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(54) **Cleaning machine.**

(57) Cleaning machine with means for blasting the goods to be cleaned by means of liquid containing granules. These granules have a size between 0.5 and 5 mm.

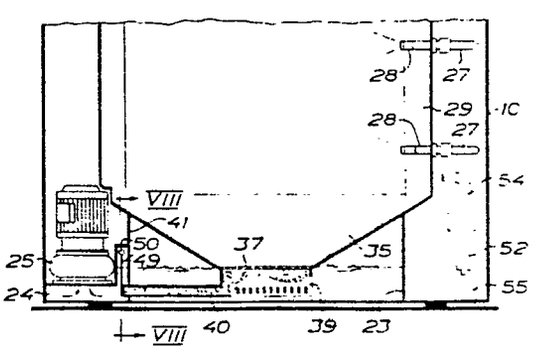

FIG. 6

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CLEANING MACHINE

The invention relates to a cleaning machine with means for blasting the goods to be cleaned by means of liquid containing granules, comprising a treatment chamber for receiving the goods, a liquid container, pump means the suction side of which is connected to the liquid container for sucking-in liquid, nozzle means connected to the pressure side of the pump means for ejecting liquid towards the goods in the treatment chamber, and means for supplying granules to liquid supplied to the nozzle means, and for separating granules from liquid ejected from the nozzle means.

Cleaning machines in which blasting of the goods to be cleaned is applied are used for instance for washing heavily soiled goods with adhereing food residues which are difficult to resolve and remove only by spraying liquid containing conventional dish-washing detergents. In a prior art embodiment (DAS 1.148,360) of a dishwashing machine of this type, commonly called heavy-duty dishwashing machine, the granules are located on a grid in the treatment chamber below the goods to be washed, and by forcing liquid from below through the grid said granules are thrown towards the goods together with the liquid. The arrangement is not satisfactory because the liquid containing granules cannot without difficulty be directed towards the goods to be washed in such a manner that an optimally effective cleaning of the goods is achieved. In another embodiment (U.S. 1,761,492) granules formed as balls are introduced by means of an injector into the liquid when it is ejected towards the goods to be washed, and are then separated from the liquid again by means of a grid when the liquid leaves the goods,

to be forwarded to the injector by means of separate conveyor means in order to be introduced into the liquid again.

The object of the invention is to optimize the cleaning effect obtained by the blasting in a cleaning machine of the type referred to above, and this is achieved according to the invention by the granules having a size between 0.5 and 5 mm.

Preferably, the granules have a specific gravity between 0.8 and 1.9, and it is also preferred that they have a maximum mass of 0.2 g.

In order to illustrate the invention an embodiment of a heavy-duty dishwashing machine using such granules will be described in more detail below, reference being made to the accompanying drawings, in which

FIG. 1 is a vertical sectional view of the heavy-duty dishwashing machine with a carriage for supplying the goods to be washed to the treatment chamber of the machine, shown in side view;

FIG. 2 is a front view of the heavy-duty dishwashing machine from the end thereof where the carriage shall enter;

FIG. 3 is a side view of the heavy-duty dishwashing machine and shows the pump means and drive means for the nozzles;

FIG. 4 is a horizontal sectional view of the heavy--duty dishwashing machine and shows the location of the carriage inside the treatment chamber;

FIG. 5 is a corresponding horizontal sectional view with the bottom of the treatment chamber shown in plan view, partly in sectional view;

FIG. 6 is a vertical sectional view of the lower portion of the heavy-duty dishwashing machine taken perpendicularly to the view in FIG. 1, and discloses the means for separating the granules from the liquid ejected from the nozzles, and for storing the granules;

FIG. 7 is a perspective view of a cassette for receiving and storing the granules; and

FIG. 8 is a fragmentary view taken along line VIII - VIII in FIG. 6 and illustrates the cassette in end view as seen towards the end of the cassette, which opens into the pump chamber.

