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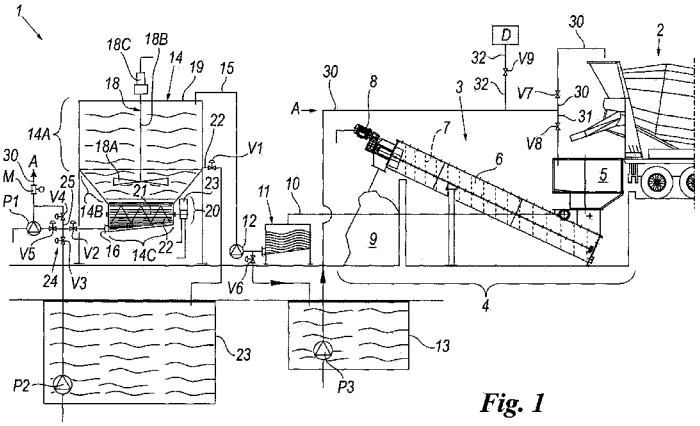


Fig. 1

(57) Abstract: A plant for treating slurries deriving from the washing of concrete mixers (2), comprising a separator (3) provided with a first tank (5) for receiving the discharge liquid of a concrete mixer (2), said receiver tank (5) being coupled to first means (6) for mechanically separating the coarse residues contained in the discharge liquid, and an accumulation tank (23) for a treated liquid, an aperture of said first tank (5) being disposed in fluid passage connection with an inlet of a decantation tank (14), the decantation tank (14) presenting at least a first zone (14A) for accumulating treated liquid substantially free of suspended particles, a second zone (14C) for accumulating slurry formed from sedimented particles, and a hopper shaped intermediate zone (14B) arranged to interconnect the first (14A) and second (14C) zone, said intermediate zone (14B) and said second zone (14C) presenting respective first (18) and second (20) stirrer means arranged to prevent the particles present in said zones from agglomerating, said first zone (14A) comprising a treated liquid outlet (22) intercepted by first valve means (V1), connected to said purified liquid accumulation tank (23), said second zone (14C) comprising a slurry discharge intercepted by second valve means (V2), said slurry discharge being connected to the suction side of a first pump (P1) the delivery side of which is connected to a loading line (30), said loading line (30) comprising a branch (32) for feeding a concrete production plant (D), a mass flowmeter (M) being present loading line (30).

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PLANT FOR TREATMENT OF SLURRIES DERIVING FROM WASHING OF CONCRETE MIXERS

DESCRIPTION

The present invention relates to a plant for treating slurries deriving from washing of concrete mixers and to the relative method.

More particularly, it relates to a plant for totally recovering the waste deriving from the process of washing concrete slurries from concrete mixers, with feedback of recycled waste to the productive cycle.

It is particularly aimed at sites with medium high production, provided with about ten truck-mounted concrete mixers. In such sites, each concrete mixer on its return presents a waste concrete concentration varying from 0.5 to 0.2 cubic metres per concrete mixer. Over the whole day, considering ten truck-mounted concrete mixers, about 4000 kg of waste is hence produced with a particle size up to a few millimetres, with the use of about 2000 litres of water to wash each concrete mixer.

Essentially, each truck-mounted concrete mixer discharges the wash liquid into a receiver tank associated with an inclined rotating conveying screw within the tank, which directly separates about 50% of the heavy materials contained in the liquid poured in. Hence only about 2000 kg of the 4000 kg of solid material discharged by the concrete mixers are recovered.

The remaining liquid part, which presents in suspension a large quantity of particles of different sizes, is conveyed into appropriate tanks fitted with stirrers and pumps. These pumps withdraw the

water mixed with particles and return it into the productive cycle (to load a new concrete mixer for example).

This latter loading part is done without effective control of the percentages of solid present in the water returned to the cycle.

In addition, the solids present in the water differ during the day.

Moreover, with current waste processing systems about two washes per day have to be carried out by the pumps; each wash uses about 2000 litres, for a total of 4000 litres. Each of these wash cycles "removes" about 0.5 cubic metres of concrete (hence about 4000 kg of concrete considering the presence of two pumps). Essentially during the day about 24,000 litres of water are used and 8000 kg of waste are produced, of which only about 4000 kg are effectively separated.

