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(54) APPARATUS FOR MANUFACTURING ELECTRICAL CABLES WITH SHEATHING MADE OF SILICONE RUBBER AND THE LIKE

(57) An apparatus for manufacturing electrical cables with sheathing made of silicone rubber and the like, comprising, within a substantially longitudinally elongated catalysis oven (11), a tank (12) for containing molten salts (13); an electrical cable (14) sheathed in silicone rubber or the like being immersed in the salts (13) and transiting therein; the tank (12) being provided with means for recirculating the molten salts (13), and means (16) for cleaning and drying the sheathed electrical cable (14) being provided in output from the oven (11). The recirculation means for the molten salts are constituted by a curved portion (17) of the tank (12), the curved portion (17) being adapted to redirect the molten salts (13) entrained by the advancement of the cable (14) immersed in the salts (13) within the rectilinear portion (18) of the tank (12) toward a recirculation channel (19), in which the molten salts (13) are guided toward the initial part (20) of the tank (12), which is preset for the entry of the electrical cable (14).

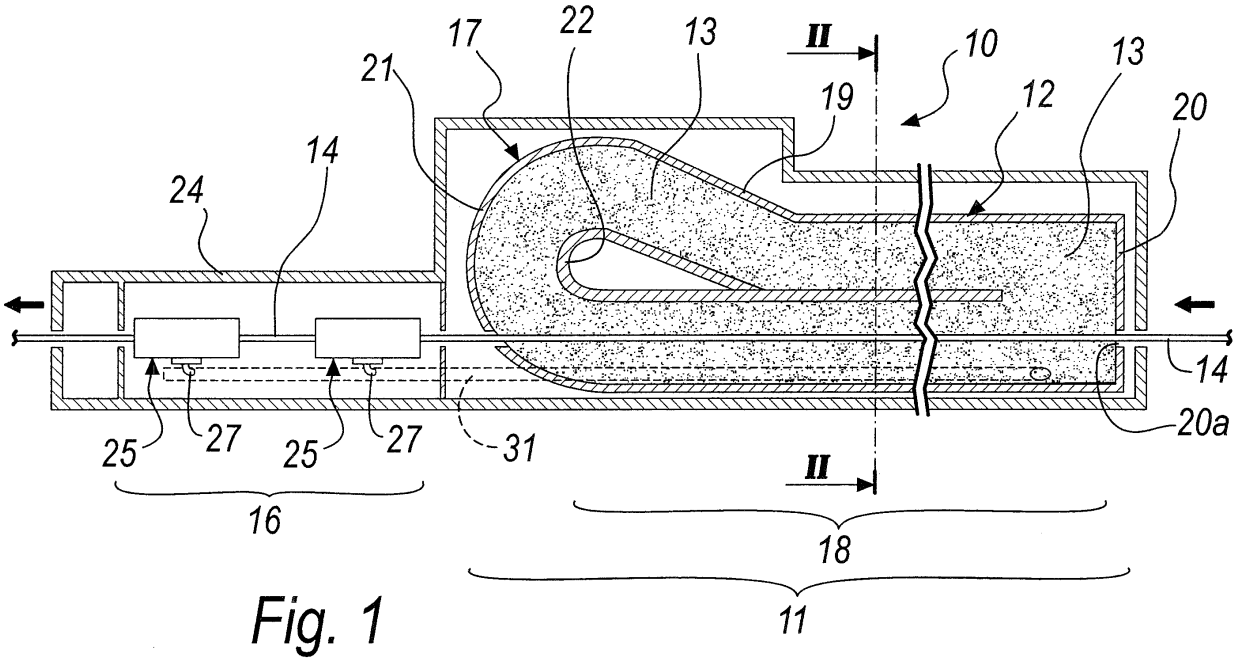

Fig. 1

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Description

[0001] The present invention relates to an apparatus particularly for manufacturing electrical cables with sheathing made of silicone rubber and the like.

[0002] Currently commercially available electrical cables are constituted generally by a conductor, made for example of copper, which is covered by insulating material, such as silicone rubber or the like.

[0003] The manufacture of an electrical cable with a silicone rubber sheathing occurs, after a process for extruding the insulating material to sheathe the copper conductor with a mixture of silicone rubber activated by means of suitable chemical components, by catalysis of the mixture of insulating material by passage through a linear oven which is approximately 20-25 m long and in which a bath in a tank of molten salts, kept at a temperature of 250-270°C, allows to complete the process.

[0004] At the outlet of the oven means for washing and drying the sheathed electrical cable are provided.

[0005] Currently known ovens with a tank for the bath of molten salts, however, have aspects that can be improved.

[0006] The main limitations are in fact linked to their structure and to the speed at which the cable is made to advance.

[0007] In fact, since the catalysis time of the insulating material is constant, the relation that links the time to the ratio between displacement and speed entails that in order to increase the transit speed of the cable and consequently increase the productivity of the system, it is necessary to increase the length of the oven.

[0008] However, the relation is not linear, since as the speed increases, due to the entrainment of the salts by the cable immersed therein, the initial part of the oven gradually empties and the molten salts gather toward the exit part, in practice limiting the useful length of the oven, consequently reducing the immersed part of the cable.

[0009] The balance between the length of the oven, the distribution of the molten salts and the production rate is therefore a physical limitation that cannot be exceeded easily.