The heavy-duty dishwashing machine comprises an outer cassette 10 in which a treatment chamber 12 for the goods to be washed is bounded by means of inside walls 11. For the supply of the goods to be washed, supported on a carriage 13, to this treatment chamber there is provided in connection with an entrance 14

which can be closed by means of doors not shown, a carriage elevator by means of which the carriage can be lifted from the floor level and can be displaced into the treatment chamber. The carriage elevator comprises a cradle 15 which can be displaced hydraulically on a horizontal support rail 16 arranged centrally at the top of the treatment chamber said rail projecting from the treatment chamber through the entrance 14. The cradle 15 supports a vertically mounted guide rail 17 on which a cross-formed lift slide 18 can be displaced hydraulically up and down. The lift slide has a number of hooks 19 to engage from below brackets 20 on the carriage 13 when the cradle 15 is in an outer end position on the support rail 16 and the lift slide is in a lower end position on the guide rail 17 and is then displaced upwardly to lift the carriage sufficiently to the position indicated by dot and dash lines so that the carriage clears the sill 21 in the entrance 14 at succeeding displacement of the carriage elevator and the carriage suspended thereon into the treatment chamber 12 from the outer end position to an inner end position shown by dot and dash lines in FIG. 1, by the cradle 15 being displaced along the support rail 16. An abutment 22 is provided on the guide rail 17 to support the carriage 13 when suspended from the carriage elevator.

The arrangement described provides a rational handling of the goods to be washed because this goods can be shelved on the carriage at different collecting places and then easily can be moved into the heavy-duty dishwashing machine without substantial manual work, but it is of course also possible to arrange the heavy--duty dishwashing machine with shelves or guides for the insertion of baskets and racks manually into the treatment chamber.

The lower portion of the cabinet 10 is formed as a liquid container 23 below the treatment chamber 12, and this liquid container is enlarged to form a closed suction chamber 24 to which a pump 25 driven by an electric motor is connected with the suction side thereof. The pressure side of the pump is connected to a pressure conduit 26 which in turn is connected by distribution conduits 27 to a number of nozzles 28 rotatably mounted in two vertical rows on two opposite side walls of the treatment chamber in niches 29 formed by these side walls. The connection between the nozzles 28 which are cranked, and the distribution conduits 27 is provided by pivot couplings 30. For the rotation of the nozzles these are provided with sprockets 31, and an endless chain 32 engages these sprockets said chain also running over two conducting sprockets 33 at the top. One of these conducting sprockets is connected to an electric drive motor 34. It will be seen that the chain 32 is extended alternatingly at one side and the other of the sprockets 31 so that the nozzles 28 in a row are driven alternatingly in one direction and the other.

The treatment chamber 12 has a bottom 35 which is perforated to the extent it covers the liquid container 23. It slopes as a funnel towards a central opening 36 covered by a grid 37. The treatment chamber 12 communicates with the liquid container through the opening 36, not directly but via a cassette 38 shown separately in FIG. 7. The cassette is connected to the opening 36 at a square socket 39 and a conduit portion 40 of the cassette, having the same width as the socket, extends through the side wall 41 of the container 23 into the closed suction chamber 24 wherein it opens. The cassette 38 is arranged to be easily removable from the heavy-duty dishwashing machine by being lifted at the socket 39 and being withdrawn through the opening 36. It

serves as a magazine for the granules used as an addition to the liquid to provide a mechanical working of the goods to be washed by liquid blasting. The perforation of the bottom 35 consists of sufficiently small openings so as not to let through the granules as long as they are not worn due to the use thereof in the machine to such extent that they are no longer effective for the purpose thereof while the grid 37 on the contrary has sufficiently large openings to let through unobstructedly the granules to the cassette 38.

The conduit portion 40 of the cassette 38 has an upper bounding wall 42 which extends over the entire width of the cassette. By means of a partition wall 43 extending angularly through the conduit portion 40 there is defined a passage 44 the opening of which at the end connected to the socket 39 has the same width as the conduit portion while the opening at the other end indicated at 45 and opening into the suction chamber 24 has a width which is only half the said width. Gill openings 46 possibly covered by a close--meshed netting to retain the granules in the cassette are provided in the side walls of the socket 39 and the passage 44 such that water can pass between the interior of the cassette 38 and the liquid container 23.

The partition wall 43 also defines a passage 47 in the conduit portion 40, which is open at the bottom thereof and also opens into the suction chamber 24 through an opening 48 of the same size as the opening 45. A plate valve 49 is displaceable on a horizontal bar 50 and is of a size to cover completely only one of the openings 45 and 48 at a time, viz. when it is located at one and the other end position thereof, respectively, on the bar 50. In intermediate positions the valve covers each opening more or less. Means can be provided for

displacement of the valve 49 manually or by means of a servo on the bar 50 but such means which can be of a known construction are not shown here.

