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(54) **Apparatus and method for the production of concrete, able to be used in a building site**

(57) Apparatus for the production of concrete, able to be installed advantageously in a building site and comprising a hopper (13) in which cement and inert materials are able to be loaded, and a mixer (20) with a horizontal axis, in turn comprising a mixing drum (21) inside which rotary mixing blades (22, 23) are present. The mixing drum (21) is provided with a loading aperture (30) and a discharge mouth (31). The mixing drum (21) is movable, by means of rotation with respect to its horizontal axis, between a loading position, in which both the loading aperture (30) and the discharge mouth (31) are disposed substantially above a horizontal plane passing through the horizontal axis, and a discharge position in which only the loading aperture remains above the horizontal plane.

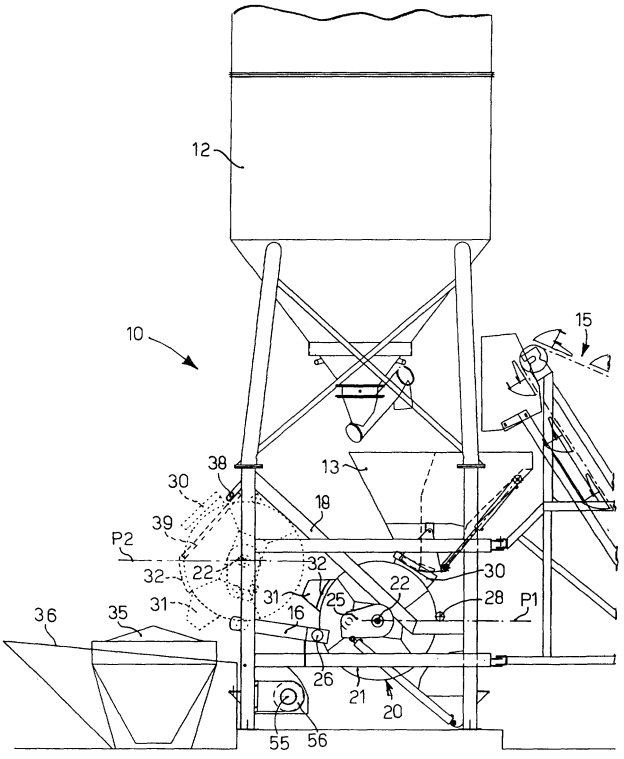

fig. 2

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Description

FIELD OF THE INVENTION

[0001] The present invention concerns an apparatus and a method for the production of concrete, able to be used in a building site. The apparatus comprises a metal supporting structure, of a size able to allow it to be transported with a motor vehicle. On the top of the metal structure a silos for cement is able to be mounted, while laterally to the structure one or more raking arms for inert materials are able to be disposed. A hopper is mounted on the supporting structure, below the silos, into which the cement, the inert materials, sand and gravel, and water can be loaded. A mixer is also disposed on the supporting structure, with a horizontal axis, which can selectively assume a loading and mixing position, below the hopper, or a discharge position, by means of at least a rotation around its horizontal axis. In the loading and mixing position, the outlet mouth of the mixer is above a horizontal plane passing through the axis of rotation of the latter.

BACKGROUND OF THE INVENTION

[0002] Apparatuses for the production of concrete in a building site are known, which use a mixer with a vertical or horizontal axis.

[0003] Mixers with a horizontal axis normally comprise a drum, rotary with respect to a fixed structure and having, on a front surface, a loading aperture, associated with a loading hopper located below a silos for the cement, and coupled to one or more raking arms for the inert materials. On the opposite front surface of the rotary drum there is an outlet mouth to discharge the concrete into a bucket. Such mixers are rather bulky and normally require the direction of rotation of the drum to be inverted in order to pass from the mixing step to the discharge step, with consequent lengthening of the production cycle.

[0004] Two examples of known mixers, with a horizontal axis, are described in the patents FR-A-1.475.995 and US-A-4,854,711.

[0005] Mixers with a vertical axis normally comprise a static or mixing container, inside which one or more shafts are mounted, able to rotate vertically, and provided with raking and mixing blades. The container has an upper cover shaped like a truncated cone, in which a loading aperture is made, and a cylindrical part below, on the lower wall of which the discharge mouth is made. The latter is selectively closed by a door, generally commanded fluid-dynamically, which must necessarily be watertight in order to prevent unwanted leakages of water and/or mixture during the mixing step.

[0006] These mixers too are very complex and expensive, and are not easy to install in building sites.

[0007] Another disadvantage of known apparatuses derives from the very large basic bulk determined by the need to provide a mobile basket to carry the bucket.

[0008] One purpose of the present invention is to achieve an apparatus for the production of concrete that is simple, reliable, which has a limited bulk, so that it can easily be transported with normal motor vehicles, which is easily installed in building sites and which at the same time allows to obtain a high productive capacity.

[0009] Another purpose of the present invention is to be able to graduate, simply and effectively, the loading into the mixer of the material that makes up the concrete, that is, the cement, the sand, the water and the gravel, and other components of the mixture for any consistency whatsoever of the concrete that is to be obtained: dry, semi-dry, plastic or fluid.

[0010] The Applicant has devised and embodied the present invention to overcome the shortcomings of the state of the art in order to achieve these purposes and obtain other advantages.

SUMMARY OF THE INVENTION

[0011] The present invention is set forth and characterized essentially in the main claims, while the dependent claims describe other innovative characteristics of the invention.

