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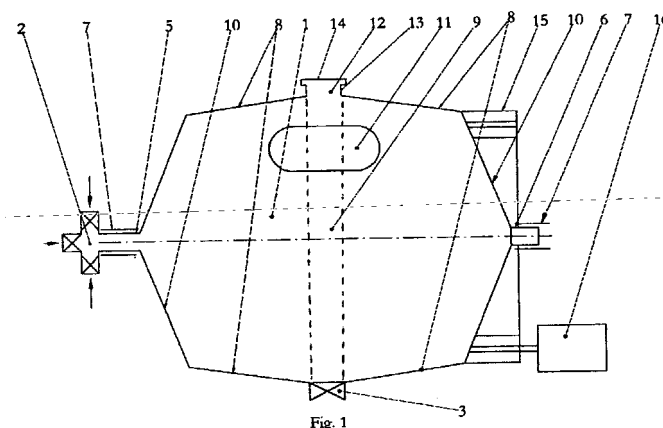
(54) **Process and installation for manufacturing lightweight concrete**

(57) The invention relates to a process and an installation for manufacturing lightweight concrete for masonry and insulations used for civil engineering and industrial constructions.

The process consists in mixing for homogenizing the dry components of the concrete at a mixing pressure (P1) higher than the atmospheric pressure (P0), introducing some fluid mixture components, such as water, air entrainers and additives, at a pressure (P2) higher than the mixing pressure (P1), homogenizing mixing for a mixing period (T1), thereafter the mixer (1) is depressurized at the atmospheric environment pressure (P0) in order to expand the mixture. The pressure is lowered to a slight vacuumatic pressure (P3) and a slow mixing is carried out for the duration (T2) for homogenously expanding the mixture and extracting the big defective air bubbles from the mixture. The expanded mixture is discharged with a uniform flow controlled by means of the vacuuming

pressure (P3) concomitantly with injecting adhesives and latices (24) into the mixture, in a mould (4) subjected to a slight vibration for a duration (T3), for uniformly dispersing the injected products in the mixture. In the mould (4) there is completed the concrete setting and maturation process.

The installation consists of a bitruncated cone shaped mixer (1) with tapered ends (10), wherein there are secured two semiaxes, in one of the semiaxes (5) there being mounted a distributor (2) for feeding some fluid components. An opening (12) for feeding the solid components and discharging the mixture is machined inside a threaded nozzle (13) provided with a thread plug (14). A discharge device (17) is coupled with the mixer (1) through a sleeve joint (18). The discharge device (17) is equipped with an installation for injecting adhesives and latices (24) into the raw mixture (22) during the discharge into a mould (4) which is moved on a system of rollers (23).



## Description

**[0001]** The invention relates to a process and installation for manufacturing lightweight concrete for masonry and insulations used in civil engineering and industrial constructions.

**[0002]** There is known a process for manufacturing the cellular concrete, RO patents no. 120632 and no. 122189 which consists in introducing a mixture consisting of cement, mineral and organic binders, water, air entrainers and additives into a mixer, in normal environment pressure conditions, thereafter the mixer is sealed and a working pressure of 1-6 bar is created therein, the mixture being mixed by rotating the mixer for 5—10 minutes thereafter the mixture is discharged into the mould under the action of the gravity force.

**[0003]** There are known the PCT/RO2004/000019 and WO 2006/068528 inventions referring to a process for mixing the components in argon environment, under a pressure less than the atmospheric pressure and placing the concrete into a pressurized discharge chamber.

**[0004]** These processes have the following disadvantages:

- by introducing water and air entrainers into the mixture under normal environment conditions, a part of the air entrainers fix the air bubbles at normal environment pressure in the mixture, so that the pressure created thereafter has no longer effect upon the growth of the air bubbles;
- by discharging the mixture into the mould under the action of the hydrostatic force there is generated a mixture jet which, in the discharge region, creates a non-uniform structure, causing the breaking of the air bubbles fixed in the mixture;
- in the mixed mixture there cannot be introduced adhesives and latexes which increase the technical performances of the lightweight concrete.