Hence current cycles evidently perform poorly, using large and subsequently lost water quantities and recovering only a minimum part of the solid material present in the concrete mixers.

Moreover it should be noted that the water recycled with current systems is fed back into the concrete mixers at the new loading.

Consequently when water is withdrawn from the storage and recycling tanks the values read by the meters do not faithfully mirror the real water quantity fed into the concrete mixer given that the percentage of solids present in the flow is ignored or in any event is considerably variable on the basis of the various times throughout the day and of the concrete mixer loading characteristics.

Document WO94/17917 describes an apparatus for treating effluent

waters comprising a tank for the discharge water, and a first sedimentation tank into which this discharge water is fed. The cleaned water is transferred to a second tank while the solid part is transferred to a third tank.

An object of the present invention is to provide a plant for treating slurries deriving from the washing of concrete mixers which represents a better-performing improvement on those of the known art.

A particular object of the present invention is to provide a plant which is able to accumulate large percentages of treated water free of suspended particles, which can then be used and metered with precision.

A further object of the present invention is to separate a greater quantity of solids than the known art, un such a manner as to be able to precisely control its metering and its return to the cycle.

These and other objects are attained by a plant for treating slurries deriving from the washing of concrete mixers, constructed in accordance with the technical teachings of the accompanying claims.

Further characteristics and advantages of the invention will be apparent from the description of a preferred but non-exclusive embodiment of the plant, illustrated by way of non-limiting example in the accompanying drawings, in which:

Figure 1 is a simplified schematic view of the plant according to the present invention, applied to already existing treatment areas;

Figure 2 is a schematic view of the plant according to the present

invention in an embodiment different from that of Figure 1; and

Figure 3 is a variant of the plant of Figure 2.

With reference to said figures, these show a plant for treating slurries deriving from the washing of concrete mixers 2, indicated overall by the reference numeral 1.

It comprises a separator 3, suitably arranged on a masonry support structure 4. The separator 3 is provided with a first receiver tank 5 for the wash liquid discharged from the concrete mixer 2. Essentially the concrete mixer 2 arriving from the site is loaded with wash liquid (the method is described hereinafter) and, after the necessary wash time has elapsed, this liquid is slowly emptied into the receiver tank 5.

As can be seen from the drawing, the tank 5 is shaped as a hopper and presents at its base a mechanical separation means for the coarser (and hence heavier) slurry present in the wash liquid.

The mechanical separation means in this case comprises a conveying screw 7 mounted within a casing 6 disposed with its axis diagonal.

The conveying screw is rotated by a suitable motor 8. The coarse material (of diameter greater than 0.6 mm) which precipitates immediately onto the base of the tank 5 is raised by the conveying screw 7 and discharged into a zone 9 for accumulating recovered solid material.

The tank 5 comprises an aperture (weir) from which water, free of very heavy particles but in which a large quantity of particles of

diameter less than 0.6 mm are suspended, is conveyed by falling, through a line 10, to a transition tank 11 coupled to a suitable loading pump 12.

The transition tank is an intermediate passage, the only purpose of which is to not allow the pump 12 to intake directly from the tank 5. In this respect, the vortices created by the pump suction would convey into the water flow on its delivery side a large quantity of suspended particles, including large-dimension, which could instead be separated by the separator.

Instead of the intermediate tank, a tank for recovering effluent water from the yard could, if present, be used for the same purpose, such as that shown in the figure and indicated by the reference numeral 13.

The intermediate tank, in the configuration illustrated in Figure 1, presents a sixth valve V6 which controls the overflow and discharges any excess liquid into the effluent water recovery tank 13.

It is used if there is an overflow situation in a decantation tank 14, described hereinafter.

The loading pump 12 has its delivery connected to a feed line 15 of the decantation tank 14.

Essentially the line 10, the feed line 15, the intermediate tank 11 and the loading pump 12 represent means adapted to place the first tank into fluid passage connection with the inlet of the decantation tank 14.

The decantation tank 14 presents a first accumulation zone 14A for

treated liquid substantially free of suspended particles. It is preferably of cylindrical shape of constant circular, square or rectangular cross-section.

Advantageously it is constructed of structural steel with galvanized walls for corrosion protection.

Below the first zone there is a second accumulation zone 14C for slurry formed from sedimented particles.

