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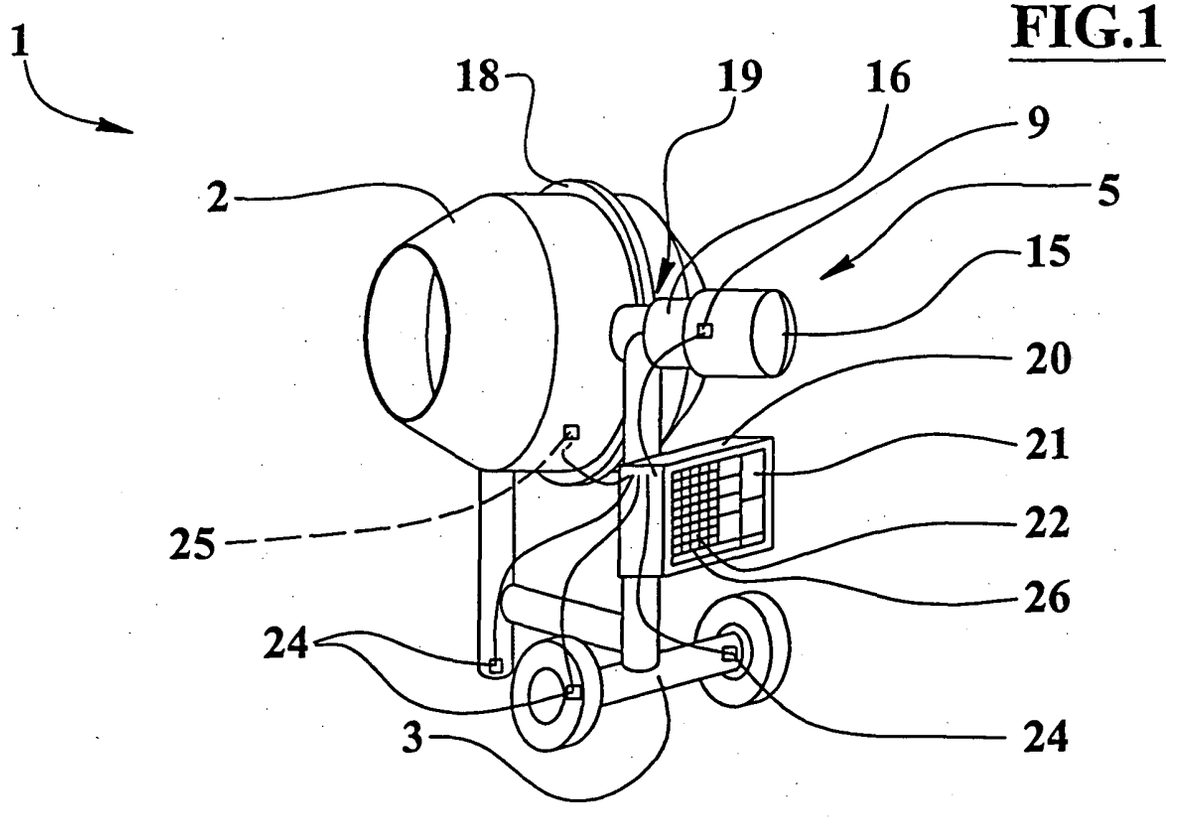
(54) Muffled Concrete Mixer Device and Method for Preparing Concrete

(57) A muffled concrete mixer device provided with a mixing tank (2) internally having mixing means (6) for the cement mixture, rotated on an rotation axis (R) by moving means (5) and rotatably supported by an arm (4), supported by a frame (3), for pivoting said tank (2) on an axis almost orthogonal to the rotation axis (R). The walls (13) of the mixing tank (2) include an external layer (11) and an internal layer (12), separated by at least an interspace (10) by means of which the sound emission generated by the cement mixture during the rotation inside the tank (2) is reduced.

FIG.1



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Description

[0001] The present invention relates to apparatuses and devices for preparing concrete and particularly it refers to a muffled concrete mixer device and method for preparing concrete thereby.

[0002] There are known and broadly diffused concrete mixers or mixing machines essentially constituted by a mixing tank or drum having cylindrical shape with truncated conical mouth, supported by a frame with three bearing points, usually provided with wheels for moving. The tank is capable to rotate on its own axis and has inside a plurality of mixing blades, which, due to the tank rotation, move down upward the material mixture including water, cement and sand, in order to obtain the mixing of the aforesaid component and the concrete.

[0003] The tank is rotatably supported by a rocking arm, through a pivot coaxial to the tank rotating axis. The rocking arm is constituted by a tubular body and it is rotatably connected to the frame by means of bushes allowing its partial rotation to according to a rocking axis orthogonal to the tank rotating axis. In fact the arm is connected to a flywheel through which it is possible to manually perform the partial rotation of the tank for unloading and loading, respectively the concrete and the mixture.

