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(54) Title: SYSTEM AND METHOD OF PROCESSING MIXTURE OF SOLIDS AND LIQUIDS (57) Abstract A method and a treating system for processing a mixture of a liquid is disclosed wherein a multiple filtration is executed at one or more screening means having different filter mediums such as plates, meshes, micro-meshes, sand and/or activated carbon filters for screening at least a portion of the solid material from the liquid during each screening and wherein the solid material removed by the screenings is set to a composting unit and the screened liquid is subjected to a bacteria killing process.		

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SYSTEM AND METHOD OF PROCESSING MIXTURE OF SOLIDS AND LIQUIDS

SPECIFICATION

The present invention relates to a method of processing a mixture of solids and liquids and is useful in particular, but not exclusively, for the processing of waste water and for the separation of solids, for example paper fibres or fruit residues, from a mixture of such solid material and a liquid.

It is already known to separate solids and liquids from a mixture by passing the mixture into the hollow interior of a rotatable cylindrical screen, having an inclined axis of rotation, so that the liquid drains downwardly through the screen and the solid material is collected on the interior of the screen. The screen is then rotated to raise the thus-collected solid material, so that it can fall into an auger extending actually through the cylindrical screen. The auger is then used to convey the thus-collected solid material upwardly from the screen for further processing.

According to the present invention, there is provided a method of processing a mixture of solids and liquids which comprises the steps of subjecting the mixture to a first screening to screen at least a portion of the liquid from the solids, and then subjecting the thus-screened liquid portion to a second screening to screen further liquid from the solids. The liquid which is in this way screened by the first and second screenings is collected and aerated and then passed through a fine filter to remove further solids from the liquid.

In a preferred embodiment of the invention the fine filter is provided by a rotatable cylindrical filter bed, and the aerated liquid is fed into a hollow central space within the cylindrical filter bed structure. The liquid is then allowed

to flow radially outwardly and downwardly through the cylindrical filter bed structure, which is then rotated, so that an upper portion of the filter bed structure can be backwashed.

Liquid used for the backwashing, together with impurities backwashed from the filter bed structure, are collected in an auger extending actually through the filter bed structure and are thereby conveyed from the filter bed structure.

A cylindrical mesh filter is preferably provided within the filter bed structure, around the central hollow space, and the aerated liquid flows radially outwardly and downwardly from the central hollow space through the mesh filter to the filter bed structure. The mesh filter is rotated and an upper portion of the mesh filter is then backwashed.

The present invention relates furthermore to compactors and is useful, in particular, for compactors for use in compacting solid material which has been separated from liquid, for example from waste water.

It has previously been proposed to provide, for the separation of solid material from liquid, a separating apparatus comprising a rotary screen, comprising screen bars extending around and spaced from an inclined axis of rotation, with an auger extending upwardly along the axis. In operation of this apparatus, a mixture of liquid and solid material is caused to flow into the interior of the screen, through an open lower end of the screen, so that the liquid can drain downwardly between the bars of the screen. The solid material is retained in the interior of the screen, on the bars. The screen is rotated intermittently to cause the solid material to be raised to an upper part of the screen, from which it falls downwardly through an upper opening in an auger tube forming part of the auger. This material is then advanced along the auger tube by an auger screw within the tube.

According to the present invention, there is provided a compactor which comprises a first feed auger section for advancing a mass of material which is to be compacted, a compact auger section for receiving and compacting the material from the first feed auger section, a second feed auger section for receiving and advancing the material from the compactor auger section, the first and second feed auger sections and the compactor auger section having co-axial auger screws, an eccentric rotor for receiving the material from the second feed auger section and deflecting the material radially outwardly of the eccentric rotor, at least two compactor passages for receiving the material deflected by the eccentric rotor and dimensioned to compact the material as the material passes there through and expansion passages for receiving the material from the compactor passages, the expansion passages being dimensioned to allow expansion of the material as the material passes there through.

Preferably, the auger screws of the first and second feed auger sections each have a screw pitch greater than that of the auger screw of the compactor auger section.

The first feed auger section preferably includes an auger tube co-axial with the auger screw of the first feed auger section and a plurality of bars extending longitudinally along the interior of the auger tube, between the auger tube and the auger screw of the first feed auger section, for cutting and guiding material as the material is advanced along the first feed auger section.

The invention further relates to an apparatus for separating solids from flowing liquids and to a collecting cage for use in such apparatuses.

Such systems are used, for example, in the field of sewage purification, where usually screening systems, which can be paternoster systems, rotary systems, climbing systems, arch systems or lifting systems, are employed.

All these systems include a standing grating which extends through the sewer transversely to the direction of flow and by means of which solids, such as sand, fine gravel, stones, mud, or - in the case of sewage-purification plants - sanitary waste, fibres etc. can be retained.

The retained solids are removed by way of screen cleaners, which may be designed, e.g., as clearing rakes and engage with the clearance between the grating of the screening system and remove the solids upwards out of the sewer and feed them to a transport device by which the solids are supplied to a further treatment or a waste disposal site.

Such screening systems have the drawback that the structure of the mechanical cleaning means is relatively complex and that it is very costly and labour-intense to completely remove adhering solids, fats and oils from the grating. In the case of certain solids, apart from the above-mentioned clearing rakes, furthermore a brush system by which solids can be completely removed from the grating has to be provided. The cleaning means themselves have to be cleaned, in turn, by high-pressure cleaning devices to be prepared for the next cleaning interval.

From the Applicant's German Patent DE 30 19 127 an apparatus ("Rotamat") for removing solids is known in which the grating has the shape of a cylinder jacket, the axis of the cylinder jacket being inclined with respect to the direction of flow in the sewer. Inside of the grating having the shape of a cylinder jacket there rotates a clearing member by which the retained solids are conveyed from the grating into a chute funnel from which the solids are removed by a worm conveyor. The clearing members and the worm conveyor have a common drive.

In this known apparatus the clearing members are likewise cleaned from the solids by high-pressure cleaning nozzles

which are formed in a portion of the cylinder jacket projecting from the liquid surface.

In all these apparatuses a great deal of work is necessary to remove the adhering solids from the grating and the clearing rakes. What is especially disadvantageous in these known apparatuses is the fact that during the cleaning operation the grating, i.e. the collecting surface, is still in contact with the liquid to be purified so that also during the cleaning operation solids can adhere to the grating.

In order to guarantee an easier cleaning, rotary rakes, as they are called, are known which are provided with a rotating collecting surface, wherein a forward-running portion of the collecting surface retains the solids, a subsequent portion of the collecting surface is moved out of the liquid and cleaned there and a return portion of the collecting surface is again immersed into the liquid so as to be transformed, after another reversal, into the forward-running portion again.

That is, in such a rotary rake the return portion of the collecting surface is already in contact with the liquid to be purified again, before it is brought into the above-described forward position. In case that in the forward position it is not possible to filter out all solids, these solids will deposit on the return portion of the collecting surface and thus reduce the separating capacity in the forward portion. Moreover the pressure loss in the liquid is increased by the return portion.

Consequently, even in the case of rotary rakes a complete cleaning of the collecting surface from solids is not guaranteed so that also in this variant a reduction of the separating capacity by the solids adhering after the cleaning operation is noted.

In comparison to that, the object underlying the invention is to provide an apparatus for separating solids and a

collecting cage for use in such apparatuses by which an improvement of the separating capacity can be achieved with a minimum effort concerning the apparatus.

This object is achieved by the following features.

The collecting means can be cleaned in a complete and simple manner by the measure to move the major portion of the collecting surface out of the liquid flow for cleaning so that an optimum efficiency is ensured after the cleaning operation.

The separating capacity of the collecting means can be substantially increased when a further collecting means is connected in parallel to the first collecting means so that the collecting surfaces of the two means are alternately brought into the working and cleaning position, resp., so that one collecting means at a time constantly separates the solid material while the other collecting means is cleaned. In order to minimize the required space the two collecting means should be arranged one behind the other seen in the direction of flow. Since only one collecting means immerses into the liquid at a time, the pressure loss can be considerably reduced in this way.

The separating capacity of each collecting means can be further increased when the collecting means is upwardly ascending while being inclined toward the flow so that the effective collecting surface is increased. The latter can be further increased when the ascending portion is curved.

A collecting means which can be adapted especially easily to different sewer geometries is obtained, when the collecting surface is formed by a plurality of collecting cages which are preferably hinged to one another and guided in the guide of a guiding base.

A collecting means having an optimum separating degree and a minimum overall height can be obtained by designing the guide

to have a comparatively large radius of curvature inside the liquid flow and to have a return portion with a comparatively small radius of curvature outside the flow, which is transformed into a nearly linear or only slightly curved cleaning portion. This structure of the guide ensures that the collecting cages inside of the liquid flow constitute a largest possible collecting surface which extends in an upward curved way, whereas in their cleaning position they are lined up practically upside down along the slightly curved portion above the liquid surface. That is, the collecting cages can be arranged at the smallest possible distance above the liquid surface and can be cleaned in a simple and thorough manner from "behind", i.e. the rear side, due to the upside-down position. The removed solids then fall into the collecting means arranged between the collecting cages and the liquid surface.

In case that two alternately operated collecting means are provided, a separate guide in the liquid flow is assigned to each collecting means, while these two guide portions end in a common cleaning portion above the liquid surface.

The control of the collecting cages from the cleaning portion into the respective guide can then be effected via a switch adapted to be driven by a central control.

Advantageously the collecting cages are guided via rollers in the guides.

A particularly simple collecting cage for the above-described apparatus is obtained when the collecting cage is provided with a cylinder jacket through the open front of which the liquid flows. Between the fronts the collecting surface is formed which, can be designed as lamella packs, the lamellas of which are spaced apart from one another via spacers and thereby form passage gaps for the liquid. Then the solids deposit on the lamellas.

A "multi-stage" separation can be attained when three lamella packs are staggered with respect to each other, seen in the direction of flow, and these staggered lamella packs again form a unity which, multiple connected side by side, constitutes the collecting surface. I.e., in this case the collecting surface has a wave-shaped design.

Due to the rectangular spacers, the diagonal of which is aligned in parallel to the direction of the liquid flow, the solids, e.g. fibres, cling to the corners of the spacers so that they can easily be removed during the cleaning operation.

Alternatively to the lamella-shaped collecting surfaces, also filter elements of any combination of the materials listed below can be formed.

The above-described apparatus can easily be adapted to different sewer widths by juxtaposing plural collecting means.

Instead of the embodiment guided in a guide means, also a collecting means can be employed the collecting surface of which is adapted to be swivelled, about an axis of rotation disposed transversely to the direction of flow, out of the liquid into the cleaning position. In the case of this variant, too, the separated solids then can be rinsed out against the normal direction of flow, e.g. by a cleaning system and fed to the transport means, e.g. by a funnel tube. I.e., in this apparatus the collecting means is swivelled out of its operating position in the form of a pendulum.

The collecting cages are adapted to be employed in particular in the above-described apparatus, whereby an especially good efficiency can be achieved.

The present invention will be more readily apparent from the following description of a preferred embodiment thereof

given, by way of example, with reference to the accompanying drawings, in which:

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Figure 1 shows a block diagram illustrating successive stages in a method embodying the present invention;

Figure 2 shows a view in longitudinal cross-section through a pre-treatment module for processing a mixture of liquid and solid material;

Figure 3 shows an end view of the apparatus of Figure 2;

Figure 4 shows a view taken in cross-section along the line 4-4 of Figure 2;

Figure 5 shows a view taken in longitudinal cross-section through module containing first and second screens for screening the mixture;

Figure 6 shows an end view, with one-half of an end plate removed, of one of the rotary screens of the apparatus of Figure 5;

Figure 7 shows a view taken in cross-section along the line 7-7 of Figure 6;

Figure 8 shows a broken-away view taken in cross-section along the line 8-8 of Figure 9;

Figure 9 shows a broken-away view, in end elevation, of parts of bars shown in Figure 6;

Figure 10 shows a view in elevation of a spacer plate;

Figure 11 shows a view taken in the direction of the arrow A of Figure 9;

Figure 12 shows sub-assembly tie bolt forming part of the apparatus of Figure 11;

Figure 13 shows a view in end elevation, of the second rotary screen of Figure 5, with one-half of an end plate removed to show underlying parts of the screen;

Figure 14 shows a view taken in cross-section along the line 14-14 of Figure 13;

Figure 15 shows a view in front elevation of a screen element forming part of the second rotary screen of Figure 5;

Figure 16 shows a view in side elevation of the screen element of Figure 15;

Figure 17 shows a view in end elevation of the screen element of Figure 15;

Figure 18 shows a broken-away view in cross-section taken along the line 18-18 of Figure 16;

Figure 19 shows a broken-away view, in cross-section, of one end of the screen element of Figure 15;

Figure 20 shows a plan view of an aeration tank;

Figure 21 shows a view taken in vertical longitudinal cross-section through the tank of Figure 20;

Figure 22 shows a view taken in vertical cross-section through a further aeration stage and a fine screening apparatus;

Figure 23 shows a view in vertical cross-section through the screening apparatus of Figure 22,

Figure 24 shows a view taken in vertical cross-section along the line 24-24 of Figure 23;

Figure 25 shows a view in vertical cross-section through part of an outer rotor forming part of the apparatus of Figure 23;

Figure 26 shows a partly broken-away view, in axial elevation, of the screening apparatus of Figure 22, taken from one end of the screening apparatus;

Figure 27 shows a view in end elevation of the opposite end of the screening apparatus of Figure 22;

Figure 28 shows a view taken in vertical cross-section through a composting and bagging module;

Fig. 29a shows an other embodiment of the modul of Fig. 5;

Figure 29b shows a view in longitudinal cross-section through apparatus for separating the solid material from liquid and then compacting and extruding the solid material;

Figure 30 shows a view taken in cross-section along the line 2-2 of Figure 29b;

Figure 31 shows a view taken in cross-section along the line 3-3 of Figure 29b;

Figure 32 shows a first modification of the apparatus of Figure 29;

Figure 33 shows a view taken in cross-section along the line 5-5 of Figure 32;

Figure 34 shows a view taken in vertical cross-section through a further modification of the apparatus of Figure 29;

Figure 35 shows a view taken in vertical cross-section through a still further modification of the apparatus of Figure 29;

Figures 36, 37 and 38 show views taken in cross-section along

the lines 8-8; 9-9 and 10-10, respectively, cf Figure 35;
Figure 39 shows a view taken in vertical cross-section
through a still further modification of the apparatus of
Figure 29;

Figures 40, 41 and 42 show views taken in cross-section along
the lines 12-12; 13-13 and 14-14, respectively of Figure 39;

Figure 43 shows a view taken in cross-section through a
modification of the apparatus of Figure 39;

Figures 44, 45 and 46 show views taken in cross-section along
the lines 16-16; 17-17 and 18-18, respectively, of Figure 43;

Figures 47 and 48 show views of two possible forms of
extrusion opening for use in the apparatus of Figure 43;

Figure 49 shows a view taken in vertical cross-section
through a modification of parts of the apparatus of Figure
43;

Figure 50 shows a diagrammatic view of a first embodiment of
an apparatus according to the invention;

Figure 51a shows a section along the line A'-A' of Figure 50;

Figure 51b shows a section along the line A''-A'' of Figure
50;

Figure 52 shows a section along the line B-B of Figure 50;

Figures 53a, 53b show a section along the line C-C of Figure
52;

Figure 54a shows another embodiment of a collecting cage in a
section along the line B-B of Figure 50;

Figure 54b shows a section along the line D-D of Figure 54a;

Figures 55 to 57 show detailed views of the guide and a connecting structure for the collecting cages;

Figure 58 shows another embodiment of the apparatus according to the invention;

Figure 59 shows further variants of arranging the apparatus according to the invention in liquid sewers;

Figures 60a, 60b show views of a sediment separating means for the apparatus of Figure 50;

Figures 61a, 61b show details of the separating means of Figures 60a, 60b;

Figure 62 shows a collecting cage of the apparatus according to Figure 50 in its cleaning position;

Figure 63 shows in detail the collecting cage of the apparatus according to Figure 50 in its cleaning position.

Figures AA1 and AA2 show a variation of the inventive embodiment of a filter station according to Figure 50.

Figure BB1 shows a further modification of the cleaning station according to Figure 63.

Figure BB2 shows a compactor-auger consisting of a plurality of auger modules, wherein one module has a housing shell made of two shell halves.

Figure BB3 defines further variations of a compactor.

Figure BB4 is a schematical view of an auger-compactor system composed of several modules according to Figures BB2 and BB3.

Figure CC1 shows an alternative to the micro mesh filters used for example in the embodiment according to Figure 22.

Figures TT1 and TT2 show a modified embodiment of the pre-treatment unit according to Figure 2 of this invention.

Figures XX1 and XX2 show a further variant of a mesh filter according to the invention.

Figures YY1 to YY3 show an alternative development of a cleaning station for example according to Figure BB1.

Figures ZZ1 to ZZ3 show in detail the structure of an auger tube, particularly the structure of the shell forming the auger tube in the neighbourhood of the cleaning station.

Referring firstly to the block diagram shown in Figure 1, which diagrammatically illustrates a preferred method for the treatment of a mixture of liquids and solids according to the present invention, reference numeral 10 indicates a pre-treatment process, in which an incoming mixture of liquids and solids is treated so as to remove floating material, rocks, particulate material and oil, and other liquids immiscible with water from waste water.

The waste water may then, if required, be passed into a buffer tank, indicated by reference numeral 12, which may serve as a surge tank for containing higher than average flows, for example during rainy weather.

The liquid is then subjected to a first screening operation 14, which separates further solid material from the liquid, the separated solid material being passed to a compacting stage 16, while liquid drained from the separated solid material is returned to the main body of liquid, which passes from the first screening stage 14 to a second screening stage 18.

In this second screening stage 18, the liquid is subjected to finer screening to remove further solid material, which is then mixed with the compacted solid material from the compacting stage 16 in a mixing stage 20.

The screened liquid from the second screening stage 18 is passed through a first aeration stage 22 and a second aeration stage 24 to a third screening stage 26, at which the liquid is subjected to fine screening to remove further solids from the liquid.

The mixture of solid materials in the mixing stage 20 is subjected to further draining and then to extrusion at an extrusion stage 28, the liquid drained from the mixing stage 20 being fed, together with the main body of liquid from the second screening stage 18, into the aeration stage 22.

The extruded solid material from the extrusion stage 28 is then passed to a composting stage 30, and the thus-composted solid material is bagged at a bagging stage 32.

The pre-treatment stage 10 is illustrated in greater detail in Figures 2 - 4.

The incoming, untreated mixture of liquid and solid material, which may for example be waste water from domestic dwellings or sewage from storm sewers, is fed in through an inlet pipe 100 into a tank indicated generally by reference numeral 102. The inlet pipe 100 discharges into a generally semi-cylindrically shaped vibratory grating 104, which is downwardly inclined into the tank 102 above an auger, indicated generally by reference numeral 106, comprising a screw 108 rotating within a tube 110. The top of the tube 110 is open below the grating 104, so that particulate material such as stones, sand and the like, which drops through the grating 104, is contained within the tube 110 and is withdrawn upwardly along the tube 110 by the screw 108, for discharge through an outlet spout 112 into a removable container 114.

Large solid objects, such as rocks, having a higher density than water are guided downwardly by the vibratory grating 104 into an auger indicated generally reference numeral 116, the

vibration of the grating 104 being effected by a vibrator 118. The auger 116 comprises an auger screw 120, which is rotatable within an auger tube 122.

The auger tube 122 is upwardly inclined from the lower end of the auger 106 and is formed, at the top of the lower end of the auger tube 122, with an opening 124 through which the heavy solid objects falling downwardly along the grating 104 can enter the auger tube 122, so as to be conveyed upwardly and outwardly of the tank 102 by the auger screw 120, which is driven by a motor 126 mounted at the upper end of the auger screw 120.

The solid objects fed upwardly by the auger screw 120 are discharged through an outlet spout 128 into a removable container 130.

Floating material from the incoming mixture is temporarily retained by downwardly displaceable gate 132, projecting downwardly through the surface of the liquid in the tank 102.

The tank 102 is provided with upwardly pivotable covers 134 and the grating 104 is provided with correspondingly upwardly pivotable covers 136, which allow access for the removal of large floating objects, for example logs and branches, from the liquid within the tank 102. The gate 132 is lowered periodically to allow other floating material remaining in the tank 102 to pass into a transverse auger indicated generally by reference numeral 138 and comprising an auger screw 140 rotating in a cylindrical auger screw housing 142.

The auger 138 is connected, at the exterior of the tank 102, to a laterally upwardly inclined auger indicated generally by reference numeral 144, which comprises an auger screw 146 connected to the auger screw 142 by a universal joint 148 and rotating within an auger tube 150. A drive motor 152 drives the auger screw 146 and, thus, the auger screw 142, and also drives a compactor 154.

The material fed by the auger screw 146 to the compactor 154 is compacted and discharged through an outlet spout 156 into a removable container 158. The tank 102 has an outlet 160 for the outflow of the liquid from the tank 102. In this way, the mixture of solid material and liquid fed into the tank through the inlet pipe 100 is discharged from the latter in a direction which is opposite to the direction of flow of the liquid from the tank 102 through the outlet 160. The incoming flow causes the floating material to float along the liquid surface in the tank 102 towards the gate 132, which is periodically lowered to allow the floating material to pass into the auger 138. The vibration of the grating 104 is required to be effected only periodically, in order to prevent the formation of an accumulation of sand or other particulate material and to ensure that large rocks and other large sinking objects are dropped into the auger 116. The grating 104 has a length which provides a long settlement and classification section for the mixture which is travelling in a direction opposite to the outflow of the liquid from the tank 102, so that even relatively fine particulate material is extracted by the auger 106. The tank 102 is also provided with a compressed air pipe 162 having an outlet nozzle 164 for aeration of the liquid in the tank 102.

The bottom of the tank 102, which is indicated by reference numeral 166, has a corrugated shape, to strengthen the tank, and to provide bottom transverse troughs 168 which are connected to a common outlet pipe 170 for the withdrawal of sediment from the bottom of the tank 102.

The tank 102 is also provided with compressed air pipes 172 and outlet nozzles 174, which extend upwardly inclined at opposite sides of the grating 104 as shown in Figure 4, and with further air outlet nozzles 176, at the bottom of the tank, to ensure a thorough aeration of the liquid in the tank.

The purpose of this aeration is to separate floating material from the sinking material, to keep the floating material in

movement so that it floats through the outlet 160, and also to counteract settlement of solid material on the bottom of the container and in the corners of the container, while keeping oil and fat at the surface of the liquid and, also, while enriching the oxygen content of the liquid.

In the vicinity of the gate 132, there is provided an oil skimmer (not shown), which removes oil and discharges it into an oil container (not shown).

The apparatus of Figures 2 through 4 is provided as a module in a container (not shown), so that the entire device can be transported on a low loader.

As can be seen from Figure 2, the tank 102 is provided with a sliding cover 180 and an equipment housing 182 at the top of the tank 102. The tank 102 may also be provided with at least three air extraction devices for air circulation and ventilation through a compressor station (not shown), so as to provide a closed system.

The containers 112, 130 and 158 are provided with lifting devices indicated generally by reference numeral 184, which can raise and lower the containers into and out of sealing engagement with overhead hoods 186.

The materials removed in the containers 112, 130 and 158 may, if desired, be subjected to further processing. The liquid outflow from the outlet 160 is fed through a pipe 200 (Figure 5), the lower end of which discharges into the hollow interior of a rotary screen indicated generally by reference numeral 202.

The rotary screen 202 is installed, with its longitudinal axis at an upward inclination, in a tank indicated generally by reference numeral 204, and a first semi-circular weir 206 at the bottom of the tank 204 has a semi-circular seal 208 in sealing engagement with one end of the rotary screen 202.

By means of an electric motor 210, driving a gear 212 secured to the upper end of the rotary screen 202, the latter is rotated periodically.

The liquid which is discharged into the rotary screen 202 drains under gravity through the screen 202, while the screen 202 remains stationary, into a collecting chamber 214, while solid material in the incoming liquid is retained within the rotary screen 202.

When the screen 202 is subsequently rotated to bring this retained solid material to an upper part of the rotary screen 202, the solid material can drop downwardly through a hopper 214 into an auger tube 216, which is provided with an auger screw 218 and which extends co-axially through the screen 202.

A grating 220 at the underside of the auger tube 216 allows liquid to drain from the auger tube 216, and the grating 220 can be periodically cleaned by sprays from a compressed water pipe 222 underlying the grating 220.

A further water supply 224 is provided above the screen 202 with a downwardly directed water nozzle 226 for directing water sprays downwardly onto the screen 202 to assist in dislodging the solid material from the upper part of the screen 202 into the auger tube 216.

As shown in Figures 6 through 12, the screen 202 has end plates 230 and 232, with a plurality of bars indicated generally by reference numeral 234 spaced apart from one another along the length of the screen 202.

Each of the bars 234 is formed of a curved outer metal strip 236 connected to a pair of straight inner metal strips 238. The bars 234 are provided in groups of three different sizes, so as to present, along the length of the inner periphery of the screen 202, a series of steps, as shown in Figure 7, forming a plurality of axially spaced annular recesses 240.

The bars 234 also form recesses 242 which extend radially outwardly from a housing around the auger tube 216.

The bars 234 are secured together by rods 246, which are secured at opposite ends to the end plates 230 and 232 and which, as shown in Figure 11, connect the largest bars 234, and also by sub-assembly tie bolts, as indicated generally reference numeral 248 in Figure 12, which connect together the groups of bars 234, together with spacer plates 250 provided between the bars 234.

As shown in Figure 8, metal strips 252, which have a width in the radial direction of the screen which is greater than that of the remainder of the bars 234, serve to interconnect the groups of bars 234.

Referring again to Figure 5, the screened liquid in the chamber 214 passes over a second weir 254 into the hollow interior of a mesh screen indicated generally by reference numeral 256.

The weir 254 has a semi-cylindrical seal 258 in sealing engagement with one end of the mesh screen 256, which is coaxial with the screen 202.

The liquid supplied into the mesh screen 256 flows outwardly and downwardly through the mesh screen 256 into a collecting chamber 258, while further solid material, of a finer size than that screened by the first screen 202, is retained at the inner side of the mesh screen 256.

An electric motor 260 driving a gear 262 secured to the upper end of the mesh screen 256 is energized periodically to rotate the mesh screen 256 so as to raise the trapped solid material to an upper part of the mesh screen 256, from which this collected solid material then falls through a hopper 264 into an auger tube 266.

Liquid from the thus-deposited solid material drains downwardly through a grating 268 in the bottom of the auger tube 266, and the grating 268 is periodically cleaned by sprays from a water supply pipe 270.

The solid material in the auger tube 266 is fed upwardly along the tube 266 by means of an auger screw 272, which is connected to the auger screw 218 through a compactor screw 274.

The compactor screw 274 has double the number of flights of the screws 218 and 272, with a smaller pitch, and serves to compact the solid material delivered to it by the auger screw 218. This compacted material is then mixed, in the auger tube 266, with the solid material deposited from the screen 256 and to the auger tube 266.

The compactor screw 274, and the auger screws 218 and 272 connected to the compactor screw 274, are driven by an electric motor 276 which drives a ring gear 278 connected to a tube 280. The tube 280 is co-axial with, and rotatable relative to, the auger tubes 216 and 266 and is connected to the flights of the auger screw 274 for transmitting drive to the latter.

The mesh screen 256, as shown in Figures 13 and 14, has a pair of opposite end plates 282 and 284, which are connected by rods 286.

The lower end plate 282 is formed with generally triangularly shaped openings 288, having rounded corners, through which the liquid flows over the weir 254 into the interior of the mesh screen 256.

The rods 286 serve to connect adjacent ends of pairs of screen elements, one of which is shown in Figures 15, 16 and 17 and indicated generally by reference numeral 290. As shown in Figure 13, the screen elements 290 are arranged in a pairs which are respectively associated with the openings 288 in

the end plate 282, each pair of the screen elements 290 defining therebetween a generally triangular recess or chamber which is open, at its radially in most end, towards the auger tube 266. Successive pairs of the screen elements 290 are separated from one another by radially extending gaps 294, which open radially outwardly of the screen.

The screen elements 290 each have a frame 296, with a screen mesh 298 secured at its end in the frame 296 and reinforced, by longitudinal and transverse reinforcement wires 300. The inner end of the frame 300 has a scaling face 302 (Figure 19) for scaling abutment against one side of a channel member 304 at the inner most end of each gap 294.

Opposite longitudinal edges of the frame 296 are formed with a sealing edge 306 (Figure 18), which slides into engagement with a cruciform, elongate, radially extending connector 320.

The liquid which collects in the collection chamber 258 passes through an outlet opening 322 into the inlet opening 324 of an aeration tank indicated generally by reference numeral 326 in Figures 20 and 21.

The solid material which is conveyed upwardly by the screw 272 passes into an extruder, indicated generally by reference numeral 328, at which a pair of eccentric rotors, one of which is indicated by reference numeral 330, press the solid material radially outwardly through extension openings 332 to form pellets, which are then conveyed upwardly by an auger indicated generally by reference numeral 334 and provided with a drive motor 336.

In the aeration tank 326, the liquid flows along a horizontally serpentine and vertically serpentine path of flow defined by a plurality of upper partitions 340, and alternating lower partitions 342, which are offset laterally and, also, vertically downwardly with respect to the partitions 340. A compressed air supply pipe system 344 feeds

compressed air into air outlet nozzles 346 provided at the bottoms of the partitions 340 and 342.

The bottom of the tank 326 is corrugated so as to form a plurality of transverse troughs 348, from which sediment can be removed through a common outlet drainage pipe 350.

The top of the tank 326 is provided with a retractable cover 352, and an air compressor 354 having an air intake 356 within the tank 326, and a second air inlet 358, supplies compressed air to the compressed air pipe system 344.

The liquid which is aerated in the tank 326 passes through a tank outlet 360 from the tank 326 into a further aeration tank indicated generally by reference numeral 400 in Figure 22.

More particularly, the liquid is introduced into the tank 400 through an inlet 402. The tank 400 is provided with vertical baffles 404, which extend transversely of the tank 400 and which are staggered from one another in both the vertical and the horizontal directions so as to provide a vertically horizontally serpentine path of flow through the 400 as indicated by arrows in Figure 22.

The baffles 404 are provided, along the bottom edges thereof, with pipe 406 having horizontally directed outlet openings for discharging air into the mixture for aerating and agitating the mixture. The pipes 406 are provided with a supply of compressed air by the compressor 354.

The air flows to the inlet duct 358 of the compressor from an air inlet duct 408, having an air inlet end 410 in the tank 400 above the level of the liquid under the control of a regulator valve 412.

At the right-hand end of the tank 400, as viewed in Figure 22, there is a rotatable screen and filter structure indicated generally by reference numeral 414, which has a

horizontal axis of rotation extending in the longitudinal direction of the tank 400 and comprises an inner rotor indicated generally by reference numeral 416, and an outer rotor indicated generally by reference numeral 418, which is co-axial with the inner rotor 416.