[0012] The apparatus for the production of concrete according to the present invention comprises a metal supporting structure, able to be installed advantageously in a building site and on which are able to be disposed, at the upper part, a silos for the cement and, laterally, one or more raking arms for inert materials. On the supporting structure, below the silos for the cement, a dosing hopper is mounted, into which at least the cement and the inert materials, for example sand and gravel, are able to be loaded. A mixer with a horizontal axis, which comprises a container or drum, for example cylindrical, inside which there are means to mix and homogenize the mixture, is mounted on the supporting structure and is provided with a loading aperture, able to be associated with the discharge aperture of said hopper, and a discharge mouth, through which the concrete produced inside the drum is able to be discharged.

[0013] According to a characteristic of the present invention, said mixer is movable, by effecting a rotation with respect to its horizontal axis, between a loading position, in which said loading aperture is disposed in correspondence with the discharge aperture of said hopper and said discharge mouth is disposed substantially above the highest level of the mixture, and a discharge position, in which said discharge mouth is below the horizontal plane passing through the horizontal axis of the mixer.

[0014] Advantageously, the loading aperture of the mixer remains above said horizontal plane even when the mixer is in the discharge position.

[0015] During the passage between said loading and said discharge position, said mixer is advantageously also raised from a lower level, where it is to be found at least during a loading step, to an upper level, so as to be

able to discharge the concrete into a bucket. The step of mixing the concrete, during which the mixing means, consisting for example of blades disposed in a spiral, are made to rotate in the same direction of rotation around said horizontal axis by means of motor means, can advantageously continue both during the loading of the material into the mixer, and also during the discharge step.

[0016] Advantageously the movement of the mixer between the loading and discharge positions, and between the lower level and the upper level, and vice versa, is obtained by means of command means of the fluid-dynamic type, with the aid of guides, suitably inclined and mounted on the supporting structure.

[0017] Moreover, the discharge mouth of the mixer is provided with a closing door, which normally remains closed due to gravity, and which is automatically opened by a mechanical device that exploits the movement of the mixer itself between its loading and discharge positions.

[0018] The fact that the mixer is movable gives the advantage of considerably reducing the basic bulk of the whole apparatus, since it is possible to eliminate the movable bucket-bearing basket, which is normally present in all plants with a fixed mixer.

[0019] According to another characteristic feature of the present invention, the hopper is divided internally into at least two substantially vertical containing compartments, a front compartment, in which the cement arriving from the silos is able to be inserted, and a rear compartment, into which a first inert material, for example sand, is able to be inserted at the lower part, to form a first layer of inert material, and then a second inert material, for example gravel, to form a second layer of inert material.

[0020] The discharge aperture, made in the lower part of the hopper, is substantially shaped so as to affect both the containing compartments. A single closing door is selectively commandable, for example by means of a fluid-dynamic device, to obtain the gradual opening of said discharge aperture of the hopper so that first the cement and the first inert material, for example sand, are introduced into the mixing drum, in order to form first of all, together with the water, the so-called cement grout, and then the second inert material, for example gravel, in order to form the concrete proper. The necessary water is advantageously introduced into the mixer laterally with respect to the discharge aperture of the hopper and is taken, by means of a pump, from a tank mounted on said supporting structure. The water, the quantity of which is dosed by suitable flow valves, is advantageously distributed in a substantially homogeneous manner along the larger side of the loading aperture of the mixer, by means of a delivery device provided with an oblong slit, or a plurality of nozzles.

[0021] Load cells of a known type are associated with the hopper, by means of which it is possible to weigh the quantity of each material, both introduced therein and discharged therefrom, in order to suitably dose the composition of the concrete to be produced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] These and other characteristics of the present invention will become apparent from the following description of a preferential form of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a lateral view of an apparatus for the production of concrete according to the present invention;
- fig. 2 is an enlarged detail of fig. 1;
- fig. 3 is a front partial view of the apparatus in fig. 1;
- fig. 4 is a front view of the mixer of the apparatus in fig. 1;
- fig. 5 is a lateral schematized view of a detail of the apparatus in fig. 1, with the mixer in the loading position with partial opening of the mouth;
- fig. 6 is a partial, plane view of the dosing hopper in fig. 5;
- fig. 7 is a section from VII to VII of fig. 5 corresponding to the loading aperture;
- fig. 8 is a lateral schematized view of the detail in fig. 5, with the loading mouth completely open;
- fig. 9 is a partial plane view of the dosing hopper in fig. 8.

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT OF THIS INVENTION

[0023] With reference to fig. 1, an apparatus 10 for the production of concrete according to the present invention, installed in a building site, comprises a supporting structure 11, consisting for example of a plurality of metal tubular elements fixed to each other so as to form a lattice shaped slightly like a truncated pyramid, having a base of about 2.5 m by 2.5 m and a height of about 2.5 m.

[0024] On the upper part of the supporting structure 11, a silos 12 for the cement is mounted in removable manner, of a known type, below which a hopper 13 is fixed. Load cells of a known type, not shown in the drawings, are provided below the hopper 13 to weigh the material inserted therein. The hopper 13 will be described in more detail hereafter.

[0025] On one side of the supporting structure 11 a raking arm device 15 is pivoted, also of a known type, which is able to collect inert material, such as sand, gravel or other, to transport it inside the hopper 13.