If it is assumed that the liquid container 23 contains liquid and that the granules to be added to the liquid from the beginning are contained in the cassette 38 the opening 48 of which is assumed to be closed while the opening 45 is open, granules will be carried by the liquid when this is sucked-up by the pump 25 from the suction chamber 24 because the suction chamber 24 is connected to the liquid container 23 through the passage 44 of the cassette only. Due to the fact that the liquid then will flow into the passage 44 from the sides through the gill openings 46 the granules will be agitated by turbulence of the liquid and will be carried away by the liquid flow to the pump without being packed in the passage 44. The liquid containing granules is expelled from the nozzles 28 at the pressure side of the pump and is thrown towards the goods to be washed on the carriage 13 in order to provide the cleaning effect thereof. Liquid and granules as well as accompanying contaminants then fall down to the bottom 35 of the treatment chamber 12 where liquid and granules are separated. The granules pass through the grid 37 and the opening 36 into the cassette 38 where they are again carried away by the liquid as this is being sucked-up by the pump 25 from the container 23 via the suction chamber 24.

The advantage of arranging the supply of the granules to the liquid in this manner is above all, as mentioned above, that there will be no accumulation of packed granules, which could prevent the circulation of the liquid, but also that the addition of granules can be controlled and can be brought to cease completely. If the valve 49 is displaced to the end

position in which the valve covers the opening 45 the pump will draw liquid only from the container 23 through the passage 47 and the suction chamber 24, and with the valve in positions between said two end positions granules will be mixed with the liquid more or less. The adjustment of the valve is preferably controlled from a timer which controls also other functions of the heavy-duty dishwashing machine.

When the pump 25 is sucking liquid through the passage 47, the liquid is forced to pass from the container 23 below the lower edge 51 of the side wall of the cassette 38, bounding the passage 47, and it is prevented thereby that air will be sucked-in by the pump.

The granules used in the heavy-duty dishwashing machine according to the invention preferably consist of plastics material such as Nylon or Delrin. The granules need not be spherical but can have any form; they can comprise for instance small polyhedrons or cylinders. The substantially spherical form is preferred, however, because balls have no tendency of adhering to the goods to be washed in the manner that can occur as far as granules with plane surfaces are concerned. As guidance for the dimensioning of the granules and the adjustment of other factors affecting the cleaning action of the granules the following specification is given:

Mass of the granules max..	0.2 g
Size of the granules	0.5-5 mm
Spec. gravity of the granules	0.8-1.9
Velocity of the granules from the nozzles	4-35 m/sec
Nozzle area	0.3-3 cm^2

The amount of granules should comprise between 10 and 50 per cent by volume of the circulating

liquid and preferably should be 20 to 40 per cent by volume.

Excellent results have been obtained by granules formed as substantially spherical bodies of Delrin having a diameter of substantially 3 mm when washing such heavily soiled goods as exist in catering centers and restaurants and comprise stainless utensils such as trays, pans, dish-plates, etc. where the existing radius of curvature practically never is less than 3 mm. When impigning against such goods balls having a diameter of 3 mm can enter into and work also the smallest existing nooks and corners of the goods.

The following values of the parameters given above, which have been obtained from experience, have been found to provide optimum cleaning action when Delrin balls having a diameter of 3 mm, are being used:

The mass of the balls	0.01946 g
The spec. gravity of the balls	1.40
Velocity	13.18 m/sec
Nozzle area	1.267 cm^2
Amount of balls	abt 35 per cent by volume

Since the cleaning in the heavy-duty dishwashing machine according to the invention is effected by the simply mechanical effect on food residues adhering to the goods to be washed the temperature of the circulating liquid can be kept low without any detrimental effect on the result; on the contrary, a low temperature is advantageous because it is thereby avoided that proteins in the food residues coagulate and adhere still firmer to the goods. By means of the granules the food residues are broken and comminuted so that they can be easily removed by the circulating liquid.

A typical dishwashing program in the heavy-duty

dishwashing machine according to the invention can comprise the following different steps:

1. Prerinsing at about 38°C without granules for 30 sec.
2. Dishwashing with granules at 38°C for 3 to 10 min.
3. Final rinsing at 38°C without granules for 30 sec for returning the granules to the cassette 38 the opening 45 being closed.
4. Final flushing at 90°C without granules for 15 sec for disinfection of the goods and for facilitating draining and drying.