The inner rotor 416 extends around and is co-axial with an auger screw 420, which has a shaft 422 and a tube 424 extending around the auger screw 420 and forcing a tubular housing for the auger screw 420.

The inner rotor 416 is supported on the auger tube 424 by means of bearings 426, which allow the inner rotor 426 to rotate about the auger tube 424. An internally-toothed ring gear 428 secured to one side of the inner rotor 416 meshes with a pinion 430 on the output shaft of a reduction gearing 432 driven by an electric motor 434, so that upon energization of the motor 434 the ring gear 428 is driven by the pinion 430 to cause the rotation of the inner rotor 416 about the auger tube 424.

The outer rotor 418 is supported at its right-hand side, as viewed in Figure 22, by means of a bearing 436 on the auger tube and, at its opposite side, on a pair of support rollers 438 in rolling engagement with the inner periphery of an annular plate 440 on an end wall 442 of the outer rotor 418. The support rollers 438 are rotatably mounted on a triangular support 444 (Figure 26), which is mounted on the auger tube 424.

An electric motor 446 (Figure 22), through a reduction gearing 448, drives a pinion 450 meshing with a ring gear 452. The ring gear 452 is mounted on a circular end wall 454 of the outer rotor 418. By energization of the electric motor 446, the outer rotor 48 is rotated about the auger tube 424.

As shown in Figure 24, the inner rotor 416 comprises a metal mesh screen 460, which is shaped to form eight radially outwardly extending, radially inwardly open chambers or

"pockets" 462, which arc equiangularly spaced around the auger tube 424 and which are spaced from one another by radially outwardly open spaces 464. The screen 460 is supported on rods 466, opposite ends of which are secured to an end wall 468 carrying the ring gear 428 and to a second circular end wall 470 at the opposite side of the inner rotor 416. The wall 468 closes off the spaces 464 between the pockets 462 from the tank 400 and is formed with eight openings 472 (Figure 26) through which the liquid in the tank 400 can flow into the screen pockets 462 of the inner rotor, as described in greater detail below.

Figure 24 also shows four spray pipes 474 located between the inner and outer rotors and provided with spray nozzles, which are directed so as to spray radially inwardly onto the mesh and into the radially outwardly open spaces 464.

Between the spray pipes 474 and the outer rotor 418 there is provided a cylindrically arch-shaped baffle or cover 476 which extends over the top of the inner rotor and which is provided with inclined gutters 478.

A weir structure 480 (Figure 23) in the tank 400 has, at a semi-circularly curved upper edge of the weir structure 480 a semicircular seal 482, which is in sliding, scaling contact with a side face of the ring gear 428. The weir 480 and the seal 482 ensure that the liquid flowing through the tank 400, in the direction of the arrows of Figure 22, flows firstly through the openings 472 in the end wall 468 and into the pockets 462 of the inner rotor and then passes through the screen mesh before passing radially outwardly through the outer rotor, as described below.

Solid material which is retained within the pockets 462 of the inner rotor 416 at the lower half of the inner rotor 416 is carried upwardly on the screen mesh, as the inner rotor is rotated until it is dislodged by water directed radially inwardly from the spray nozzles 474. The rotation of the inner rotor and the spraying from the spray nozzles 474 are

effected intermittently, at time intervals which are selected in accordance with the rate of deposition of the solid material on the screen mesh.

The auger tube 424 has an upwardly directed opening through which the solid material which is dislodged by the sprays from the spray nozzles 474 and by gravity from the pockets 462 is deposited into the auger tube 424.

The shaft 422 of the screw 420 is rotated by an electric motor 476 through a reduction gearing 478. The rotation of the auger screw shaft 422 causes the solid material deposited into the auger 478 to be fed along the auger tube 424 for discharge through an outlet pipe 478 into a container (not shown) or the like.

The construction of the pockets 462 of the inner rotor is similar to those of the mesh screen 202 and is therefore not described in greater detail.

The outer rotor 418 forms a filter structure and has three annular walls 480 extending transversely of the axis of rotation of the outer rotor. The walls 480 are secured to one another and to the opposite end walls 442 and 454 of the outer rotor by means of inner and outer perforated cylindrically curved plates 482, which support wire meshes 484. Between the inner and outer plates 482, the outer rotor is packed with sand 486, which serves as a filter medium.

The liquid which passes radially outwardly through the screen mesh of the inner rotor 416 then passes through the sand 486 of the outer rotor and is retained in an end portion 488 of the tank 400, which is provided with an overflow pipe 490, through which the filtered liquid can flow from the tank end portion 488.

The weir structure 480 is provided with a semi-circular seal 492, in sliding, sealing contact with the end wall 468 of the outer rotor. The seal 492 ensures that the liquid which has

passed through the screen mesh of the inner rotor is retained in the outer rotor until it flows through the sand 486.

A water pipe 494 with spray nozzles 496 is provided above the outer rotor for periodically backwashing the sand 486.

The tank 400 is provided with retractable cover 498, which can close off the top of the tank from the atmosphere.

Consequently, noxious fumes from the liquid being processed can be retained within the interior of the tank 400 so as to avoid pollution of the surrounding atmosphere. The inner and outer rotors 416 and 418 are rotated periodically, and independently of one another, when they require cleaning by backwashing from the water sprays, which preferably employ a portion of the liquid treated by the apparatus and discharged through the outlet pipe 490.

The extruded solid material conveyed upwardly by the auger 333 (Figure 5) is discharged under gravity into a pre-composting unit 500 (Figure 28), which allows this solid material to trickle into the lower end of an upwardly inclined first auger indicated generally by reference numeral 502, containing auger screw 504.

The auger screw 504 includes a hollow flight 506, into which a heat exchange fluid, for example cold water, can be fed through an inlet pipe 508.

A water sprinkling system 510 is provided for sprinkling water into the interior of the auger 502.

At the upper end of the auger 502, the heat exchange fluid is passed downwardly through rotary hydraulic couplings 512 and 514 and a connecting pipe 516 to the lower end of a second auger, indicated generally by reference numeral 518.

The solid material which travels upwardly along the auger 502 can be mixed with air through an adjustable air vent 520 at

the upper end of the auger 502 and is sterilized at 75°C and at least partially composted during its upward travel along 502.

From the upper end of the auger 502, the solid material is discharged onto an adjustable screen 522, which deflects any non-biodegradable solid material down an outlet duct 524 and through a hood 526 into a removable waste container 528.

The solid material falls downwardly through the screen 522 is directed by a hopper 530 into the lower end of the auger 518 which, as can be seen from Figure 28, is inclined upwardly in a direction opposite to the auger 502.

The auger 518 is provided with a water sprinkling system 532 and adjustable air vents 534, and includes an auger screw 536 having a hollow flight 538 through which the heat exchange liquid from the connecting pipe 516 flows upwardly along the auger 518. At the upper end of the auger 518, this heat exchange liquid is discharged, as hot water, through a rotary hydraulic coupling 536 and an outlet pipe 538.

The solid material which is fed upwardly along the auger 518 is forced, at the upper end of the auger 518, into an extrusion device indicated generally by reference numeral 540, which has a pair of eccentric rotors 542, by which the solid material is forced through extrusion openings 544, by which it is formed into pellets. The thus extruded and pelletized solid material drops downwardly into a bagging machine indicated generally by reference numeral 546.

Exhaust gases from this composting process rise upwardly through a serpentine flu 548 in a chimney indicated generally by reference numeral 550. The chimney 50 is mounted on the top of a housing indicated generally by reference numeral 552, and is pivotable about a hinge 554 between a lowered position, in which it is shown in Figure 28 and in which it is located for transportation of the apparatus, and into an upright position, in which it extends upwardly over an outlet

opening 556 in the housing 552. The chimney 550 may be employed to extract heat from the exhaust gases by a heat exchange process.

Referring again to Figure 1, it will be apparent from the above description, that the initial pretreatment stage 10 is performed in the pretreatment tank 102 of Figures 2-4.

The optional buffer tank 12, when provided, may be identical to the aeration tank 326 of Figures 20 and 21.

The first screening stage 14 and the second screening stage 18 correspond to the first screen 202 and the second screen 256 of Figure 5.

The first aeration stage 22 is the aeration effected in the aeration tank 326 of Figures 20 and 21, whereas the second aeration step 24 is the aeration which is effected in the tank 400 of Figure 22.

The third, fine screening step 26 is effected in the inner and outer rotors 416 and 418 of Figure 22.

The first drainage and compacting of stage 16 are effected by the grating 220 and the compactor 274 of the Figure 5, while the mixing and drainage of stage 20 take place in the auger tube 266.

The extrusion of stage 28 is effected by the extrusion head 328, the sterilization and composting of stage 30 is effected by the augers 502 and 518 of Figure 28, and the final bagging of the solids, in stage 32, is effected in the bagging machine 546.

The method of processing a mixture of liquid, comprising the steps of:

- a. subjecting the mixture to a first screening to screen at least a portion of the solid material from the liquid;
- b. subjecting the thus-screened liquid to a second screening to screen further solid material from the liquid;
- c. collecting and aerating the liquid screened by the first and second screenings; and
- d. subjecting the thus-aerated liquid to a third screening to remove further solids from the liquid.

The method further includes composting the solid material removed by the first and second screenings.

The method provides that the third screening step comprises feeding the aerated liquid into a hollow central space within a rotatable, generally cylindrical filter bed structure; allowing the liquid to flow radially outwardly and downwardly through said cylindrical filter bed structure; rotating said filter bed structure and backwashing an upper portion of said filter bed structure.

The method further includes collecting a mixture of liquid used for the backwashing, together with impurities backwashed from said filter bed structure, in an auger extending axially through said filter bed structure and conveying said mixture of backwash liquid and impurities in said auger from said filter bed structure.

The method further includes providing a cylindrical mesh screen filter within said filter bed structure around said central hollow space; causing the aerated liquid to flow radially outwardly and downwardly from said central hollow space through said mesh screen; rotating said mesh screen and backwashing an upper portion of said mesh screen.

The method showing the step of subjecting the mixture to a first screening comprises feeding the mixture with a hollow interior of a rotatable screen; allowing the liquid to drain downwardly through said rotatable screen; intermittently rotating said screen; depositing solid material from an upper part of said screen into an auger; conveying the deposited solid material in the auger and compacting the thus-conveyed solid material.

The method further comprises collecting the liquid which drains downwardly through the rotatable screen; feeding the thus-collected liquid into a hollow interior space of a rotatable mesh screen; allowing the material to drain downwardly through said mesh screen while collecting solid material on said mesh screen; intermittently rotating said mesh screen; feeding the compacted material axially through said mesh screen and depositing the solid material from an upper part of said mesh screen into the compacted material passing through said mesh screen to form a mixture of the materials.

The method includes extruding the compacted material to form pellets.

The method further showing the step of subjecting the mixture to a first screening comprises passing the mixture into radially inwardly open and radially outwardly extending recesses formed by said first screen, intermittently rotating said first screen and backwashing the upper part of said first screen to dislodge the solid material radially inwardly from said recesses into said auger.

The method includes allowing liquid to drain downwardly from said auger while conveying the solid material along said auger.

The method further includes allowing liquid to drain downwardly from the mixture of a material within said mesh screen.

The method comprises providing in the interior of said screen a plurality of steps extending around the inner periphery of said screen and forcing axially spaced annular recesses in the inner periphery of said screen.

The method providing the step of aerating the liquid comprises feeding the liquid along a serpentine path while discharging air into the liquid.

The method further comprises employing spaced baffles which are alternately laterally offset and alternately vertically offset to define the serpentine path of the liquid.

The method further comprising the step of pre-treating the mixture of solids and liquids to remove large solid objects and floating material from the mixture prior to the first screening step.

The method shows the step that the pre-treating of the mixture includes removing particulate material from the mixture separately from the large solid objects and the floating material.

The method provides that the pre-treating of the mixture includes aerating the mixture.

It will be clear from the above description that the treatment units used for the individual method steps according to Figure 1 are preferably formed as individual devices constructed as modules which can be interchanged like in a unit construction assembly, and which can be arranged one after the other in an arbitrary order.

As was already described above, the pre-treatment apparatus of Figures 2 to 4 is provided as a single module which can selectively be arranged in front of the modular double filter unit according to Figure 5. This double filter unit, in turn, could of course be assembled from two or more individual filter means which are constructed independently of each other as module units. Thus, the first ventilation stage, the second ventilation stage together with the third microfilter station as well as the subsequent pre-composting unit 500 also form individual modules which, depending on the use of the whole system, are selectively connected to the preceding filter modules, and which can of course also be exchanged for differently designed units of the kind which will be described in the following.

The buffer tank 12 is also preferably formed as a ventilation means. This ventilation may either be provided by a natural ventilation obtained for example by installing swirling obstacles, or by a forced ventilation achieved by the arrangement of additional aerating nozzles, or by a combination of these variants.

Furthermore, it is to be mentioned that in particular in the first and second ventilation station according to Figures 20 to 22 a basically closed ventilation cycle is respectively provided by taking in gases rising from the liquid via the intake openings 356 or 410 by employing a compressor, and, after a possible filtration by means of an activated carbon filter and an enrichment with oxygen effected by supplying ambient air, by pressing the gases out again via the aerating nozzles 346 or 406. The most important advantages of this construction can be seen in that, on the one hand, malodorous

gases are prevented from escaping into the atmosphere, and, on the other hand, it can be observed that the gases compressed and filtered in the compressor heat up to a predetermined temperature. Thus, when passing through the liquid these gases are suitable for destroying bacterial cultures contained therein and, consequently, for sterilizing the liquid. Moreover, it is possible to add chemical or biological additives such as flocculating agents, chlorine, or pure oxygen to the liquid to be aerated, this being effected preferably in the ventilation stage directly preceding the microfilter station. As was described above, the microfilter station uses a sand filling disposed between wire meshes as a liquid filter. However, it is also possible to use cloth filters for effecting a cloth filtration. Furthermore, sand can be replaced by other filter materials such as for example activated carbon etc.

In Figure 29a second preferred embodiment of the double filter unit according to the invention is shown; in the following merely those technical features will be described which differ from the embodiment of Figure 5.

As can be seen from Figure 29a, the driving motor 276 of the auger screw 218, 272 is formed at the right end of the auger, with the auger tube 266 being formed as one piece in this embodiment. Instead of the ring gear 278 and the tube 280 in Figure 5, a necked-down portion 266A having an adjustable diameter is provided in the auger tube 266 in the auger according to Figure 29a; by means of this necked-down portion the compression pressure exerted on the solid material can be controlled. Furthermore, an annular duct 328A is connected to the auger's discharge opening formed as an extruder 328; in the following this annular duct will be explained in greater detail in the description passage concerning the individual auger variants.

In the inventive embodiment according to Figure 29a the solid material conveyed by the auger screw 218, 272 is pressed through the extruder 328 into the annular duct 328A in which

a further compression of the solid material takes place due to the frictional resistance at the annular walls. The degree of compression can be influenced by means of two necked-down portions 328B in the annular duct 328A, the diameter of the necked-down portions being adjustable. Like in the embodiment according to Figure 5, a further externally driven auger screw 334 arranged behind the necked-down portions 328B is employed for removing the solid material from the annular duct.

In the following further possible variants for an auger system with which the aforementioned modular treatment units can be selectively equipped will be described by means of theoretical embodiments.

Referring to Figure 29, reference numeral 10A indicates generally a rotary screen of known type, which is rotatable by means of an electric drive motor 12A about the axis of an auger, which is indicated generally by reference numeral 14A, the drive motor 12A having a drive pinion 16A in driving engagement with a ring gear 18A secured to one end of the rotary screen 10A.

The rotary screen 10A is arranged with its axis of rotation at an inclination, to allow a mixture of solid and liquid material to flow into the open lower end of the screen 10A.

The auger 14A comprises an auger screw 20A, which forms a first feed auger section, and which is rotatable within auger tube 22A.

The upper end of the screen 10A is supported on the auger tube 22A by means of a bearing 24A, while the lower end of the screen 10A is supported by a support roller 26A, which is mounted on the lower end of the auger tube 22A and which is in rolling engagement with the inner periphery of an annular plate 28A at the lower end of the screen 10A.

The auger tube 22A is provided, within the screen 10A, with an upper opening 28 through which solid material can be deposited into the auger, as described below, and is also provided at its underside with a drainage grating 30A.

A high pressure water spray system 32A is provided above the screen for backwashing the screen, and a further high pressure water spray system 34A is provided beneath the grating 30A for backwashing the grating 30A.

In operation of the apparatus, the mixture of liquid and solid material flows into the lower end of the screen 10A, so that the liquid can then flow radially outwardly of the screen 10A, while the solid material is retained on the interior of the screen.

The screen 10A is rotated periodically to raise the retained solid material to an upper part of the screen, from which it can drop through the opening 28A into the interior of the auger tube 22A. The high pressure spray system 32A is used to spray water downwardly onto the upper part of the screen to assist in dislodging the solid material from the interior of the screen.

The material deposited into the auger tube for 22 is advanced along the tube 22A by rotation of the auger screw 20A and liquid can drain downwardly from the tube 22A through the grating 30A, which is periodically cleaned by backwashing from the high pressure spray system 34A.

The first feed auger section 20A extends to a compactor, which is indicated generally by reference numeral 36A and which comprises a compactor auger section 38A.

The flights of the compactor auger section 38 have a pitch which is substantially less than the pitch of the flights of the first feed auger section 20A so that as the material is advanced from the latter into the compactor, the speed of

advance of the material decreases and, therefore, the material becomes compressed.

Beyond the compactor 36A the compressed material passes into a second feed auger section which is indicated generally by reference numeral 40A and which comprises a feed auger screw 42A.

Beyond the second feed auger section 40A, there is provided an extension section indicated generally by reference numeral 44A, which comprises a rotary extruder head formed by a pair of dia-metrically opposite, eccentric, curved pressure members 46A, which are mounted on a shaft 48A.

As can be seen from Figure 29, the shaft 48A is common to the auger 14A, the compactor 40A and the extrusion head 44A and is journaled at opposite ends in bearings 50A and 52A. The shaft 48A, and thus the auger 14A, the compactor 40A and the extruder head 44A, are driven by an electric drive motor 54A, through a pinion 56A on the output shaft of the motor 54A and a gear 58A on the upper end of the shaft 48A.

Longitudinally extending, circumferentially spaced bars 60A are provided between the auger screws 20A, 38A and 42A, and the pressure members 46A, on the one hand, and the inner surface of the auger tube 22 and a cylindrical housing 62A in the extruder section 44A, on the other hand.

The cylindrical housing 62A is formed with circumferentially spaced extrusion openings 64A, through which solid material is extruded, as described below, the extruded material then being broken into separate pieces by deflector members 66A mounted at the exteriors of the extrusion openings 64A.

As can be seen from Figure 29, the first feed auger section 20A and the second feed auger section 42A each have a pitch which is substantially greater than that of the compactor auger section 38A.

Also, the compactor auger section 38A has a number of flights, i.e. four, which is double that of the first feed auger section 60A.

The lower pitch of the compactor auger screw 38 as compared with the feed auger screw section 20A causes the solid material to be compacted into a plug, which is desirable to ensure intensive compacting of the material and also, comminution and dewatering of the compacted material. Water which is expressed from the compacted material at the compactor 36A can flow downwardly along the auger tube 22A.

The pitch and the number of flights of the auger screws may be varied in accordance with the requirements of the material to be processed.

The bars 60A counteract about the shaft 48A of the solid material being advanced and compacted by the auger screws, thereby ensuring that the pressure in the material is increased at the compactor 36A and the extrusion section 44A. The bars 60A are made of sharp-edged stainless steel, and also serve to cut the solid material, as it is advanced along the auger tube 22A.

At the compactor 36A, the solid material is compacted to about 50% solid material content.

The rotary extruder head formed by the eccentric pressure members 46A is provided, at its upper end, with an auger blade 68A having a pitch which is opposite to that of the second feed auger section 42A, so that the solid material which advances between the auger blade 68A and the uppermost end of the second feed auger section 42A is caught and is pressed outwardly, by the rotation of the eccentric pressure members 46A. The solid material which is extruded outwardly through each of the openings 66A is broken into small pieces or pellets by the deflectors 66A.

In the extrusion section 44A, the solid material is further compressed to a solid material content of 50 - 80%.

The extrusion section 44A has an outer housing 70A, which guides the pieces or pellets of solid material into a discharge spout 72A for discharge into a suitable container (not shown).

The high pressure water spray systems 32A and 34A may, if desired, be replaced by compressed air sprays.

The screen 10A may be varied, as required, and may be formed of spaced bars and/or a mesh filter screen.

By providing separate drives 12A and 54A for the screen 10A, on the one hand, and for the auger screws and extrusion head, on the other hand, the screen 10A can be periodically rotated through 180° independently of the operation of the auger screws. In this way, it can be ensured that the screen 10A remains stationary for long periods of time.

The water sprayed from the high pressure spray systems 32A and 34A may be heated for example by heat exchangers as described below with reference to Figure 49 of the accompanying drawings, and may, if appropriate, have cleaning chemicals added.

In the modified apparatus illustrated in Figures 32 and 33, in which parts which are the same as though of Figure 29 have been indicated by the same reference numerals and are not described here again in greater detail, the first feed auger screw 20A is replaced by a first feed auger screw 11A, which is connected through a universal joint 13A to a frusto-conically shaped compactor auger screw 15A, which extends to a second feed auger screw section 17A.

The compactor auger screw 15A is rotatable in a generally frusto-conically shaped housing 19A, which merges with a cylindrical tube 21A containing the auger screw section 17A.

A hopper 23A, through which additional material can be added to the solid material conveyed by the first feed auger screw section 11A, is provided with a pivotable lid 25A. The lid 25A may serve as a toilet and is provided with a pivotable cover 27A.

The second feed auger screw section 17A extends to an extrusion head, similar to the extrusion head of Figure 29 having diametrically opposed, eccentric, curved pressure members 46A, carried on shaft 29A which also carries the auger screws 15A and 17A.

The extrusion head is provided in an extrusion section 31A similar to the extrusion section 44A of Figure 29 but with the extrusion openings 64A replaced by relatively large outlet openings 33A in a cylindrical housing 47A.

The pressure members 46A rotate within the cylindrical inner housing 47A, which is provided within and spaced from cylindrical outer housing 35A, which opens into a discharge spout 37A.

Longitudinally extending bars 39A, 41A and 43A, which correspond to the bars 60A of Figure 29 and which serve the same purpose, are provided around the auger screws 11A, 15A and 17A, respectively, the bars 43A also extending into the housing 47A of the extruder section.

The shaft 29A, which is driven by an electric drive motor 45A, has a greater inclination than the axis of the first feed auger screw section 11A.

As shown in Figure 32, the auger screw section 11A has only a single flight, but it may alternatively have two or more flights.

In the apparatus illustrated in Figure 34, in which parts corresponding to those of Figure 29 have been indicated by the same reference numerals, increased by 10A, first feed

case serves to compress the solid material and which discharges into second feed auger screw section 42A.

Drive motor 154A, through pinion 156A and gear 158A drives the first feed auger screw section 120A and the rotor of the extruder head 144A, and drive motor 112A, through pinion 116A, gear 118A and a drive tube 119A extending from the gear 118A to the screen 110A, drives the screen 110A.

In addition, the gear 118A drives a further gear 121A at the lower end of the second feed auger screw section 142A, so that the latter is also driven by the drive motor 112A. By suitable selection of the gears 118A and 121A, the second feed auger screw section 142A can be driven at a speed greater than that of the first feed auger screw section 120A.

In Figure 35 parts which correspond to those of Figure 29 have been indicated by the same reference increased by 200A.

In this case 210A is provided with auger tube 222A, which contains a first feed auger section 238A.

The compactor auger screw section 238A is connected by second feed auger screw section 242A to an extruder head 244A.

An inner auger screw 280A extends co-axially through the auger screws 220A, 238A and 242A and through the extruder head 244A. Beyond the extruder head 244A the auger screw 280A extends upwardly through an auger tube 282A to a discharge spout 284A. At the upper end of the auger screw 280A an electric drive motor 286A is provided for driving the auger screw 280A and, also, a classifier screw assembly indicated generally by reference numeral 288A, which is connected to the lower end of the auger screw 280A by a universal joint 290A and which is arranged beneath a grating 292A. Particulate material and small objects having a density greater than that of water can sink through the grating 292A into the classifier screw assembly 288A, so that they are then conveyed by the auger 280A and discharged separately through the discharge spout 284A.

The compactor screw section 238A is connected, at its outer periphery, to a tubular housing 294A, which is connected at one end to a gear 296A. An electric drive motor housing 298 through a pinion 299A, drives the gear 296A and, thus, the compactor auger screw section 238A, the feed auger screw section 220A and 242A and the rotor of the extrusion head 244A.

Corresponding to the apparatus of Figure 29 the compactor auger screw section 238A has a lesser pitch, and twice the number of flights, as compared with the feed auger screw sections 220A and 242A.

A semi-circular weir 291A, having a semi-circular seal 293A in sealing engagement with the lower end of the screen 210A is provided for ensuring that the mixture of liquids and solids flows into the interior of the screen 210A.

Figure 39 shows a further modification of the apparatus of Figure 29, and parts of the apparatus of Figure 39 which correspond to those of Figure 29 have been indicated by the same reference numeral, increased by 300A and are therefore not described again in detail herein.

In the apparatus of Figure 39 the extrusion openings 64A of the extrusion head 44A of Figure 29 are omitted, and the material which is pressed radially outwardly by pressure members 346A passes into a pair of diametrically opposed outlet passages 380A, which are dimensioned so as to effect further compression of the material.

From the passages 380A the material is forced into wider passages 382A, which allow expansion of the material, and the material is then extracted from the passages 382A by an output auger indicated generally by reference numeral 384A having an output spout 386A. The output auger 384A is driven from the upper end of shaft 348A through a universal joint 388A.

Shaft 348 is driven by electric drive motor 388A through gears 389A and 390A and a tubular housing 391A, which is connected to compactor auger screw section 338A and to gear 390A.

The output auger 384A comprises an auger screw 392A extending through an auger tube 393A with a plurality of bars 394A extending longitudinally between the auger screws 392A and the tube 393A. Like the bars 60A of Figure 29, the bars 394A serve to shear the material, and to counteract rotation of the material, as the material is fed along the auger 384A.

The apparatus of Figures 43 through 46 is similar to that of Figures 39 through 42 except that, in the former case, extrusion openings 364A are provided around extruder head 344A. As shown in Figure 46, the extrusion openings 364A are provided with deflectors 366A, similar to the deflector 66A of Figure 31.

Also in this case, instead of the two passages 380A of Figure 39 the apparatus is provided with four compactor passages 396A for receiving the material pressed radially outwardly from the extruder head 344A and for further compacting this material. The passages 396A extend to wider passages 397A, which allow expansion of the material, as the material is fed into the output auger 384A.

The extruder openings 364A may be circular in shape, as shown in Figure 47 or may be modified so as to be in the form of slots, one of which is illustrated in Figure 48.

Figure 49 shows a modification, indicated generally by reference numeral 400A, of the output auger 384A of Figures 39 and 43.

The output auger 400A has an auger screw 402 rotating in a tubular housing 404A, with longitudinal bars of 406A spaced around the auger screw 402A between the auger screw 402A and housing 404A. The auger tube 404A is provided with a heat-

insulating jacket 408A, and with a hot gas outlet 410A and a hot gas inlet 412A at the upper and lower ends, respectively, of the auger screw 402A. The auger screw 402A extends to an extrusion section indicated generally by reference numeral 414A, which is similar to the extruder section 44A of Figure 29 and which is provided with a hot gas outlet 416A.

The hot gas outlets 410A and 416A are connected by pipes 418A and 420A to the hot gas inlet 412A and an air inlet 422A connects to the pipe 418A for supplying fresh air with the auger 400A.

In operation the material is fed for about an hour into the auger 400A while the auger 400A is stationary. The auger 400A is then rotated in one direction through 180°, and the material is again fed into the auger for one hour, after which the auger is rotated through 180° in the opposite direction. The material is thereby mixed and rearranged, so that oxygen is distributed so as to promote the growth of bacteria for composting the aeration also provides a temperature rise, by which the material is maintained at about 75°. When it is determined, e.g. by an echo-sounder device (not shown), that the material has reached a predetermined height, the motor rotates the auger screw 402A through 360° and the solid material is conveyed through the length of one turn of the auger screw 402A.

The auger screw 402A has two flights and can then convey about twice the amount that would be conveyed by a single flight auger.

The above-described operation is repeated until the material, after being composted is extruded by the extrusion section 414A. The material then has a solid content of 50-80% depending on its intended use.

By these proceedings, and the composting, the volume of the material is reduced by about 95%.

By this means, a large variety of screened and sieved materials from waste water from industrial, commercial or domestic sources, ships or aeroplanes, for example, can be hygienized at 75°C over a period of several days and reduced in volume by 95%.

Also screened and sieved solid waste materials from sanatoria, hospitals and the like can be separated, compacted and hygienized and finally can be pelletized. The resulting pellets can be combusted or the non-biological solid material can be removed and the remaining organic material can be mixed with additives in the form of carbons for subsequent further com-posting or for return into the auger 400A.

The auger 400A may be replaced by a double-walled auger, used for heat exchange, whereby fluid passed through the auger is heated, the flow being controlled to ensure that the temperature of the solid material is maintained at about 75°C, so that the bacteria in the material are not killed.

Alternatively, the fluid can be heated to 250°C to speed up the hygienization of the material.

The compactor, comprising:

- a. a first feed auger section for advancing a mass of material
which is to be compacted;
- b. a compactor auger section for receiving and compacting the material from said first feed auger section;
- c. a second feed auger section for receiving and advancing the material from said compactor auger section;
- d. first and second feed auger sections and said compactor auger sections having co-axial auger screws; and
- e. a rotary head for receiving the material from said second feed auger section and deflecting the material radially

outwardly of said rotary head.

This compactor further comprising at least two compactor, passages for receiving the material deflected by said eccentric rotor, said compactor passages being dimensioned to compact the material as the material passes therethrough; and expansion passages for receiving the material from said compactor passages, said expansion passages being dimensioned to allow the expansion of the material as the material passes therethrough.

For this compactor it is provided that said auger screws of said first and second feed auger sections each have a screw pitch greater than that of said auger screw of said compactor auger section.

The compactor has the feature that said first feed auger section includes an auger tube co-axial with said auger screw of said first feed auger section and a plurality of bars extending longitudinally along the interior of said auger tube, between said auger tube and said auger screw of said first feed auger section, for cutting and guiding the material as the material is advanced along said first feed auger section.

The compactor has the further feature that said auger screw of said compactor auger section has a greater number of flights than said auger screws of said first and second feed auger.