[0026] The supporting structure 11 also comprises a first pair of guides 16 (figs. 1, 2 and 3), parallel to each other and inclined upwards and towards the front part of the apparatus 10 (on the left in fig. 1) by about 10° with respect to a horizontal plane, and a second pair of guides 18, parallel to each other and inclined upwards and towards the front part of the apparatus 10 by about 45° with respect to a horizontal plane.

[0027] A mixer 20 with a horizontal axis is mounted on the two pairs of guides 16 and 18, which comprises a

mixing drum 21, made of metal and with a substantially cylindrical shape, inside which a rotary shaft 22 is disposed (fig. 4), provided with blades 23 disposed in a spiral. In this case, the capacity of the mixing drum 21 is about 0.5 m^3.

[0028] A drive unit 25 is mounted on a lateral surface of the mixing drum 21 to make the shaft 22 and the blades 23 rotate.

[0029] The mixing drum 21 is provided with wheels 26 and 28, able to slide on the guides 16, respectively 18, thrust by a pair of oil-dynamic jacks 29 of a known type, to move between a first working or loading position, shown with a continuous line in figs. 1 and 2, and a second working or discharge position, shown with a line of dashes in the same figures.

[0030] The mixing drum 21, substantially at the center of its cylindrical surface, is provided with a loading aperture 30, constantly open, which in the first working position is below the hopper 13, and a discharge mouth 31, offset angularly by about 100° with respect to the loading aperture 30.

[0031] The discharge mouth 31 is selectively closed by a metal door 32 and, like the loading aperture 30, is above the horizontal plane P1 passing through the axis of rotation of the shaft 22, when the mixing drum 21 is in the first working position. On the contrary, when the mixing drum 21 is in the second working position, the loading aperture 30 remains above a horizontal plane P2, also passing through the axis of rotation of the shaft 22, while the discharge mouth 31 is to be found below the horizontal plane P2.

[0032] In this case, the mixer 20, in passing from the first to the second working position, by means of the rotation of the mixing drum 21, is also raised so that in the second working position the discharge mouth 31 is above a bucket 35 disposed in a bucket-bearing basket 36.

[0033] Moreover, the metal door 32 of the discharge mouth 31, which normally remains closed due to the effect of the force of gravity, during the passage from the first to the second working position of the mixer 20, is automatically opened by means of a fixed stop 38 (fig. 2), which cooperates with a lateral arm 39 connected to the door 32.

[0034] The blades 23 are able to rotate always in the same direction of rotation and are conformed so as to constantly thrust the mixture constituting the concrete towards the center of the mixing drum 21, thus also facilitating the discharge of the latter from the discharge mouth 31.

[0035] The hopper 13 (figs. 2, 5, 6, 7, 8 and 9) is made of metal sheets welded together and is shaped so as to define a front compartment 40, or containing zone (on the left in the above figures), divided by means of a U-shaped inner dividing wall 41, from a second compartment 42, autonomous and bigger than the first and which surrounds it on three sides. The cement arriving from the silos 12 is able to be inserted into the front compartment 40, while the inert material arriving from the raking arm device 15 is able to be inserted into the second compartment 42.

[0036] The hopper 13, in its lower part, is provided with a single discharge aperture 43 (figs. 5, 6 and 7), shaped so as to have a front zone 45 and a rear zone 46, each of which is substantially rectangular, with the rear zone 46 having a greater area than the front zone 45. The latter, moreover, is in turn divided into a sub-zone 45a (fig. 7), which is substantially equal to the sizes of the lower part of the front compartment 40, and into a sub-zone 45b, adjacent to and smaller than the sub-zone 45a.

[0037] A lower door 48, consisting of two lateral arms 49 (figs. 5 and 6), pivoted on horizontal pins 50, has a lower part consisting of a metal plate having a rectangular development, but curved so as to be coaxial with an axis passing through the pins 50. The lower door 48 is commanded by an oil-dynamic jack 52 connected thereto at an intermediate rear point 51.

[0038] Under the hopper 13 a water delivery device 53 is disposed, having a longitudinal slit as long as the greater side of the loading aperture 30 of the mixer 20, to deliver the water uniformly together with the material that is discharged from the hopper 13, when the lower door 48 is opened.

[0039] By means of a pump 55 and valves to regulate the delivery, of a known type, the delivery device 53 (figs. 2 and 3) is connected to a water tank 56, mounted on the lower part of the supporting structure 11.

[0040] In order to perform a cycle of concrete production, the apparatus 10 as described heretofore functions as follows.

[0041] First of all the mixer 20 is in the first working position, below the hopper 13, and the lower door 48 is completely closed.

[0042] From the silos 12 a determinate quantity of cement C (fig. 5) is transferred to the front compartment 40 of the hopper 13 and, by means of the raking arm device 15, a determinate quantity of first inert material, for example sand S, is loaded into the second compartment 42, thus forming a lower layer. After this, with the same raking arm device 15, or with another device not shown in the drawings, for example a second raking arm, a determinate quantity of second inert material, for example gravel G, is loaded above the layer of sand S, thus forming an upper layer.

[0043] The lower door 48 of the hopper 13 is then gradually opened (figs. 5 and 6), so as to leave the rear zone 46 still closed (fig. 7). Consequently, in this first loading step, from the hopper 13 only the cement C from the sub-zone 45a, and part of the sand S (indicated by the line of dashes in figs. 5 and 6) from the sub-zone 45b, are introduced into the mixer 20, but not the gravel G. At the same time, a determinate quantity of water is also introduced, by means of the delivery device 53.