**[0005]** The installations and equipments for manufacturing the lightweight concrete for masonry and insulations, disclosed in RO patents no. 120632 and no. 122189, consist of: equipments for mixing and discharging the mixture into the mould, thereafter the moulds with the expanded mixture are subjected to Known and currently used operations; these equipments contain a mixer that is a cylindrical metal recipient provided or not with a trough for discharging the mixture, having an opening used for feeding and discharging the concrete mixture, it further has mounted to the inner side some baffle plates for homogenizing the mixture, the mixer achieving the mixing of the mixture in conditions of pressure that is higher than the normal environment pressure.

**[0006]** This mixer has the following disadvantages:

- the trough is prominently outwards and by feeding the same with mixture it creates an unbalance in the rotary motion, causing shocks and vibrations;

- the baffle plates mounted along the inner side of the mixer do not carry out a good homogenization of the concrete mixture, having negative effects by breaking the air bubbles embedded in the mixture.

**[0007]** The equipment for discharging the mixture into the mould consists of a connecting piece or a flexible connection which carry out the discharge of the mixture under the action of the hydrostatic force, these discharging equipments producing, in the region of impact with the mould, a mixture jet which destroys a large part of the air bubbles fixed in the mixture, thereby making a non-uniform cellular structure.

**[0008]** The present invention solves the technical problem of obtaining a lightweight concrete for masonry and insulations, having a homogenous cellular structure, with low thermal conductivity, improved mechanical qualities and free of flaws and capillaries and with low water absorption.

**[0009]** The process for manufacturing the lightweight concrete claimed by the invention, solves the technical problem and eliminates the disadvantages of the solutions known in the state of the art *in that* a dry mixture comprising sand, cement and other solid additions is introduced, under normal *environment* atmospheric pressure conditions, into a mixer which is then sealed to create a *mixing* air pressure higher than the environment atmospheric pressure, the solid components are homogenized by rotating the mixer and there are introduced into a distributor some fluid mixture components, for example water, air entrainers and additives, at a pressure higher than the *mixing* air pressure, the dry components are homogenized with the fluid ones for a mixing duration of, for example, 15-25 minutes, then the mixer is depressurized to the environment atmospheric pressure, there starting the mixture expansion and the pressure in the mixture is further lowered down to a slight vacuumatic pressure, for example from -0.05 to -0.5 bar, at which there takes place a slow mixing, for example of 1 - 2 minutes, for the homogenously expanding the mixture and extracting the big defective air bubbles from the mixture, thereafter the mixture is discharged with a uniform flow controlled by means of the vacuumatic pressure, concomitantly with injecting some adhesives and latices into a mould subjected to a slight vibration for a period, for example, of 30-60 seconds to favour a uniform dispersion of the injected products in the mixture, in said mould there is completed the process of concrete setting and maturation in normal environment conditions or in controlled conditions such as temperature, pressure, humidity, atmospheric composition etc.

**[0010]** The installation for the application of the process for manufacturing the lightweight concrete claimed by the invention, consists of a mixer consisting of two truncated cone-shaped sections joined in the central region by a cylindrical ring, and of two tapered ends, wherein there are fixed two semiaxes and provided with some bearing boxes for resting on a support not represented

in the figure, in one of the semiaxes there being mounted a distributor for feeding some fluid components, the liquid part of the mixture and the pressurized air, the mixer having a manhole cover, an opening for feeding the solid components and discharging the mixture, said opening being cut in a threaded nozzle and provided with a thread plug and a depressurizing and vacuuming device, the mixer being further provided with a crown gear and a driving mechanism and a discharge mechanism which is coupled with the mixer through a sleeve joint having an inlet cross-section in the shape of a circle and an oval-ablong shaped outlet cross-section, and which has mounted at the rear side a partitioning wall, the discharge device being equipped with an installation for injecting some adhesives and latices into the raw mixture discharged into a mould, the said injection installation consisting of a supply conduit and several distribution conduits which are supplied in a controlled manner from a tank which is not represented in the figure.