The compactor shows that said eccentric rotor is co-axial with said second feed auger section and comprises a pair of curved impellers at opposite sides of the axis of rotation of said eccentric rotor and an auger screw at an axial end of said eccentric rotor remote from said second feed auger section and having a screw thread opposite to that of said second feed auger section preventing movement of the material along said axis beyond said eccentric rotor.

The compactor further comprising an extrusion head extending around said eccentric rotor and formed with extrusion openings for extruding the material deflected radially outwardly by said eccentric rotor.

The compactor shows that said extrusion head is provided with means for breaking into separate individual pieces the material extruded through each of said extrusion openings.

It is evident from the above that the output auger 400 according to Fig. 49 can be used as a pre-composting module already directly connected to, for example, the double filter unit according to Figure 5 or 29a, whereby in this case the external pre-composting unit 500 according to Figure 28 could be dispensed with. In addition, this variant makes it - in an advantageous manner possible that, by way of a heat exchanger which is merely outlined, spray water used for backwashing the screens in the double filter unit is heated by the waste heat of the pre-composting module (according to tests possible up to 75°C), in order to wash off grease and oil residues. By operatively connecting the auger screw 402A with the auger screw 11A via the coupling joint 13A it is also possible to combine the output auger 400A directly with the auger 28 according to Figure 32. Here, it is also to be mentioned that the conveying capacity of the output auger 400A according to Figure 49 which, as was mentioned above, takes over the function of the pre-composting module 500, can, due to a reduction in the volume of the filled-in solid material after the plant has been started for the first time, be doubled within only a few hours, while a sufficient sterilization of the solid material is still guaranteed.

The above embodiments merely are to be understood as examples of an auger system. Other combinations for the arrangement of auger screws, compactors, and extruders can of course be provided. However, according to the invention all these individual components influencing the consistency of the solid material are constructed as modules and can therefore be assembled at will.

In the following there will be described a further embodiment of a means for separating solids from flowing liquids as well as a collecting cage to be used in such a means, as can inter alia be used as an alternative to the drum-shaped screen according to figure 5 or 29 installed in the above explained double or plural filter unit.

In Figure 50 a first embodiment of an apparatus 1B according to the invention for separating solids from flowing liquids is shown. The apparatus 1B is arranged in a sewer 2B the ground area 4B of which is indicated in Figure 50. The maximum water level is indicated by a triangle in Figure 50 and the reference numeral 5B denotes the upper edge of the sewer.

The apparatus according to the invention comprises two guides 6B, 7B disposed in a base 3B, the guide 7B being disposed behind the guide means 6B - seen in the direction of flow Y. In each guide means 6B, 7B a plurality of collecting cages 8B (e.g. seven in the shown embodiment) which are movable along the guide 6B and 7B resp., is guided.

The two guides 6B, 7B extend from the ground area 4B of the sewer in the direction of flow concavely curved upwards above the water level so that the guide portions 6B, 7B extend in U-shape against the flow direction Y above the water level. The radius of curvature of this portion of the guides 6B, 7B may have any curvature, for instance that of an elliptic portion or of a circular arc portion.

In the area above the water level the radius of curvature may be reduced so as to save overall height. Whereas the radius of curvature below the water level is chosen to be approximately equal for both guides 6B, 7B, the radius of curvature above the water level is chosen for the guides 6B, 7B such that the guides 6B, 7B are transformed into a common cleaning portion 9B which extends approximately in parallel to the liquid surface. The cleaning portion 9B can be

straight or can have a comparatively large radius of curvature.

The two successively arranged guides 6B, 7B thus have an approximately U-shaped design including a common U-leg formed by the cleaning portion 9B. The collecting cages 8B are connected to each other by hinge means 12B, the design of which is described in detail further below. Accordingly, the plurality of collecting cages 8B forms a chain of collecting cages which is movable via a drive means 10B along the guide 6B and 7B, respectively. In the embodiment shown in Figure 50 the drive means 10B is provided with a drive motor acting on a tension means 11B which engages in the collecting cages 8B.

In Figure 50 the collecting cages 8B of both guides 6B and 7B are shown in their operating position in which the liquid in the sewer (flume) flows through the collecting cages in the direction of arrow X. The solids can be separated from the liquid by collecting surfaces formed inside the collecting cages 8B the structure of which will be described in detail further below.

Each chain of collecting cages can be moved out of the shown operating position along the guide 6B and 7B, resp., via the drive means 10B, which may be, e.g., a cable or chain drive, out of the liquid flow. The chain of collecting cages is moved along the curved portion toward the cleaning portion 9B of the guides 6B, 7B so that the collecting cages 8B are brought into a position in which their inlet opening 14B is directed downwards, i.e. toward the water level.

In the area of the cleaning portion 9B cleaning systems 15B including, for instance, discharge nozzles for highpressure vapour or high-pressure fluid are provided by which the collecting surfaces of the "upside-down" collecting cages 8B can be cleaned.

At the end of the cleaning portion 9B of the guides 6B, 7B a removable buffer (not shown) may be provided which restricts

the movement of the chain of collecting cages. By removing the buffer new or further collecting cages may be added to the apparatus 1B. Advantageously the buffer is provided with a limit switch through which the drive means 10B receives the pulse for interrupting the drive when the collecting cages 83 have reached their "upside-down" cleaning position. In order to be able to remove and add the collecting cages 8B more easily when the buffer is detached, a roller path 18B (hatched line in Figure 50) which is formed approximately in extension of the guides 6B, 7B or, more exactly, of the cleaning portion 9B can be provided in the final area of the guide 6B, 7B.

In the view of Figure 50 below the cleaning means 15B, i.e. between the cleaning portion 9B of the guides 6B, 7B and the water level, a funnel tube 20B is provided, the funnel-shaped portion of which immerses partly into the liquid.

The length of the funnel tube 20B corresponds to the length of the cleaning portion 9B of the guides 6B, 7B so that the solid material rinsed out by means of the cleaning system 15B can be collected.

A worm conveyor 22B driven by a drive 23B extends out of the funnel tube 20B. The solid material can be discharged out of the funnel tube 20B upwardly inclined (view according to Figure 50) through the worm conveyor 22B.

The worm conveyor 22B may be, as can be taken from Figure 50, a double-lead worm conveyor, the worm conveyor having a comparatively small gradient in a portion which is partly below the water level. To this portion a compacting portion 25B having a comparatively large worm gradient is connected in which the collected solids are dehydrated and compacted (compactor). The compacting portion 25B is equipped with four worm spirals (four-start), as one can infer in particular from Figure 51b. Then the dehydrated solids are discharged via a discharge opening of the worm conveyor 22B. In the area of this discharge opening the worm conveyor is provided with

opposed gradients so that the bearing of the worm conveyor at the side of the discharge opening is relieved. The design of this compactor is described already in several prior applications of the Applicant (cf. e.g. Canadian patent application 2,107,172) so that for details reference can be made to this prior application. In the area of the discharge opening 27B and the compacting portion 25B the worm conveyor 22B is provided with a housing shell 29B, while the worm conveyor runs open inside the funnel tube 20B in the portion which is immersed in the water.

In the Figures 51a, 51b partial sections across the worm conveyor 22B along the lines A'-A' and A''-A'' are shown.

As shown in Figure 51a, in the lower area of the funnel tube 20B in which the solids collect and along which also at least part of the worm conveyor 22B extends, shear or guide beads 24B which are arranged at small distance from the outer diameter of the worm conveyor 22B and are distributed along a circumferential portion are provided. These shear beads prevent a rotation of the solids to be transported and thus a formation of dough or clods so that a complete removal of the solids is guaranteed.

The lower portion of the funnel tube 20B in which the worm conveyor runs open is designed as filter or grate surface 26B so that residual liquid in the solids and superfines can be returned to the liquid flow.

In accordance with Figure 51a, in the area of the lower portion of the funnel tube 20B a further high-pressure cleaning means 28B may be provided by which cleaning fluid (vapour, fluid) can be sprayed at high pressure onto the grate surface 26B so that solids or other impurities (fats, oils etc.) adhering thereto are rinsed off and returned to the liquid flow.

As one can see from Figure 51b, the housing shell 29B encloses the worm conveyor 22B in the area of the four-start

compacting portion 25B, the shear beads 24B being distributed along the inner circumference of the housing shell 29B.

As it can further be inferred from Figures 51a, 51b, the funnel tube 20B is supported via braces 31B at the sewer 2B.

The solids can be supplied to another step of treatment, as for instance a pelleting means, via the worm conveyor 22B (not shown).

As one can moreover take from Figure 50, in the area in which the two guides 6B and 7B are transformed into the common cleaning portion 9B the guide 6 is designed as switch 30B by which it is safeguarded that the chain of collecting cages is moved out of the cleaning position from the cleaning portion 9B back into the provided guide 6B or 7B. To this end, the switch 30 can be swivelled by means of a drive means 32 so that either the guide 6B is connected to the cleaning portion 9B or the switch 30B is moved out of the collision area of the guide 7B. The drive means can act against the force e.g. of a tension spring 34B so that for resetting the switch 30B into a home position no separate control pulse for the appropriate movement of the drive means must be transmitted, but the tensile force of the spring is exploited.

Moreover in the transition area of the guides 6B and 7B a guide plate 34B and 36B, resp., is provided from the portions arranged in the liquid to the cleaning portion 9B, the guide plate 34B being assigned to the guide 6B and the guide plate 36B being assigned to the guide 7B.

The guide plates 34B, 36B are arranged at a distance from the guides 6B and 7B which corresponds approximately to the height H of a collecting cage. Moreover the guide plates 34B, 36B are adapted to the curvature of the assigned guides 6B and 7B.

The guide plates 34B, 36B extend approximately away from the water level in the direction of the funnel tube 20B, the

guide plate 36B assigned to the rear guide 7B being pivoted in the guiding base 3B.

The curvature of the guide plates 34B and 36B is selected so that they are arranged, when moving the collecting cages 8B out of their operating position into the cleaning position, only at a small distance from the inlet opening 14B of the collecting cages and thus prevent the solids from falling out of the collecting cages when they are moved toward the cleaning portion 9B. The length of the guide plates 34B, 36B is designed such that the solids cannot miss the funnel. The movable guide plate 36B is swivelled, when the collecting cages are moved along the guide 6B out of the position shown in Figure 50 away from the guide 6B so that the collecting cages 8B cannot collide with the guide plate 36B on the guide 6B. On the other hand, the guide plate 36B is brought into its position shown in Figure 50 when the collecting cages 8B are moved on the guide 7B.

Moreover the apparatus according to the invention comprises a water level sensor 38B including an associated circuit by which the drive means of the collecting cages 8B is controlled, when the water level rises due to added collecting surfaces, so that the collecting cages 8B are moved out of their operating position into the cleaning position.

Below the water level the guides 6B and 7B end in the area of the ground 4B of the sewer, wherein a stepped elevation 40B, which at the same time forms a stop for the collecting cages 8B is provided for each of the guides 6B, 7B.

The leading surface 42B seen in the flow direction Y of the elevation 40B is adapted approximately to the curvature of the guide 7B and extends approximately in extension of the inlet openings of the collecting cages 8B.

In the area of the lower end portion in Figure 50 of the front guide 6B a sediment separating means 41B by which sand,

pebbles, fruit stones etc. can be discharged is indicated in broken lines. This means is optionally provided and is described in more detail in connection with Figures 60 to 62.

In Figure 52 a section across a collecting cage 8B is shown in a first embodiment along the line B-B in Figure 50.

The collecting cage 8B comprises a shell 50B the open front sides of which form the inlet opening 14B and an outlet opening 52B for the liquid. In the embodiment shown in Figure 52 the shell 50B has a necking 54B at its upper part so that the shell 50B is enlarged toward the inlet opening 14B and toward the outlet opening 52B. In the shown embodiment it is preferred to design the shell 50B with an approximately rectangular cross-section (transversely to the flow direction X) so that it is adapted to the normally used rectangular cross-section of the liquid channels or flumes. However, other cross-sections can be used as well.

On the circumferential edge of the shell 50B restricting the inlet opening 14B there are arranged sealing lips 56aB, bB or the like approximately in parallel to the guides 6B, 7B which are in contact with or at least at a small distance from guide plates 58B, 59B which are fixed to the side wall 60B of the sewer. As one can take from Figure 53, the sealing lips 56aB, bB are approximately adapted to the curvature of the guides 6B, 7B. The guide plates 58B, 59B ensure that the liquid flow X is deflected in the direction of the center of the collecting cage 8B and cannot flow laterally past the collecting cage. Thus a further improvement of the degree of separation is permitted by these guide plates 58B, 59B.

When the chain of collecting cages is moved, the sealing lip 56B also gets in contact with or in the vicinity of the guide plates 34B, 36B so that a sealing locking of the collecting cage in its upside-down position is guaranteed until it reaches the collect-ing area of the funnel tube 20B.

According to Figure 52 at the rear end, i.e. the end facing the sewer ground 4B, of the inlet opening 14B of each collecting cage 8B a stripping member 57B is provided which, when the collecting cages 8B are moved in the direction of the cleaning portion 9B, gets in contact with the guide plate 34B or 36B so that the separated solids are prevented from falling downward out of the collecting cage.

The necking 54B likewise supports the liquid flow toward the center of the collecting cage 8B so that solids at first deposit in the center of the collecting surface 62B and only afterwards in the marginal areas.

In the shown embodiment the collecting surface 62B seen in the flow direction X - is arranged below the necking 54B. The collecting surface 62B is formed by lamellas 64B which extend in circular arc shape across the interior of the collecting cage 8B. In the shown embodiment the lamellas are concavely curved in the direction of flow, wherein initially solids deposit in the lower part of the lamellas 64 due to the necking 54B and the effect of the guide plates 58B, 59B.

The structure of the collecting surface 62B can be taken from the Figures 53a, 53b, Figure 53a being a side view of Figure 52 and Figure 53b being a magnified detailed view of the lamellas 64B.

As one can take therefrom, the collecting surface 62B is formed by a plurality of lamella packs 66B, 68B, 70B which are staggered in the flow direction X so that the collecting surface 62B extends in approximately rectangular wave shape transversely to the flow direction X. In the shown embodiment five lamella packs are staggered in series so that a concave profile is resulting (cf. Figure 53a).

The lamella packs 66B consist of a plurality of individual lamellas 64B (Figure 53b) which are held in parallel distance from one another via spacers 72B. Thereby passage gaps 74B for the liquid to be purified are formed between the lamellas

64B of a lamella pack. When the liquid flows through these lamella packs 66B, 68B, 70B, the solids cling to the front portions 76B seen in the flow direction X - of the lamellas, wherein practically a multi-stage separation can be achieved by the stepwise arrangement of the lamella packs.

In Figure 53a a possibility of fixing the lamella packs 66B, 68B, 70B to the shell 50B of the collecting cage 8B is shown.

Accordingly, fastening bolts 77B, 78B which are screwed with the shell 50B are guided through the lamella packs 66B, 68B.

The lamella pack 70B which is positioned lowest in the flow direction X is screwed with the lamella packs 68B and/or the shell 50B through fastening means, which are not shown, so that the entire lamella pack is detachable from the collecting cage 8B merely by unscrewing (cf. Figure 54b) the fastening bolts 77B, 78B. The lamellas of each lamella pack are likewise screwed to one another through bolts.

As one can infer in particular from Figure 52, the spacers 72B have a rectangular approximately plate-shaped structure, one corner being arranged in the direction of flow X. In this way the spacers 72B have a conical flow surface on which solid material, such as e.g. fibres, can settle down. The special arrangement of the spacers 72B also facilitates the rinsing of the added solids in the cleaning position of the collecting cage 8B because - as described in the foregoing - the cleaning nozzles act against the flow direction X and thus the solids are easily removable from the tapered flow surfaces of the spacers 72B.

As one can furthermore take from Figure 52, at the ends of the lamellas 64B triangular spacers 80B are provided so that the desired gap width, which may be up to 10 mm, preferably 1 mm, depending on the application, is also ensured in the marginal area of the lamellas.

These spacers 80B may likewise be used for fixing the lamellas at the shell 50B.

The collecting cage 8B is provided with a roller means further below described in more detail which runs in the guides 7B of the guiding base for the collecting cages 8B.

In Figures 54a,b another embodiment for the design of the lamella packs 66B, 68B and 70B of the collecting surface is illustrated. In this embodiment each lamella 64B of a lamella pack 66B, 68B, 70B comprises an approximately circular arc-shaped or elliptically curved central portion 82B which is transformed into approximately straight marginal portions 84B extending to a shell portion in the area of the inlet opening 14B. In the view according to Figure 54, the marginal portions 84B form a funnel through which the liquid is guided to the central portions 82B. In this way the necking 54B of the shell 50B provided in the above-described embodiment can be omitted or at least made smaller so as to considerably reduce the manu-facturing costs of the shell.

The lamellas 64B are in turn held at the desired distance from one another by the spacers 72B and 80B.

The lamellas 64B shown in Figures 54a,b may have a multipart structure, wherein the central portion 82B may be manufactured of a circular arc-shaped member adapted to the modular dimensions of usual sewers, whereas the marginal portions 84B may be manufactured in different lengths so that the lamellas 64B can easily be adapted to different sewer widths. The central portions 82B may be connected to the marginal portions 84B via the spacers 72B. The other components of this collecting cage correspond to those of the collecting cage shown in Figures 52, 53a, 53b so that, to simplify matters, in this respect reference is made to the above description.

The collecting cage 8B however, need not be equipped with the above-described lamella structure as collecting surface 62B,

but any filter elements may be used, such as e.g. sand, activated carbon or ceramic fillings or else perforated plates or filter cloths. Such filter structures are described in the Canadian applications No. 2,106,291 and 2,107,172 of the Applicant relating to a BIOVERTER System, which are herewith referred to, to simplify matters, and the content of which shall belong to the disclosure of the present application.

In the Figures 55 to 57 the guiding and connection of the collecting cages 8B in the guide 6B or 7B of the guiding base is shown.

Each guide 6B or 7B includes two guide rails 86B, 87B arranged on a common base 88B. The distance of the guide rails 86B, 87B approximately corresponds to the width (cf. Figure 52) of a collecting cage 8B.

In the illustrated embodiment an axis 90B is assigned to a collecting cage 8B at the end of the axis there are formed guide rollers 92B which run in the guide rails 86B, 87B. In the shown embodiment the guide rails 86B, 87B are U-profiles the legs of which extend approximately in parallel to the axis 90B. However, it would also be possible to provide the U-profiles turned by 90°, i.e. in an upright position, and to guide the guide roller with its radially projecting portions in the rails 86B, 87B. Then, however, a retaining means would have to be provided so as to retain the rollers in the upside-down position of the collecting cages 8B in the cleaning portion 9B.

As one can infer from Figure A, the collecting cages 8B of a chain of collecting cages are connected to each other via hinge clips of the hinge means 12B disposed at the upper edge (view according to Figure 53) of the collecting cage.

In the further embodiment of the hinge means 12B shown in Figures 56, 57 this hinge means includes strap hinges 94B and 96B which are arranged alternately on the axis 90B. The

fixing clips of the strap hinges 94B are fixed to a collecting cage 8aB while the fixing clips of the further strap hinges 96B are fixed to the adjacent collecting cage 8bB. This hinge means ensures that the collecting cages 8B are adapted to follow the arc shape of the guide 6B, 7B, wherein the relative position of the collecting cages 8aB 8bB to each other may change. Moreover the collecting cages 8B are fixed to one another via the strap hinges 94B, 96B so as to form the above-described chain of collecting cages. Thus the axis 90B has a double function which consists, on the one hand, in supporting each collecting cage 8B on the guides 6B, 7B and, on the other hand, in supporting the strap hinges 94B, 96B.

In Figure 58 another variant of the apparatus according to the invention is illustrated. While in the foregoing embodiment the collecting surface was formed by a plurality of collecting cages 8B permitting a variable adaptation of the apparatus to different sewer widths, in Figure 58 a variant having a simpler structure is suggested. According to this embodiment, the collecting surfaces are formed by segment faces 98B and 100B each being supported in a rigid frame 102B, 103B which is pivotable about a rotatable axis 104B.

Each of the segment faces 98B, 100B as a circular arc-shaped or elliptic design so that the collecting surface 62B has approximately the same shape upwardly ascending in a curved manner as in the case of the foregoing embodiment. At the ground area of the sewer stepplings having appropriate stops are formed for restricting the rotary movement of the frames 102B, 103B with the segment faces 98B, 100B.

The segment faces 98B, 100B, in turn, may be provided with the above-described lamellas or else be filled in any way with other filter mediums - as in the case of the a.m. PCT applications.

In Figure 58 the segment faces 98B, 100B can be swivelled upwards into a cleaning position in which the collecting surfaces are upside down.

In their cleaning position rinsing fluid can be applied to the segment faces 98B, 100B against the normal flow direction X via high-pressure fluid nozzles 15B so that the separated solids are rinsed out and transported into a funnel tube (not shown) or the like. In principle, the embodiment shown in Figure 58 works in the same way as in the foregoing Figures.

The design of the collecting surfaces 62B and the separating means is not restricted to the above-described embodiments, of course. For adaptation to different sewer widths plural apparatuses can be juxtaposed transversely to the direction of flow so as to remove solids also from sewers having a large width. In that case each apparatus includes a separate drive and a separate guide comprising collecting cages 8B or segment faces 98B, 100B.

As it is further shown in Figure 59, in each collecting cage plural preferably convexly curved lamellas 64B may be formed side by side so that the collecting surface can be enlarged at will.

In order to prevent the sediments from being rinsed out during the time in which the separating means 41B moved out of its shown operating position upwards into the horizontal position, a retaining gate 48B may be provided at the ground area 4B ahead of the guide 6B, the retaining gate being brought in its vertical position shown in broken lines, when the separating means 41B is moved upwards so that the deposited solids are retained in the bottom area at the retaining gate, until the separating means has been returned to its operating position. Then the retaining gate is swivelled back into the position indicated by a continuous line.

In the Figures 60 to 62 embodiments of the sediment separating means 41B are shown.

According to Figure 60, the separating means 41B is formed in extension of the front guide 6B. To this end, the elevation 14B for the guide 6B has been omitted and the guide rails 86B, 87B have been enlarged until they extend approximately in parallel to the ground area 4B.

In these extensions of the guide rails 86B, 87B separating screens 108B are guided, each comprising a screen-like bottom portion 110B, a rear wall 112B and two side walls 114B (Figure 61a).

As it can further be taken from Figures 60a,b, a plurality of separating screens 108B are successively guided in the guide rails 86B, 87B each rear wall 112B of a separating screen 108B overlapping with the adjacent end portion of the bottom portion 110B so that the rear wall 112B is located between the two side walls 114B of the adjacent separating screen 108B.

As one can take from Figure 61a, the separating screens 108B are supported with their side walls by an axis 90B including guide rollers 92B which, in turn, are received in the guide rails 86B, 87B.

As one can moreover infer from Figure 61a, the selfsupporting end portions of the side walls 114B are curved conically outwardly and overlap with the guide plates 116B arranged in extension of the guide plates 56B so that a sealing is formed between the side wall 116B and the side wall of the sewer.

In the area between the rear wall 112B and the free end of the bottom portion 110B two further impact walls 118B are fixed on the latter so that the area between two adjacent rear walls 112B is divided into three sections of approximately equal size.

According to Figure 60a, the rear walls and the impact walls 118B are arranged to be ascending toward each other, seen in the direction of flow, so that the last rear wall 112B, seen in the direction of flow, of the separating means 41 has almost the height H of a collecting cage 8B. Accordingly, also the side walls of the successively arranged separating screens 108B are formed to have an ascending height so that the side wall 114B of the rearmost separating screen 108B has about the height H of a collecting cage 8B. The side wall 114B of a separating screen 108B rises above the rear walls 112B by a predetermined distance. When liquid flows through the separating means 41B the sediments deposit on the screen-like bottom portions 110B, the fluid and the superfines being able to flow through the screen mesh.

As one can infer from the detailed view of Figure 61a, the screen-like bottom portion 110B can be made of cross struts 11B arranged in parallel to each other around which a screen material (steel, plastic) is wound in wave shape. The bottom portion may be formed of one layer (cross struts 11 and a screening surface) or of two superimposed layers 132aB, 132bB.

When moving the collecting cages 8B along the guide 6B into the cleaning position, also the separating means 41B is entrained and brought into an upside-down position so that the solids, possibly with the help of a cleaning means, fall out of the separating means and are supplied to a transport means, e.g. a worm conveyor (not shown).

In Figure 62 another embodiment for a separating means is shown. This embodiment may be used for a construction of the guiding base as it is visible in Figure 50, without the front elevation 40B for the guide 6B having to be omitted.

To this effect, in the ground area 4B of the sewer bottom a transverse recess 120B is formed in which a transverse worm conveyor 122B is formed to which laterally in the area of the sewer side wall or outside the sewer a discharge worm

conveyor 124B is connected. In this variant the sediments are conveyed from the transverse worm conveyor 122B to the discharge worm conveyor 124B and are then conveyed laterally out of the sewer to a storage means or to a further treatment. Of course, in this embodiment also other conveying means can be used instead of the worm conveyor. This variant has the advantage that the construction of the conveying base needs not to be modified and moreover the flow resistance in the central area of the sewer is reduced to a minimum.

The function of the apparatus for separating solids is to be explained as follows by way of the embodiment shown in Figure 50.

At the beginning of the separation the collecting cages 8B arranged on the guide 6B are in their shown operating position in which they are immersed into the liquid. The collecting cages 8B arranged on the guide 7B are in their cleaning position in which they are lined up upside down along the cleaning portion 9B. Via the cleaning system 15B high pressure, vapour or fluid, which flows in through the outlet opening 52B passes through the passage gaps 74B between the lamellas and flows out through the inlet opening 14B of each collecting cage 8B, flows past the collecting cages 8B in the cleaning position. Due to the flow of the rinsing fluid the solids are entrained and fall in the funnel tube 20B provided below the cleaning system 15B. The rinsed out solids are dehydrated and supplied to a further treatment via the worm conveyor. In parallel to the rinsing operation, the solids are separated in the liquid flow in the sewer, wherein the liquid to be purified enters through the inlet opening 14B into the collecting cages 8B, the solids are separated at the lamellas 64B and the liquid free of solids flows out of the collecting cages 8B, through the outlet opening 52B. Since the collecting cages 8B of the guide 7B which are located behind the collecting cages 8B provided on the guide 6B are not immersed in the liquid, the pressure loss of the liquid is determined by the collecting cages 8B which are in operating position. In the rotary means

described in the beginning the pressure loss was influenced, on the one hand, by the collecting surfaces in forward motion and, on the other hand, by the collecting surfaces in return motion.

With an increasing dwell time of the collecting cages 8B in the liquid the passage gaps 74B between the lamellas are filled so that the water level is slowly rising. After a predetermined rise of the height of the water level, which may be for instance 4m, whereas the permitted rise is 0.5m, a signal is transmitted via the water level sensor 38B to the system control so that the collecting cages 8B in cleaning position are lowered into the water level along the guide 7B via the drive means. In so doing, the switch 30 is in a position closing off the guide 6B. As soon as the collecting cages 8B on the guide 7B have reached their operating position, the switch 30 and the guide plate 36B are swivelled into a position releasing the guide 6B and the collecting cages 8B on the guide 6B are transported upwards to the cleaning portion 9B. The collecting cages 8B are brought into their upside-down position, the separated solids being prevented from falling out by the guide plate 34B and the sealing lips 56B in the strongly curved portion of the guide between the water level and the cleaning portion 9B.

As soon as the collecting cages 8B have reached their cleaning position (Fig. 63), the cleaning system 15B is actuated and the solids are rinsed out against the direction of flow in Z direction out of the collecting cage 8B into the funnel tube 20B, until the collecting cages 8B are completely freed from the adhering solids, oils and fats. The solids fall through the funnel 20B onto the open-running portion of the worm conveyor 22B and are conveyed by the latter out of the funnel 20B and compacted and dehydrated in the compacting portion.

With the clogging of the collecting surface 62B of the collecting cages 8B the water level rises, until the drive is again actuated via the water level sensor and the

collecting cages 8B in cleaning position are returned to the above-described home position (Figure 50). In this way it is ensured that with a minimum pressure loss in the liquid flow always an optimum separation is performed.

If a row of collecting cages fails, the liquid can still be cleaned with sufficient efficiency by the chain of collecting cages connected in parallel.

The apparatus for separating solids from flowing liquids, comprising a first collecting means for the solids which can be discharged from the area of said collecting means by a first transport means, wherein the collecting surface 62B of said first collecting means 1 is movable out of an operating position in the liquid flow into a cleaning position outside the liquid flow by a drive means.

A further collecting means is associated to said first collecting means and said collecting means are adapted to be alternately brought into the operating position and the cleaning position, respectively.

As a third aspect said first collecting means and said further collecting means are arranged in series in the direction of flow (Y).

As a fourth aspect said collecting means has a preferably curved collecting surface 64B obliquely ascending from the ground area of the liquid flow in the direction of flow (Y) to the liquid surface.

Furthermore, said collecting means comprises one or a plurality of collecting cages 8B forming said collecting surface 64B.

As a further aspect said collecting cages 8B are hinged to one another and are guided by a guide 6B, 7B along which said collecting cages 8B are movable out of the operating position into the cleaning position.

Furthermore, said guide 6B, 7B has a substantially circular arcshaped curvature in the area of the liquid flow and is returned above the liquid level preferably with a smaller radius of curvature and subsequently comprises a cleaning portion 9B extending substantially in parallel distance from the liquid surface.

Furthermore, a guide 6B, 7B ending in a common cleaning portion 9B is assigned to each collecting means.

A switch 30B is disposed in the area between said common cleaning portion 9B and a branching to the guides 6B, 7B.

As a further aspect each collecting cage 8B is guided via guide rollers 92B in guide rails 86B, 87B.

As a further aspect the inlet and outlet opening 14B, 52B of each collecting cage 8B is disposed approximately in parallel to the guide 6B, 7B.

As a further aspect a funnel tube 20B assigned to said transport means 22B is provided in the area between the liquid surface and said cleaning portion 9B of said guide 6B, 7B.

Furthermore, each collecting cage 8B comprises a shell 50B the open rectangular fronts of which form the inlet opening 14B for the fluid loaded with solids and an outlet opening 52B for the fluid free from solids and which encloses a cage collecting surface 62B.

Said collecting cages 8B are hinged to one another along adjacent shell faces.

Furthermore, said cage collecting surface 62B comprises a plurality of lamellas 64B spaced apart from one another which are concavely curved toward said inlet opening 14B, wherein

passage gaps 74B for the fluid are formed between said lamellas 64B.

As a further aspect each lamella 64B is strip-shaped, the large areas restricting said passage gaps 74B and the front faces being arranged transversely to the direction of flow X.

As a further aspect spacers 72B, 80B defining the gap width are arranged between said lamellas 64B.

As a further aspect said spacers 72B have rectangular bearing surfaces, a diagonal being aligned approximately in parallel to the direction of flow X.