[0044] During the first loading step the shaft 22 and the blades 23 are made to rotate by the drive unit 25, in order to thus form the cement grout.

[0045] After a determinate time, of the order of some

tens of seconds, which can be selected as desired, the opening of the lower door 48 is completed (figs. 8 and 9), by means of the jack 52, so that the rest of the sand S (without the dashes in fig. 5) and the gravel G are also introduced into the mixer 20.

[0046] After this, the lower door 48 is closed.

[0047] When the formation of the concrete inside the mixer 20 has been completed, after the blades 23 have been rotating for some minutes, while they continue to rotate in the same direction of rotation, the mixer 20 is displaced by the jacks 29 from the first to the second working position. During this displacement, the mixing drum 21 rotates in an anti-clockwise direction (fig. 2), guided by the guides 16 and 18, and takes its discharge mouth 31 below the plane P2. Moreover, when the displacement is nearly finished, the door 32 is also automatically opened, so that the concrete is discharged from the mixer 20 to the bucket 35 below, facilitated by the screw-type blades 23 which thrust the concrete towards the center of the mixing drum 21 and hence towards the discharge mouth 31.

[0048] The mixer 20 is then returned to the first working position, below the hopper 13, which in the meantime has been filled with a new load of cement and inert material, as previously described, in order to effect another cycle of concrete production.

[0049] With the apparatus 10 it is therefore possible to regulate the quantities of each component of the concrete, obtaining a very high and constant quality, without increasing the overall time of the working cycle.

[0050] Moreover, all the drive and command members, from the drive unit 25 to the jacks 29 and 52, the pump 55, the relative regulation valves and the load cells associated with the hopper 13, are advantageously controlled by an electronic control unit, selectively settable, so that the working cycle for the production of concrete can even take place in a completely programmable and automated manner.

[0051] It is clear, however, that modifications and/or additions of parts may be made to the apparatus 10 as described heretofore, without departing from the scope of the present invention.

[0052] For example, according to a variant, instead of rotating and translating in order to be lifted, the mixer 20 could simply rotate, to take the discharge mouth 31 from the first to the second working position, without rising from plane P1 to plane P2. In this case, the mixer 20 should be located at a higher level with respect to the ground in order to be able to discharge into a bucket or a transportable mixer below, or a trench should be provided in the ground where the bucket 35 can be disposed, or conveyor means provided to convey to the bucket 35 the concrete discharged from the mixer 20.

[0053] It is also clear that, although the present invention has been described with reference to a specific example, a person of skill in the art shall certainly be able to achieve many other equivalent forms of apparatus for the production of concrete, having the characteristics as set forth in the following claims and hence all coming within the field of protection defined thereby.

Claims

1. Apparatus for the production of concrete, comprising a supporting structure (11), able to be installed advantageously in a building site and with which are able to be associated first loading means (12) for loading cement and second loading means (15) for loading inert materials, a hopper (13) mounted on said supporting structure (11) into which said cement and said inert materials are able to be loaded, and a mixer (20) with a horizontal axis, mounted on said supporting structure (11) and comprising in turn a mixing drum (21) inside which rotary mixing means (22, 23) are present, said mixing drum (21) being provided with a loading aperture (30), able to be associated with a discharge aperture (43) of said hopper (13), and a discharge mouth (31) through which the concrete produced inside said mixing drum (21) is able to be discharged, **characterized in that**

   a) said mixing drum (21) is movable, by means of rotation with respect to its horizontal axis, between a loading position, in which both said loading aperture (30) and said discharge mouth (31) are disposed substantially above a horizontal plane passing through said horizontal axis, and a discharge position in which said discharge mouth (31) is below said horizontal plane, while said loading aperture (30) remains above said horizontal plane, **in that**

   b) during the passage between said loading position and said discharge position, said mixing drum (21) is also lifted from a lower level (P1), in which it is to be found at least during a loading step, to an upper level (P2), so as to be able to discharge easily the concrete produced therein, and **in that**

   c) the movement of said mixing drum (21) between the loading and discharge positions, and between said lower level (P1) and said upper level (P2), and vice versa, is obtained by sliding said mixing drum (21) on a pair of guides (18), mounted on said supporting structure (11) and inclined with respect to said horizontal plane, command means (29) of the fluid-dynamic type being provided to selectively thrust said mixing drum (21) along said pair of guides (18).

2. Apparatus as in claim 1, **characterized in that**, in said loading position, said loading aperture (30) is disposed substantially in correspondence with said discharge aperture (43) of said hopper (13).

3. Apparatus as in claim 1, **characterized in that** said

mixing means comprise a shaft (22) rotating with respect to said mixing drum (21) and on which a plurality of blades (23) disposed in a spiral are mounted.

4. Apparatus as in any claim hereinbefore, **characterized in that** said mixing means (22, 23) are able to rotate in the same direction of rotation around said horizontal axis, by means of a drive unit (25), both during the step of mixing the concrete and also, possibly, during the loading of the material into said mixing drum (21), and also during a discharge step.

5. Apparatus as in any claim hereinbefore, **characterized in that** said discharge mouth (31) is provided with a first closing door (32), able to remain normally closed due to gravity, and able to be automatically opened by mechanical means (38, 39) which exploit the movement of said mixer (20) between said loading position and said discharge position.