When liquid containing granules is being circulated friction heat is generated to some extent by the granules impigning against the goods to be washed, and in the dishwashing cycle described this friction heat can be sufficient in order to maintain the temperature at about 38°C if the liquid supplied has substantially this temperature from the beginning.

In the steps 1 to 3 the same liquid can be used for the dishwashing. For cleaning this liquid between the steps the dishwashing machine can be provided with a hydrocyclone 52 which is connected at the inlet side thereof to a conduit 53 which communicates with the pressure conduit 26, and is connected at the outlet side thereof to a conduit 54 opening into the treatment chamber 12 so that liquid without granules can be pumped through the hydrocyclone between the steps 1 and 2 and between the steps 2 and 3, respectively, or part of the liquid can be pumped continuously through the hydrocyclone during the steps 1 and 3. In the cyclone entrained food residues are separated and discharged to a drain 55. After the step 3 the liquid is discharged to the drain and then fresh, clean liquid at the temperature 90°C is supplied for the final flushing.

All these operations can be controlled from the timer by means of solenoid valves.

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CLAIMS

1. Cleaning machine with means for blasting the goods to be cleaned by means of liquid containing granules, characterized in that the granules have a size between 0.5 and 5 mm.

2. Cleaning machine according to claim 1, characterized in that the granules have a size of about 3 mm.

3. Cleaning machine according to claim 1 or 2, characterized in that the granules have a specific gravity between 0.8 and 1.9.

4. Cleaning machine according to claim 3, characterized in that the granules have a specific gravity of about 1.4.

5. Cleaning machine according to any of claims 1 to 4, characterized in that the granules have a maximum mass of 0.2 g.

6. Cleaning machine according to claim 5, characterized in that the granules have a mass of about 0.03 g.

7. Cleaning machine according to any of claims 1 to 6, characterized in that the granules consist of a plastic material.

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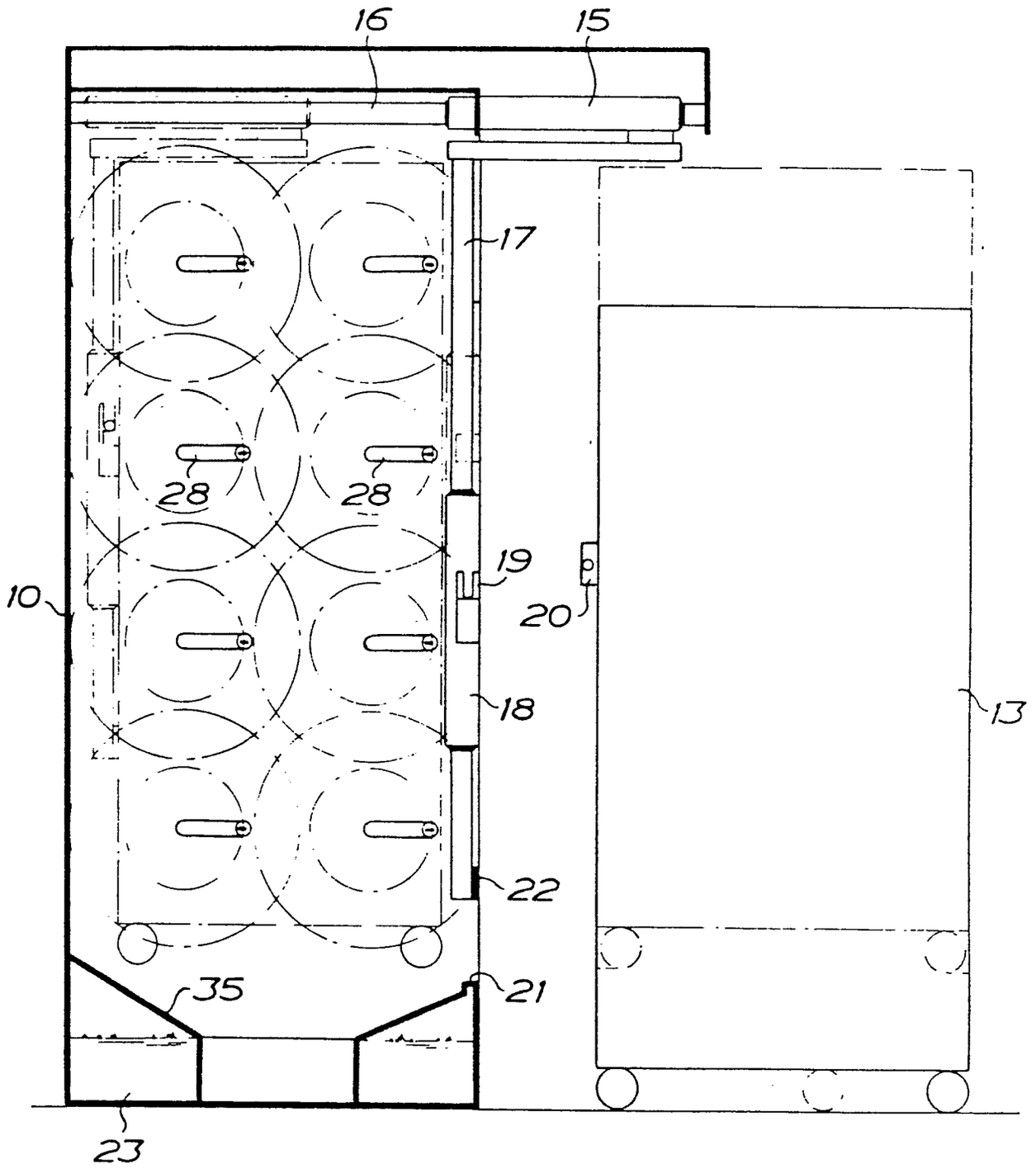

