
16
12
3
2
13
8
9
10
18
11

Fig. 1

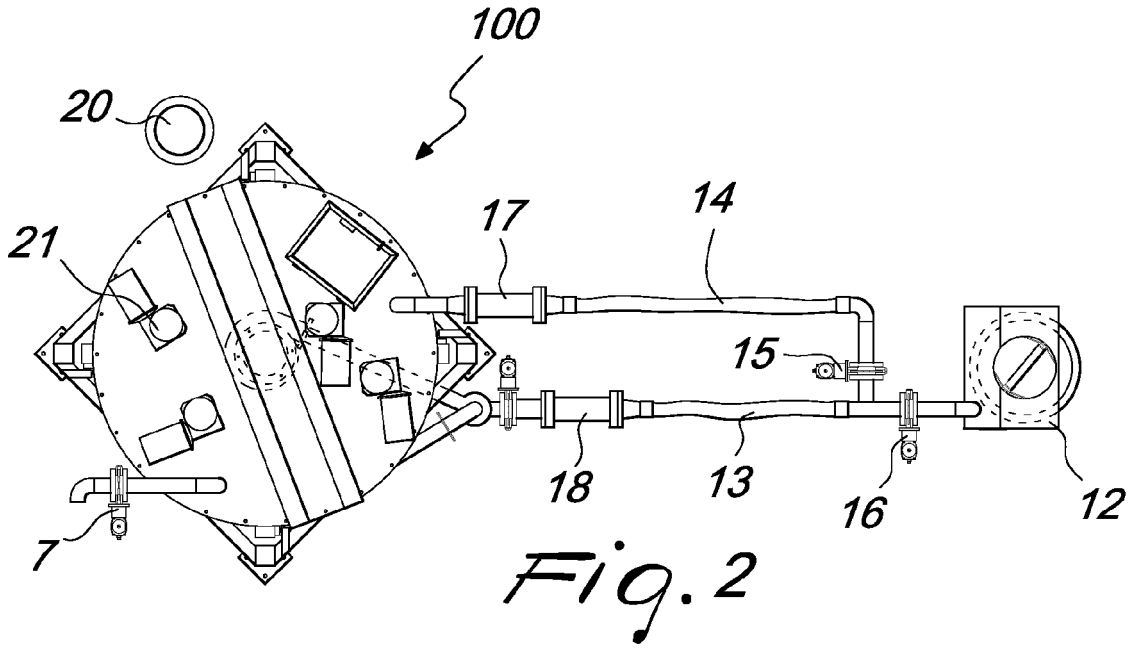
100
20
21
17
14
15
18
13
16
12
7

Fig. 2

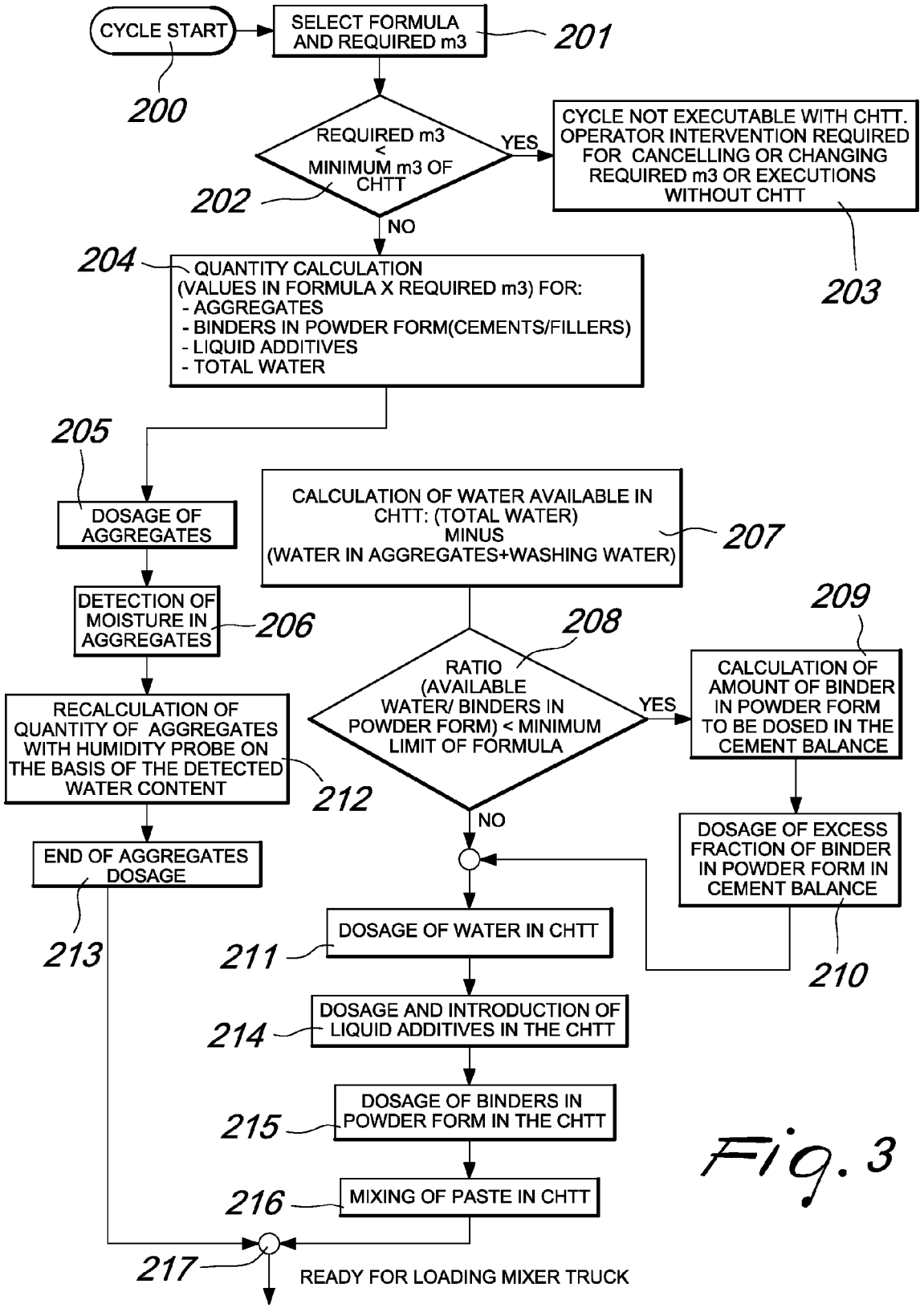
CYCLE START
200
SELECT FORMULA AND REQUIRED m3
201
REQUIRED m3 < MINIMUM m3 OF CHTT
202
YES
CYCLE NOT EXECUTABLE WITH CHTT. OPERATOR INTERVENTION REQUIRED FOR CANCELLING OR CHANGING REQUIRED m3 OR EXECUTIONS WITHOUT CHTT
203
NO
204
QUANTITY CALCULATION (VALUES IN FORMULA X REQUIRED m3) FOR:
- AGGREGATES
- BINDERS IN POWDER FORM(CEMENTS/FILLERS)
- LIQUID ADDITIVES
- TOTAL WATER
205
DOSAGE OF AGGREGATES
DETECTION OF MOISTURE IN AGGREGATES
206
RECALCULATION OF QUANTITY OF AGGREGATES WITH HUMIDITY PROBE ON THE BASIS OF THE DETECTED WATER CONTENT
212
END OF AGGREGATES DOSAGE
213
CALCULATION OF WATER AVAILABLE IN CHTT: (TOTAL WATER) MINUS (WATER IN AGGREGATES+WASHING WATER)
207
208
RATIO (AVAILABLE WATER/ BINDERS IN POWDER FORM) < MINIMUM LIMIT OF FORMULA
YES
209
CALCULATION OF AMOUNT OF BINDER IN POWDER FORM TO BE DOSED IN THE CEMENT BALANCE
DOSAGE OF EXCESS FRACTION OF BINDER IN POWDER FORM IN CEMENT BALANCE
210
NO
DOSAGE OF WATER IN CHTT
211
DOSAGE AND INTRODUCTION OF LIQUID ADDITIVES IN THE CHTT
214
DOSAGE OF BINDERS IN POWDER FORM IN THE CHTT
215
MIXING OF PASTE IN CHTT
216
217
READY FOR LOADING MIXER TRUCK