As a further aspect each lamella 54B comprises a curved central portion 82B and two approximately straight marginal portions 84B connected thereto which extend away from said central portion 82B in the direction of said inlet opening 14B.

The apparatus has furthermore preferably triangular fastening elements 80B disposed between said lamellas 64B for fastening said lamellas 64B at the shell 50B, said fastening elements at the same time serving as spacers 72B.

Furthermore, a plurality of spaced lamellas 64B is combined to a lamella pack 66B, 68B, 70B and plural lamella packs 66B, 68B, 70B are staggered with respect to each other in flow direction X.

As a further aspect said cage collecting surface 62B includes filter elements of sand, ceramics, activated carbon, carbon, perforated plates or filter cloth.

Furthermore, a plurality of collecting means are juxtaposed transversely to the liquid flow Y.

As a further aspect a cleaning system 15B for rinsing the solids out of said collecting means in its cleaning position,

the fluid ejected by said cleaning system flowing through said collecting surface 62B against the flow direction X.

As a further aspect said collecting means is pivoted about an axis of rotation 104B.

A collecting cage, in particular for use in the above-described apparatus, shows a combination of the features listed above.

Thus, the essential difference of the embodiment according to Figure 50 compared to the embodiment according to Figure 5 or Figure 29 consists in that the collecting surfaces of the screen are no longer moved in a rotatory manner - as before - but in a translatory manner from the working position to the cleaning position and vice versa. As far as the design of the collecting surfaces themselves is concerned, there are the same possibilities, as were already described for the drum-shaped screens. This means that the collecting cage according to Figure 52 can selectively also be designed as a mesh filter as shown in Figure 14, or as a microfilter having a cross section as shown in Figure 25, or as a combination of both variants.

As a further variant to the above described mesh filter, the construction according to Figures XX1 and XX2, which is similar to that of the plate filter, is suggested. According to Figure XX1, the collecting surface of the mesh filter is formed by a number of three or more bags arranged side by side and having different depths, with a staggered, curved collecting surface contour being formed, as can be gathered from Figure XX1. The separating walls forming the bags are cut out of an impermeable material in the form of trapezoids. The upper, lower, and rear side of each bag is formed by a micro-mesh having a structure described before. The separating walls furthermore show a trapezoidal recess at the respective front edge. By means of this construction the effect is achieved that in the shallow angle range of inclination the flow speed is increased in the area of the

flattest bag, sweeps away the fine mud and thus keeps clear the filter surface for a longish time.

According to a further modification of the cleaning station according to Figure BB1, the collecting surfaces are first cleaned off by means of compressed air before they are rinsed out with water. This has the advantage that the dumped solid material, in particular the superfines and the solid mud particles contained therein, are not again liquefied and flushed out, but can already be discharged in a simple manner as a solid filter cake. For this purpose, the cleaning station can be extended by a further funnel tube forming the blow-out portion. This means that the collecting surfaces are first guided over the funnel tube in the blow-out portion and, after they have been cleaned off by means of compressed air, are returned over the funnel of the liquid washing device.

It is possible that also in the case of this embodiment the cleaning water is heated, for example, by means of the above mentioned heat exchanger and/or can be mixed with a chemical cleansing agent. Furthermore, dosing devices can be arranged in the funnel tubes at an appropriate position; by means of these dosing devices various chemical and/or biological additives can be added to the solid material. Biological additives may be the following: biological waste, scraps of any kind from trees and plants, sawdust (as carbon-containing substance and as thicken-ing substance).

In the case of this embodiment it can also be fallen back on the above described various components of a compactor-auger system designed in the form of modules. Thus, it is possible to supply the solid material fed via the funnel tubes into the auger tube provided with axially extending guide beads to a compactor module and/or a subsequently arranged pelletizer. Here the compactor module can be designed as a four-speed clogging compactor for compressing and disintegrating the solid material in the transitional area between the auger tube and the compactor whose housing shell consists of two

shell halves. This offers the possibility to eliminate possibly occurring cloggings by folding out the shell halves. As a further variant of a compactor, a cone-shaped discharge module according to Figure BB3 would be conceivable which consists of individual rings axially arranged side by side and having a different diameter. Also the above mentioned necked-down portion having an adjustable diameter can preferably be designed as an individual module and can be arranged in the auger-compactor system at any position whatsoever.

It is basically provided to rotatably support the augercompactor system composed of the individual modules according to Figure BB4 at one end, preferably on the feed side of the solid material, so as to bridge the height distances between individual treatment stations.

A further development of the cleaning station is shown by Figures YY1 to YY3. According to these Figures, the above described cleaning station is designed with an additional washing device extending from the top to the bottom. By means of this washing device solids discharged by the auger screw can additionally be washed. Moreover, a kind of tub or casing can be perceived in Figure YY3 which, underneath the cleaning station, is formed around the auger screw or the spray means arranged therebelow. The tub is arranged such that the lower end portion of the auger screw is permanently under water irrespective of the current liquid level. Due to overflow openings arranged in the tub, the liquid level within the tub is constantly kept at a predetermined level.

In the embodiments described before, the auger tube is, in the feed area for the solid material, preferably formed as a kind of grating allowing excess liquid to drip off. According to Figures ZZ 1 to 3, an additional mesh, a fine mesh or micromesh, is arranged above the grating. This additional mesh is supported by the grating and is selectively held by guide beads. In this manner, fine, superfine or micro mud particles, which had previously again be returned to the

liquid, are largely held back in the solid material and are discharged by the auger screw.

Figures TT1 to TT3 show a modified embodiment of the pretreatment unit 10 according to Figure 2 of this invention.

According to Figure TT1, the tank shows two slides or weirs at a side wall thereof, which, during normal operation according to the above description, block the access to two deflection sewers. Compared to the tank, the deflection sewers only have a low depth, with the liquid level being preferably 20 cm, and are provided with aerating nozzles at the respective sewer bottom and/or side walls. Each of the sewers leads to a respective oil separating device; in their operating position, these oil separating devices block the corresponding sewer. If, for example, a sensor detects oil in the waste water, the weirs open. As a result, the waste water surface is drawn into the sewers and hot air from the aerating nozzles flows therethrough. Thus, the heated oil and grease contents can easily be separated by means of the oil separating devices and can be stored in the corresponding tanks so as to be reused. After this process has been terminated, the oil separating devices are lifted out of the sewers, thus releasing the sewer exits. The liquid cleaned in this manner can subsequently be supplied to the first filter station, with the floating upper layer, which consists of flatable solid material, being swept away by the current in the sewer. By lifting the oil separating devices, the weirs are closed again so that new waste water can be collected in the tank. Furthermore, the pre-treatment unit 10 can selectively be equipped with an additional buffer tank for the quick and complete collection of faecal matter; from this buffer tank these faecal wastes, for example, from house filter plants, can be added to the waste water via a valve.

In Figures AA1 and AA2 a variation of the inventive embodiment of a filter station according to Figure 50 is shown.

According to Figure AA1 a sewer is subdivided into two separate channels each of which can be opened or closed by means of a flow switch. In this embodiment the two collecting cage trains which, according to Figure 50, are arranged one after the other, are now arranged side by side in the channels. Behind the first filter station the sewer exhibits a curvature of 180° after which a second filter station exhibiting a preceding switch is provided. It has the same design as the first filter station.

When in operation, the individual collecting cage trains of each station are alternately moved to and from between the working position and the cleaning position, with the switches being caused to swivel accordingly. According to Figure AA1 the discharge of the solid material at the two filter stations can be effected into one and the same funnel tube of a single auger system, so that in this way construction space and production costs are saved. In this context it is to be pointed out that in this manner several filter stations comprising differently formed collecting cages (mesh, micro mesh, etc.) can be arranged one after the other. So as to improve the efficiency of the collecting cage trains, the sewer or the corresponding channel in the effective range of the collecting cage train according to Fig. AA2 is designed with a deepening, whereby the effective total filter surface can be increased.

As a further variant it is also conceivable to divide the filter drum according to Figure 5 into two half shells respectively and to support them in the individual channels such that they can be swivelled. Compensating weights can, if necessary, facilitate the swivelling motion of the drum halves. A corresponding embodiment is shown in the enclosed Figure AA3.

The embodiment according to Figure CC1 is an alternative to the above described micro mesh filters.

It consists of at least one, but preferably two containers, each of which is subdivided into individual chambers. The side walls of the containers are fluid-tight, and the upper and lower side is formed by a micro-mesh texture including a supporting wire, as is already described above with regard to Figure 25. The containers are filled with sand, activated carbon, or with a similar filter material, and they are pivoted about a swivel axis. Above each container a sprinkler system is arranged which is respectively connected to a collecting container as a buffer tank. Each of the collecting containers is also supported such that it can swivel.

When in operation, the prefiltered and possibly aerated liquid is distributed over the first container by means of the first sprinkler system and passed through the filter material. Below the first container the liquid is then collected and, if necessary, supplied to a further filter process by means of a second container. This filtering can then be concluded by an irradiation of the liquid by ultraviolet light, whereby germs can be destroyed.

For cleaning the filter and collecting containers they are simply rotated by 180° and rinsed out with water; for this purpose previously filtered liquid should preferably be used.

CLAIMS

1. A method of processing a mixture of liquid, **characterized by the steps of:**
 - a. subjecting the mixture to a multiple filtration executed at one or more screening means having different filter mediums such as plates, meshes, micro-meshes, sand and/or activated carbon filters for screening at least a portion of the solid material from the liquid during each screening,
 - b. subjecting the thus screened liquid to a bacteria killing process,
 - c. composting the solid material removed by the screenings.
2. A method according to claim 1, **characterized by the step of:**
 - d. collecting the liquid screened by the screenings and subjecting the liquid to an aerating process in one or more aerating stations.
3. A method according to claim 2, **characterized by the step of:**
 - e. heating up gas and/or air used for the aerating process in at least one of said aerating stations in order to thereby execute the bacteria killing process.
4. A method according to one of claims 1 to 3, **characterized by the step of:**
 - f. using the heat generated in the composting process for heating up water or another cleaning liquid used for cleaning the screening means.
5. A treating system for processing a mixture of liquid according to the method of one of claims 1 to 4, comprising the following treating components: one or more screening means for screening at least a portion of the solid material from the liquid, aerating means for aerating the mixture and/or the liquid screened by the screening means, an auger system for conveying and compacting the solid material and a

composting unit for composting and fermenting the solid material,
wherein
the treating components as well as the conveying and compacting components of the auger system are designed as independent modules which can be combined in any arbitrary sequence according to the required filtration quality.

6. A treating system according to claim 5, **characterized by** at least two screening stations preferably constructed as one unit, followed by one or more aerating means preferably having an air/gas recycling system and being arranged upstream of a further screening station finishing the screening process of the liquid.

7. An apparatus for separating solids from flowing liquids preferably used as a screening station in a treating system according to claim 5 or 6, comprising a first collecting or screening means for solids which can be discharged from the area of the collecting means by a transport means, **characterized in that** the collecting or screening surface of the first collecting means can in a translatory manner be moved by a drive means from an operating position in the liquid flow into a cleaning position outside the liquid flow.

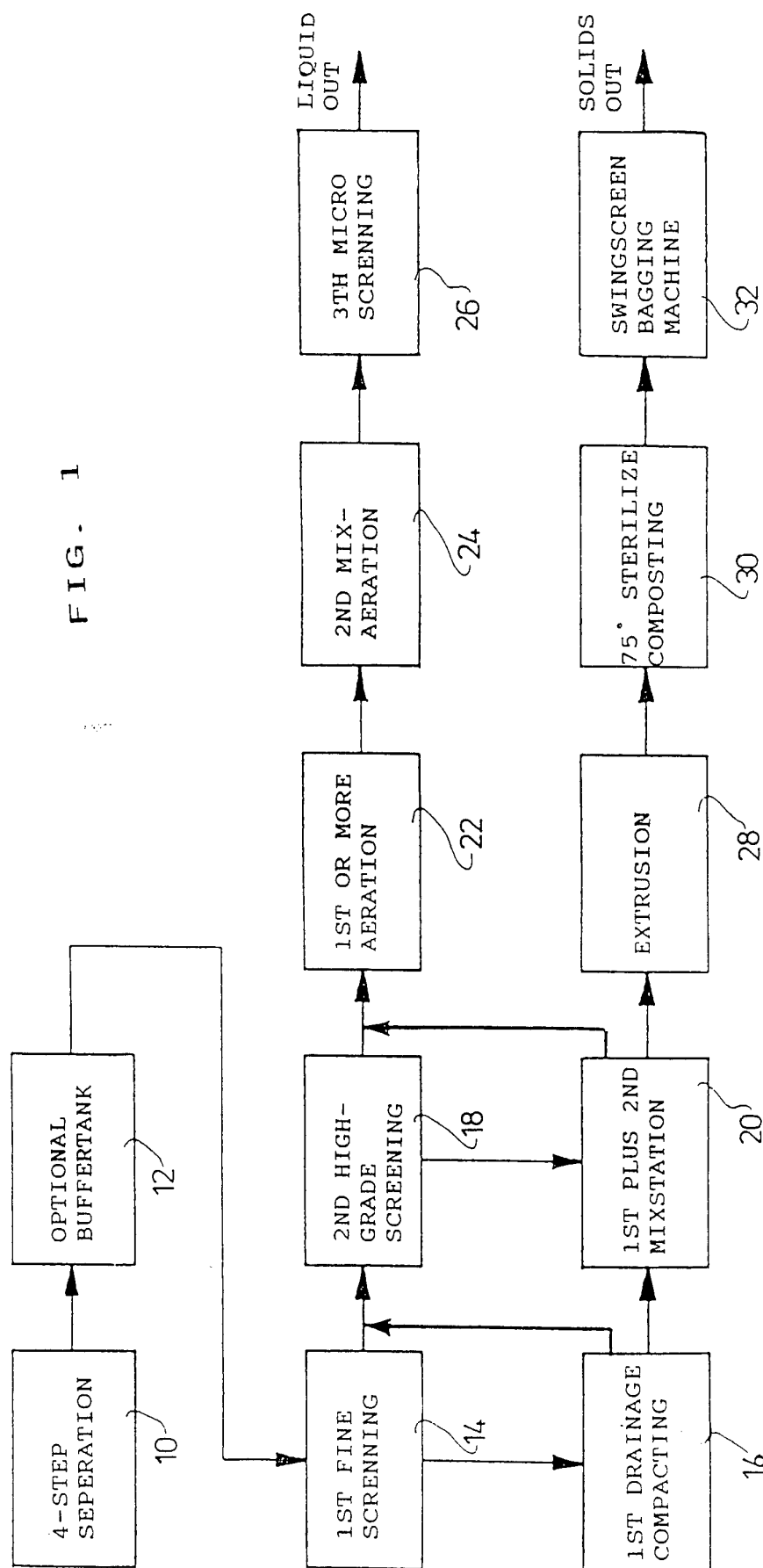
8. An apparatus according to claim 7, **characterized in that** a further collecting or screening means is associated with the first collecting means, with the collecting means being adapted to be alternately brought into the operating position and the cleaning position, respectively.

9. An apparatus according to claim 7 or 8, **characterized in that** the first and second collecting means are arranged side by side, with a flow switch being provided upstream of the collecting means leading the mixture to that collecting means which is in the operating position.

10. An apparatus according to one of claims 7 to 9, **characterized by**

an auger adapted to convey solid material screened by both the first and the second collecting means.

FIG. 1



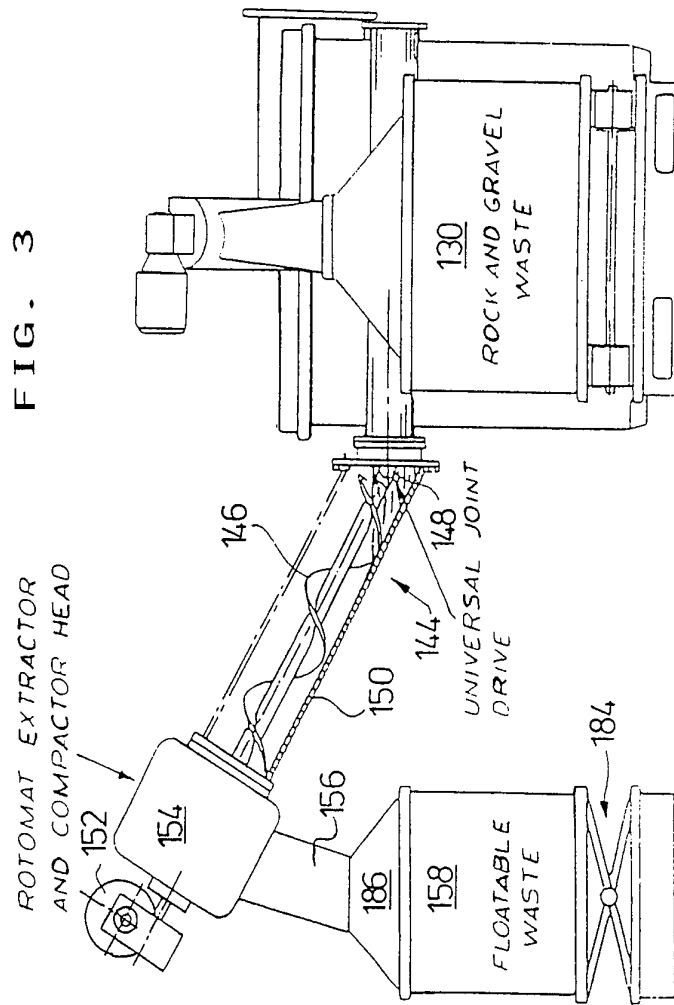


FIG. 4

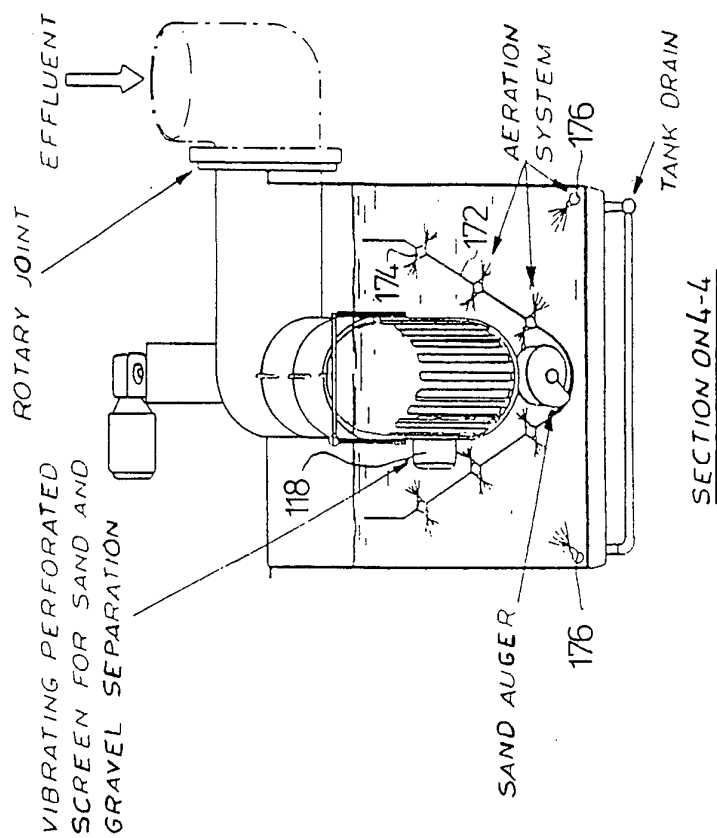


FIG. 5

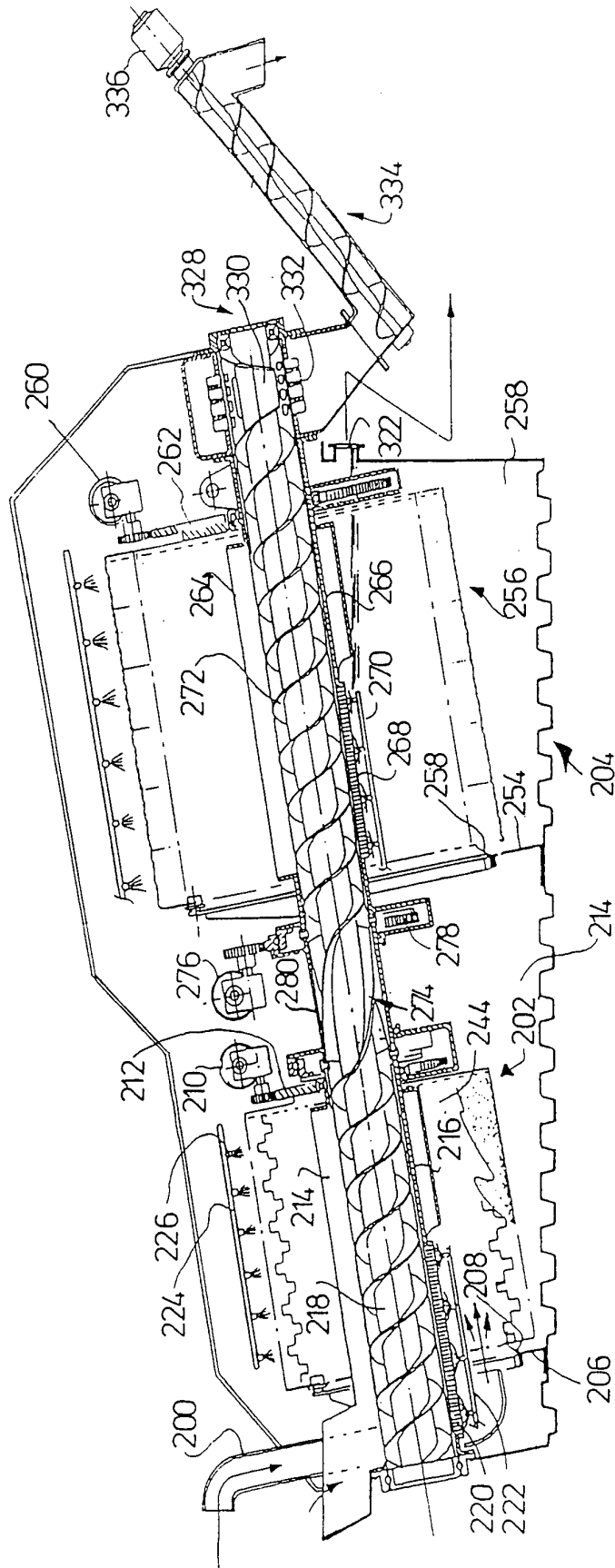


FIG. 6

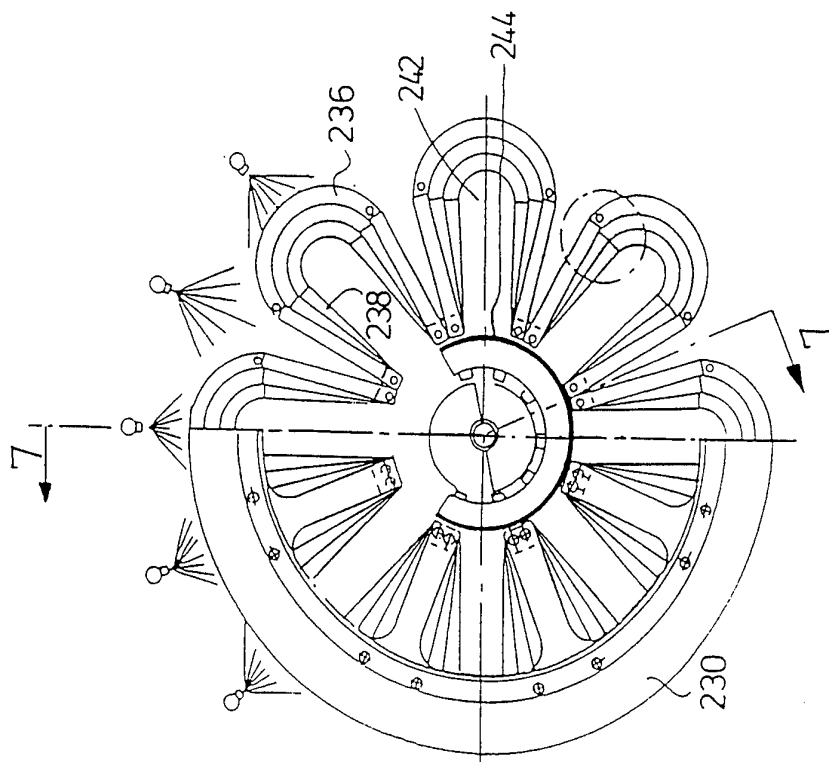
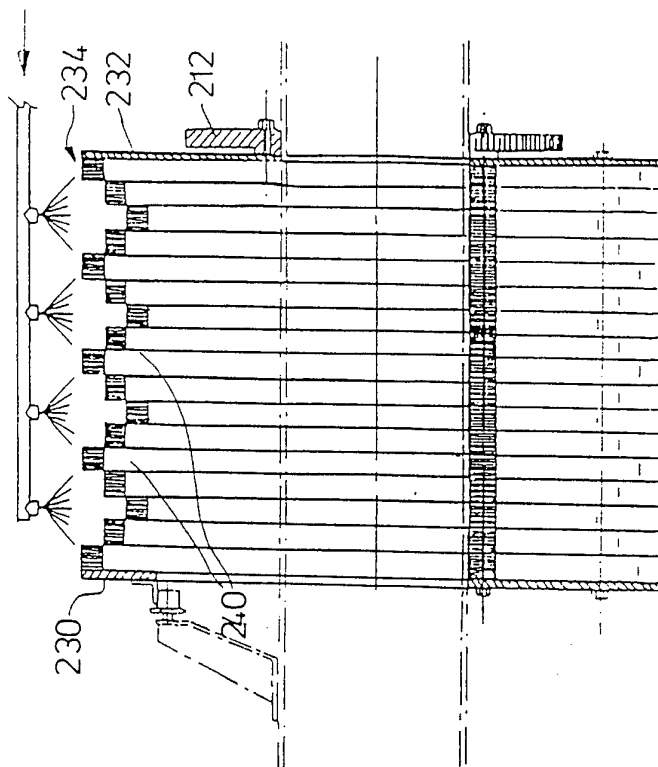
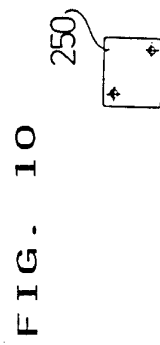
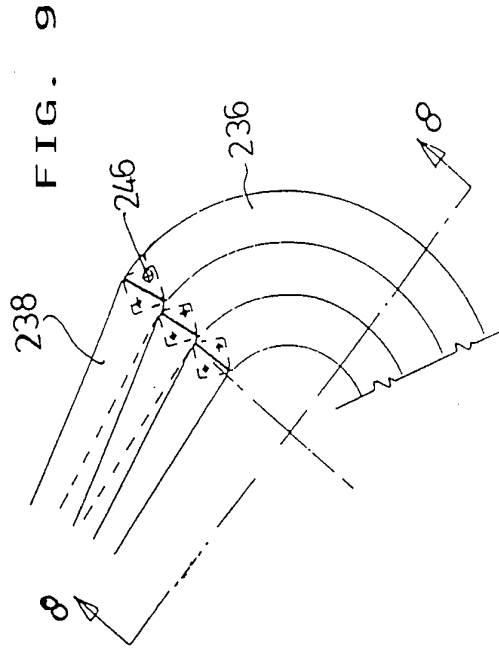
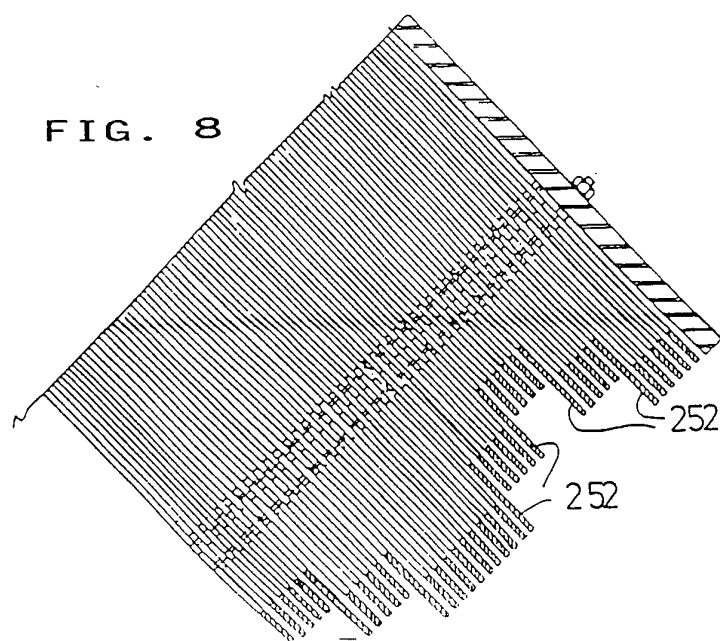
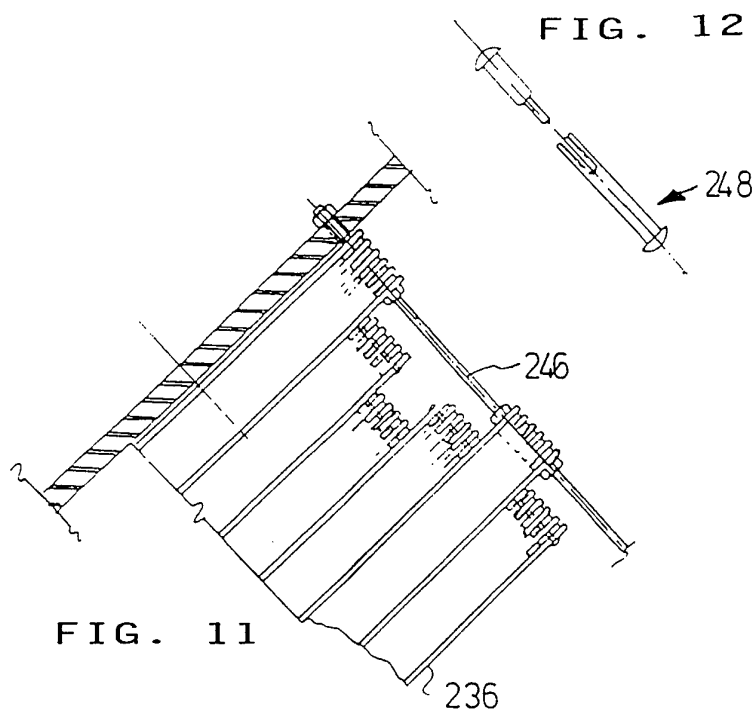