6. Apparatus as in any claim hereinbefore, **characterized in that** said hopper (13) is divided internally into at least two substantially vertical containing compartments (40, 42), into a first (40) of which the cement is able to be inserted, and into a second (42) of which said inert materials are able to be inserted, and that a single discharge aperture (43) is made in the lower part of said hopper (13) and is shaped so as to affect both said containing compartments (40, 42).

7. Apparatus as in claim 6, **characterized in that** a first type of inert material is able to be loaded at the lower part into said second compartment (42), in order to form a first layer of inert material, and a second type of inert material is able to be loaded at the upper part, in order to form a second layer of inert material, different from the first.

8. Apparatus as in 7, **characterized in that** a second door (48) is associated with said discharge aperture (43) and is selectively commandable to obtain the gradual opening of said discharge aperture (43) so that first the cement and the material of said first layer are introduced into said mixer (20), and then the material of said second layer.

9. Apparatus as in any claim hereinbefore, **characterized in that** it also comprises a water delivery device (53), disposed laterally with respect to said discharge aperture (43) of said hopper (13) in order to introduce water into said mixer (20) together with the content of said hopper (13), said delivery device (53) being connected by means of a pump (55) to a water tank (56) mounted on said supporting structure (11).

10. Method for the production of concrete, using at least: a hopper (13), divided into two autonomous compartments (40, 42); first loading means (12) for loading cement into a first compartment of said hopper (13); second loading means (15) for loading inert materials into a second compartment (42) of said hopper (13); and a mixer (20) with a horizontal axis, able to mix said cement and said inert materials, together with water, **characterized in that** it comprises at least a first step of loading said hopper (13), during which cement is loaded into said first compartment (40) and a first type of inert material is loaded at the lower part into said second compartment (42), to form a first layer of inert material, and at the upper part a second type of inert material, to form a second layer of inert material, different from the first, and a second step of loading said mixer (20), during which, through a single discharge aperture (43) of said hopper (13), first the cement and said first inert material are introduced, to form first of all, with the water, the so-called cement grout, and then said second inert material is introduced, to form the concrete proper.

11. Method for the production of concrete as in claim 10, **characterized in that** the necessary water is introduced into said mixer (20) laterally with respect to said discharge aperture (43) of said hopper (13).

12. Method for the production of concrete as in claim 10 or 11, **characterized in that** said first type of inert material is sand and said second type of inert material is gravel.