[0004] The tank rotation is obtained by the mesh of a metallic alloy pinion, powered by a motor, with a ring gear made of solid metallic alloy, fixed to the external wall of the tank, approximately at the middle thereof. The connection between pinion and motor, usually an electric asyncronous single-phase or three-phase motor, is carried out by interposing one or more pulleys and belts, which act as motion reduction unit. Motor and reduction and transmission unit members are housed in a huge box fixed to the frame.

[0005] The main drawback of said known concrete mixers or mixing machines consists in the loud noise generated thereby during the operation, because the mixing of the material which rotating bumps against the tank walls especially during the starting "dry" phase and because of the transmission characterized by the coupling ring gear -pinion gear above described.

[0006] Other drawback consists in that the known concrete mixers do not allow to mix the components maintaining vertical the tank axis, since the utilized blades do not allow to mix the mixture in such vertical condition.

[0007] Other drawback of the known concrete mixers consists of the big dimensions and weight of the moving system, constituted by the motor and by the set of pulleys and gears needed for the tank motion transmission and reduction.

[0008] Further drawback consists in that said moving systems having known ring gear - pinion gear are subject to high wear, thus they need periodic maintenance with cost increase.

[0009] There are also known concrete mixers or mixing machines in which the tank rotation is carried out by rotating the bearing pivot of the rocking arm, said pivot being directly operated by a suitable ratiomotor directly supported by the arm, or operated by a motor fixed to the frame of the concrete mixer by means of a transmission chain, housed inside the arm.

[0010] The drawback of said known concrete mixers is the high cost thereof, due to the need to use specific motor and reduction gears, with particular not standard shapes and dimensions, or due to necessity to have complex motion transmissions, which besides reduce the overall energetic efficiency of the system.

[0011] In the traditional systems the method for preparing concrete provides the operator loading the components, that is cement, sand and water after having measured more or less precisely, often roughly, the exact quantity of the single components, in order to obtain a concrete with predefined mechanical characteristics. These last ones and particularly the compression strength essentially depend on the water/cement ratio and on the sand/cement ratio in the mixture in progress. In effects, it results that the concrete compression strength is inversely proportional to the square of the concrete volume not occupied by the mixture and it is a decreasing function of the water/cement ratio. To obtain a high compression strength of the concrete it is necessary to seek for an optimal granulometric distribution of the aggregate, characterized by the maximum specific weight of the mixture.

[0012] The workability is also an important mechanical characteristic and it depends on the granulometric distribution and also on the water/cement ratio, workability being an increasing function of this ratio.

[0013] In order to reduce water/cement ratio so increasing the compression strength without losing workability, the cement measuring is increased or the water quantity is decreased, using a fluidifying additive when needed.

[0014] Once dosed the components, the operator starts the concrete mixer, which mixes the aggregate rotating at constant speed, for a time defined by said operator, on the base of his own experience and on the empirical analysis of the mixture.

[0015] Also the rotation speed and the mixing duration are very important parameters establishing the physical-mechanical characteristics of the concrete.

[0016] The main drawback of said method for preparing concrete consists in that the dosing of the different mixture components is very inaccurate and does not allow making mixture of desired fluidity and concretes with predefined mechanical characteristics of compression strength.

[0017] Other drawback of the known concrete mixer and methods consists in the preset mixing speed of the tank, which cannot be varied and adapted according to the cement mixture to be worked and according to the required mechanical characteristics of the concrete.

[0018] Other drawback consists in that it is not possible to check the accuracy of the process for preparing the concrete by evaluating physical characteristics thereof and to determine the final quality of the concrete.

[0019] The main object of the present invention is to propose a concrete mixer device and a method for preparing concrete having a sound emission or noise level very low, during all the mixing phases of mixture.

[0020] Other object is to propose a device having a moving system of the mixing tank which has very small dimensions and weight, constituted by component having reliable and safe operation, not requiring particular maintenance and characterized by high efficiency and mechanical performance and by a low energetic consumption.

[0021] Further object of the present invention is to propose a device and a method allowing executing an accurate weight dosing of the cement mixture components, in order to obtain a final product having the desired characteristics of workability and mechanical strength.

[0022] Other object is to propose a device and a method allowing to adjust the rotation speed of the mixing tank and the tilt thereof according to the mixture characteristics, the components thereof and the concrete typology to be obtained, in such a way to support the first homogenization of the mixture and to decrease the energetic consumption during the mixing.

[0023] Further object of the present invention is to propose a device and a method allowing to check, during all the mixing phases, the correct processing and the mixture quality, in order to modify and to correct the chemical-physical parameters thereof and to obtain the desired final product.

[0024] The above-mentioned objects are achieved according to claim content.