**[0011]** The invention has the advantages of obtaining a concrete

- with homogenous structure;
- free of flaws and capillaries;
- with low thermal conductivity;
- with low water absorption.

**[0012]** There is given hereinafter an embodiment of the invention in connection with figures 1...4, which represent:

- figure 1 - a side view of the mixer assembly;
- figure 2 - a front view of the discharge device;
- figure 3 - a side view of the discharge device;
- figure 4 - a cross-section through the installation, expanding the mixture in the mixer and casting into the mould.

**[0013]** The process for manufacturing the lightweight concrete claimed by the invention consists of the following steps and operations:

- the mixture consisting of sand, cement and other solid additions is introduced into a mixer **1**, in normal *environment* atmospheric pressure **P0** conditions,
- the mixer **1** is sealed to create a *mixing* air pressure **P1** therein higher than the environment atmospheric pressure **P0**,
- there is started the mixing to homogenize the solid components and
- there are introduced through a distributor **2** the fluid mixture components: water, air entrainers and additives, at a pressure **P2** higher than the *mixing* air pressure **P1** in the mixer **1**;
- after introducing the liquid part of the mixture, the rotary motion of the mixer is continued for a *mixing* duration **T1**, for example of 15-25 minutes,
- thereafter the mixer **1** is depressurized to the envi-

ronment atmospheric pressure **P0**, during the depressurizing step there starting the mixture expansion, and

- the pressure in mixer **1** is further lowered, by means of a depressurizing and vacuuming device up to a slightly vacuumatic pressure **P3** of for example - 0.05 to - 0.5 bar,
- a slow mixing at this low pressure is carried out for a duration **T2** of, for example, 1 - 2 minutes, for homogenizing the mixture and extracting the big defective air bubbles from the mixture,
- after the mixture is discharged with a uniform flow, controlled by means of the vacuumatic pressure **P3** into a mould **4**, wherein the concrete setting and maturity process is carried out in normal environment conditions, or in controlled conditions such as temperature, pressure, humidity, atmospheric composition etc. By the controlled discharge by means of the vacuumatic pressure **P3** there is obviated the occurrence of the discharge jet and the elimination of the negative effects thereof.

**[0014]** The discharge of the mixture into the moulds **4** is carried out by moving the mould below the discharge part.

**[0015]** During the discharge into the moulds **4**, into the mixture flow, there are injected in admixture adhesives and latices for whose uniform dispersion in the mixture, the mould **4** is subjected to slight vibrations, by means known per se, for a duration **T3** of, for example, 30-60 seconds.

**[0016]** The final vibration for the duration **T3** has a positive effect both on dispersing the adhesives and latices in the mixture and on the cellular structure, by evacuating the air bubbles deteriorated by breaking or by uniting several of them, and on the mechanical strength of the final product.

**[0017]** There is given hereinafter a non-limiting embodiment of the installation for manufacturing lightweight concrete for masonry and insulations, as claimed by the process of the invention.

**[0018]** The mixer **1** rests on a support not represented in the figure, by means of a semiaxis **5**, wherein there is mounted the distributor **2** for feeding the fluid components, and of a semiaxis **6**, both semiaxes being provided with some bearing boxes **7**.

**[0019]** The mixer **1** comprises two truncated cone-shaped sections **8** joined in the central region by a cylindrical ring **9** and two taper ends **10** wherein there are secured the semiaxes **5** and **6**. The mixer **1** has a manhole cover **11**, and an opening **12** for feeding the solid components and discharging the mixture, said opening being machined in a threaded nozzle **13** provided with a thread plug **14**. Through the distributor **2** the pressurized air and the liquid components of the mixture are introduced. The mixer **1** is provided with a crown gear **15** for being driven by a driving mechanism **16**.