Fig. 3

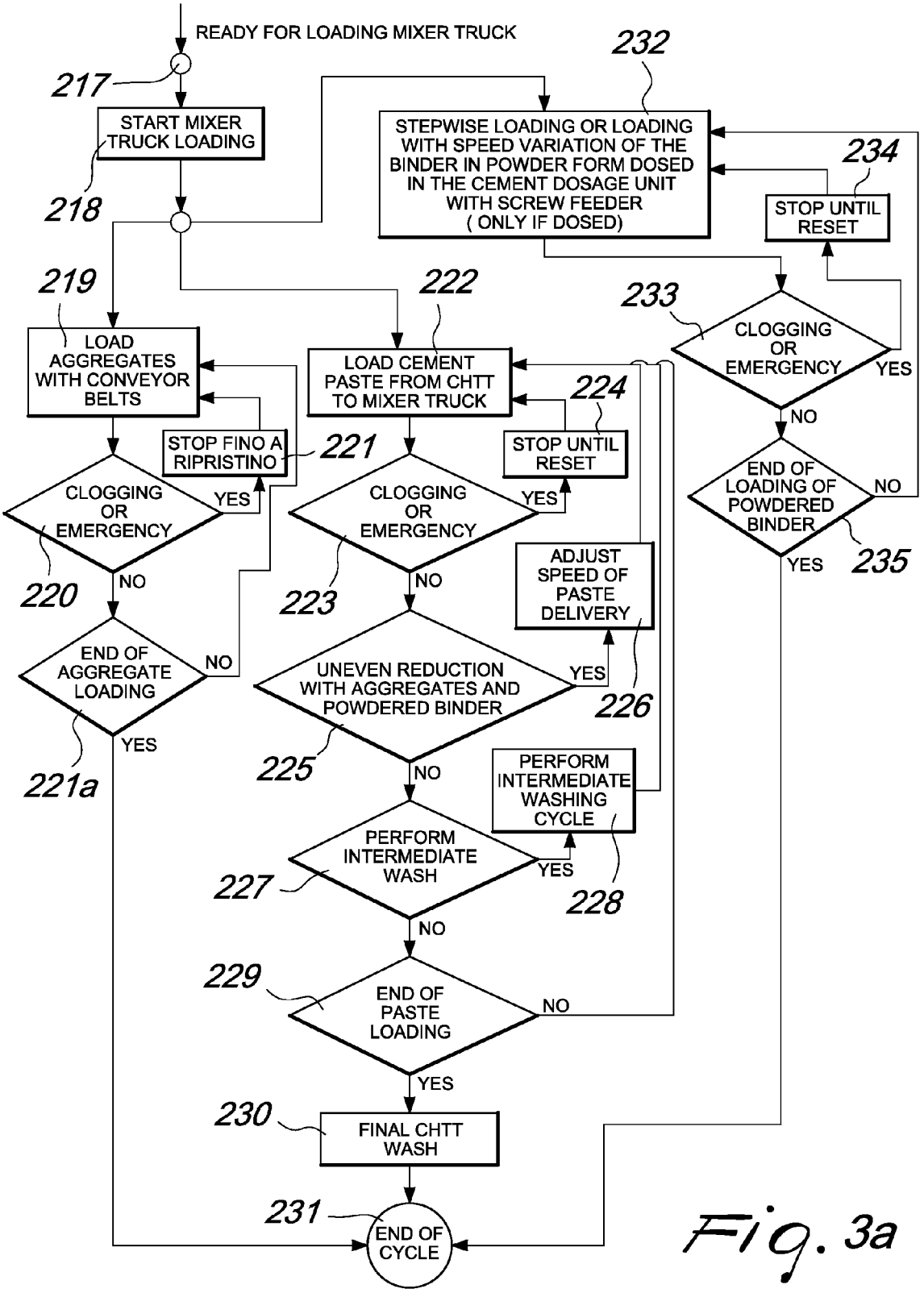
READY FOR LOADING MIXER TRUCK
217
START MIXER TRUCK LOADING
218
219
LOAD AGGREGATES WITH CONVEYOR BELTS
STOP FINO A RIPRISTINO
221
CLOGGING OR EMERGENCY
YES
NO
220
END OF AGGREGATE LOADING
NO
YES
221a
222
LOAD CEMENT PASTE FROM CHTT TO MIXER TRUCK
224
STOP UNTIL RESET
CLOGGING OR EMERGENCY
YES
NO
223
ADJUST SPEED OF PASTE DELIVERY
UNEVEN REDUCTION WITH AGGREGATES AND POWDERED BINDER
YES
226
NO
225
PERFORM INTERMEDIATE WASHING CYCLE
PERFORM INTERMEDIATE WASH
YES
227
228
NO
229
END OF PASTE LOADING
NO
YES
230
FINAL CHTT WASH
231
END OF CYCLE
232
STEPWISE LOADING OR LOADING WITH SPEED VARIATION OF THE BINDER IN POWDER FORM DOSED IN THE CEMENT DOSAGE UNIT WITH SCREW FEEDER (ONLY IF DOSED)
234
STOP UNTIL RESET
233
CLOGGING OR EMERGENCY
YES
NO
END OF LOADING OF POWDERED BINDER
NO
YES
235