[0025] The characteristics of the present invention are underlined in the following with particular reference to the attached drawings, in which:

- figure 1 shows an axonometric view of the muffled concrete mixer device of the present invention;
- figure 2 shows a top view of the device of figure 1;
- figure 3 shows a plan view of a variant of the device of figure 1;
- figure 4 shows a plan view of a further variant of the device of figure 1;
- figure 5 shows a partial section view according to line V-V of figure 2;
- figures 6 and 7 show respectively a front view and a cross section view of a ring gear associated to a respective pinion gear of the device of figure 1;
- figure 8 shows a partial section view according to line VIII-VIII of figure 6.

[0026] With reference to figures 1, 2 and from 5 to 8, numeral 1 indicates a muffled concrete mixer device substantially constituted by a mixing tank 2, which is internally provided with mixing means 6 for a cement mixture and is rotated on a rotation axis R by moving means 5. The tank 2 is further rotatably supported by an arm 4, hinged to a bearing frame 3, which allows pivoting said tank 2 on an axis almost orthogonal to the rotation axis R.

[0027] The mixing tank 2 has an approximately cylindrical shape, provided with a truncated-conical mouth and has walls 13, including two layers, external 11 and internal 12, preferably made of metallic sheet and spaced by at least an interspace 10 containing air or a layer of soundproofing material.

[0028] More precisely, two portions, a bottom one 2A and a conic one 2B, jointed in a single block by means of a continuous welding, constitute the tank 2.

[0029] The mixing means 6 include first order blades 7 and second order blades 8, fit for mixing the cement mixture respectively at a dry mixing condition, in which the rotation axis R of tank 2 is vertical, and a mixing condition with water, in which on the contrary the rotation axis R is tilted.

[0030] The walls 13 of the mixing tank 2 due to the interspace 10 reduce the noise emission generated by the cement mixture, which bumps the walls of tank 2, inside which it is mixed.

[0031] The first order blades 7 in the dry mixing condition are capable to mix and to homogenize the cement mixture, allowing the appropriate circulation with central drop and remarkably reducing the noise emission.

[0032] For this reason and in order to increase the operation life, the blades 7, 8 are further covered with wear-proof material.

[0033] The device includes a programmable control and processing unit 20, fit for operating and controlling the moving means 5 and provided with a control panel 21, having a keyboard 22 and an alphanumeric display 23, for the operation data input and the display of messages and relative information regarding the operation of device 1.

[0034] There are load sensor means 24, consisting of load cells of known type positioned at the supports of frame 3 and fit for measuring the weight of device 1 and for sending respective signals to the control and processing unit 20.

[0035] Electric conductibility sensor means 25, positioned inside the mixing tank 2, are capable to measure the electric conductibility of the concrete mixture and to send relative signals to the control and processing unit 20.

[0036] The control and processing unit is furthermore provided with storage means 26 of permanent type, for instance Eprom cards, in which the data and the chemical-physical characteristics regarding the concrete components and operational parameters, such as the concrete characteristics, the required compression strength, the volume to be produced, the use of fluidifying additive are stored.

[0037] The moving means 5 include a motor 15, di-

rectly connected to a speed reduction gear 16, and fit to drive the tank 2, through transmission means 19.

[0038] In the preferred embodiment the motor 15 and the speed reduction gear 16 are assembled coaxial and the transmission means 19 are constituted by a pinion gear 17, which is fixed to an outlet shaft of the reduction gear 16, and is in mesh with a ring gear 18 externally fixed to the tank 2.

[0039] The ring gear 18 has a conic shape and is carried out by cold forming of a metal sheet and it is welded to the mixing tank 2, approximately at the middle thereof.

[0040] The pinion 17 is made of plastic material having low friction coefficient and high wear strength and hardness, not lower than 80 shores, in order to guarantee a very silent coupling and at the same time reliable and strong. For this reason, the pinion toothing has a tooth profile with addendum correction in order to give greater strength to the teeth, subjects to collisions due to the inertia of the mixing tank 2.

[0041] The ring gear is completely covered by a removable and shaped carter 28 for the operator safety.

[0042] The motor 15 is electric of synchronous monophase or tri-phase type with a power ranging between 0,3 and 1,5 KW and preferably is operated by control means 9 which control the speed thereof. The control means 9, consisting for instance of an inverter, are connected to the control and processing unit 20, which is thus capable to select and to vary the speed of motor 15 according to preset operational parameters and to the aggregate conditions.

[0043] The speed reduction gear 16 consists of an eccentric or epicycloidal or "Harmonic drive®" type reduction gear having reduction ratio not lower than 1:6 and characterized by very small axial dimension, for allowing the direct coaxial link with the motor 15 and for reducing the overall dimension. It is important to underline that the use of such kind of reduction gear, instead of the normally used assembly of pulleys and belts, allows reducing the overall dimension of the moving means 5 and using any type of motor on the shelf having the required characteristics, the demand to reduce the dimension not subsisting anymore due to the reduction gear use.