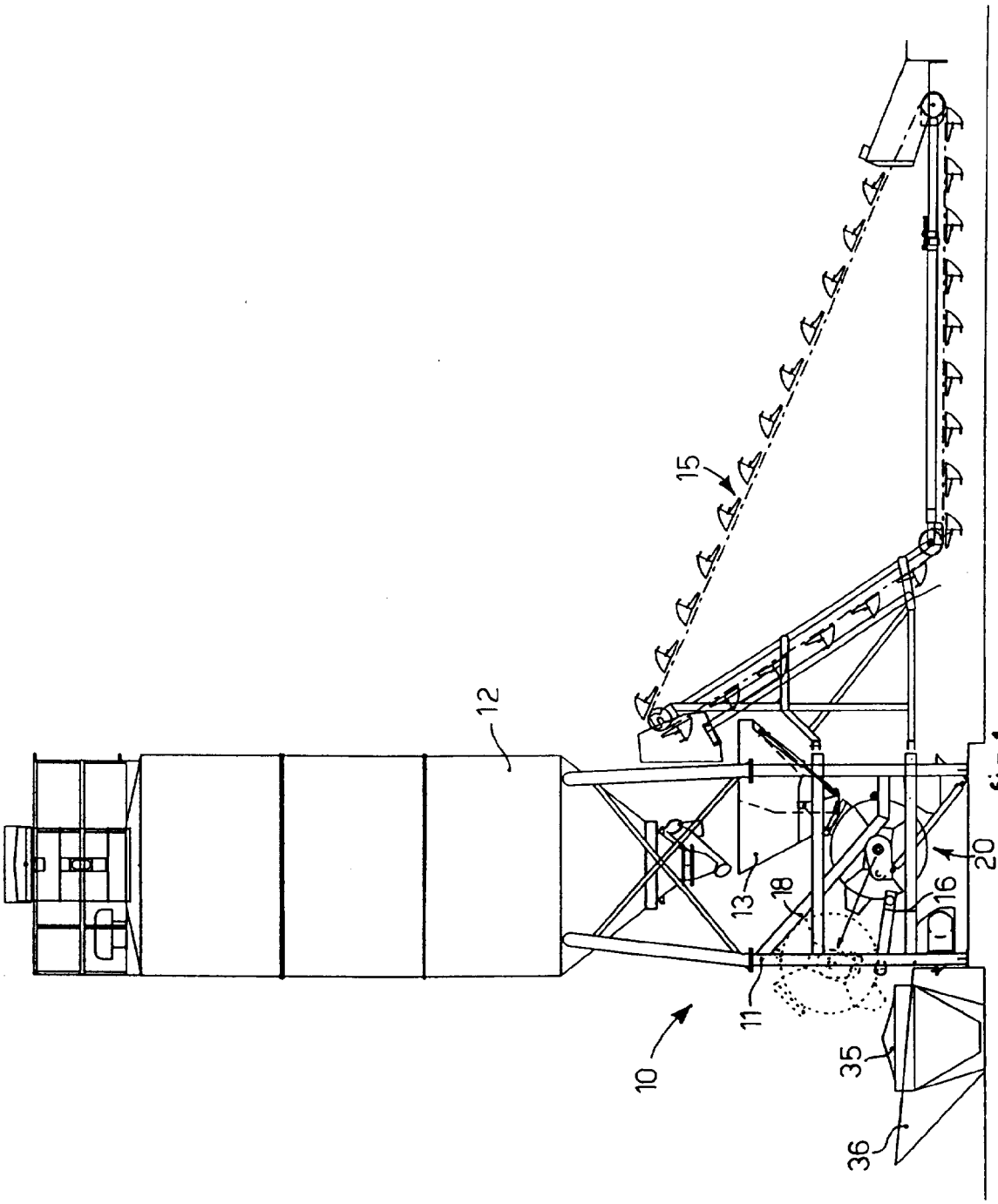

fig.1

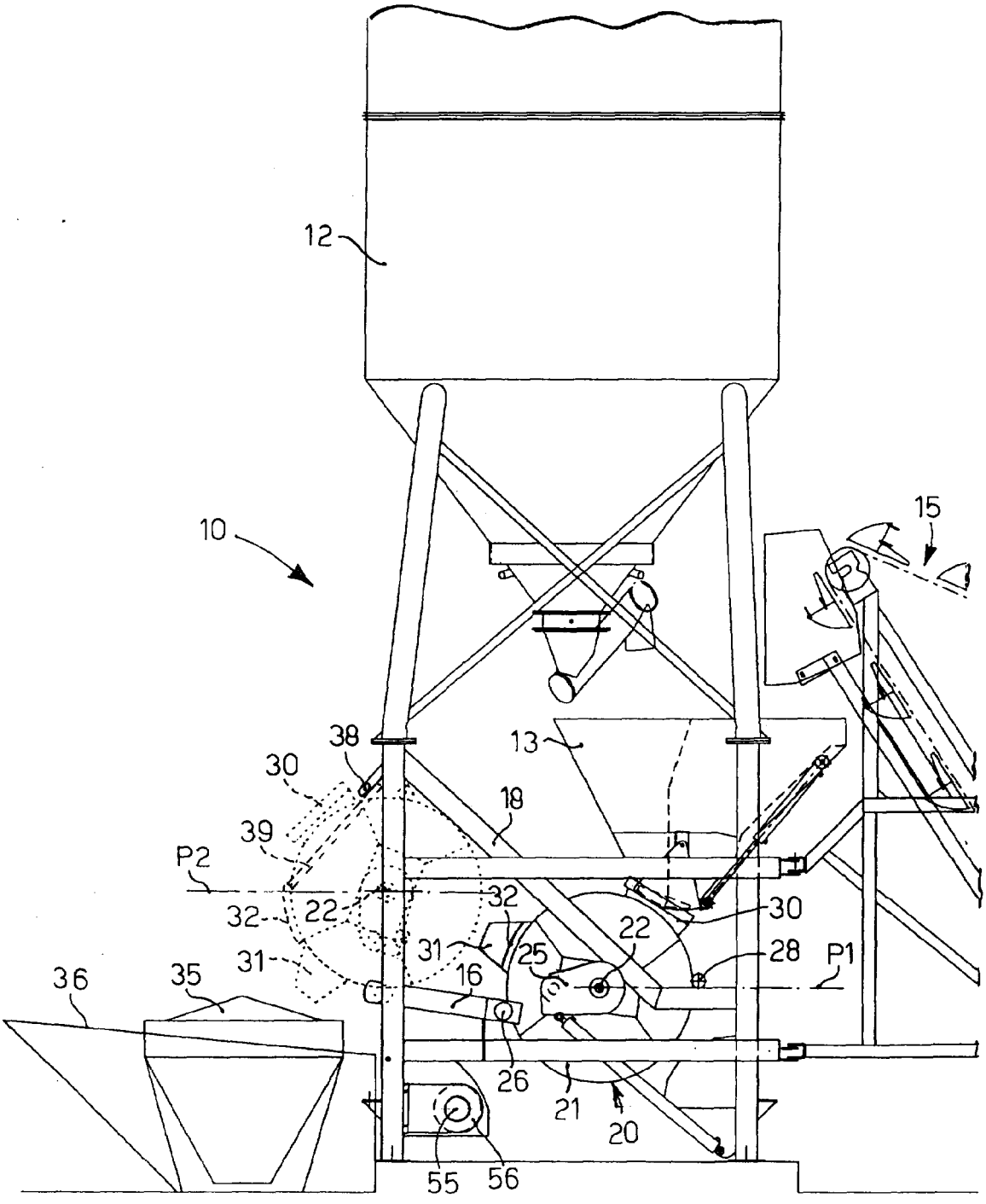
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fig. 2