This zone is constructed for example of stainless steel, and is suitably shaped (as shown in the figure) to enable the slurry accumulated by decantation to be conveyed towards a discharge 16.

The adjustable tank seals are appropriately designed to maintain air-tightness, the supports for the external shafts not being in contact with the slurry.

The first and second zone are interconnected by a hopper-shaped intermediate zone 14B.

First and second stirrer means are provided respectively in the intermediate zone and in the second zone.

The first stirrer means 18 comprises substantially an impeller 18A mounted on a vertical shaft 18B and rotated by a suitable geared motor 18C. The first stirrer 18 is fixed to a walkway 19, to which access is gained by a marine ladder (not shown).

The second stirrer 20, positioned in the second zone 14C, is formed from a pair of horizontal mixing shafts 21 to which suitably dimensioned blades 21 are applied, inclined in the opposite direction to the shaft drive motors 23.

Advantageously the shafts are easily accessible via access manholes for their extraction and via lateral inspection holes.

Essentially, on being time-set and rotated as required, the stirrer means prevent the particles/slurry present in the second zone and in the intermediate zone from undergoing sedimentation and mutual agglomeration.

The vertical stirrer is obviously dimensioned to move water highly charged with particles, with the opposing propeller system of the horizontal mixer not allowing slurry agglomeration on the bottom.

In completing the description of the decantation tank it should be noted that the first zone comprises an outlet 22 for treated liquid (i.e. substantially free of solid particles), suitably intercepted by first valve means V1.

The outlet 22 is positioned at the interconnection between the first zone 14A and the intermediate zone 14B, in particular at the beginning of the intermediate zone 14B.

The outlet 22 is connected to a purified liquid accumulation tank 23. In the example of Figure 1, this accumulation tank is installed underground, however it will be seen hereinafter that it can assume different configurations and positions and can for example be configured as a tanker.

The second zone also comprises a slurry discharge 16, this discharge being intercepted by second valve means V2.

As can be seen from the drawing, the slurry discharge 16 is connected to the suction side of a first pump P1, the delivery side of

which is connected to a loading line 30. The loading line 30 presents a branch 32 intercepted by a suitable valve means V9, which diverts the fluid present therein to metering for a concrete production plant. The loading line 30 proceeds downstream of the branch 32 towards the concrete mixer via a valve V7.

A second pump P2 is also present with its suction side drawing from the treated liquid accumulation tank 23 and its delivery side also connected to the loading line 30.

As can be seen from the drawing, a mass flowmeter M, expressible in kg/h, for example of the Coriolis effect type, is provided on the loading line 30. In particular, the flow measurement based on the Coriolis effect generates a signal which is proportional to the mass flow rate, and is virtually independent of fluid properties, such as conductivity, pressure, viscosity or temperature. In particular, by means of two signals it transfers the percentages relative to the passage of the liquid mass and of the slurry to a control centre which by means of a suitable software programme is able to effect by precise metering the correct ratio of water, inerts and slurry without altering the quantity of the new concrete. In the figures, it is to be understood that the loading line 30, downstream of the meter M, indicated by the letter A, joins the loading line 30 at the point A which in the figure is in proximity to the motor 8.

Proceeding with the plant description, it can be seen that upstream of the mass flowmeter M, means 24 are provided for regulating the flow rate of said slurry and of said treated liquid withdrawn from said

accumulation tank.

In particular these flow regulator means comprise a mixing connection 25 provided with a first and second inlet which are coupled respectively to the second valve means V2 present in the slurry discharge 16 and to third valve means V3 present in a delivery line from the second pump P2 which draws from the accumulation tank 23.

A first and a second outlet of said mixing means are coupled respectively:

- to the loading line 30, upstream of the meter M and downstream of the pump P1 (via a fourth valve means V4), and
- to the inlet of the first pump P1 (via a fifth valve means V5).

By suitable regulation of the valves V2-V5 and gauged starting of the pumps P1 and P2, the following can be obtained at the loading line 30:

- only slurry (mainly intended for metering to the concrete production plant)
- only purified water (intended for loading the concrete mixer or for metering to the concrete production plant)
- a desired mix of slurry and purified water (mainly intended for metering to the concrete production plant).

Compared with the known art, this provides the undoubted advantage of completely eliminating slurry residues, by reusing them in known percentages for new production cycles, and of having high percentages of clarified water for reuse, for example in the tanks of

tank trucks/truck-loaded concrete mixers.