FIG. 1

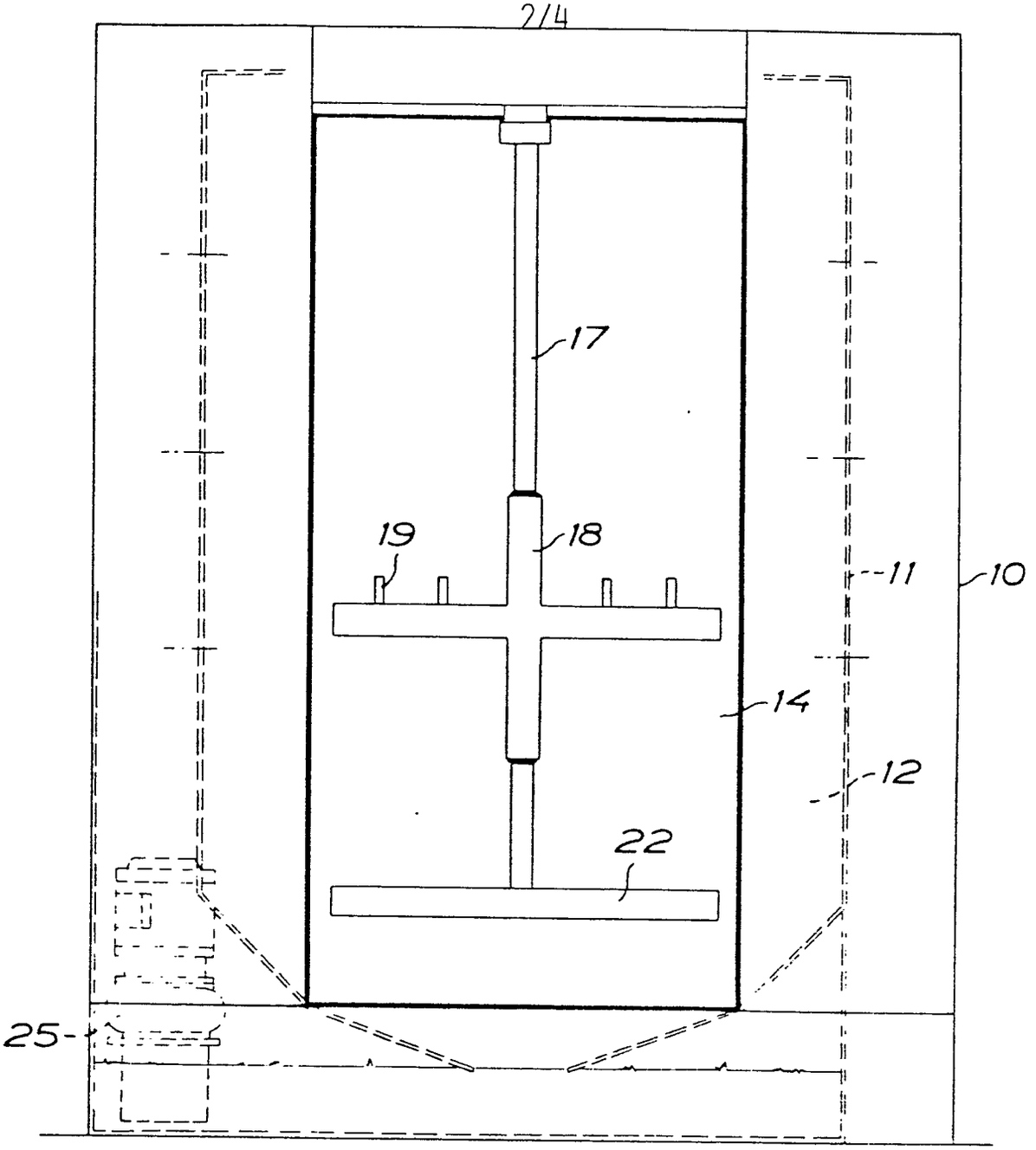

FIG. 2

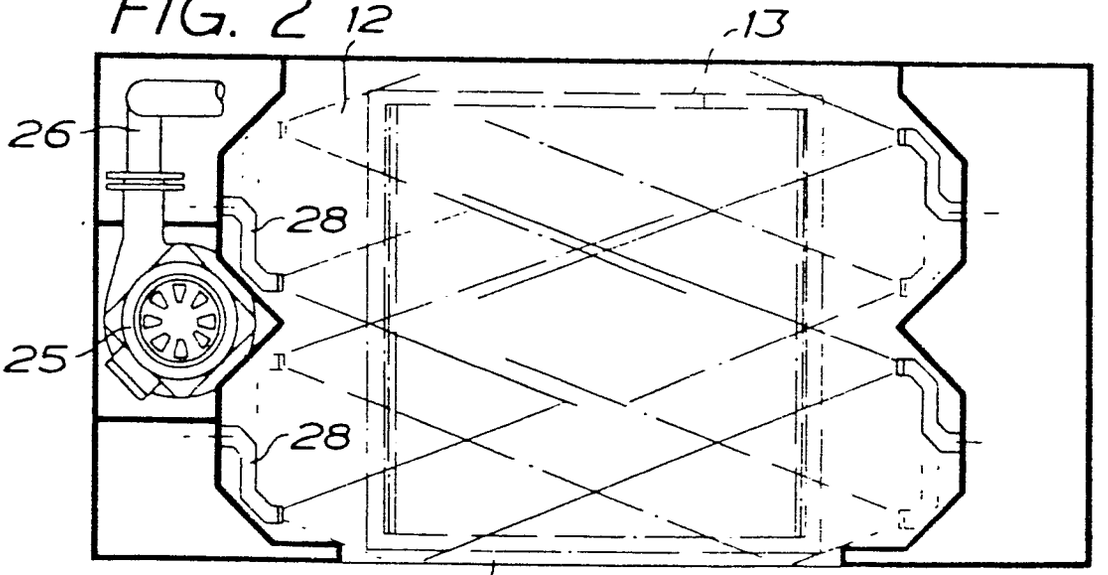