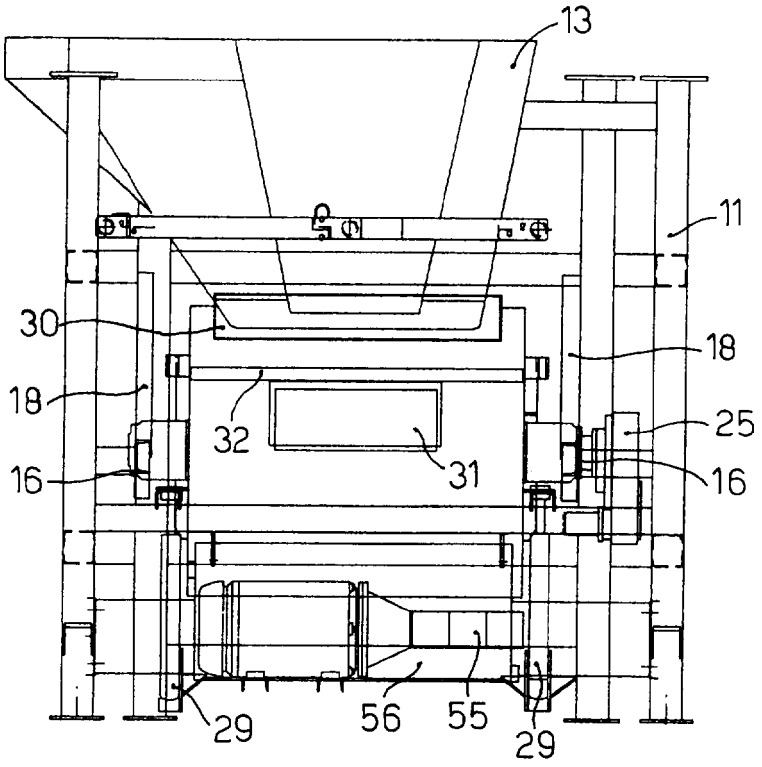

fig. 3

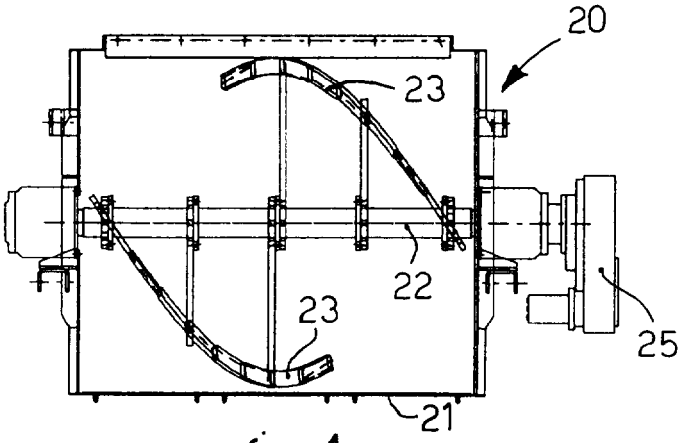

fig. 4

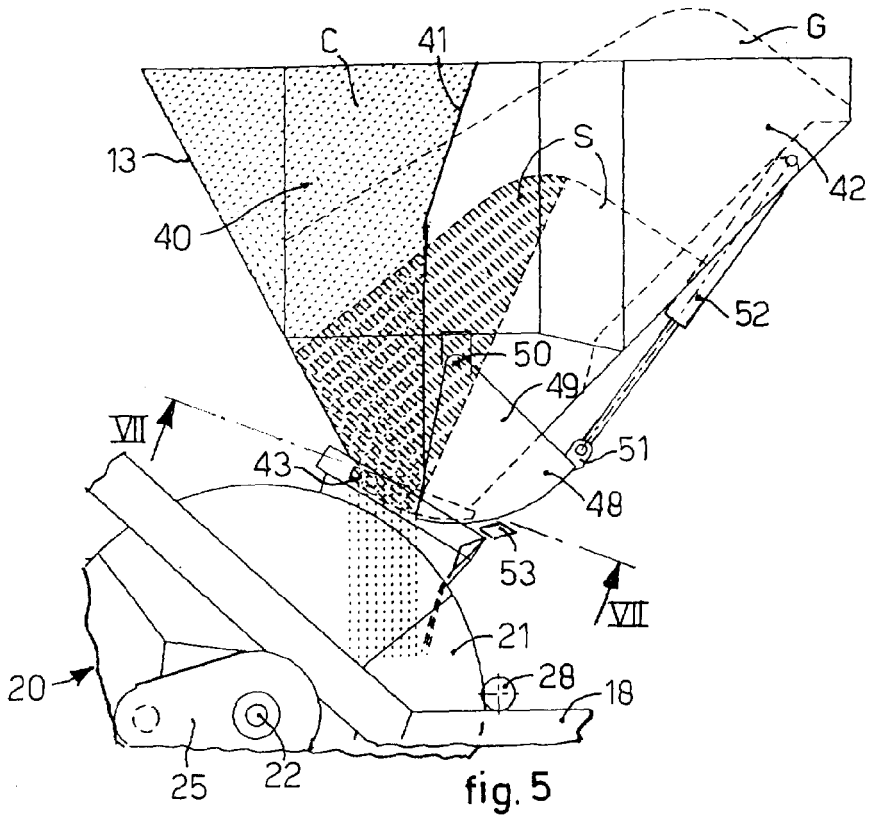

fig. 5

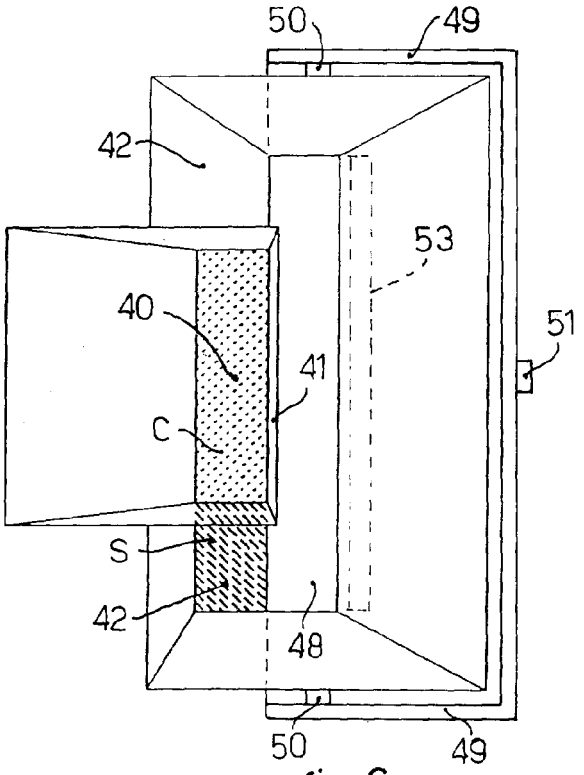

fig. 6