The plant according to the present invention is advantageously provided with a recycling line 31, intercepted by a suitable solenoid valve V8, arranged to deviate said loading line 30 into said receiver tank 5. A further solenoid valve V7 is also provided, required to operate the recycling line 31, downstream (concrete mixer side) of the branch between the loading line 30 and the recycling line 31.

In concluding the plant description it should be noted that the tank 13 for recovering the yard effluent water comprises a third pump P3 drawing therefrom, and having its delivery side connected to said concrete mixer loading line 30.

The main purpose of the pump P3 is to recycle the liquid present in the tank 13 into the discharge tank 5 (valves V4, V5 and V7, V9 closed, valve V8 open), to enable the effluent and discharge water to be treated by the plant. Before being fed to the tank 5, this liquid can be conveyed through a deoiler.

The plant operates in substantially the following manner.

A concrete mixer discharges its wash liquid content into the tank 5 and the liquid is pretreated by the separator, which eliminates its coarsest and heaviest particles by accumulating them at the conveying screw exit.

The liquid overflowing from the tank 5, still loaded with suspended particles, spills into the tank 11 from which it is pumped into the decantation tank 14. If the decantation tank is too full, it is conveyed into the effluent water tank 13 awaiting treatment.

On reaching the decantation tank 14 the liquid is left at rest to enable physical decantation of the solid materials (particles) by physical separation. At least 2 hours are required for this operation, but 6-7 hours are preferable.

The first zone 14A of the decantation tank 14 is then automatically emptied by opening the valve V1, to obtain clarified water equal to 80% of the content of the decantation tank 14.

At the level at which the outlet 22 is located, the tank 14 is provided with a level sensor which automatically closes the valve V1 when the level falls too far.

At this point only liquid charged with residues ad particles remains in the tank (about 8 cubic metres).

The process of maintaining the slurry in suspension to avoid its agglomeration is then commenced under the control of a PLC installed in a control panel on the machine. By driving the stirrers, which rotate deliberately in the two opposite directions, the slurry mass can be extracted without causing clogging of the appropriate extraction cone.

The described solenoid valve system, controlled by the PLC and interfaced with a mass flowmeter M, enables the quantity of slurry fed to the loading line 30 to be controlled on the basis of the percentage to be obtained, acting on the valves V2 and V3 (V4 is closed and V5 opened).

The mixed mixture is conveyed by the pump P1, which is of vortex type.

By virtue of the regulation by the PLC and the control by the flowmeter M a very low error margin on the mixture setting can be achieved (about 0.1% error).

Pipe cleaning to prevent incrustation or residue deposition is controlled by the PLC, which automatically provides for washing by acting on the valves V2-V5 and the pumps P1 and P2. For example pipe and pump washing is achieved by reusing the liquid in the tank 23. In the past, the accumulation tanks had instead to be drained and the waste be disposed of.

When required, the concrete mixer loading procedure is started via the loading line 30.

Essentially the aforedescribed plant provides innumerable advantages, including:

- recovering clarified water to the extent of 80% of that produced;
- recovering inert material usable for new productions;
- recovering slurry (source of water bed contamination) by elevating it to a by-product;
- eliminating sediments deposited in its interior by creating a closed cycle for total recovery of the produced effluent;
- no cost for disposing of the by-product, even in solid form;
- considerable reduction in maintenance costs for components used for process water disposal, namely pumps, impellers, valves, stirrers and pipes;
- reduction in costs of supplying water from distribution mains;
- reduction in costs of supplying fine inert material;

- no alteration to structures currently present on site;

- downgrading of current waste to a by-product originating from a production process;

- preliminary identification and definition, before introduction into the new production process, of the requisite liquid and solid percentages without the need for further treatment;

- provision of more water than the current quantity with potential accumulation even of first rainwater;

- better working environmental conditions by concentrating waste and turbid water in airtight containers/tanks;

- metering of "waste" in predetermined percentages without error margin equal to 0.1% per cubic metre on the percentage balance between solids and liquids;

- deduction of solids from the design mix with integration to the current metering systems by adding water in the correct percentage such as to satisfy, and in certain cases improve, the product requirements.