FIG. 4

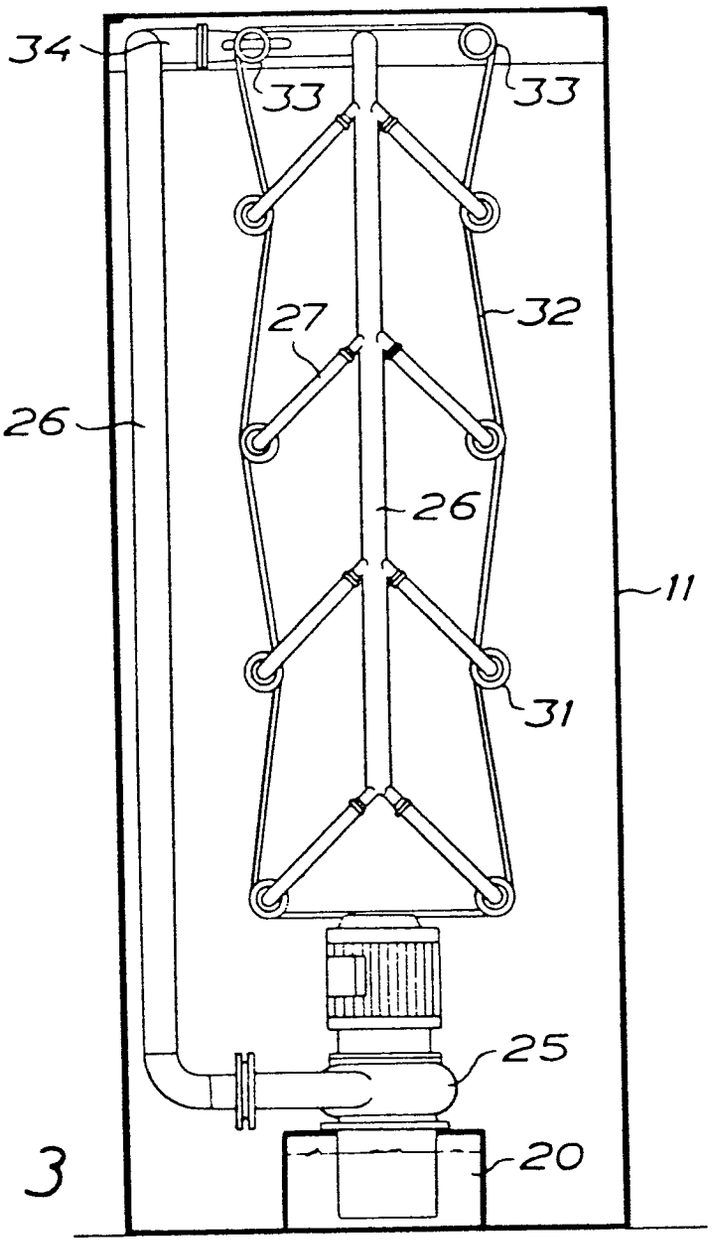
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FIG. 3