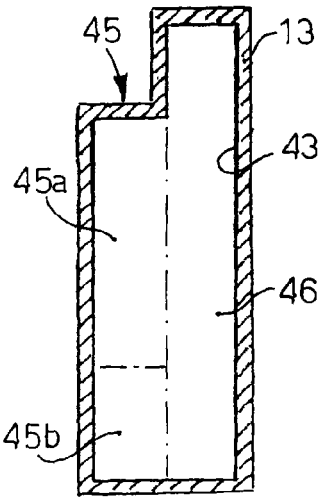

fig. 7

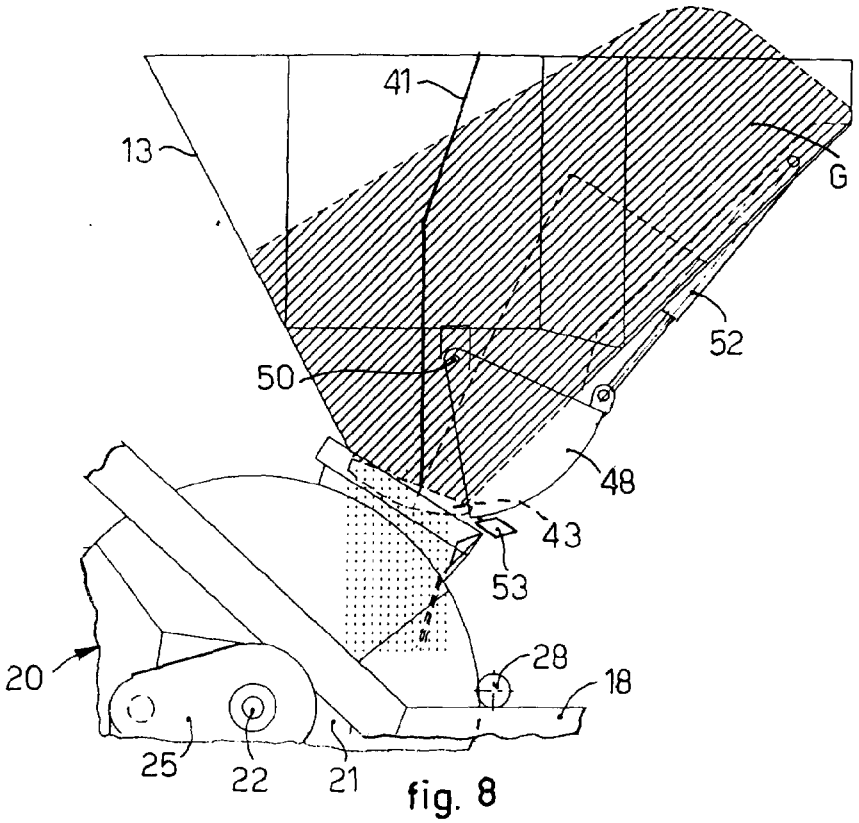

fig. 8

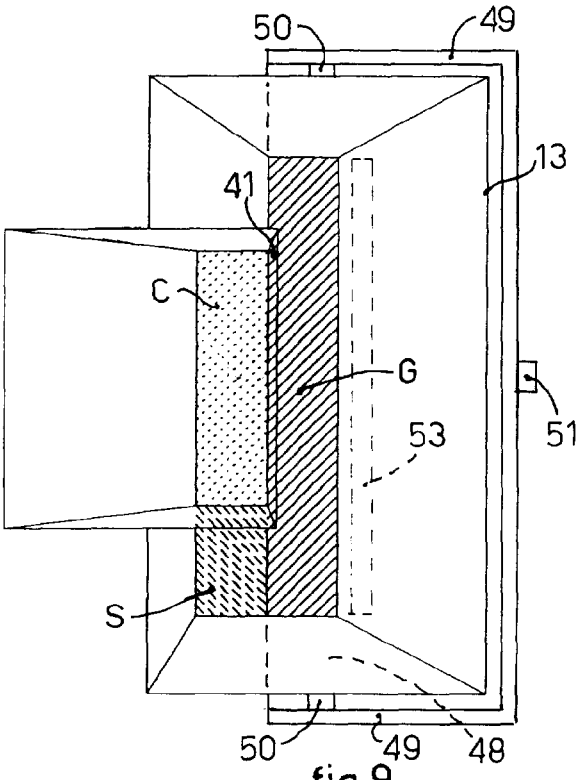

fig.9

REFERENCES CITED IN THE DESCRIPTION

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