Fig. 3a

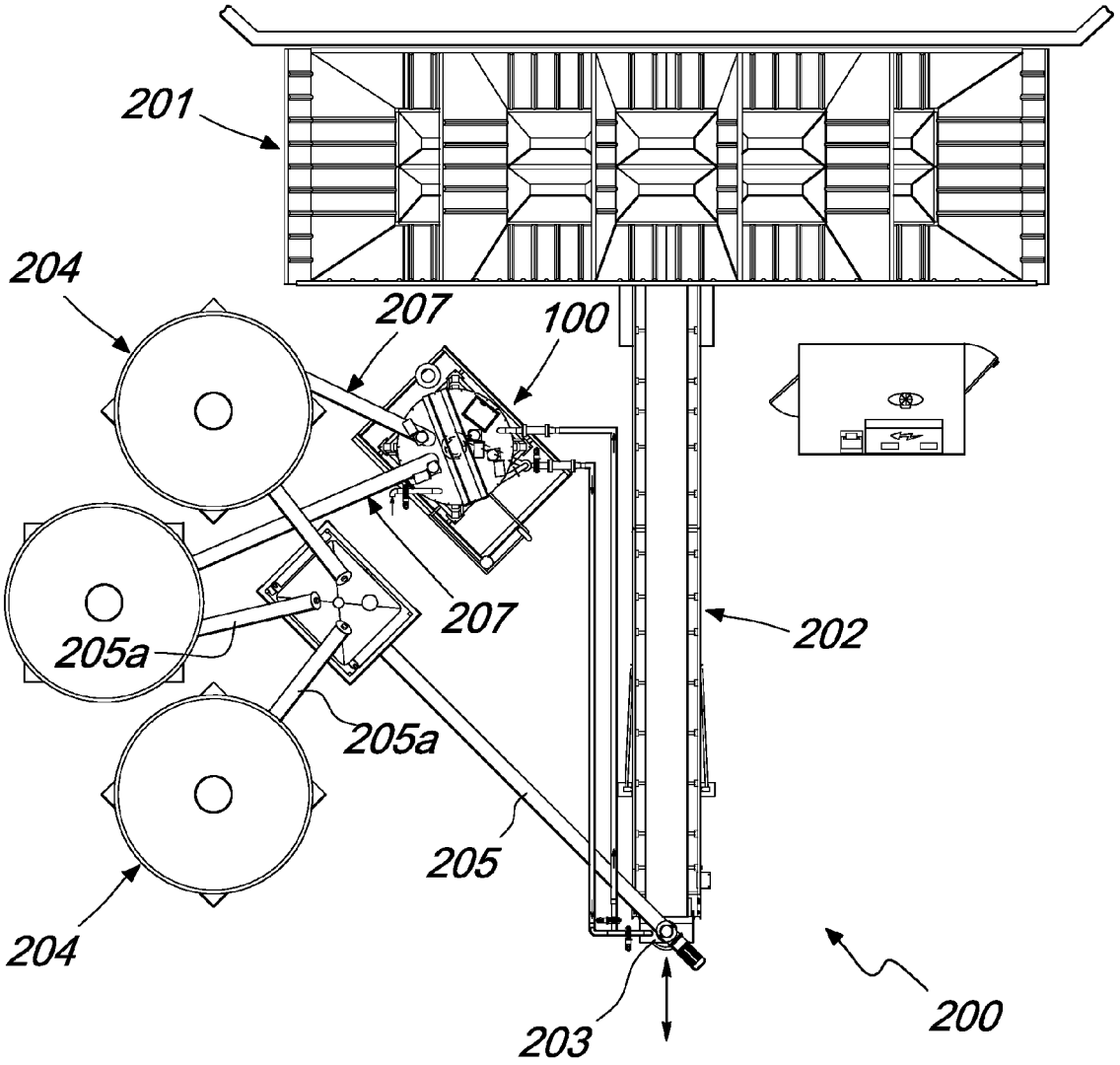

Fig. 4

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- IT M02006000177 A **[0061]**