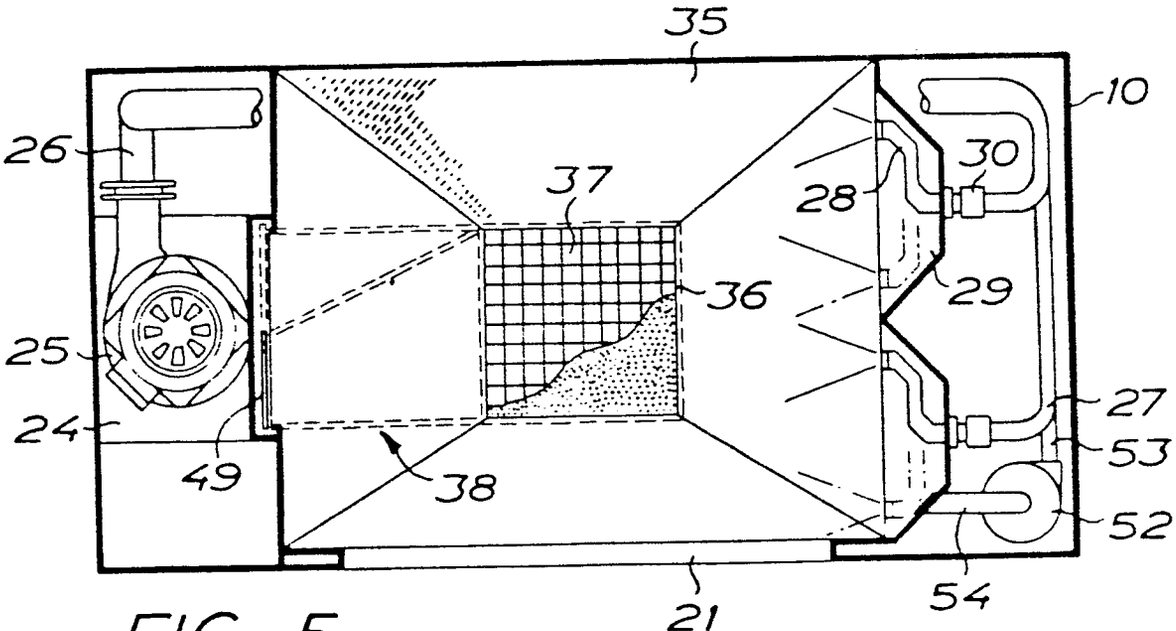
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FIG. 5