**[0020]** A discharge device **17** is coupled with the mixer

**1**, through a nozzle **18**. The discharge device **17** has an inlet cross-section in the shape of a circle and an oval-oblong shaped outlet cross-section, and has mounted at the rear side a partition wall **19** which separates the full part of the mould **4** containing the mixture from the empty part of the mould, up to fully filling the mould, which is moved below the discharge part.

**[0021]** The discharge device **17** is equipped with an injection installation consisting of a supply conduit **20** and more distribution conduits **21**, wherethrough, during the discharge, adhesives and latices are introduced into the mixture, said adhesives and latices cannot be introduced during the mixing (these not being compatible with the air entrainer), but whose presence in the mixture leads to obtaining high performance lightweight concretes.

**[0022]** This discharge device **17** has the advantage of eliminating the mixture jet upon discharging into the mould and ensures the discharge of the expanded mixture from the mixer into the mould, without breaking the air bubbles, and by injecting into the mould, during the discharge, some adhesives and latices, high performance lightweight concretes are obtained.

**[0023]** The solid components of the mixture are introduced into the mixture **1**, under normal environment pressure conditions **P0**. Thereafter the mixer is sealed to create therein the mixing pressure **P1**, then the mixer is set into rotary motion, and through the distributor **2** the liquid part of the mixture is introduced at a pressure **P2** higher than the mixing pressure **P1**, then the mixture is mixed for 15-25 minutes (the mixing duration **T1**).

**[0024]** After the mixing time **T1** elapsed, the mixture is expanded in the mixer by lowering the pressure inside the mixer to the environment pressure **P0**. After the expansion of the mixture, the mixer is sealed again and there is created again a slight vacuumatic pressure **P3** therein, thereafter the mixer is rotated for a duration **T2**, for example of 1-2 minutes with low rotation speed to extract the big air bubbles from the mixture.

**[0025]** After extracting the big air bubbles from the mixture, the mixer is stopped from the rotation motion and the inner side of the mixer is brought to the environment pressure **P0**, the discharge device **17** is coupled, then a slight vacuumatic pressure **P3** is created in the mixer and the expanded mixture **22** is passed into the mould **4** which is moved on a system of rollers **23**, through the discharge device **17** while controlling the vacuumatic pressure **P3** created in the mixer **1**. During the discharge of the expanded mixture through the feeding conduit **20** and the distribution conduits **21**, there are continuously or intermittently injected, into the expanded mixture **22**, adhesives and latices **24** that cannot be introduced during the mixing due to the incompatibility thereof with some initial components, such as, for example, the air entrainers, but whose presence in the mixture leads to obtaining high performance lightweight concrete. The adhesives and latices **24** polymerize in the concrete mass, having the effect of obtaining high performance lightweight concrete.

**[0026]** During the process there are performed manoeuvres and operations with the installation for manufacturing concrete, as follows:

**[0027]** - - - The mixer **1** is brought with the opening **12** for feeding the mixture, in upper position. The solid part of the mixture is introduced, the opening **12** is sealed, by screwing up the plug **14** on the thread nozzle **13**. Air at a pressure **P1** of 1.5 - 7.0 bar, from a source not represented in the figures, is introduced according to the manufacturing formula, through the distributor **2**.

**[0028]** The mixer **1** is subjected to a rotary motion by means of the crown gear **15** and the driving mechanism **16**, in order to mix for a mixing duration **T1** of 15-25 minutes, and through the distributor **2** there is introduced the liquid part of the mixture.

**[0029]** After completing the mixing, the mixer **1** is stopped to move in rotary motion by the depressurizing and vacuuming device **3**, to the upper side, and the inner side of the mixer **1** is brought in contact with the environment pressure **P0** and the mixture **22** is expanded in the mixer **1**.