Advantageously, the described system enables the following regulations to be satisfied:

- soil protection regulations;

- regulations regarding water protection against pollution and water resources management;

- waste handling regulations;

- environmental damage compensation regulations;

- observance of emission limits for water discharge from industrial

processes;

- observance of prohibition of direct discharge of meteoric water into groundwater sources.

By concentrating in a single tank, the techniques of the invention enable the produced waste to be eliminated and totally reused.

Optimal water clarification is achieved for new productions and other uses but without energy wastage for solid maintenance.

Sedimented aggregates can be reused by feeding them into the new concrete, with reduction of the fresh quantity required.

Large quantities of waste wash slurry from the mixers and truck-mounted concrete mixers are eliminated by elevating it to a by-product without altering the new concrete quality (without the addition of chemical compounds or additives, without drying or use of filter presses).

Starting from the inventive concept of the aforedescribed plant, various alternative embodiments can be developed, two of which are shown in Figures 2 and 3. In these, parts similar to those already described in the preceding embodiment are indicated by the same reference numerals, and will therefore not be further described.

The plants of Figures 2 and 3 can be provided in new installations, in which underground tanks are not already present.

The only differences compared with the previous solution are, with regard to Figure 2, the presence of a purified liquid accumulation tank 23 disposed above ground. Hence a further pump 50 is provided for feeding fluid therein. The tank for recovering effluent

water from the yard is not present.

With regard to Figure 3, compared with the plant of Figure 2, the stirrers of the second zone comprising a double conveying screw are replaced by a second impeller 18D mounted coaxially to the first 18A and rotated by the same shaft 18B.

In all plants formed in accordance with the innovative concept of the present invention, pumps can either be provided, or not provided, for transferring the liquids from one tank to the other, depending on the level at which these tanks are positioned.

CLAIMS

1. A plant for treating slurries deriving from the washing of concrete mixers (2), comprising a separator (3) provided with a first tank (5) for receiving the discharge liquid of a concrete mixer (2), said receiver tank (5) being coupled to first means (6) for mechanically separating the coarse residues contained in the discharge liquid, and an accumulation tank (23) for a treated liquid, an aperture of said first tank (5) being disposed in fluid passage connection with an inlet of a decantation tank (14), the decantation tank (14) presenting at least a first zone (14A) for accumulating treated liquid substantially free of suspended particles, a second zone (14C) for accumulating slurry formed from sedimented particles, and a hopper shaped intermediate zone (14B) arranged to interconnect the first (14A) and second (14C) zone, said intermediate zone (14B) and said second zone (14C) presenting respective first (18) and second (20) stirrer means arranged to prevent the particles present in said zones from agglomerating, said first zone (14A) comprising a treated liquid outlet (22) intercepted by first valve means (V1) connected to said purified liquid accumulation tank (23), said second zone (14C) comprising a slurry discharge intercepted by second valve means (V2), said slurry discharge being connected to the suction side of a first pump (P1) the delivery side of which is connected to a loading line (30), said loading line (30) comprising a branch (32) for feeding a concrete production plant (D), a mass flowmeter (M) being present in said loading line (30).

2. A plant as claimed in claim 1, wherein a second pump (P2) is present having its suction side drawing from the treated liquid accumulation tank (23) and its delivery side connected to the loading line (30).

3. A plant as claimed in the preceding claim wherein, upstream of the mass flowmeter (M), means (24) are provided for regulating the flow rate of said sedimented particles and of said treated liquid withdrawn from accumulation tank (23).

4. A plant as claimed in the preceding claim, wherein said flow rate regulator means (24) comprise a mixing connection (25) provided with a first and a second inlet coupled respectively to the second valve means (V2) present in the slurry discharge and to third valve means (V3) present in a delivery line from the pump (P2) which draws from the accumulation tank (23), and a first and second outlet coupled respectively via a fourth valve means (V4) to a loading line (30) for the concrete mixer (2) and, via a fifth valve means (V5), to the first pump (P1).

5. A plant as claimed in claim 1, wherein a recycle line (31) is present to deviate said loading line (30) into said receiver tank (5).

6. A plant as claimed in claim 1, wherein the fluid passage connection between said aperture and the decantation tank (14) comprises a transition tank (11) coupled to a loading pump (12).

7. A plant as claimed in claim 6, wherein a recovery tank (13) for effluent water from the yard is provided, together with a pump (P3) drawing from said recovery tank (13) and with its discharge

connected to said loading line (30).