FIG. 7







9 / 5 2

FIG. 13

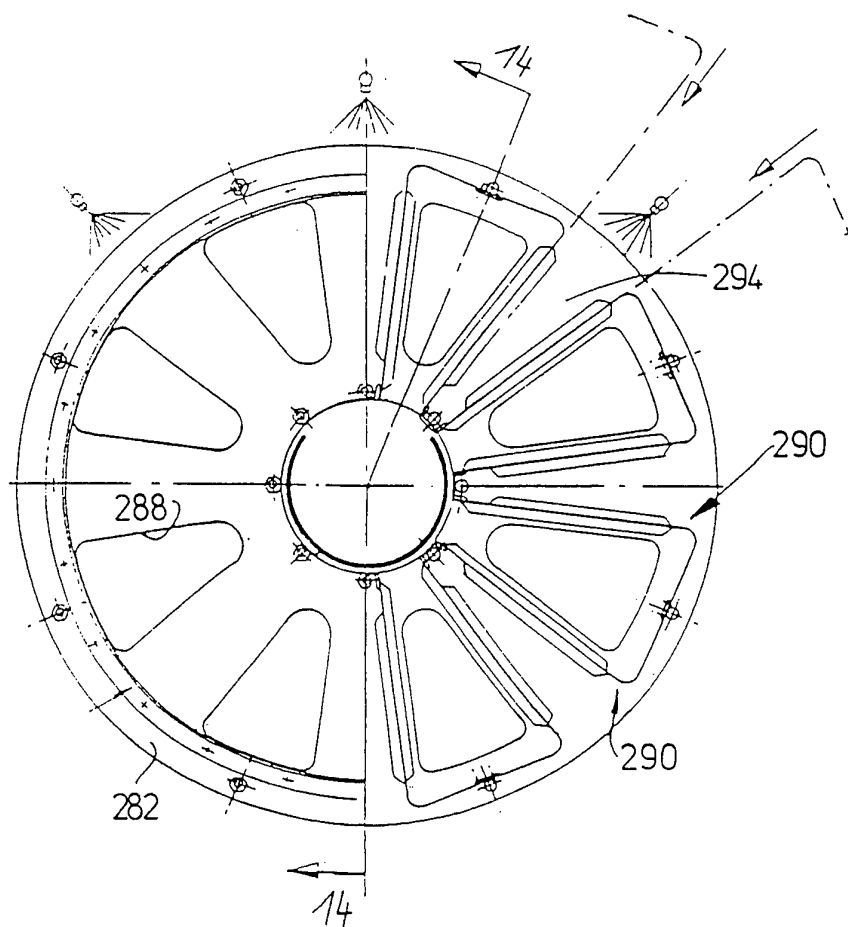
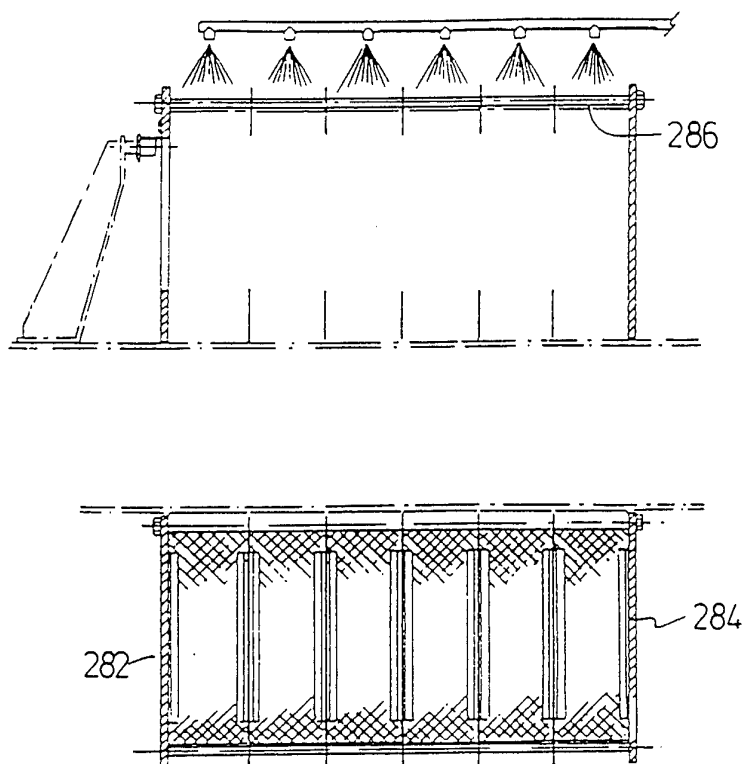


FIG. 14



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FIG. 15

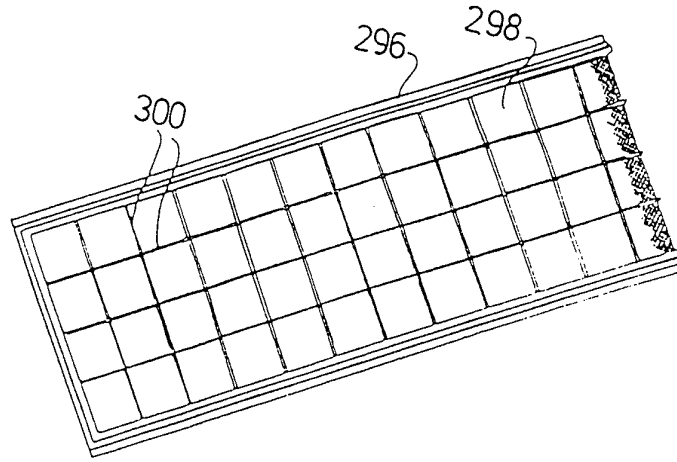


FIG. 16

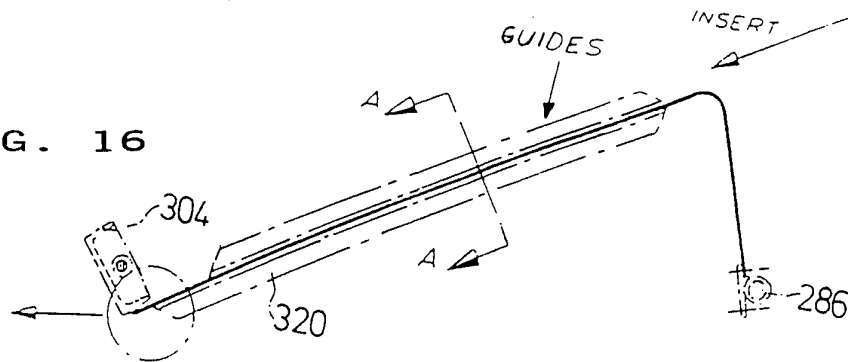


FIG. 18

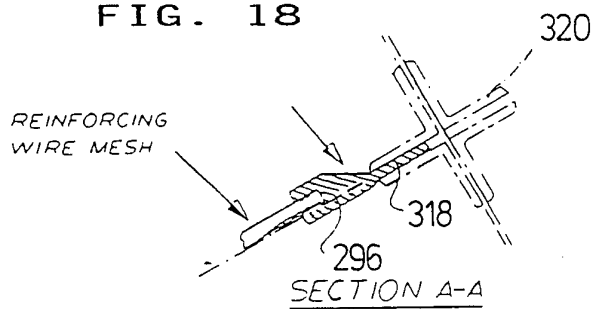


FIG. 19

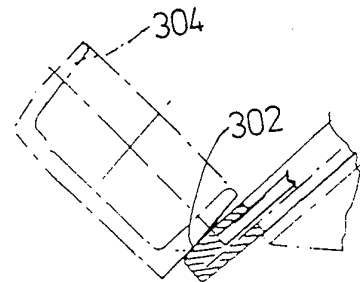


FIG. 17

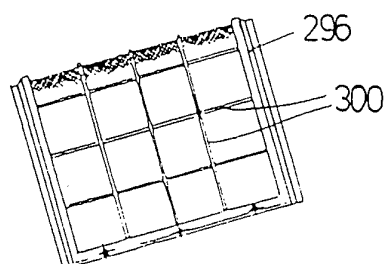
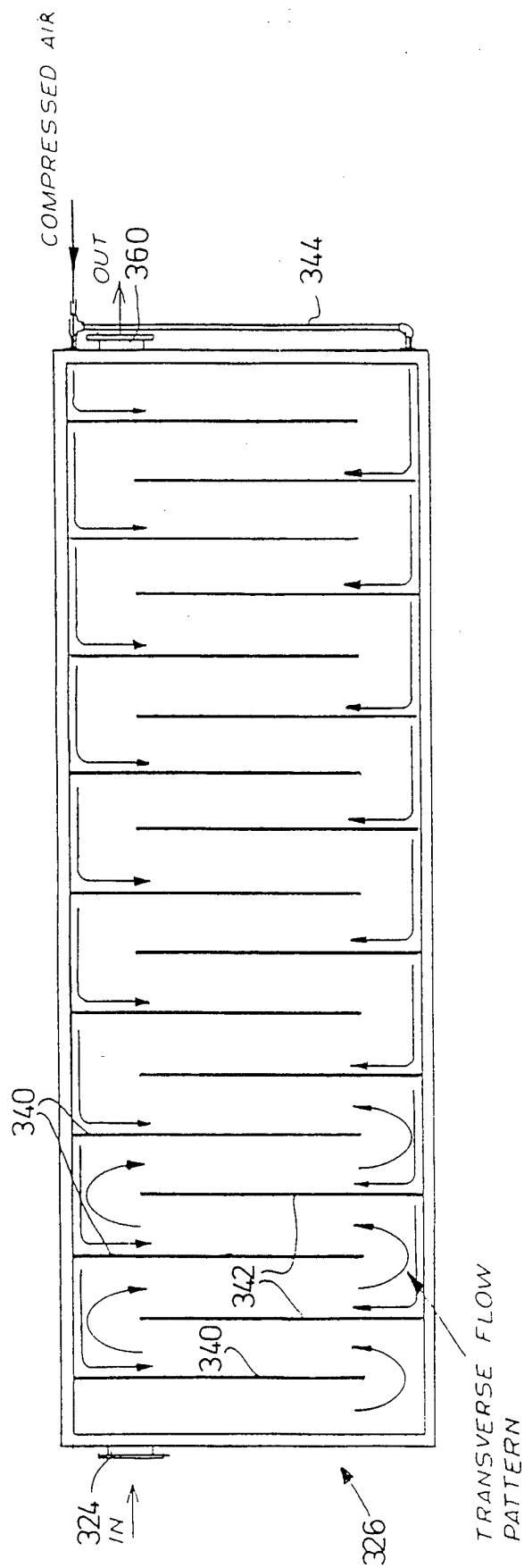


FIG. 20



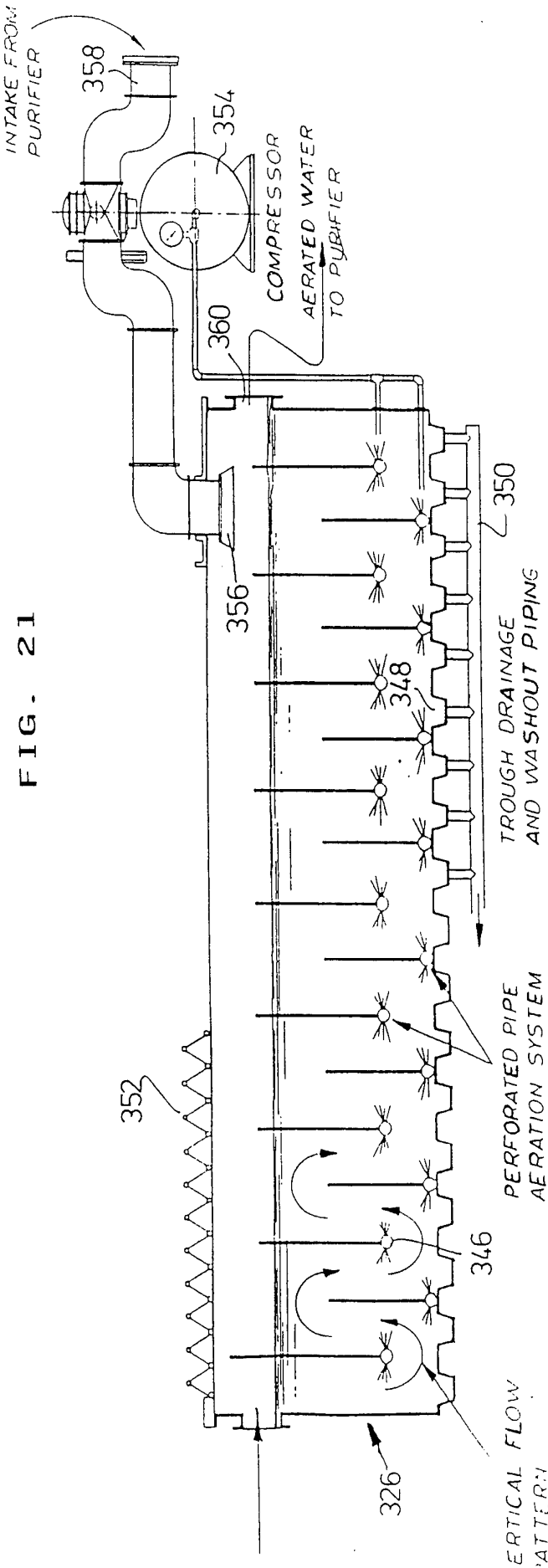


FIG. 21

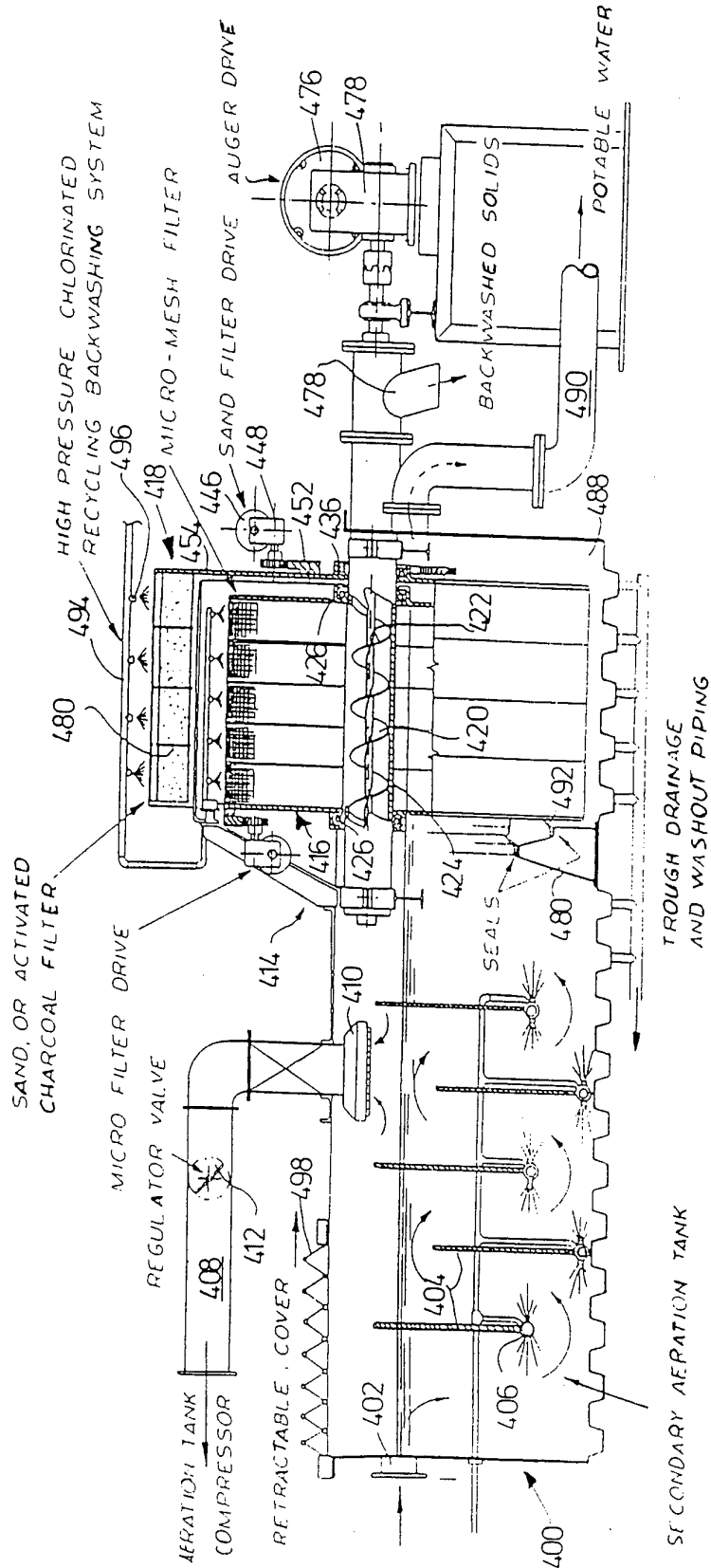
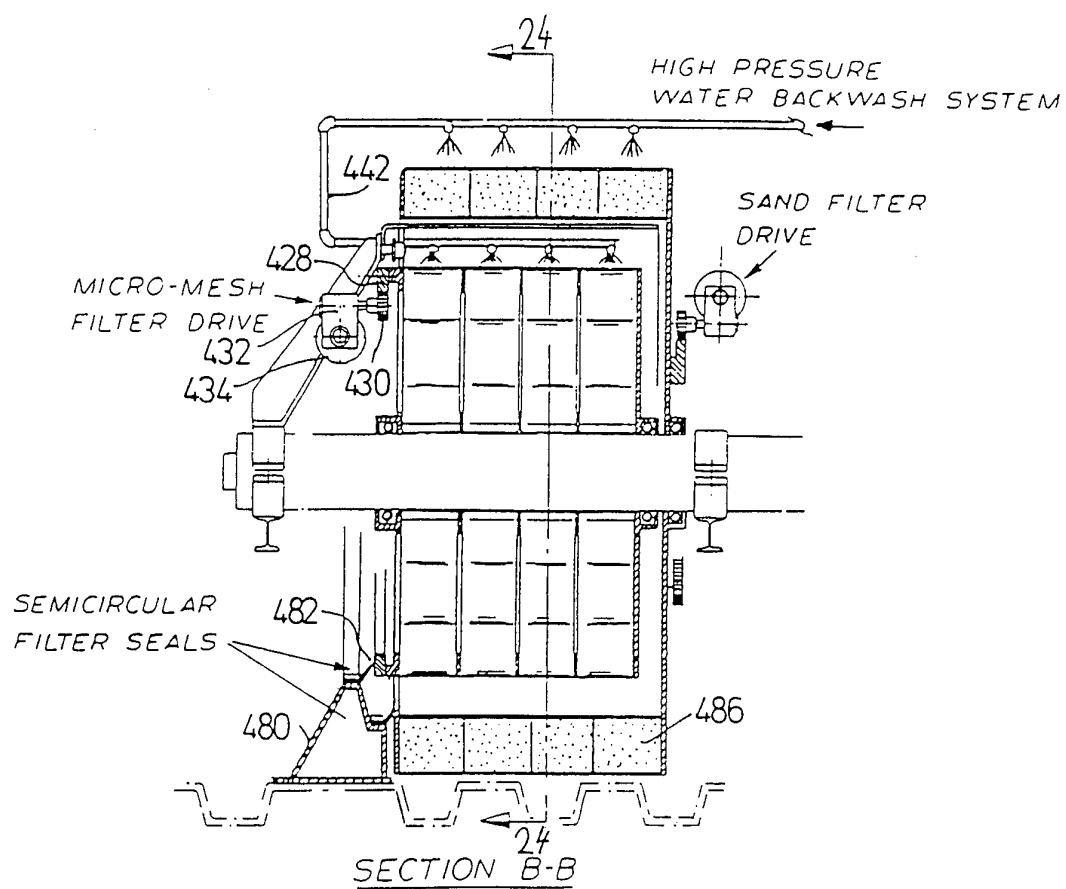


FIG. 22

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FIG. 23



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FIG. 24

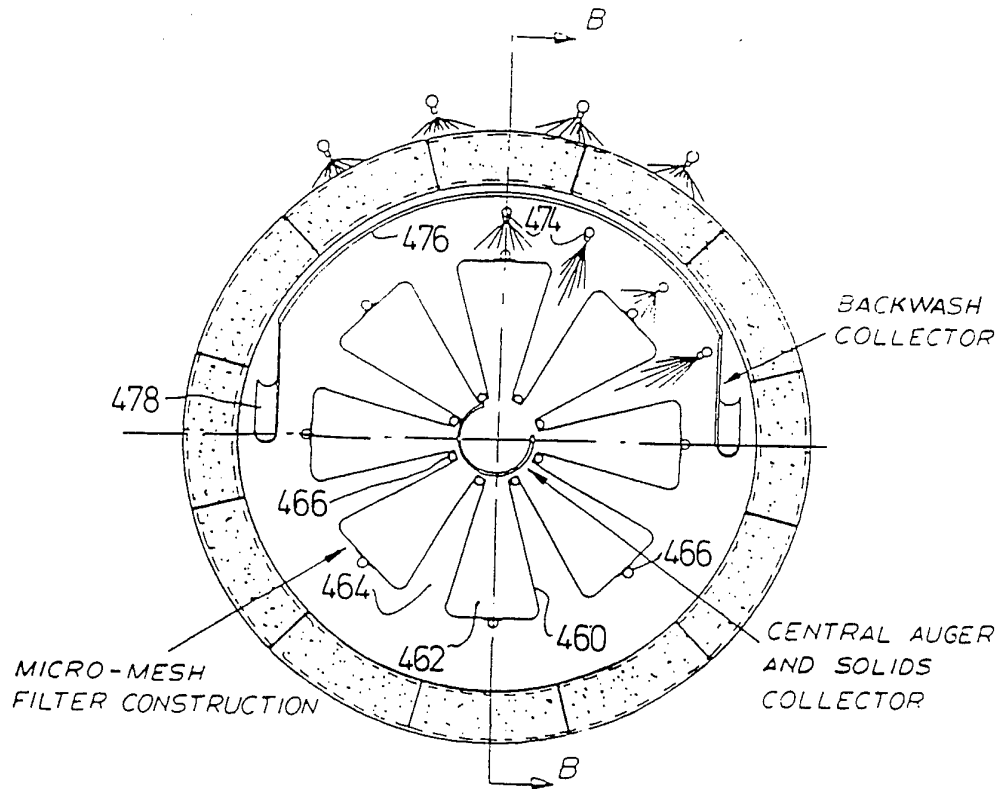


FIG. 25

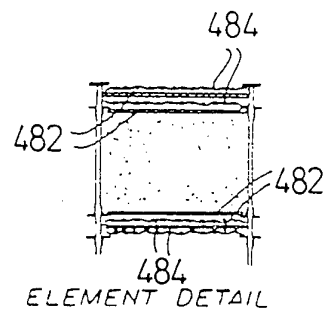
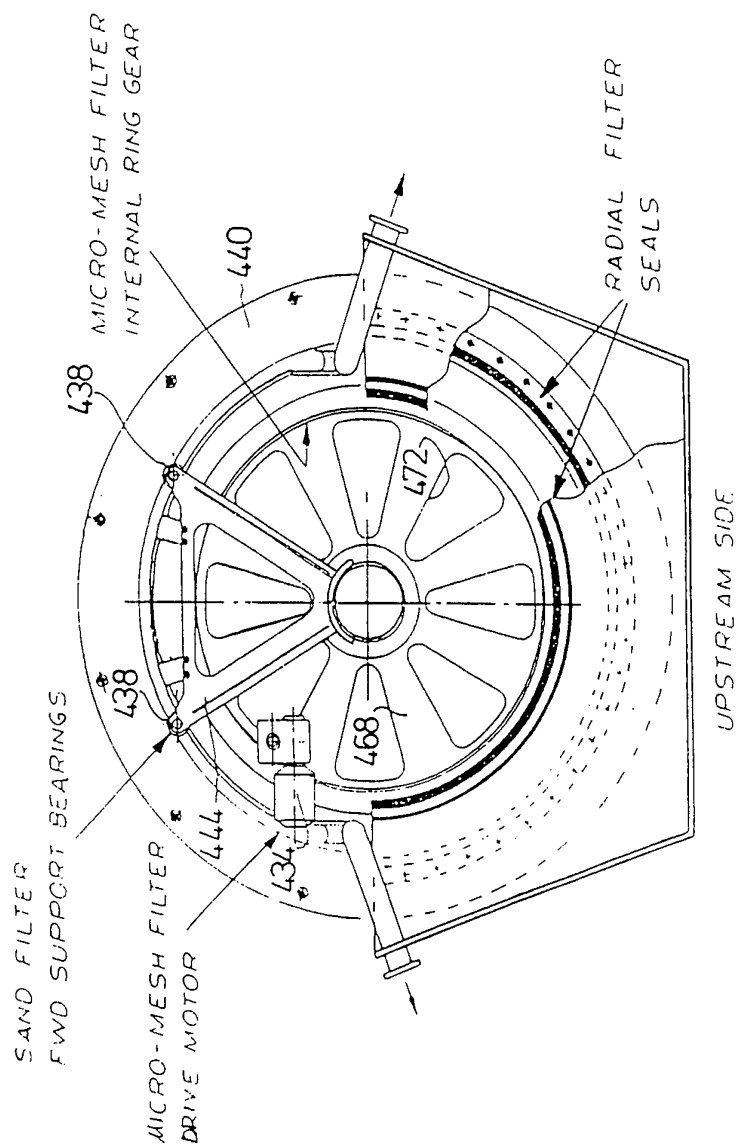


FIG. 26



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FIG. 27

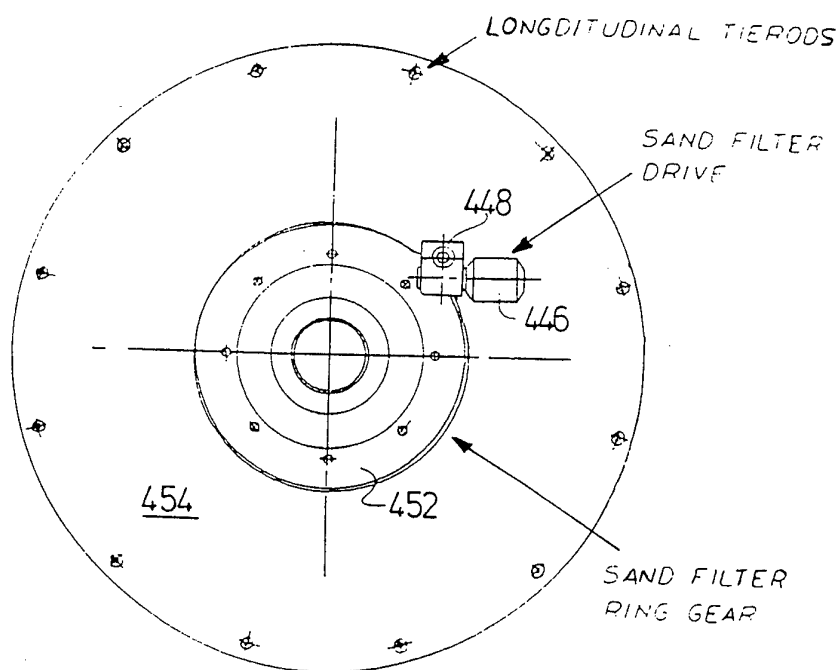
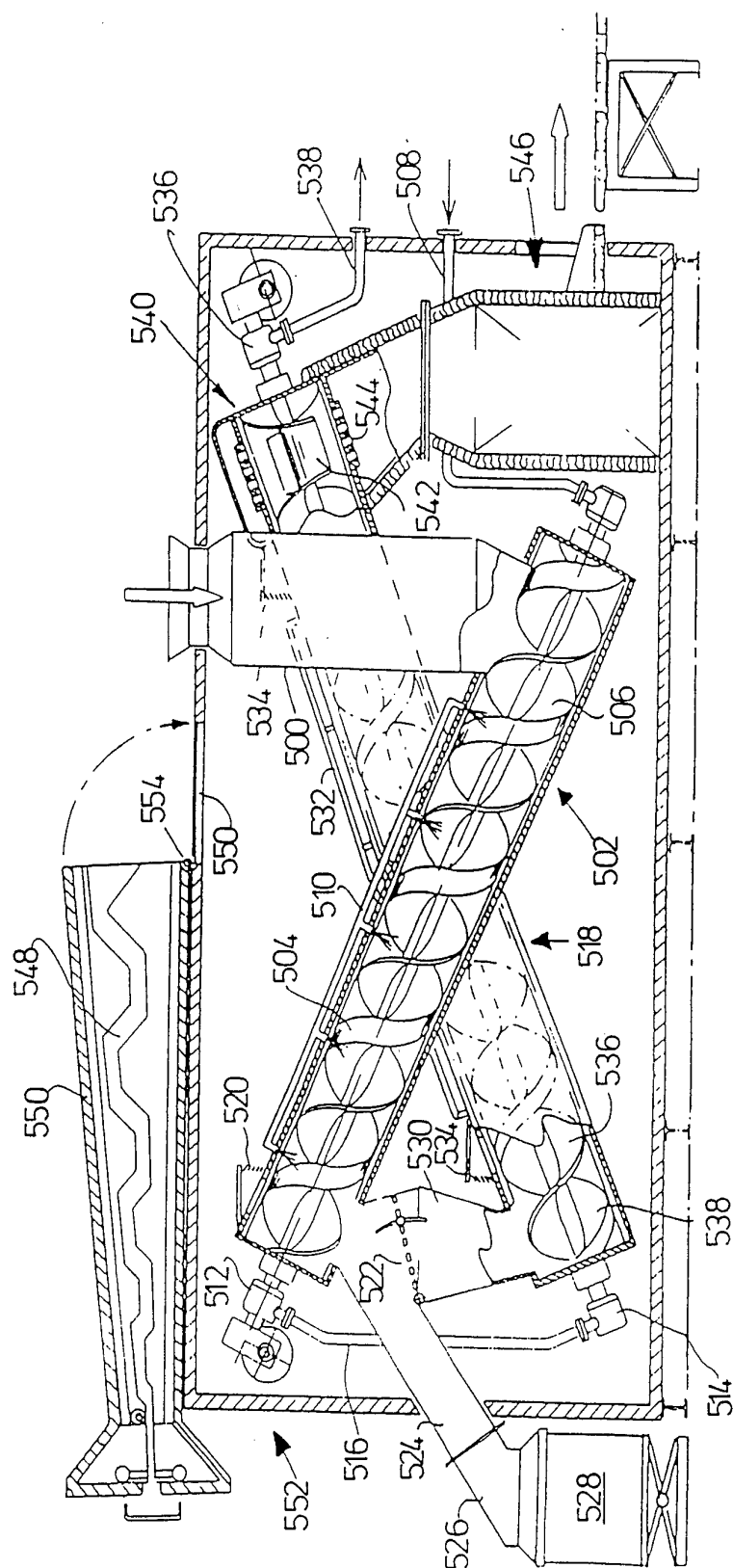