**[0030]** After expanding the mixture, the mixer is sealed again and a slight vacuumatic pressure **P3** is created therein. The mixer **1** is set in rotary motion with a low speed for a duration **T2**, for example of 1-2 minutes, for homogenizing and for extracting the big defective air bubbles from the mixture, then it is stopped and put again in contact with the inner side of the mixer with the environment pressure **P0**.

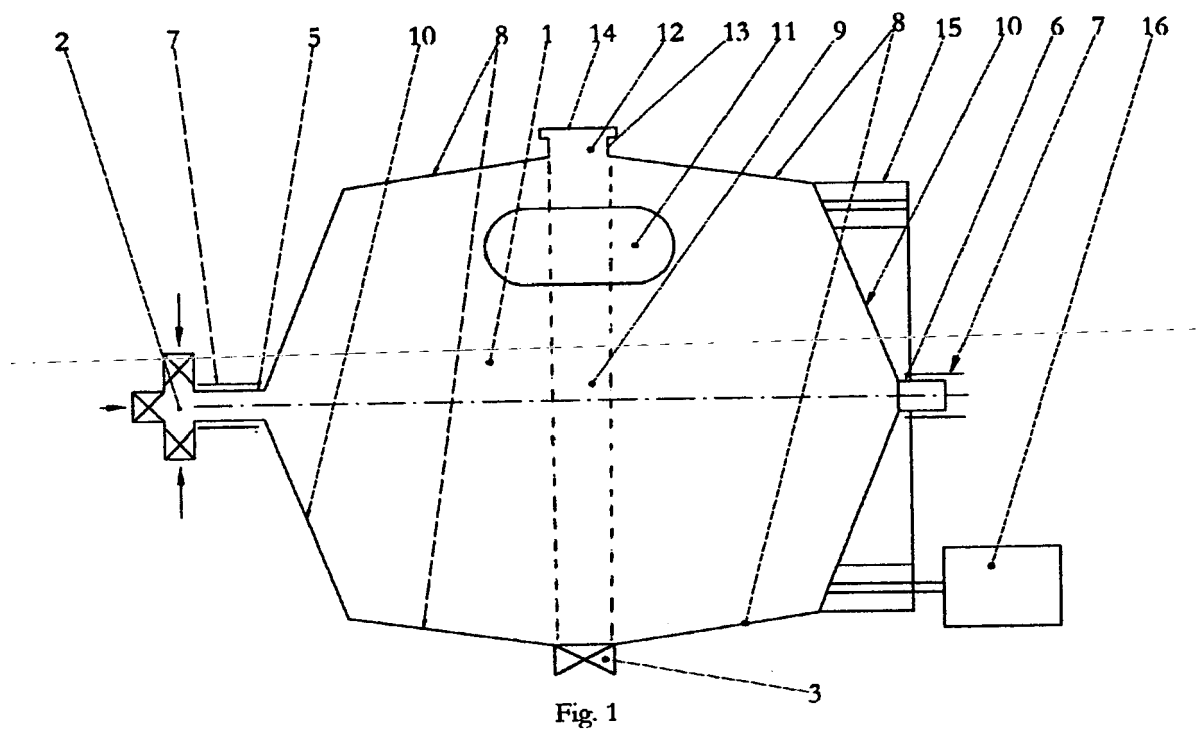
**[0031]** The discharge device **17** is coupled on the opening **12**, and the mixer **1** with the discharge part **17** is brought to the lower side for discharging the mixture **22** into the mould **4**. By the depressurizing and vacuuming device **3**, a negative vacuum pressure **P3** is carried out inside the mixer from a source not represented in the figures, which provides the mixture discharge free of jet and without breaking the air bubbles. Concomitantly with discharging the raw mixture **22** into the mould **4**, which is being moved by means of a roller system **23**, some adhesives and latices **24** are injected into the raw expanded mixture mass **22** through the feeding conduit **20** and the distribution conduits **21**. The mould **4** filled with the expanded mixture is conveyed to the maturation place where it is left for 5-10 hours, under normal or controlled environment conditions, thereafter the concrete is cut, palletized and delivered. The controlled environment conditions for the maturation process refer to parameters such as temperature, pressure, humidity, atmosphere composition etc.