[0044] The operation of the muffled concrete mixer device 1 object of the present invention provide to input into the control and processing unit 20 the data regarding the characteristics of concrete, aggregate, sand and possible additive constituting the cement mixture and regarding the concrete characteristics required according to the different typologies of building construction such as walls, bridges, foundations, attics in which the concrete will be used.

[0045] According to said data and information stored in the storage means 26, the unit 20 is capable to determine the exact quantity of components to be used for the concrete and the procedures for inserting in sequence said components inside the tank. By means of the load sensors 24 the control and processing unit 20 is capable to indicate to the operator the achievement in the tank 2 of the preset weight quantity of each component, such as cement, sand, water, etc.

[0046] In the storage means 26 there are furthermore stored data related to the so-called production curves, which correlate the mixing of components with the tank rotation speed and its tilt. Said data allow the unit to define optimal rotation speeds and tilts of tank 2 according to the concrete in progress. The tank speed is adjusted and varied acting on the control means 9 according to predefined working cycles of the mixture.

[0047] Once loaded the components and started the mixing, it is possible to control and to verify in real time the quality of the cement mixture thanks to the electric conductibility sensors 25, sending signals to the unit 20, allowing the latter to vary if necessary the tank speed and inclination or rather to modify the working cycle and/or to communicate to the operator the need to correct the mixture composition by further adding one or more component.

[0048] The figure 2 shows a variant of the muffled concrete mixer device silenziata in which the motor 15 is fixed to the arm 4 and the transmission means 19 are substantially constituted by rotating shaft 29, which provides to connect the outlet shaft of reduction gear 16 to the mixing tank 2. With this arrangement of the motor 15, the reduction gear 16 and the tank 2 are aligned and coaxial with respect to the rotation axis R, so simplifying the transmission and reducing the dimension.

[0049] Alternatively, as shown in figure 4 by a second variant of the concrete mixer device 1, the transmission means 19 may include an angle driving gear 27, which interposed between the rotation shaft 29 and the reduction gear 16 allows to position the latter and the motor 15 in position almost orthogonal to the rotation axis R of the tank 2, further reducing the dimensions.

[0050] The operation of the two above described variant substantially differs for the different moving means 5 of the mixing tank 2 which allows to replace the coupling pinion gear - ring gear with a direct connection between motor-reduction gear and tank and thus to further reduce the noise emission level of device 1 in all the operation conditions.

[0051] The method for preparing concrete using the above described muffled concrete mixer device substantially includes:

- to input into a control and processing unit 20 data related to the concrete characteristics;
- to input into the control and processing unit 20 data related to the cement type;
- to define by the control unit 20 the weight quantities of the components needed for constituting the cement mixture for preparing the concrete;
- to insert said components up to achieve a preset weight amount, signaled by the unity 20 by means of a related signal;
- to dry mix to the cement mixture using the mixing tank 2, positioned with rotation axis R vertical, for a

predefined first period of time at a preset first rotation speed, in a dry mixing condition of the device 1;

- to mix with water the cement mixture using the mixing tank 2 positioned with rotation axis R tilted, for a predefined second period of time at a preset second rotation speed, in a mixing condition with water of device 1.

[0052] Using the control and processing unit 20, it is further provided to calculate the rotation speeds and the times needed respectively to dry mix and to mix with water the concrete.

[0053] The method also allows measuring, during the dry mixing condition and the mixing with water condition, the electric conductibility of the concrete, eventually modifying the weight quantity of components, the speed, the rotation time of tank 2.

[0054] The main advantage of the present invention is to provide a concrete mixer device and a method for preparing concrete having a very low sound emission or noise level during all the mixing phases of mixture and allowing executing an accurate weight dosing of the cement mixture components, in order to obtain a final product having the desired characteristics of workability and mechanical strength.

[0055] Other advantage is to provide a device and a method allowing to adjust the rotation speed of the mixing tank and the tilt thereof and allowing to check, during all the mixing phases, the correct processing and the mixture quality, in order to modify and to correct the chemical-physical parameters thereof.

[0056] Other advantage is to provide a device having a moving system of the mixing tank which has very small dimensions and weight, constituted by component having reliable and safe operation, which not require particular maintenance and are characterized by high efficiency and mechanical performance and by a low energetic consumption.

Claims

1. Muffled concrete mixer device provided with a mixing tank (2) internally having mixing means (6) for the cement mixture, rotated on an rotation axis (R) by moving means (5) and rotatably supported by an arm (4) borne by a frame (3) for pivoting said tank (2) on an axis almost orthogonal to the rotation axis (R); said device (1) being **characterized in that** walls (13) of the mixing tank (2) include an external layer (11) and an internal layer (12), separated by at least an interspace (10); the walls (13) of mixing tank (2) reduce, due to the interspace (10), the sound emission generated by the cement mixture during the rotation inside the tank (2).