FIG. 28



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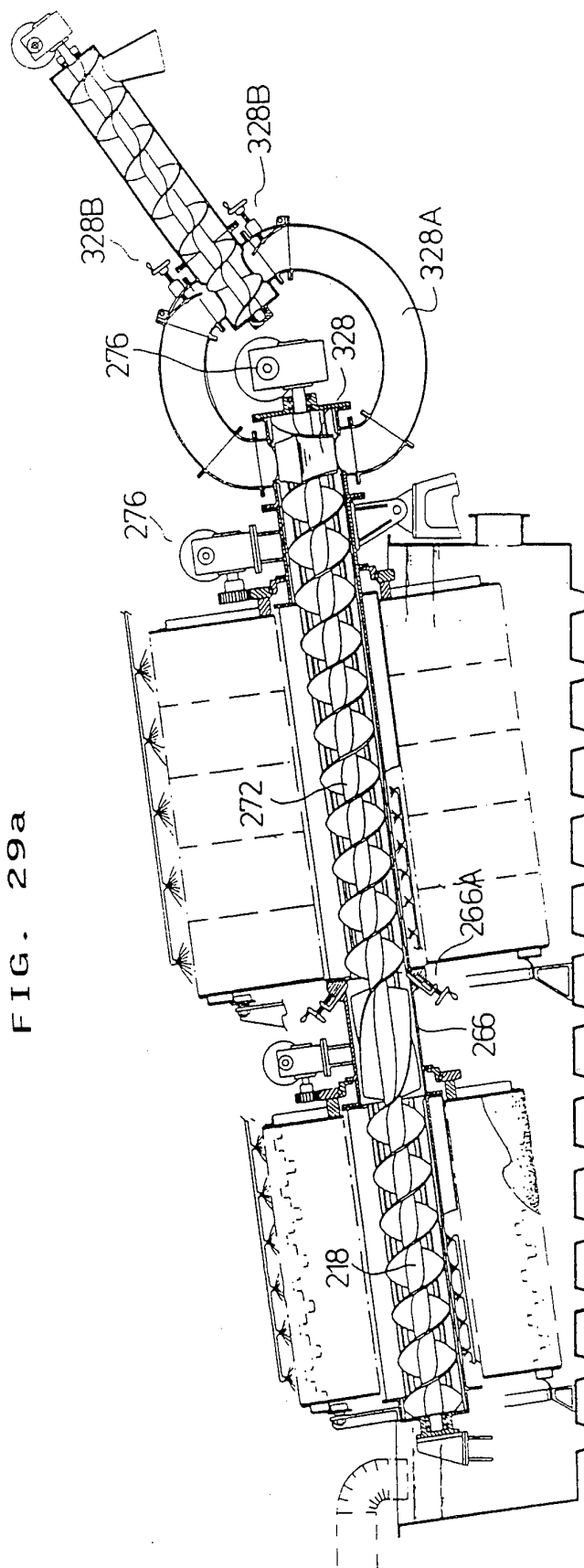


FIG. 29a

FIG. 29b

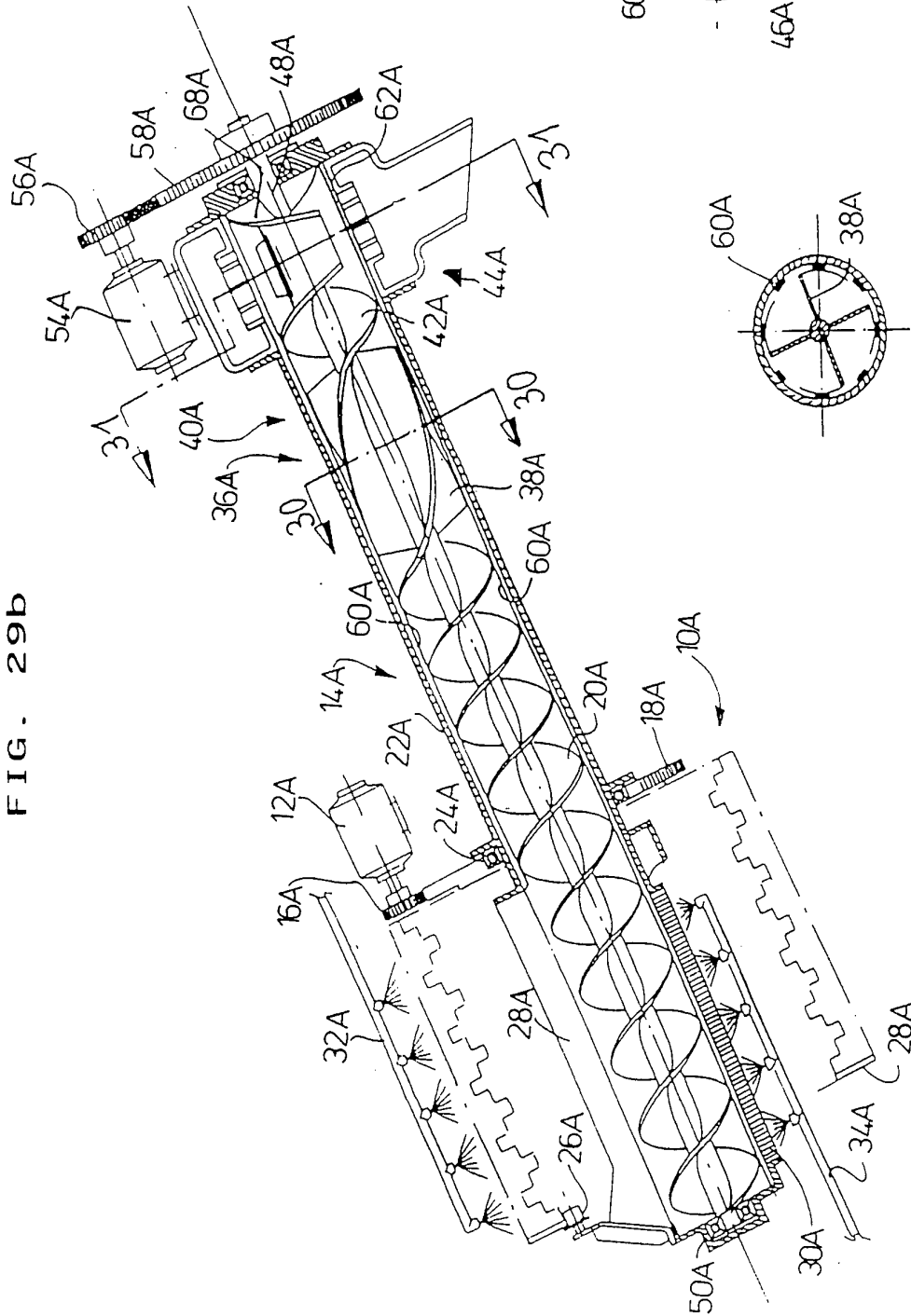


FIG. 30

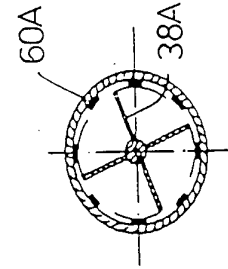


FIG. 31

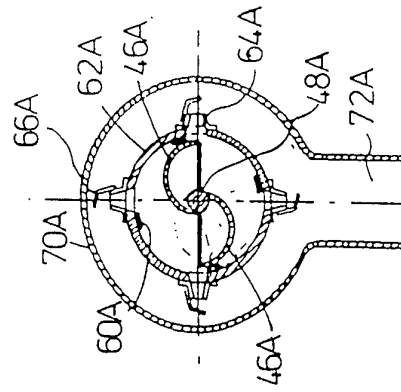


FIG. 32

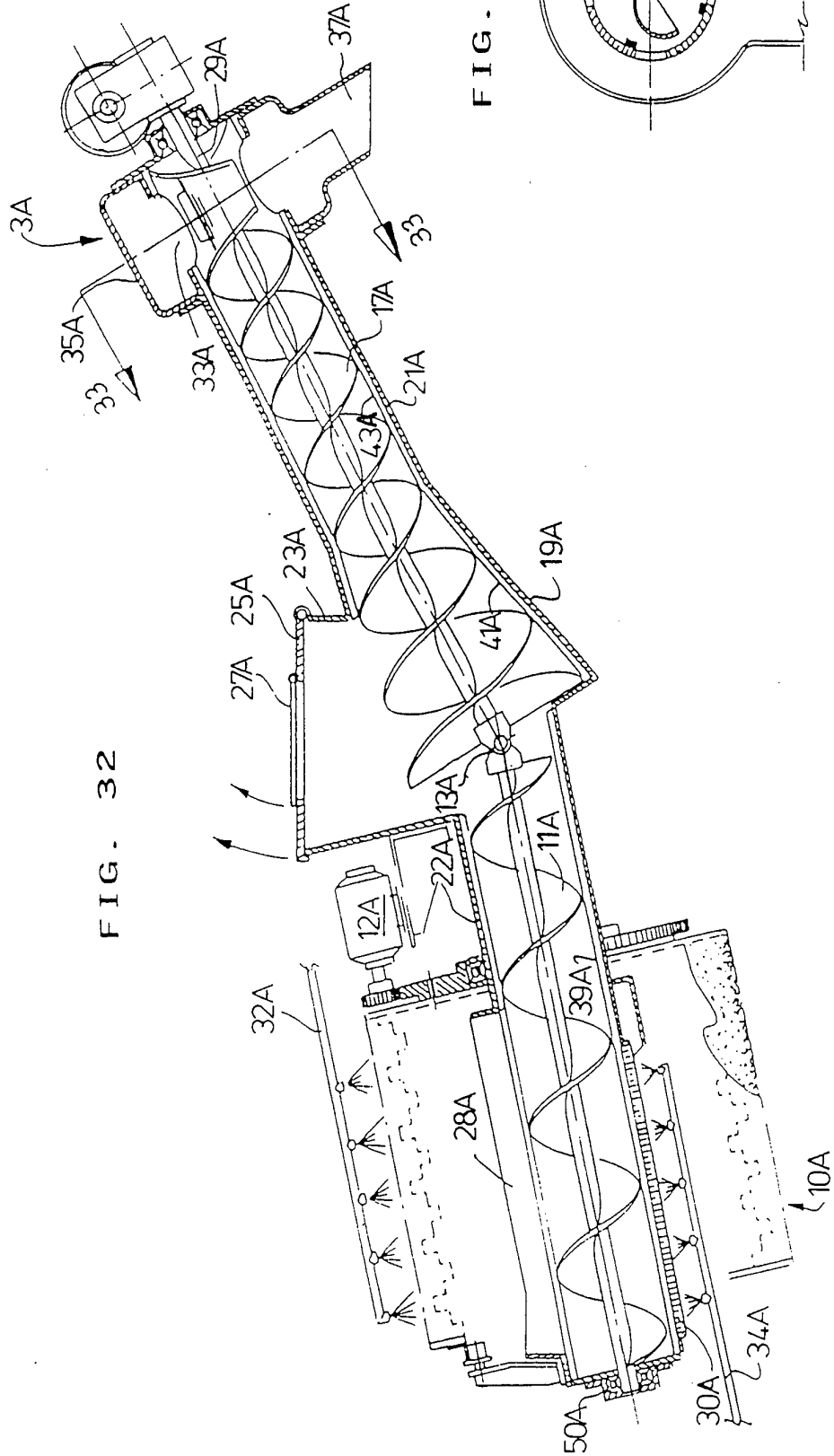
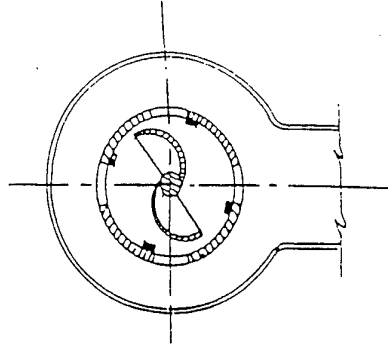


FIG. 33



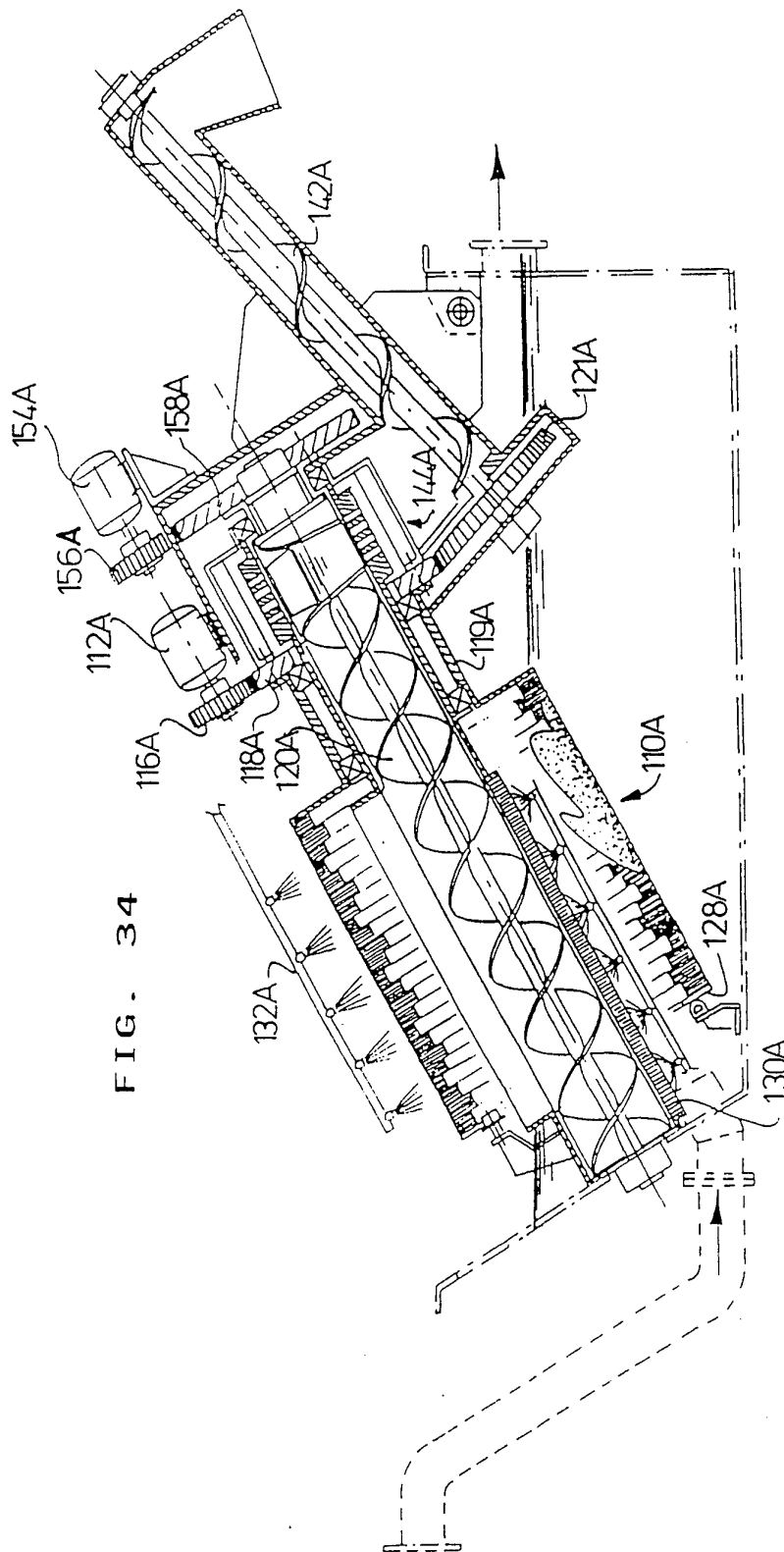
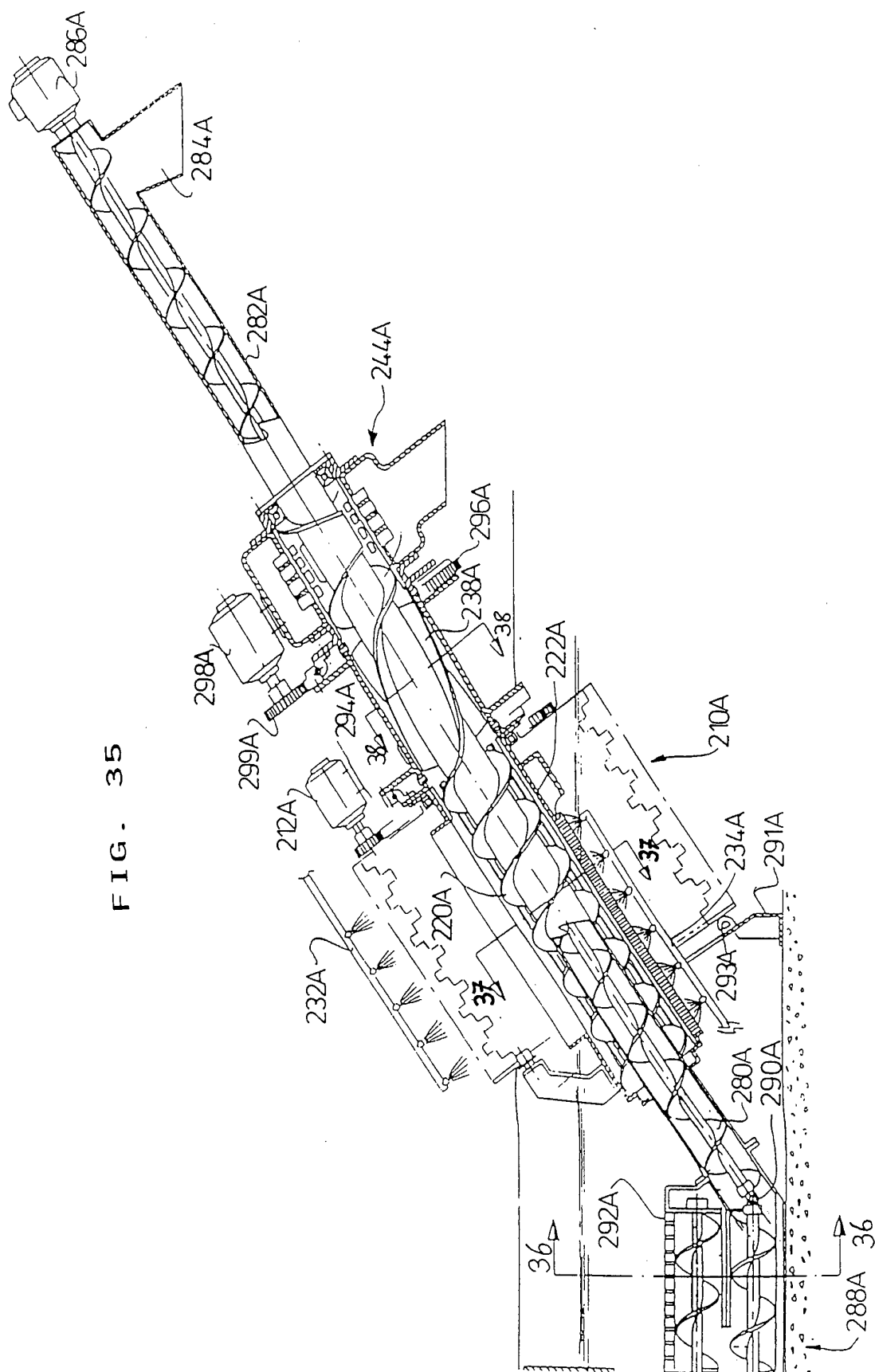


FIG. 35



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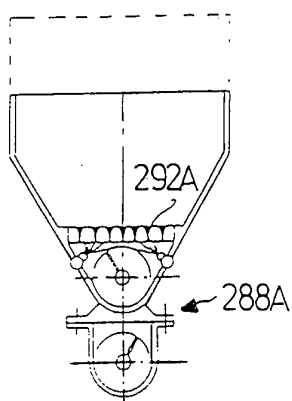


FIG. 36

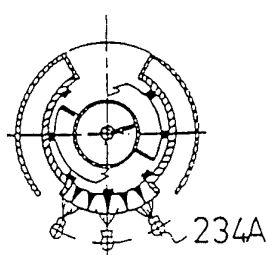


FIG. 37

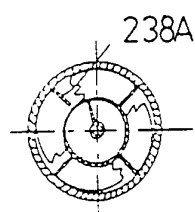
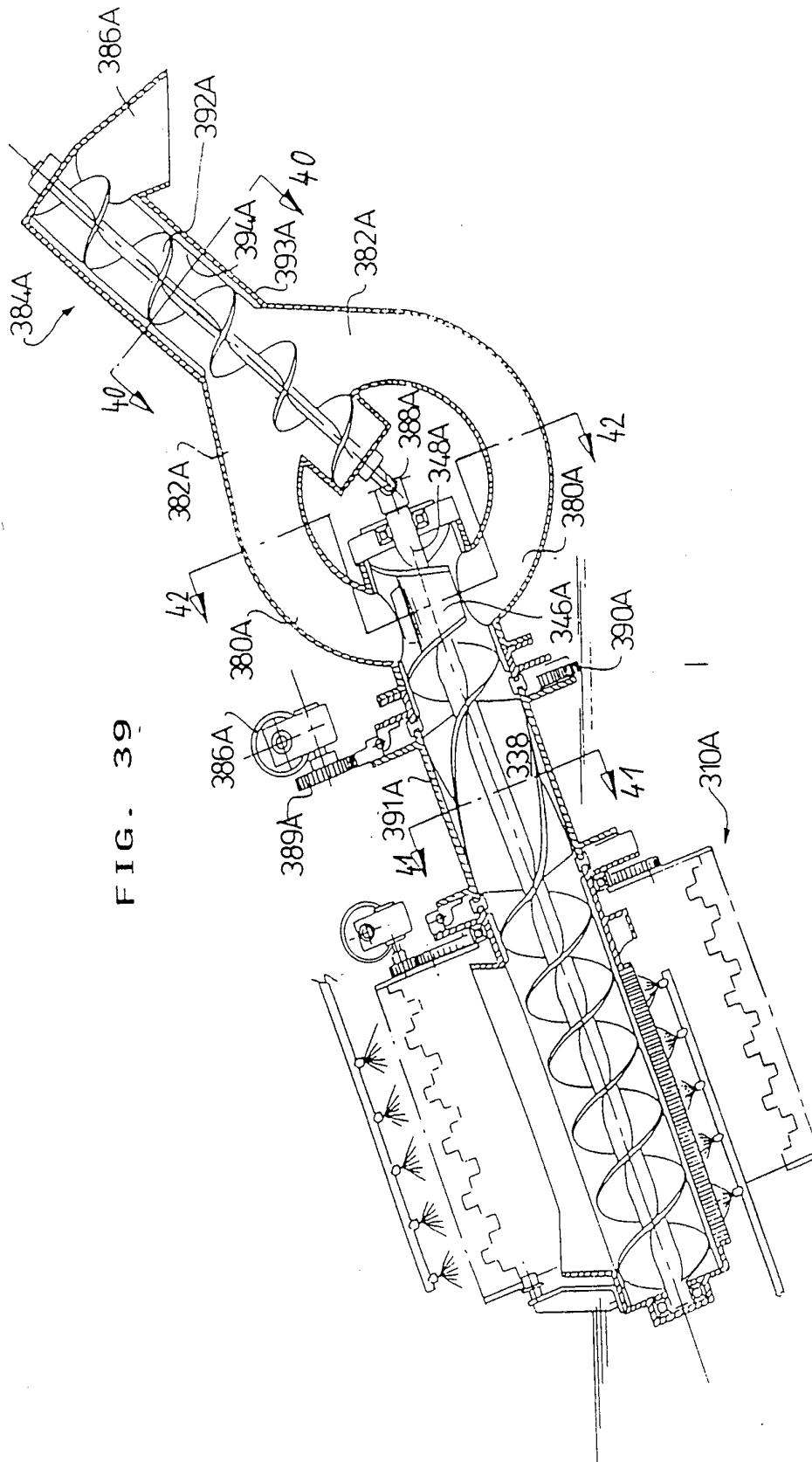


FIG. 38

FIG. 39



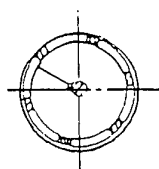


FIG. 40

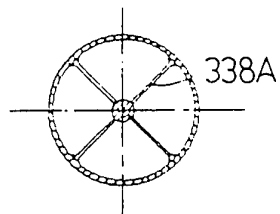


FIG. 41

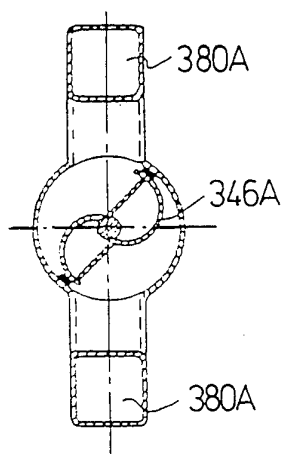
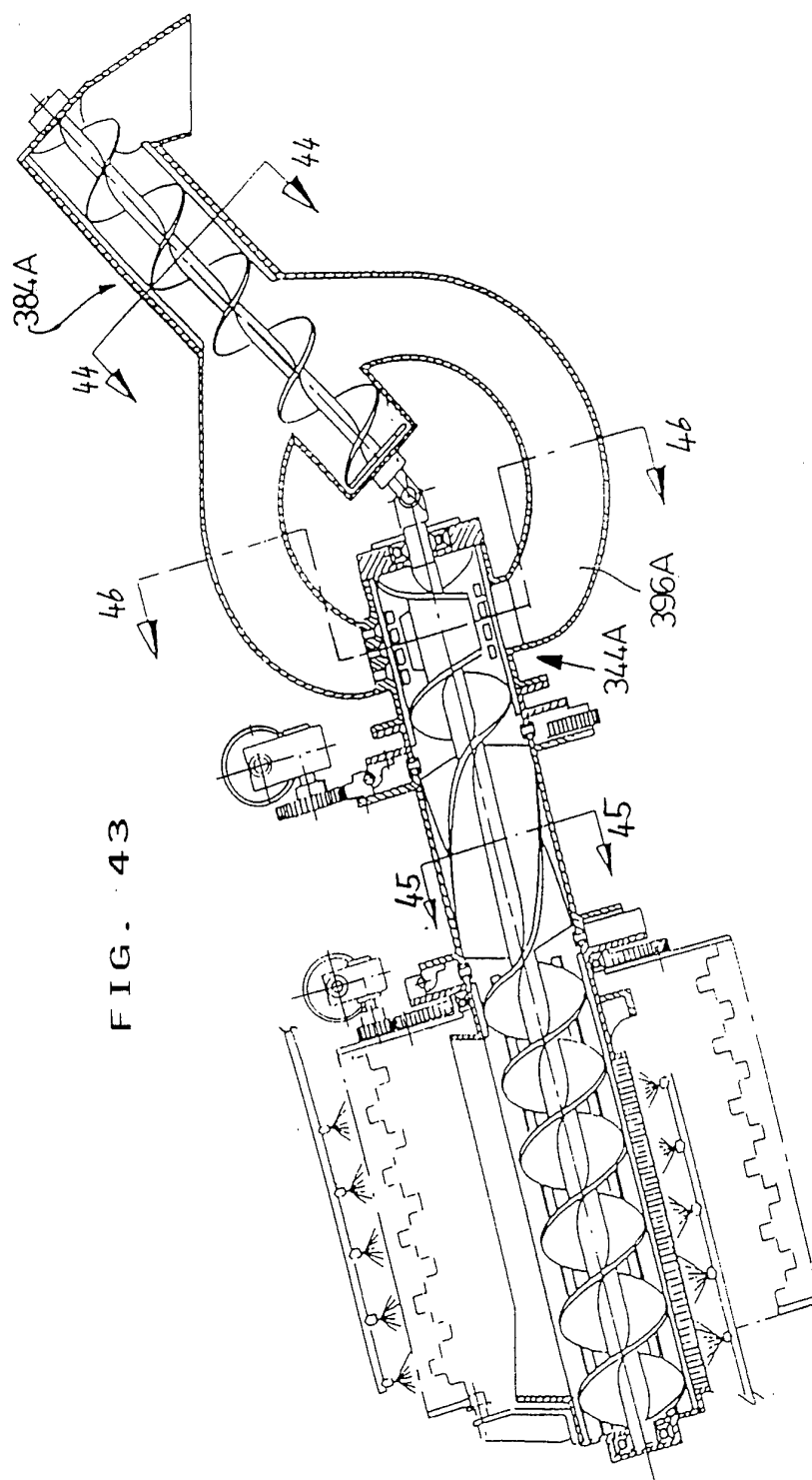