8. A plant as claimed in the preceding claim, wherein a discharge from the transition tank (11) opens into said recovery tank (13) to cope with any overloading of the decantation tank (14).

9. A plant as claimed in claim 1, wherein said first mechanical separation means (6) comprise a conveying screw (7) one end of which is immersed in the receiver tank (5).

10. A plant as claimed in claim 1, wherein said first stirrer means (18) comprise a first impeller (18A) of vertical axis driven by a suitable motor (18C).

11. A plant as claimed in claim 10, wherein said second stirrer means (20) comprise a second impeller (18D) mounted coaxially to the first impeller (18A), or wherein said second stirrer means (20) comprise a pair of substantially horizontal screws (21) of parallel axes with opposing blades (21).

12. A method for treating slurries deriving from the washing of concrete mixers, comprising the steps of: discharging a first mixture composed of a liquid part and a solid or semisolid part into a receiver tank, separating the coarse residues contained in said first mixture to eliminate the coarser and heavier particles and provide a second mixture, feeding said second mixture to a decantation tank, decanting said second mixture for at least two hours, discharging the liquid part from said decantation tank via an outlet positioned at a predetermined height in said decantation tank and feeding it into an accumulation tank for the treated liquid part, mixing the solid or

semisolid part, discharging said solid or semisolid part from said decantation tank through a pipe, measuring the quantity of the solid or semisolid part, feeding said solid or semisolid part in a predetermined quantity to a loading line.

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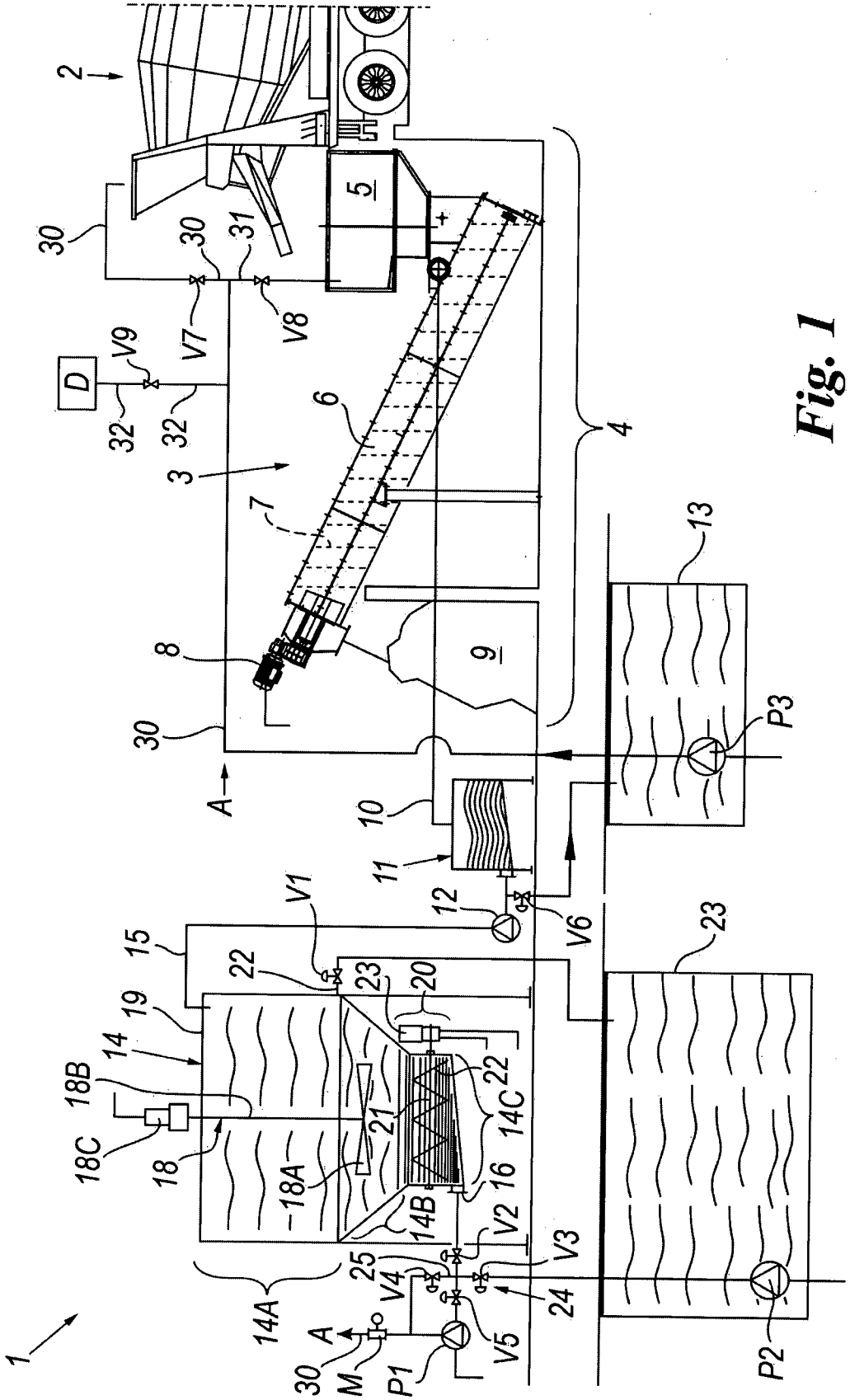