**[0032]** In a non-limiting embodiment, the lightweight concrete for masonry and insulations comprises sand and mineral binders in a 2 to 1 or 1 to 1 ratio of 1.5-3.0 kg/ cubic meter of cellulose fibres, 0.6-1.0 kg/cubic meter carbon fibres, normal or magnetized water in a proportion of 50-60 liters in 100 kg, cement, additives, adhesives and latices that are specific to concretes, in a percentage of 0.2-1.0 liters/ cubic meter.

## Claims

1. Process for manufacturing the lightweight concrete, **characterized in that** a dry mixture comprising sand, cement and other solid additions is introduced, under normal atmospheric environment pressure (**P0**), into a mixer (**1**) which is then sealed and there is created therein a *mixing* air pressure (**P1**) higher than the atmospheric environment pressure (**P0**), the solid components are homogenized by rotating the mixer (**1**), and there are introduced, through a distributor (**2**), some fluid mixture components, water, air entrainers and additives, at a pressure (**P2**) higher than the mixing air pressure (**P1**), the dry components are homogenized with the fluid components for a mixing duration (**T1**), with values ranging from 15 to 25 minutes, thereafter the mixer (**1**) is depressurized to the environment atmospheric pressure (**P0**), there starting an expansion of the mixture, and the pressure lowering in the mixer is continued up to a slight vacuumatic pressure (**P3**), with values ranging from -0.05 to -0.5 bar, which is slowly mixed for a duration (**T2**) with values ranging between 1-2 minutes, for homogenously expanding the mixture and extracting the big defective air bubbles from the mixture, then the mixture is discharged with uniform flow, controlled by means of the vacuumatic pressure (**P3**) concomitantly with injecting additives and latices (**24**) into the mixture into a mould (**4**) subjected to a slight vibration, for a duration (**T3**) with values ranging from 30 to 60 seconds in order to favour a uniform dispersion of the injected products in the mixture, in the said mould (**4**) the concrete setting process is completed and concrete maturation is carried out under normal environment or controlled conditions.
  
2. Installation for applying the process for manufacturing lightweight concrete as defined in claim 1, **characterized in that** it consists of a mixer (**1**) which comprises two truncated cone-shaped sections (**8**) joined in the central region by a cylindrical ring (**9**) and two taper ends (**10**) wherein there are secured two semiaxes (**5**) and (**6**) provided with some bearing boxes (**7**) for resting on a support not represented in the figures, in one of the semiaxes (**5**) there being mounted a distributor (**2**) for feeding fluid components, the liquid part of the mixture and the pressurized air, the mixer (**1**) having a manhole cover (**11**), an opening (**12**) for feeding the solid components and discharging the mixture, said opening being cut in a threaded nozzle (**13**), provided with a thread plug (**14**) and a depressurizing and vacuuming device (**3**), the mixer (**1**) being further provided with a crown gear (**15**) and a driving mechanism (**16**) and a discharge device (**17**) which is coupled with the mixer (**1**) through the sleeve joint (**18**) which has an inlet cross-section in the shape of a circle and an oval-oblong shaped outlet cross-section and which has

mounted to the rear side a partition wall (**19**), the discharge device (**17**) being equipped with an installation for injecting adhesives and latices (**24**) into the raw mixture (**22**) discharged into a mould (**4**) which is moved on a system of rollers (**23**), the said injection installation consisting of a feeding conduit (**20**) and more distribution conduits (**21**), which are fed in a controlled manner from a tank not represented in the figure.