FIG. 42



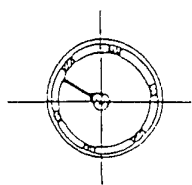


FIG. 44

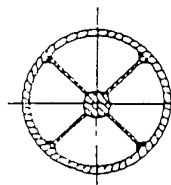


FIG. 45

FIG. 46

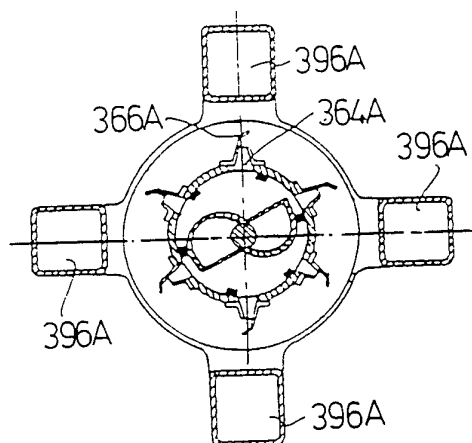


FIG. 47

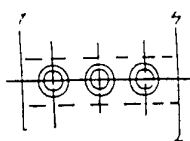


FIG. 48

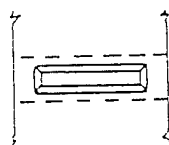


FIG. 49

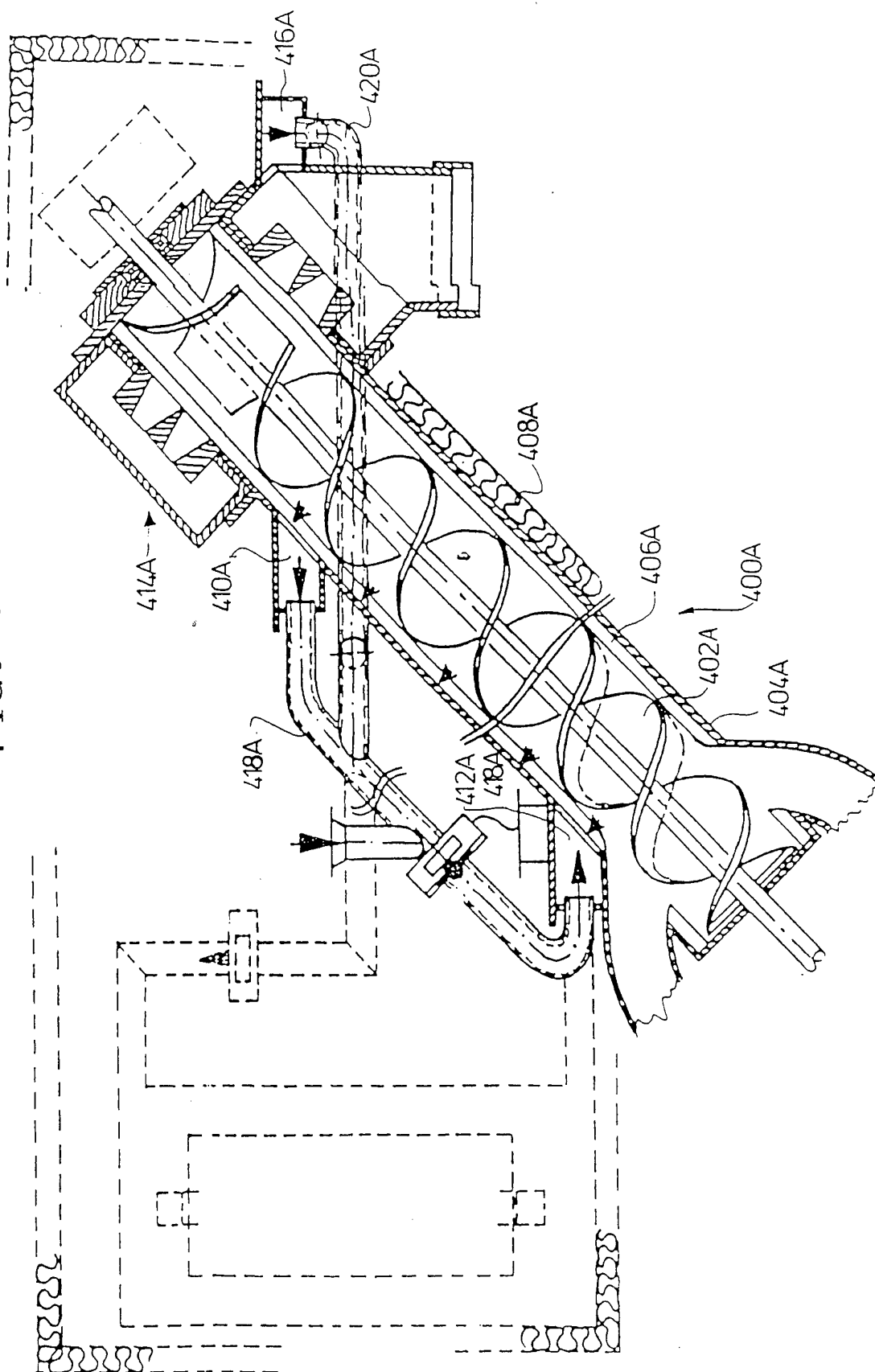
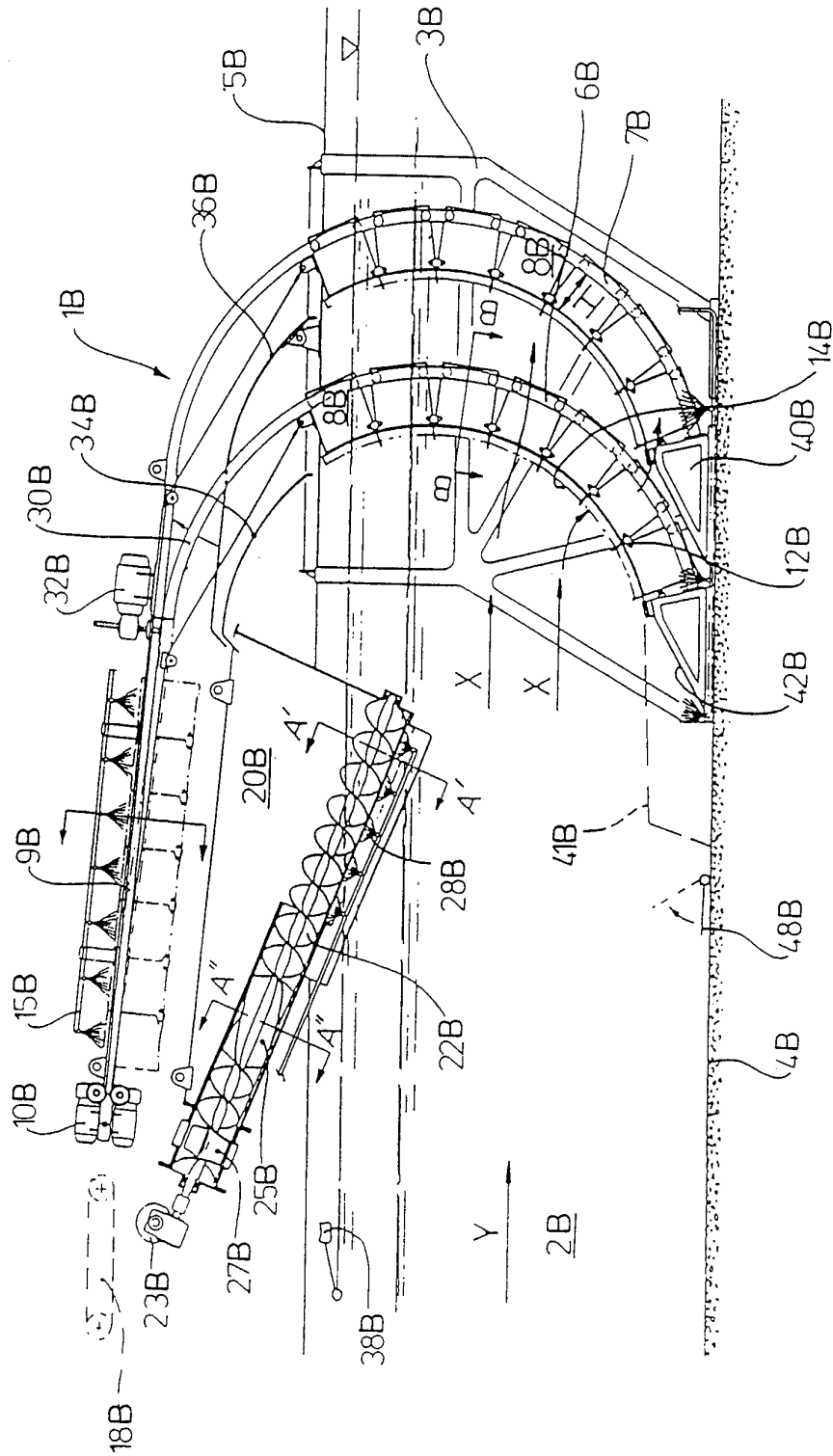


FIG. 50



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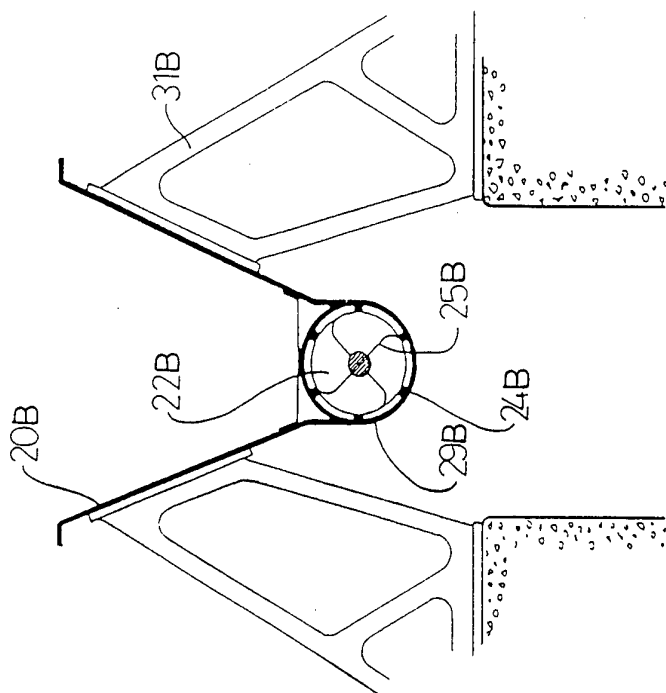


FIG. 51b

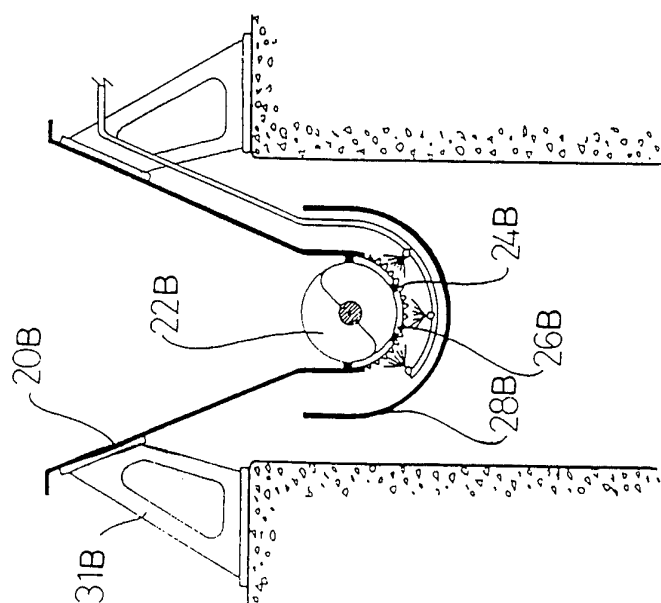


FIG. 51a

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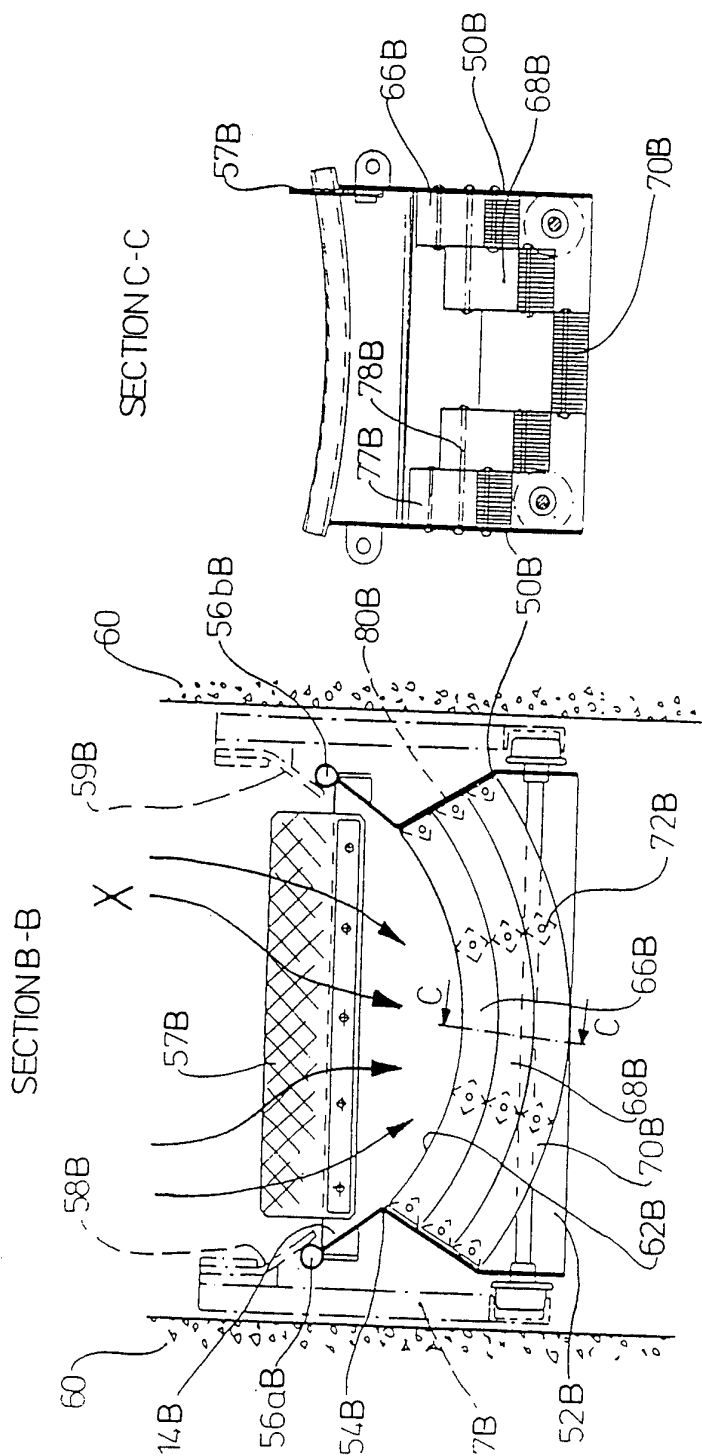
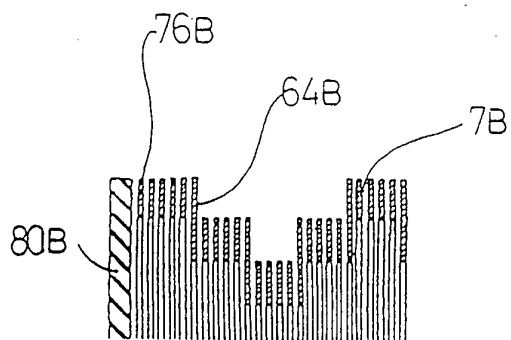


FIG. 53a

FIG. 52

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FIG. 53b



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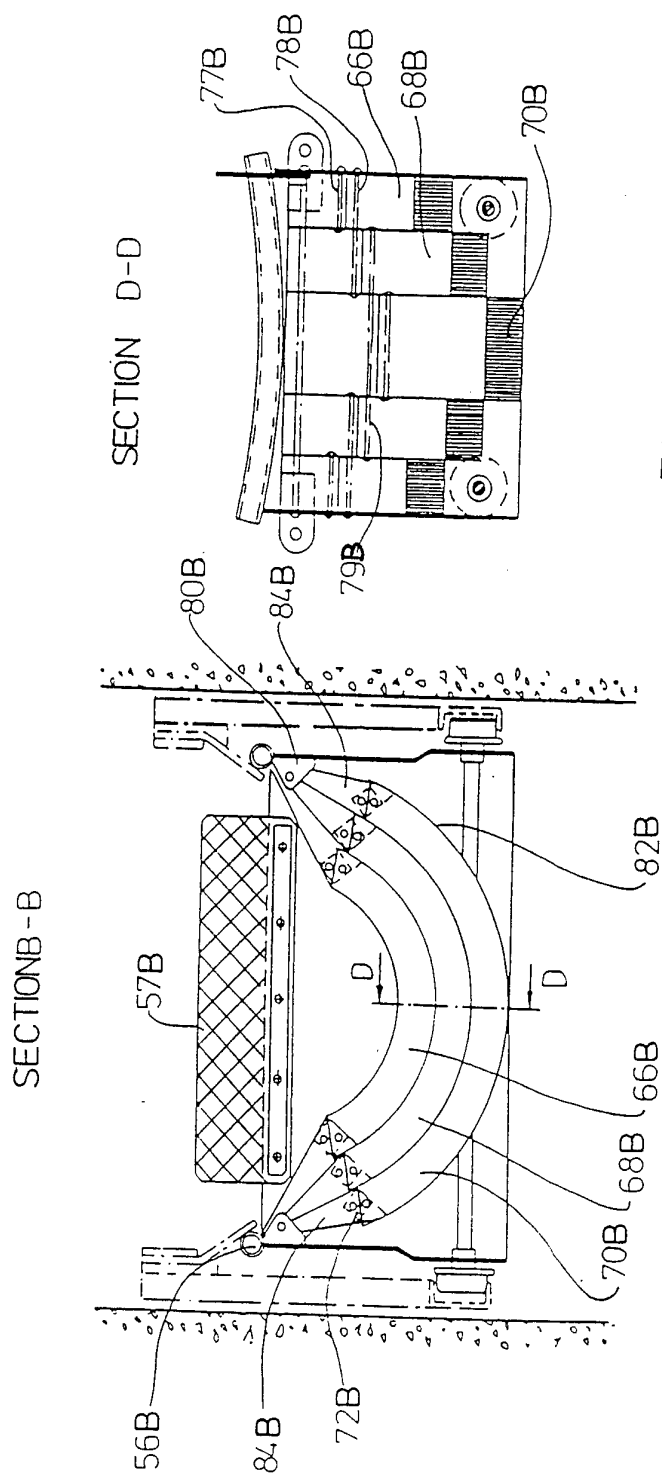


FIG. 54b

FIG. 54a

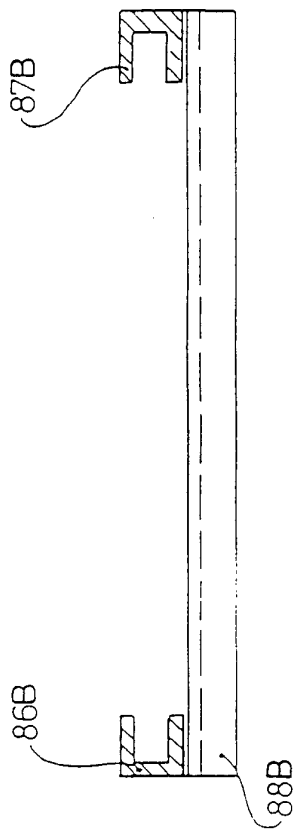


FIG. 55

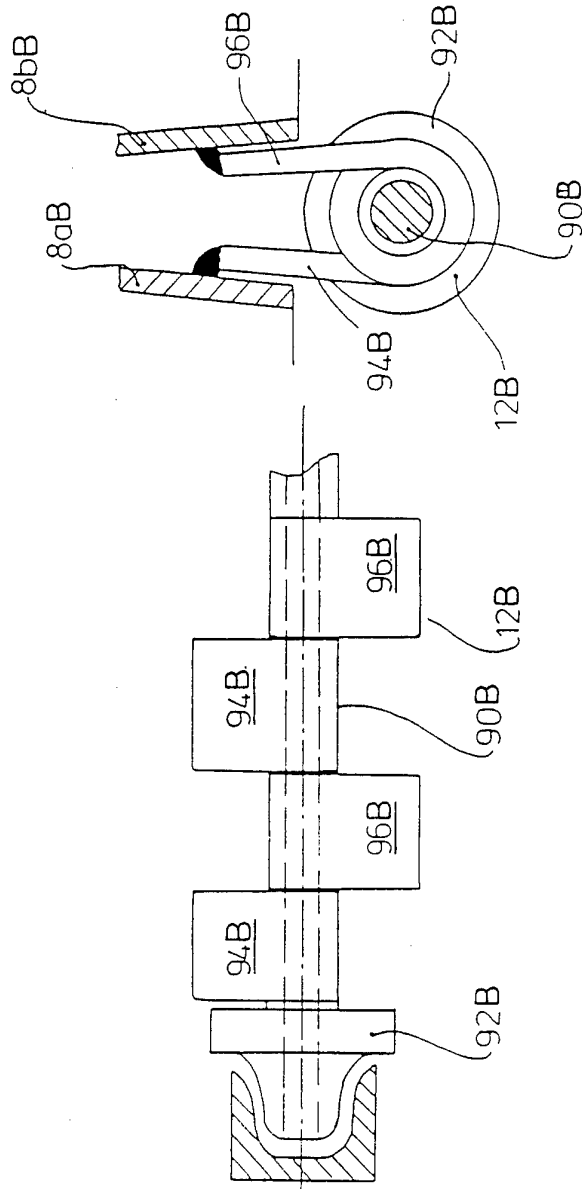


FIG. 56

FIG. 57

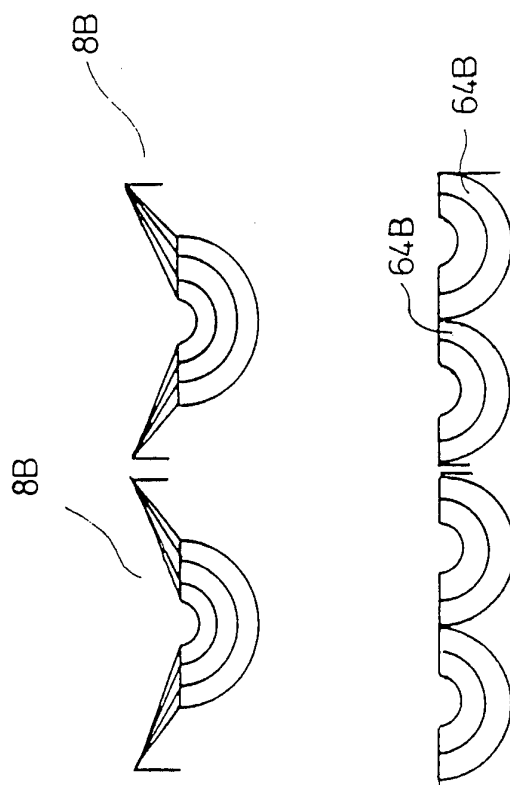


FIG. 59

FIG. 60b

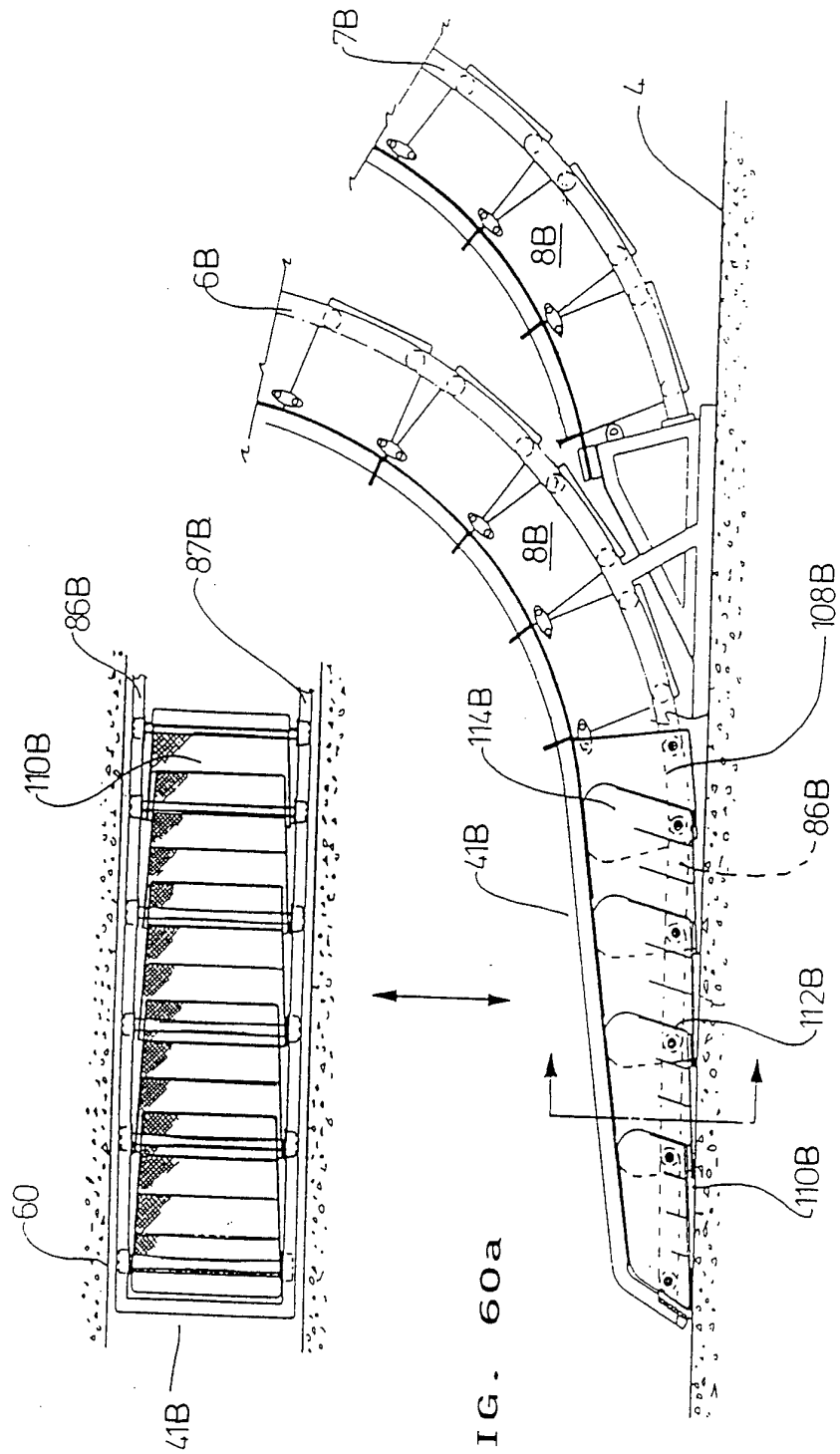


FIG. 60a

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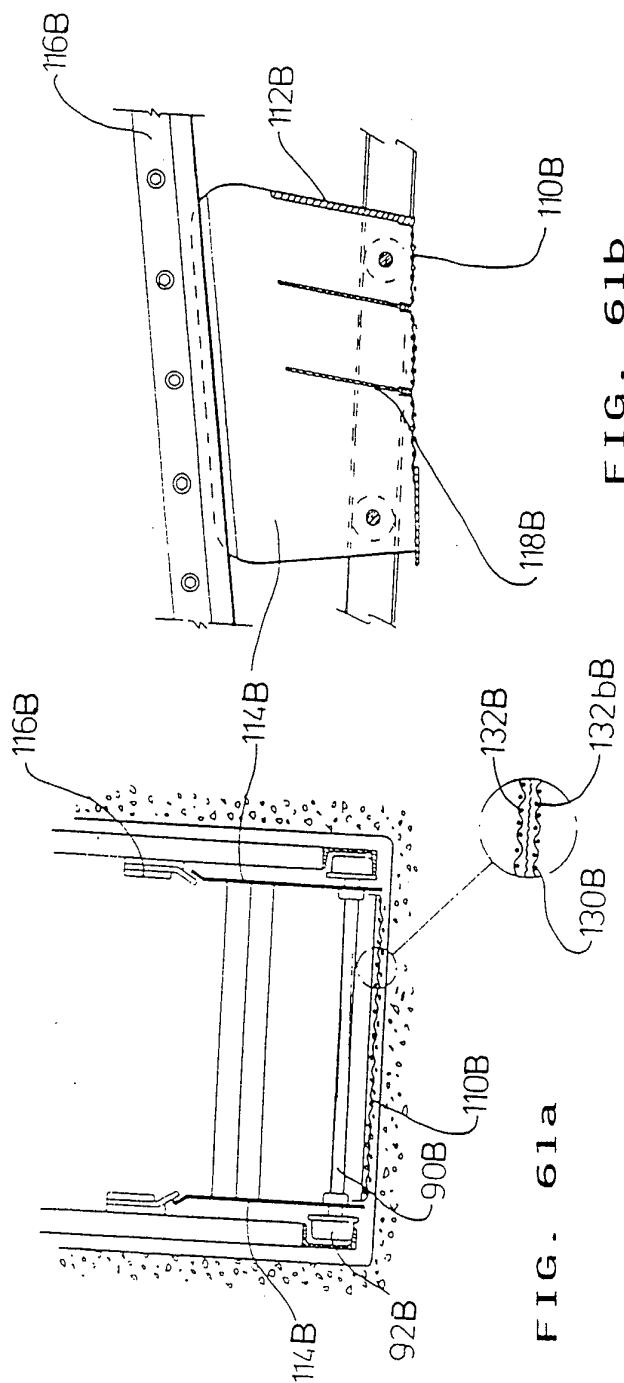
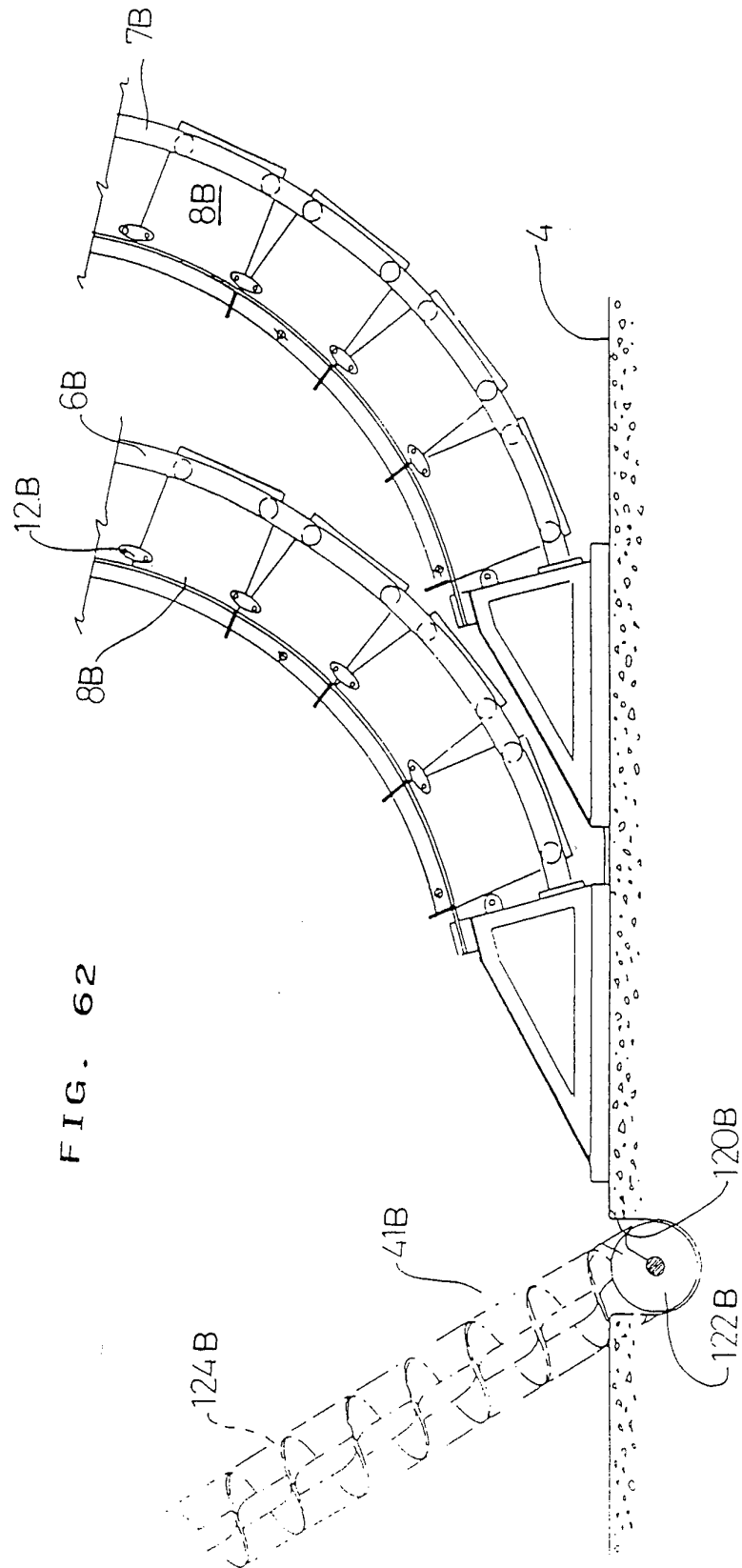