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Fig. 1

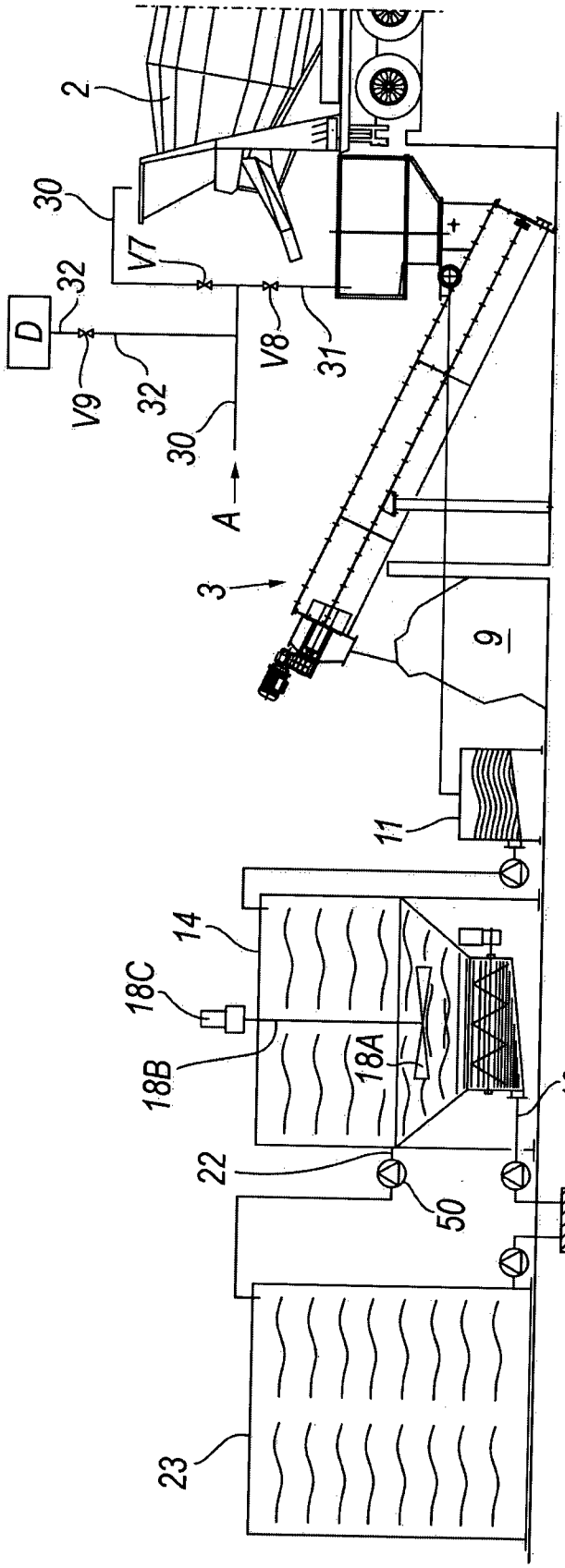


Fig. 2

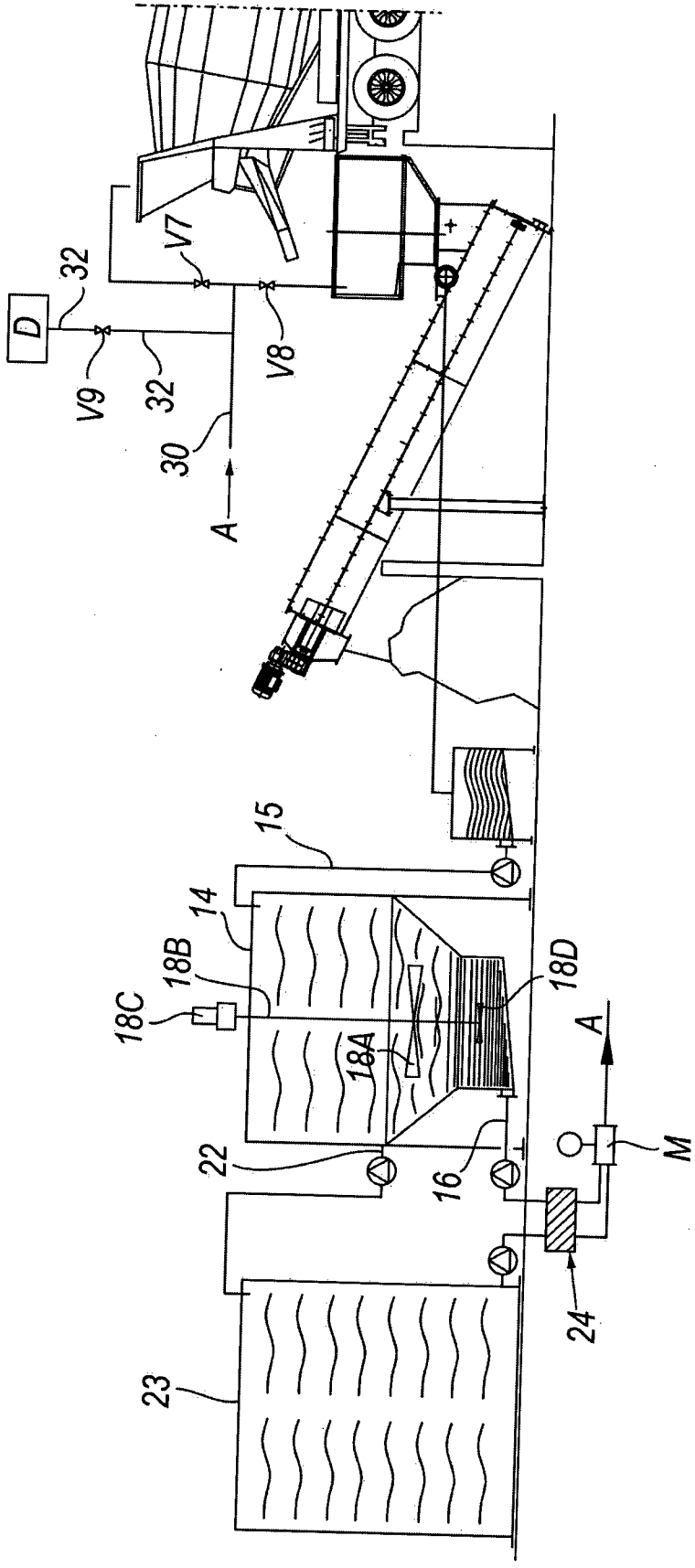


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/001092

A. CLASSIFICATION OF SUBJECT MATTER
INV. B03B9/06 C02F11/12
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C02F B01D B03B B08B B01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94/17917 A1 (BRENNER HORST [DE]) 18 August 1994 (1994-08-18) page 1, line 11 - line 23; figure page 4, line 5 - page 5, line 23 page 6, line 18 - page 9, line 35	1-12
A	JP 62 204867 A (P M CONCRETE ENG KK) 9 September 1987 (1987-09-09) abstract; figure 2	1
A	EP 0 062 339 A2 (BOZENHARDT FRIEDRICH) 13 October 1982 (1982-10-13) page 2, line 27 - line 35; figure 1 page 4, line 7 - page 5, line 21	1
A	CN 101 347 961 A (JIANJUN HUANG [CN] JIANJUN HUANG) 21 January 2009 (2009-01-21) figure 3	11

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
7 October 2013	29/10/2013

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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