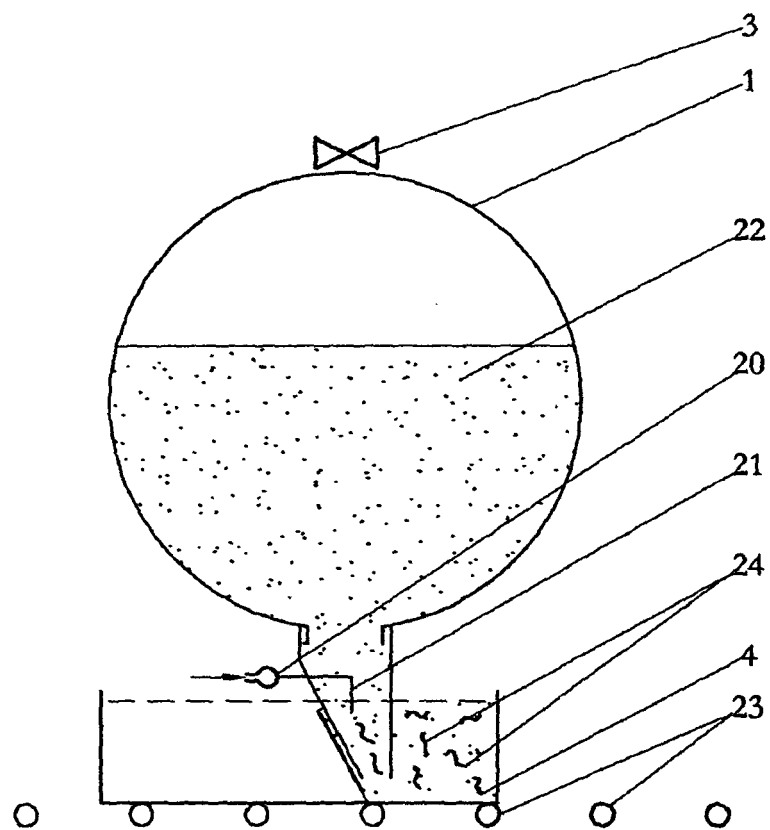
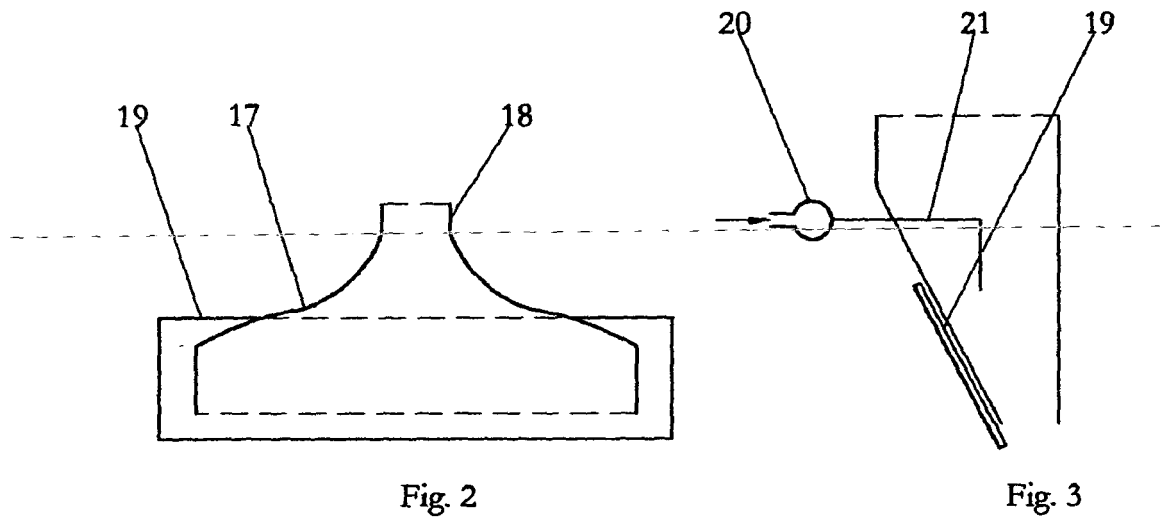


Fig. 4

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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- RO 2004000019 W [0003]
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