2. Device according to claim 1 **characterized in that** at least one of the layers external (11) and internal (12) are made of metallic sheet.

3. Device according to claim 1 **characterized in that** the interspace (10) contains air or a layer of insulating material.

4. Device according to claim 1 **characterized in that** the mixing means (6) include at least first order blades (7) and second order blades (8), fit for mixing the concrete respectively in a dry mixing condition of the concrete, in which the rotation axis (R) of tank (2) is vertical, and in a condition of mixing with water, in which the rotation axis (R) is tilted; the first order blades (7) allowing in the dry mixing condition to mix and to homogenize the concrete reducing the sound emission.

5. Device according to claim 1 **characterized in that** includes a control and processing unit (20) of programmable type and fit for operating and controlling at least the moving means (5).

6. Device according to claim 5 **characterized in that** the control and processing unit (20) includes a control panel (21) provided with a keyboard (22) and an alphanumeric display (23), for the input of operational data and the display of messages and functional information by an operator.

7. Device according to claim 5 or 6 **characterized in that** includes load sensor means (24) positioned at the supports of frame (3) and capable to measure the weight of device (1) and to send respective signals to the control and processing unit (20).

8. Device according to claim 5 or 6 **characterized in that** includes electric conductibility sensors means (25) positioned inside the mixing tank (2) and fit to measure the electric conductibility of the concrete and to send related signals to the control and processing unit (20).

9. Device according to claim 5 **characterized in that** include storage means (26) of permanent type, for storing data and chemical-physical parameters relative to the concrete and the operational procedures.

10. Device according to claim 1 **characterized in that** the moving means (5) include at least a motor (15) directly connected to a speed reduction gear (16) for driving the tank (2) by transmission means (19).

11. Device according to claim 10 **characterized in that** the motor (15) and the speed reduction gear (16) are coaxial.

12. Device according to claim 10 **characterized in that**

the motor (15) is fixed to the frame (3) and the transmission means (19) include a pinion gear (17) connected to an outlet shaft of the reduction gear (16) and in mesh with a ring gear (18) of the tank (2).

13. Device according to the claim 10 **characterized in that** the motor (15) is fixed to the arm (4) and the transmission means (19) include a rotation shaft (26) for linking the reduction gear (16) to the tank (2).

14. Device according to claim 13 **characterized in that** the transmission means (19) include an angle driving gear (27) interposed between the rotation shaft (26) and the reduction gear (16) for positioning the last and the motor (15) almost orthogonal to the rotation axis (R) of tank (2).

15. Device according to claim 10 **characterized in that** the motor (15) is electric of synchronous monophase or tri-phase type.

16. Device according to claim 10 **characterized in that** includes control means (9) at least of the speed of the motor (15).

17. Device according to claims 5 and 16 **characterized in that** the control means (9) are in signal connection with the control and processing unit (20).

18. Device according to claim 10 **characterized in that** the speed reduction gear (16) consists of an eccentric or epicycloidal or "Harmonic drive®" type reduction gear, having reduction ratio not lower than 1:6.

19. Device according to claim 1 **characterized in that** the mixing tank (2) includes two portions, a bottom portion (2A) and conic portion (2B), jointed by means of a continuous welding.

20. Device according to claim 12 **characterized in that** the ring gear (18) is carried out by sheet cold forming and it is joined to the mixing tank (2), approximately at the middle thereof.

21. Device according to claim 20 **characterized in that** the ring gear (18) is conic.

22. Device according to claim 12 **characterized in that** the pinion gear (17) is made of plastic or rubbery material having low friction coefficient and high wear strength and hardness not lower than 80 shores.

23. Device according to claim 4 **characterized in that** the shaped first and second order blades (7, 8) are made of wear-proof material.

24. Method for preparing concrete using the muffled concrete mixer device of any of the claims from 1 to 23 **characterized in that** includes:

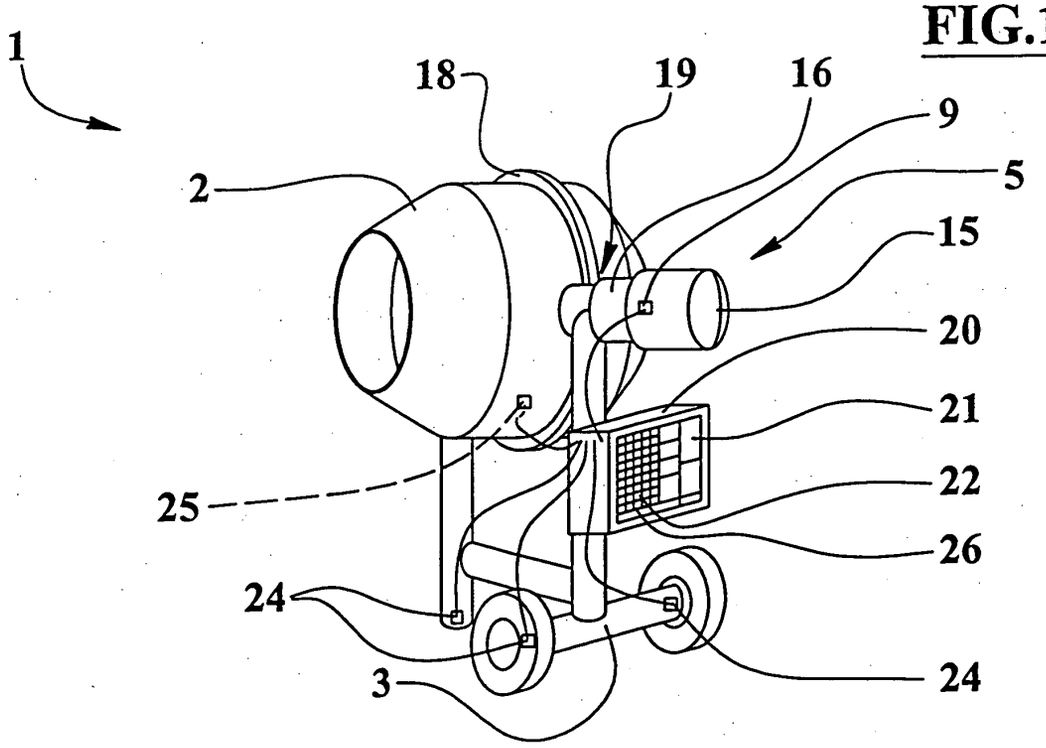
- to input into a control and processing unit (20) data related to the concrete characteristics to be prepared;
- to input into the control and processing unit (20) data related to the cement type at least;
- to define by the control unit (20) the weight quantities of the components needed for constituting the cement mixture for preparing the concrete;
- to insert said components up to the signal provided by the control and processing unit (20) that a preset weight amount has been achieved;
- to dry mix the cement mixture using the mixing tank (20), positioned with rotation axis (R) vertical, for a predefined first period of time at a preset first rotation speed, in a dry mixing condition of the device (1);
- to mix with water the cement mixture using the mixing tank (2) positioned with rotation axis (R) tilted, for a predefined second period of time at a preset second rotation speed, in a mixing condition with water of device (1).

25. Method according to claim 24 **characterized in that** includes to calculate by the control and processing unit (20) the rotation speeds and time intervals needed respectively for dry mixing and mixing with water the cement mixture.

26. Method according to claim 24 **characterized in that** includes to measure at least during the mixing with water at least the electric conductibility of the concrete.

27. Method according to claim 26 **characterized in that** includes to modify the weight quantity of the components and/or speed and/or rotation time of the tank (2) to bring the electric conductibility value within a preset range of values.