FIG. 61a

FIG. 61b

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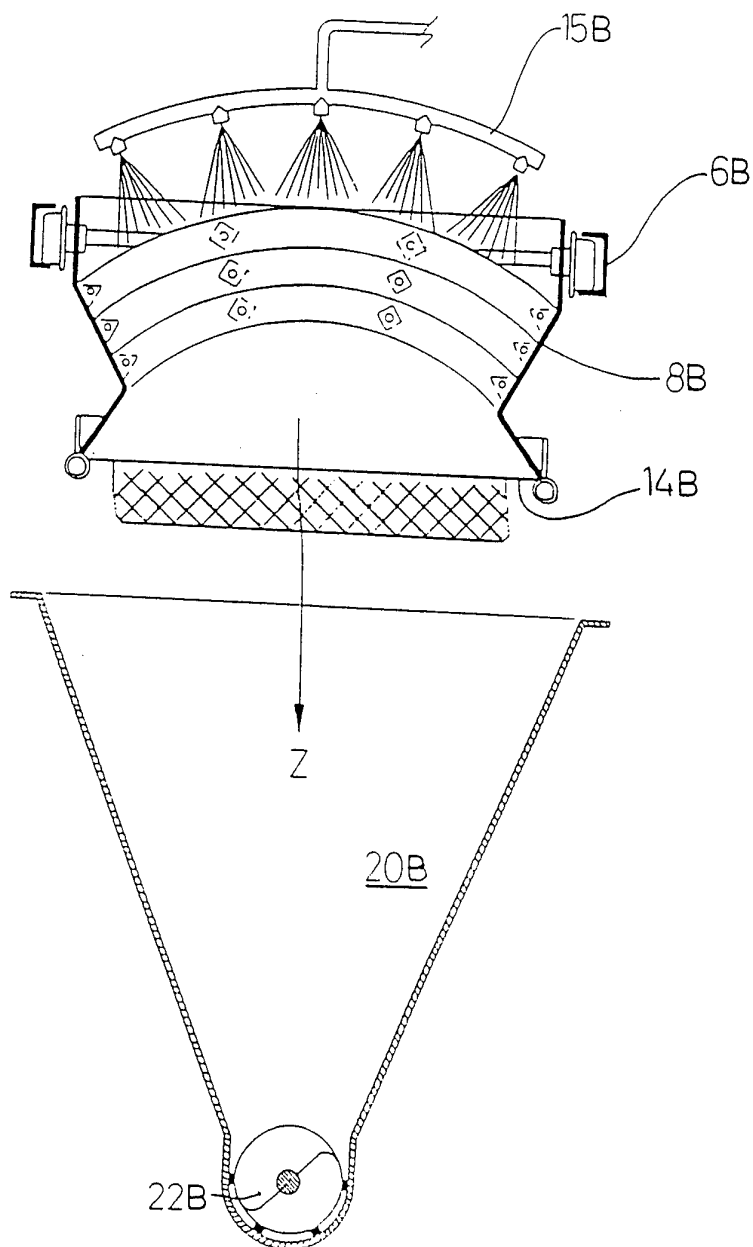


FIG. 63

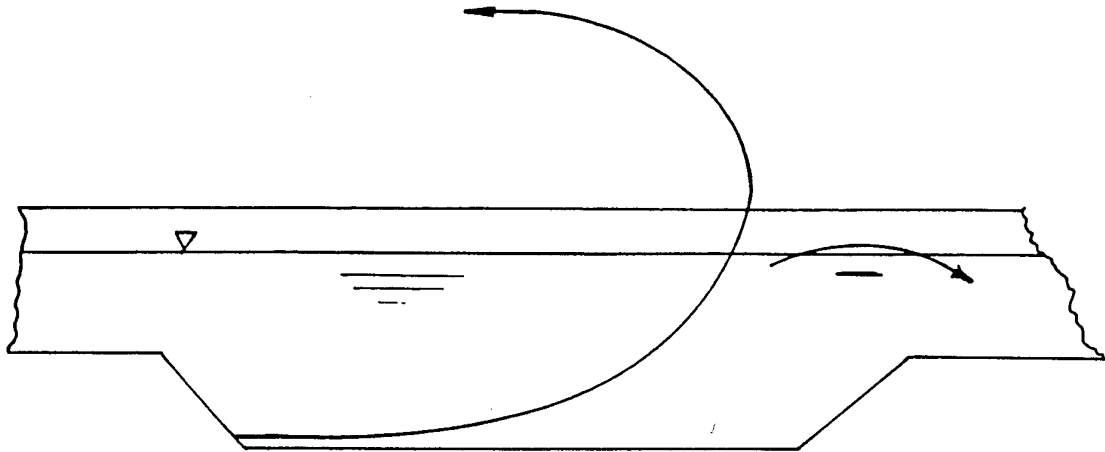


FIG. AA2

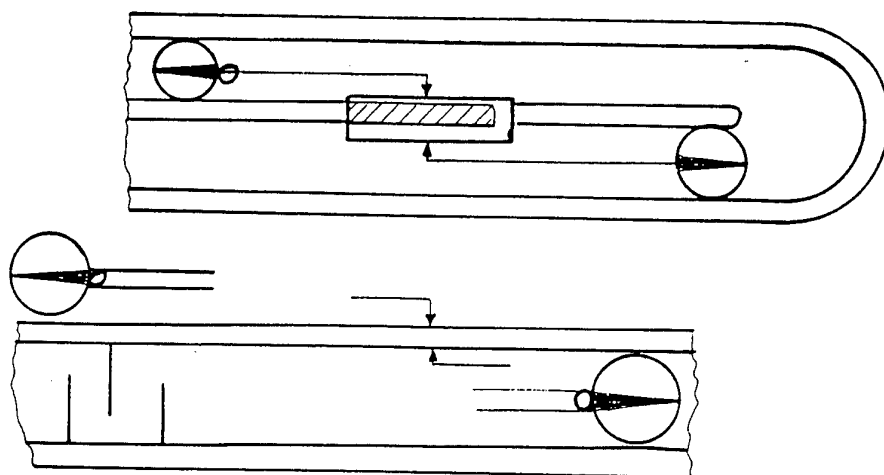


FIG. AA1

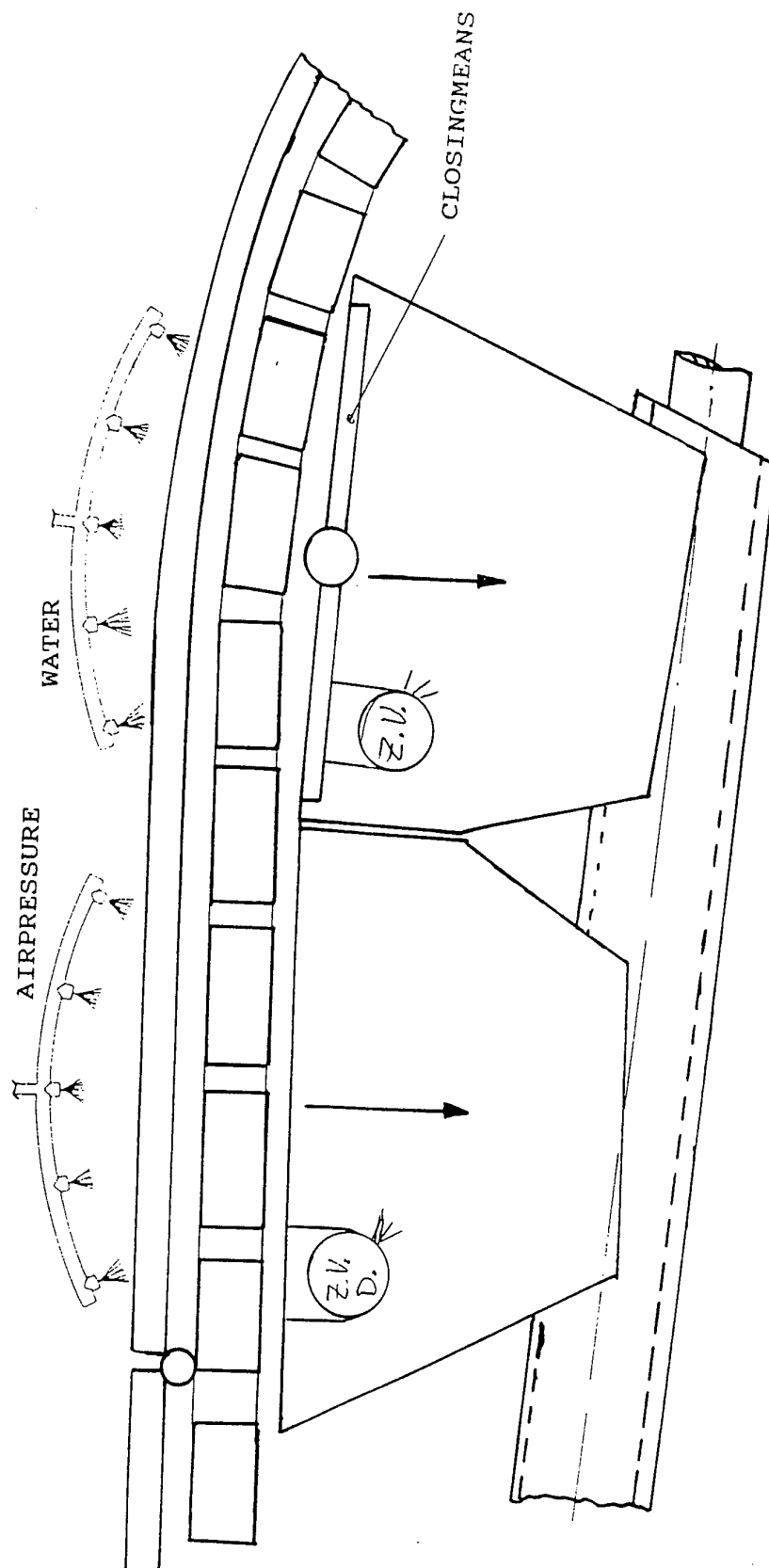
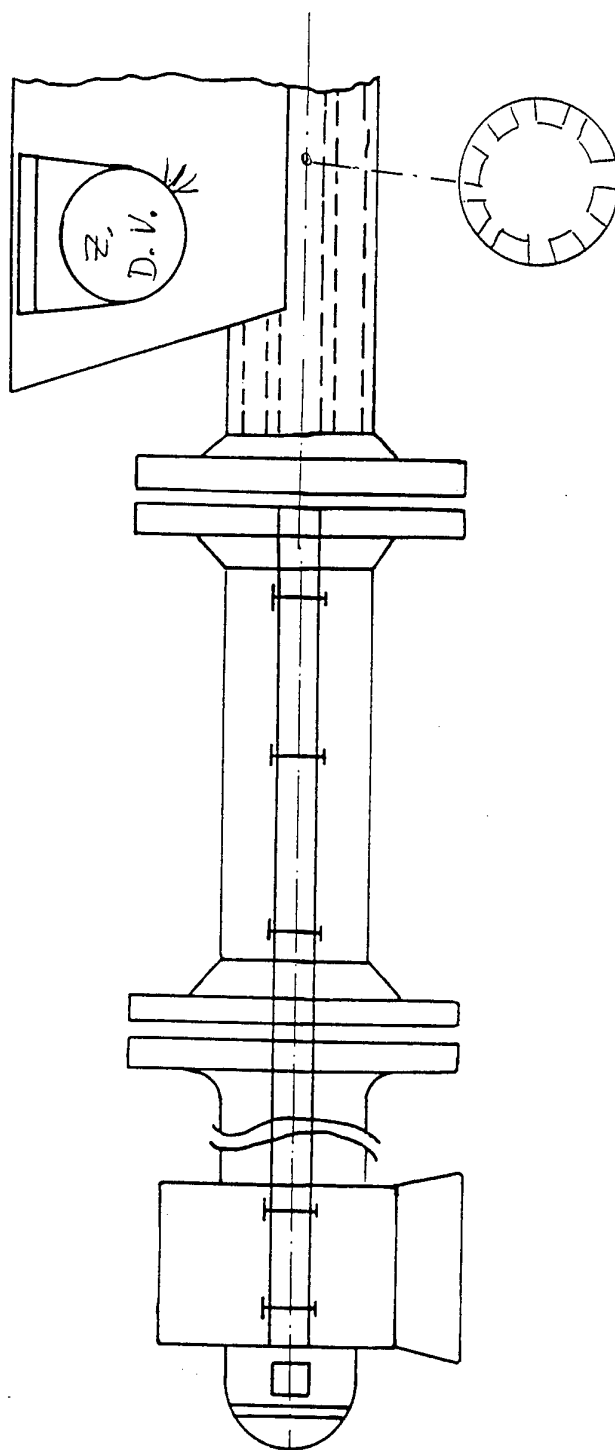


FIG. BB1

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FIG. BB2



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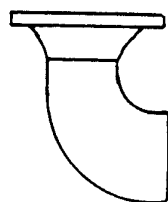
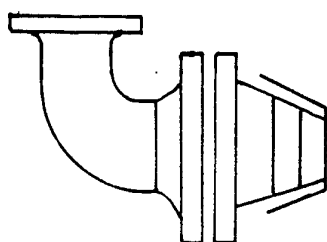
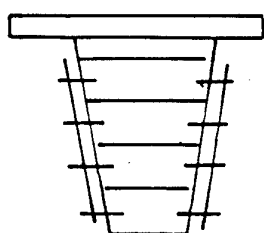
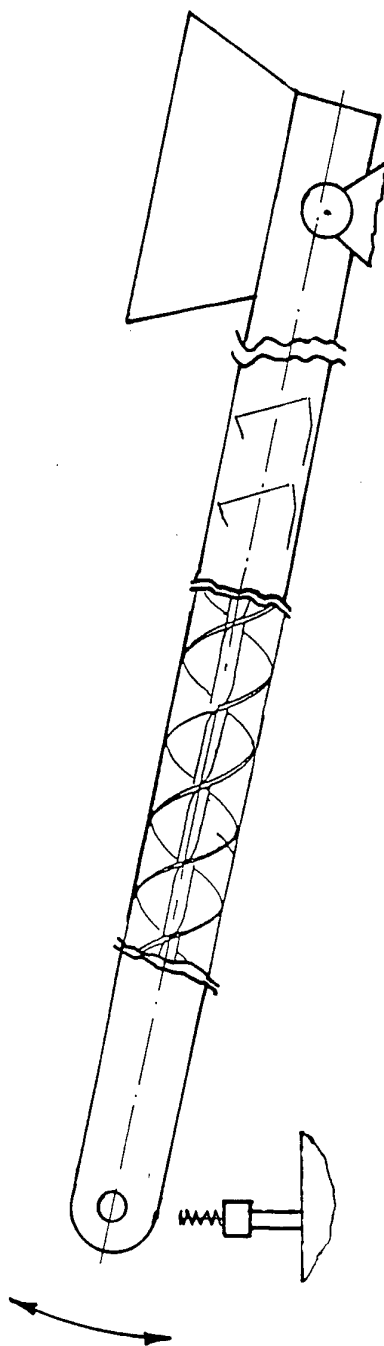


FIG. BB3

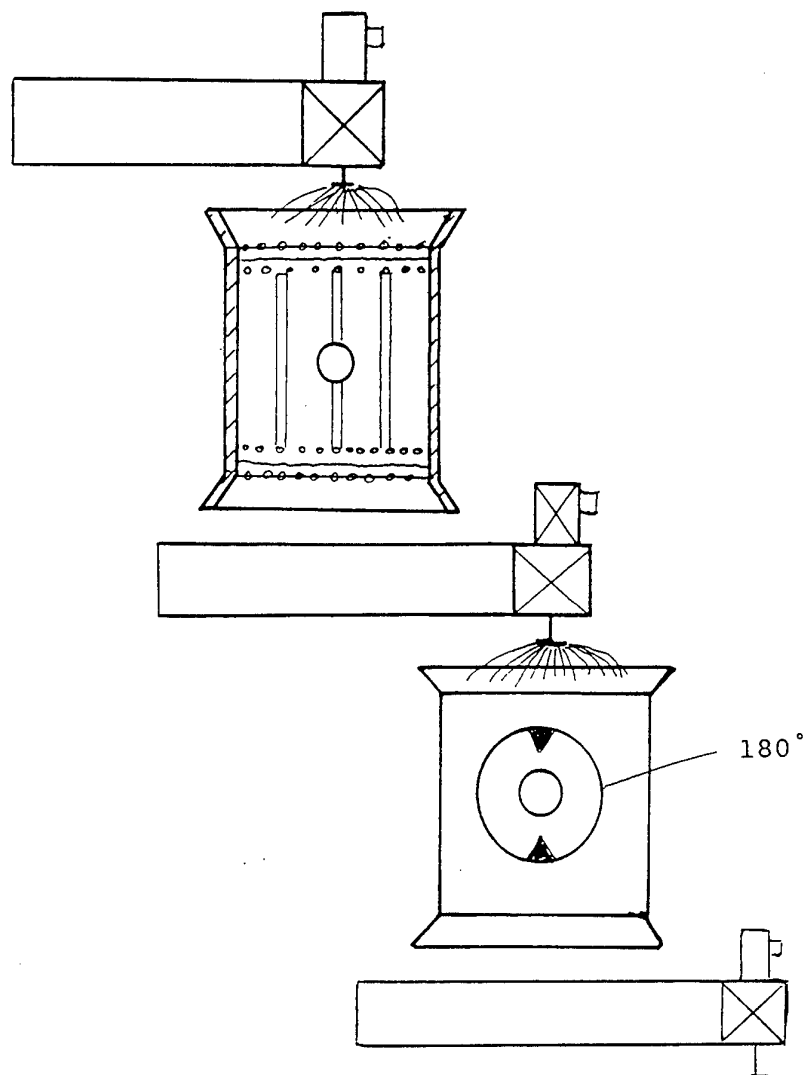
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FIG. BB4

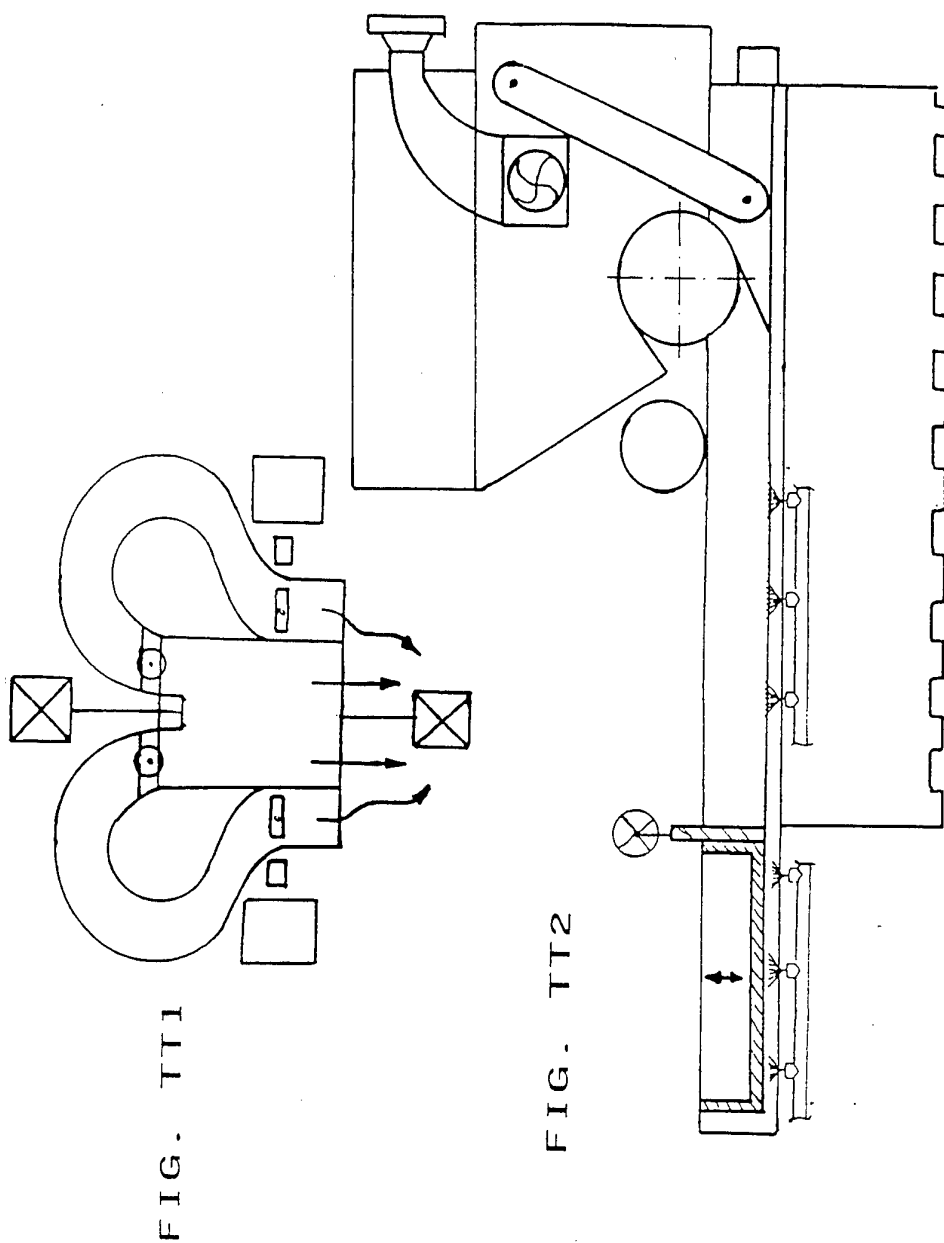


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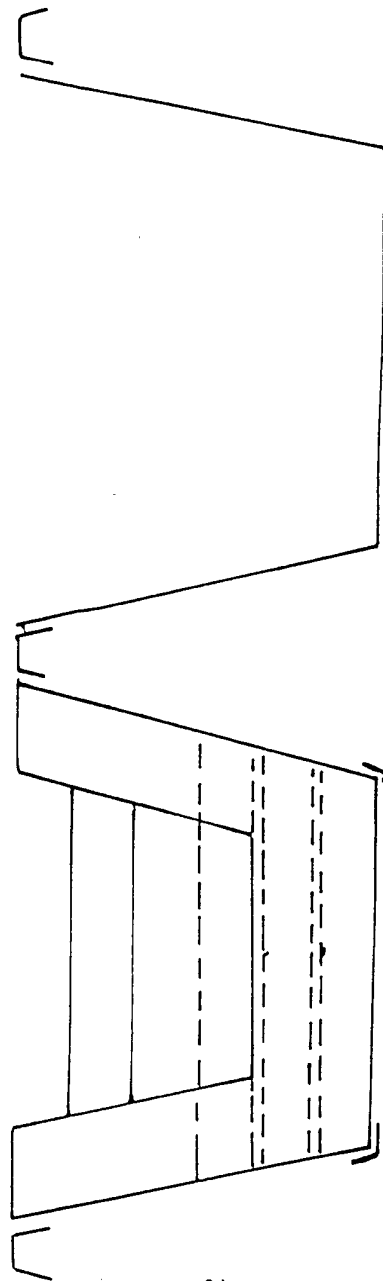
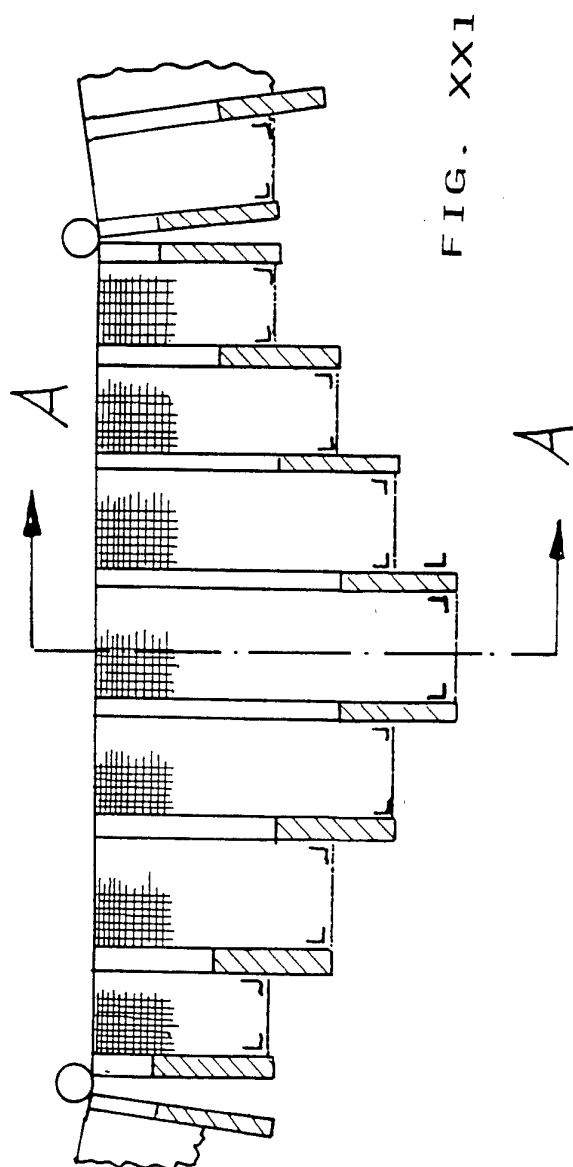
FIG. CC1



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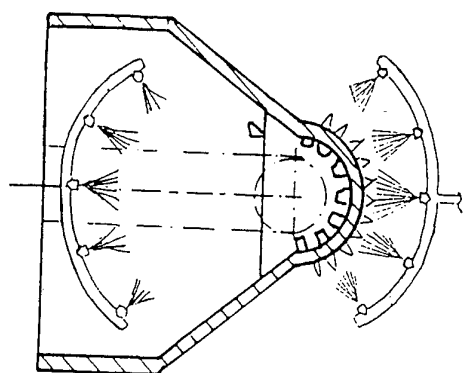


FIG. YY1

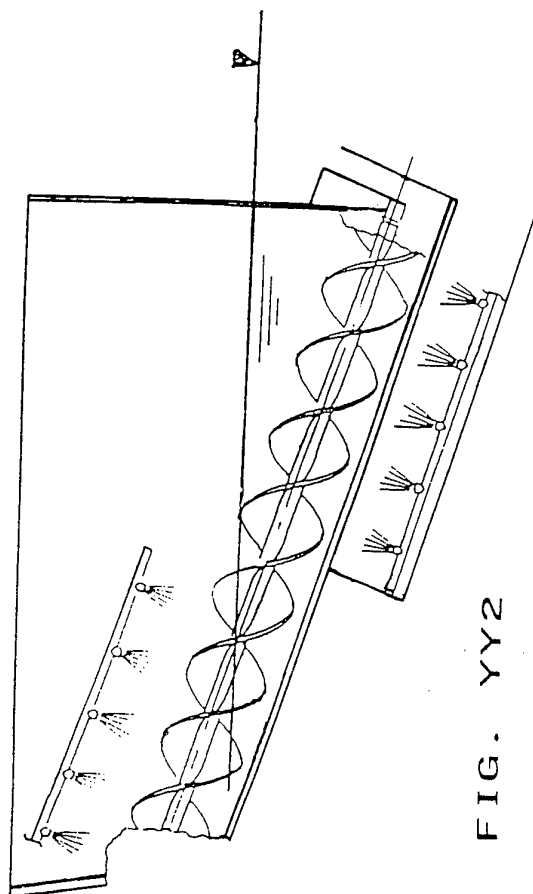


FIG. YY2

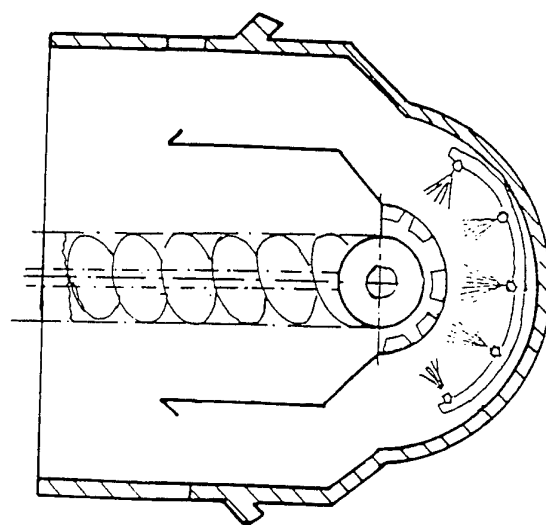


FIG. YY3

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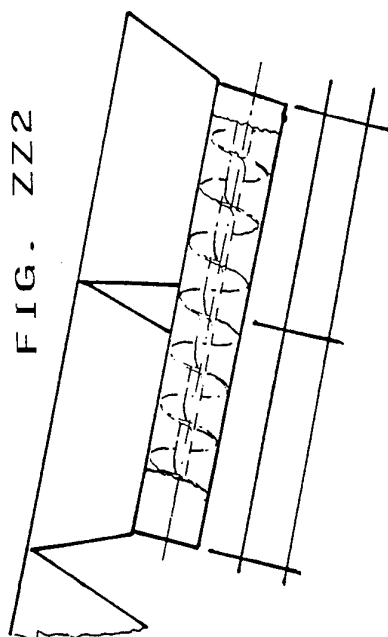
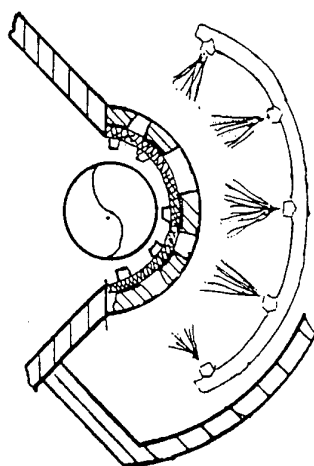


FIG. ZZ2



FIG. ZZ3

FIG. ZZ1



INTERNATIONAL SEARCH REPORT

Int: International Application No

PCT/EP 94/03093

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 B01D33/11 B01D33/27 B01D33/46 B01D33/58 B01D33/64
 B01D33/76 B01D29/23 B01D29/68 B01D29/92 B01D24/32
 B01D24/46 B01D21/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B01D C05F

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DATABASE WPI Week 9239, Derwent Publications Ltd., London, GB; AN 92-320973 & JP,A,4 227 899 (EBARA) 17 August 1992 see abstract; figure ---	1
Y	WO,A,92 04094 (ABEL, G.) 19 March 1992 see the whole document ---	1
A	---	5-10
A,P	US,A,5 256 378 (ELSTON) 26 October 1993 see column 4, line 7 - column 8, line 7; figures -----	1-3,5



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

27 January 1995

Date of mailing of the international search report

13.02.95

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Plaka, T

INTERNATIONAL SEARCH REPORT

information on patent family members

Int. Application No

PCT/EP 94/03093

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9204094	19-03-92	US-A- 5110461	05-05-92
		AU-A- 7457891	10-10-91
		AU-A- 8405391	30-03-92
		WO-A- 9113672	19-09-91
		EP-A- 0518938	23-12-92
		EP-A- 0500866	02-09-92

US-A-5256378	26-10-93	NONE	