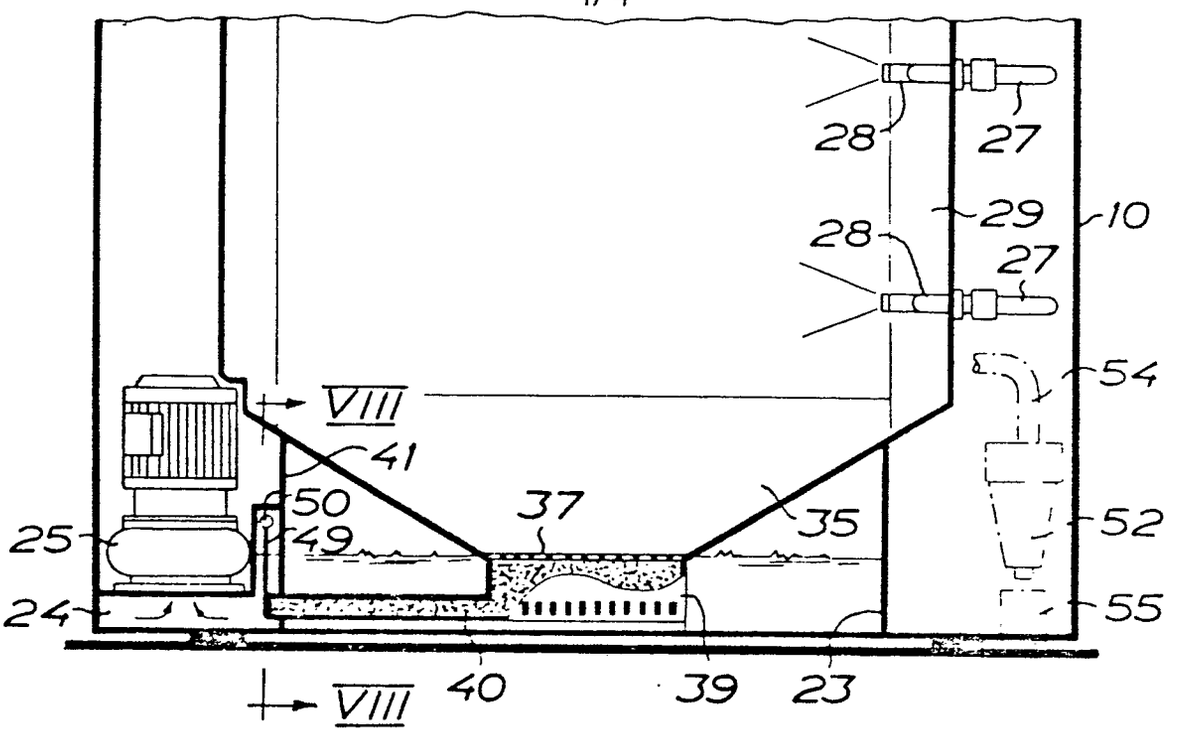

FIG. 6

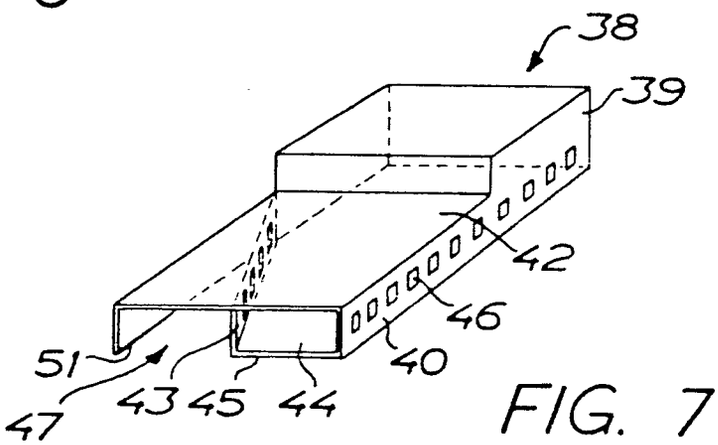

FIG. 7

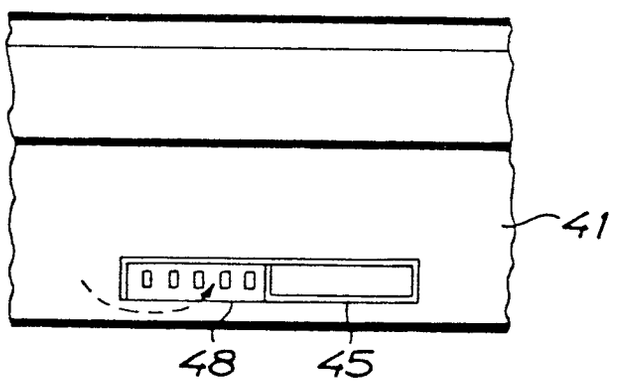

FIG. 8