FIG.1



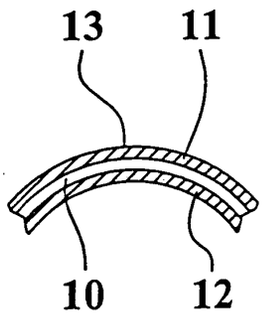


FIG.5

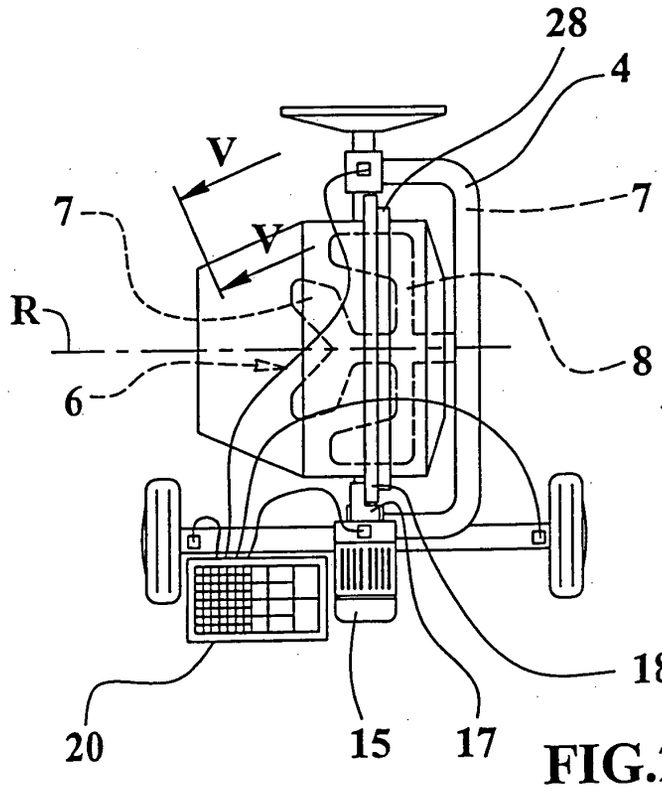
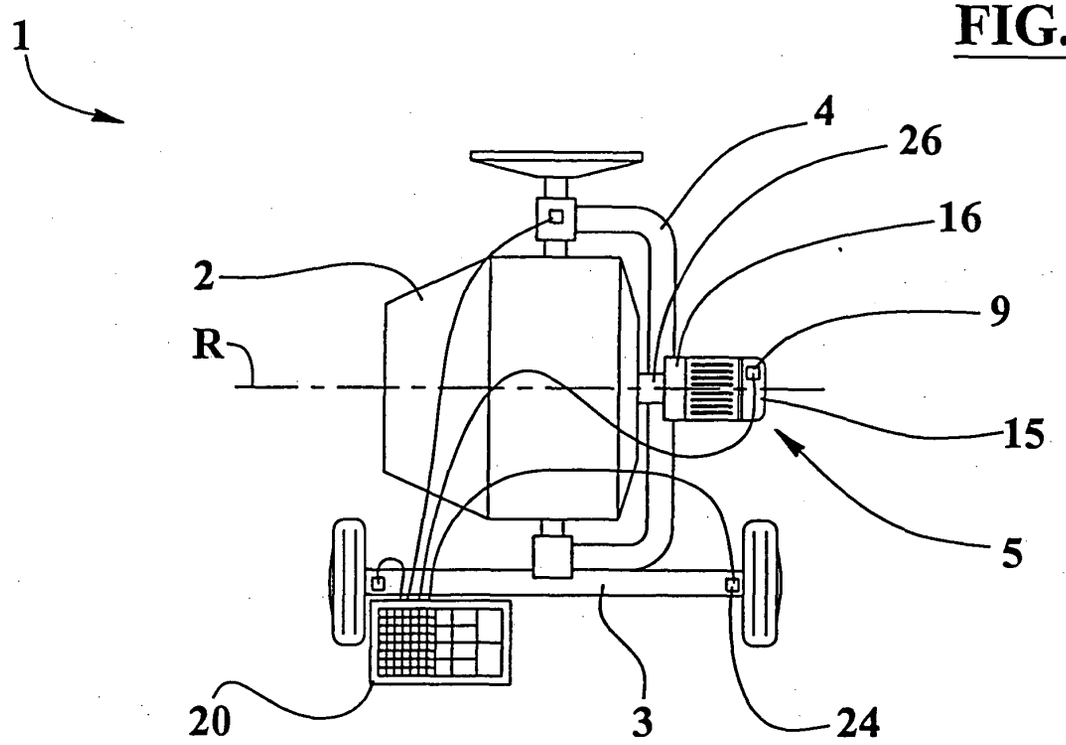


FIG.2

FIG.3



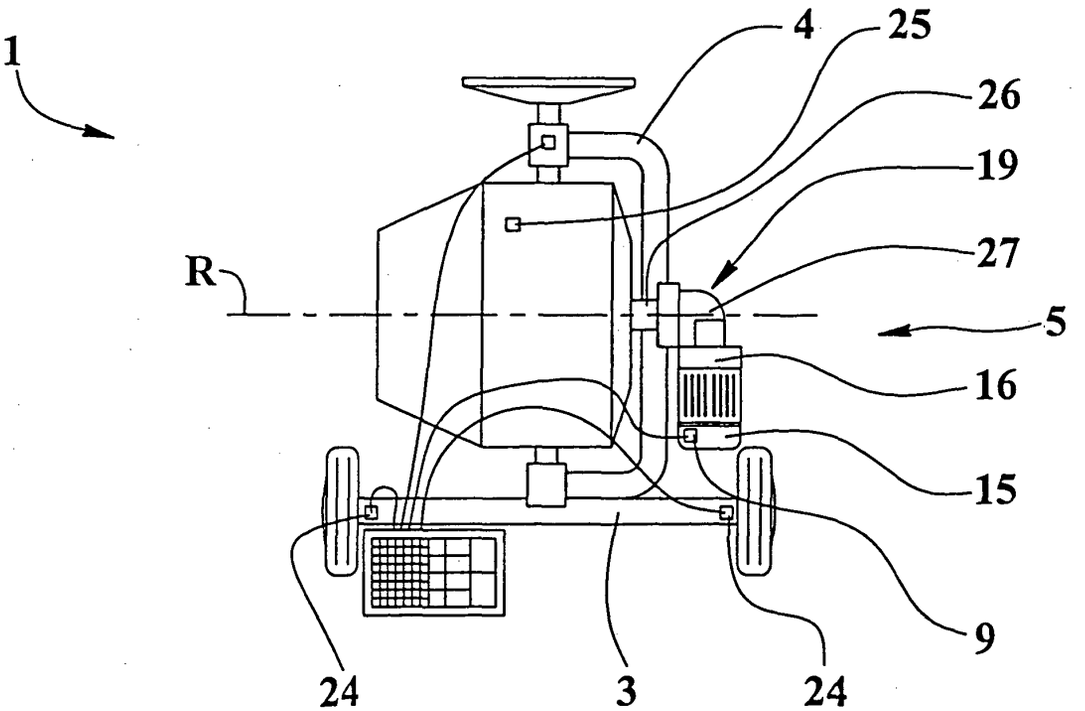


FIG.4

FIG.6

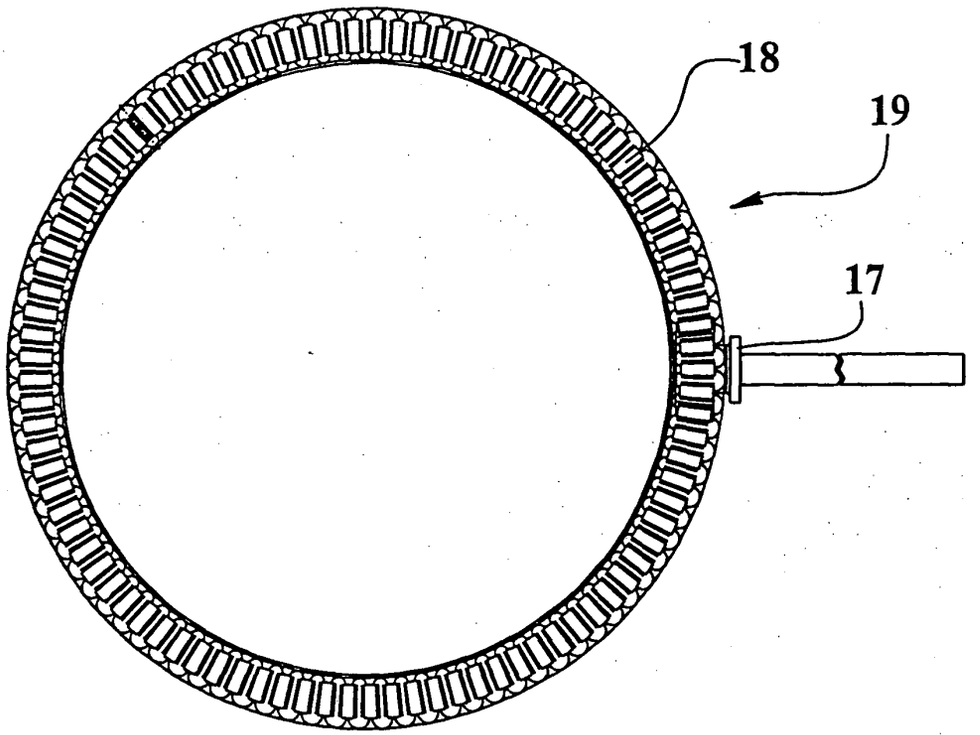
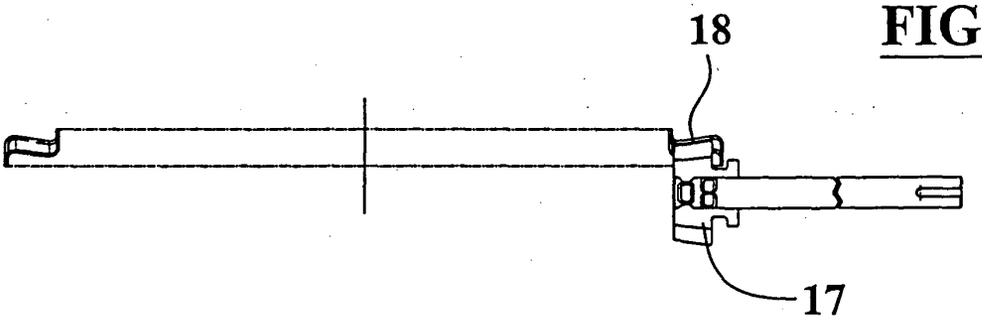


FIG.7



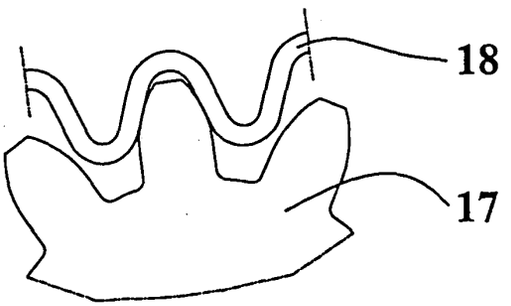


FIG.8