[0010] Italian Patent Application No. PD2000A232, filed on 6 October 2000 in the name of this same Applicant, discloses an oven which comprises a tank for containing the molten salts which has, arranged in an operating sequence, a longitudinally elongated initial portion, an intermediate motorized wheel for redirecting the electrical cable being processed from the longitudinal direction of the initial portion to the longitudinal direction of a final portion which is also longitudinally elongated, and forms, on the horizontal plane, an angle of approximately 30 sexagesimal degrees with respect to the initial portion.

[0011] The oven further comprises a duct for the passage of the molten salts, which is immersed in such bath of salts and is arranged at the bottom of the tank, with an inlet arranged at the intermediate portion in a direction which matches the direction of motion of the molten salts, and with outlets arranged proximate to the inlet part of the initial portion.

[0012] In this manner, by utilizing the turbine effect of the redirection wheel immersed in the bath of salts, a certain amount of molten salts passes through the submerged duct and is returned at the initial portion and dynamically compensates the difference in level of the bath of salts between the end part and the initial part of the oven caused by the entrainment effect of the electrical cable.

[0013] This type of oven solves effectively the problems related to apparatuses of the known type, in which a difference in level of the bath of molten salts is produced between the inlet and outlet portions of the oven during the processing of the cable, but its structure is rather complicated and comprises for example the redirection wheel, the supporting means and the antislip means thereof, as well as its motorization means.

[0014] Moreover, despite being motorized, the wheel for redirecting the sheathed electrical cable may operate unevenly, due to the variable friction and resistance forces constituted by the mass of molten salts in which it is immersed.

[0015] Even the slightest variation in the angular velocity of the redirection wheel can cause unevenness in the catalysis of the silicone rubber sheathing and lack of uniformity of the thickness of contiguous portions of said sheathing, depending on whether the cable has undergone or not a variation in tension, caused indeed by an unwanted change in the rotation rate of the wheel.

[0016] The aim of the present invention is to provide an apparatus particularly for manufacturing electrical cables with sheathing made of silicone rubber and the like, which is capable of obviating the problems and drawbacks of known types of apparatus.

[0017] Within this aim, an object of the present invention is to provide an apparatus which is capable of redistributing and recirculating the molten salts no less effectively than known types of apparatus.

[0018] Another object is to provide an apparatus which allows to increase production speed and capacity.

[0019] Another object is to provide an apparatus which is simpler and cheaper than known apparatuses and entails at the same time an energy saving.

[0020] Further object of the invention is to provide an apparatus which allows to save on logistics and personnel costs.

[0021] Still further object of the present invention is to provide an apparatus which ensures a cleaning and drying of the sheathed cable that exits from the oven whose quality is not inferior to that of known types of apparatus.

[0022] Another object is to provide an apparatus which can be manufactured cheaply with known types of apparatus and technology.

[0023] This aim and these and other objects, which will become better apparent hereinafter, are achieved by an apparatus for manufacturing electrical cables with sheathing made of silicone rubber and the like, of the

type which comprises, within a substantially longitudinally elongated catalysis oven, a tank for containing molten salts, an electrical cable sheathed in silicone rubber or the like being immersed in said salts so as to transit therein, said tank being provided with means for recirculating said molten salts, means for cleaning and drying the sheathed electrical cable being provided in output from said oven, said apparatus being characterized in that said recirculation means for the molten salts are constituted by a curved portion of said tank, said curved portion being adapted to redirect the molten salts entrained by the advancement of the cable immersed in said salts within the rectilinear portion of said tank toward a recirculation channel, which is adapted to guide the molten salts toward the initial part of said tank, in which the inlet of the electrical cable is located.

[0024] Further characteristics and advantages of the invention will become better apparent from the following detailed description of a preferred but not exclusive embodiment thereof, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a sectional top view of an apparatus according to the invention;

Figure 2 is a sectional view, taken along the line II-II of Figure 1;

Figure 3 is a side view of a portion of an apparatus according to the invention;

Figure 4 is a sectional top view of a detail of an apparatus according to the invention;

Figure 5 is a sectional view, taken along the line V-V of Figure 4.

[0025] With reference to the figures, an apparatus for manufacturing electrical cables with sheathing made of silicone rubber and the like according to the invention is generally designated by the reference numeral 10.

[0026] The apparatus 10 comprises, inside a catalysis oven 11 which is substantially longitudinally elongated, a tank 12 for containing molten salts 13, inside which catalysis of the insulating material with which an electrical cable 14 is sheathed occurs.

[0027] The electrical cable 14, sheathed beforehand in silicone rubber or the like by means of a known type of extrusion means (not shown for the sake of simplicity) and immersed in the salts 13, which are of a commercially known type such as nitrites, nitrates and the like, travels through at a speed of up to 400-500 m per minute.

[0028] The tank 12 is provided with recirculation means for the molten salts 13.

[0029] The salts 13 are in fact entrained by the advancement motion of the cable 14 toward the end of the tank 12 from which the cable 14 then exits.

[0030] At the output from the oven 11 there are means 16 for cleaning and drying the sheathed electrical cable 14.

[0031] The recirculation means for the molten salts are constituted by a curved portion 17 of the tank 12.

[0032] The curved portion 17 is adapted to redirect the molten salts 13, entrained as mentioned by the advancement of the cable 14 immersed therein, toward a recirculation channel 19, which is adapted to guide the molten salts 13 toward the initial part 20 of the tank 12.

[0033] The part 20 is provided with an inlet 20a for the electrical cable 14, which arrives from the extrusion means, which have sheathed it with insulating material.

[0034] The curved portion 17 of the tank 12 traces substantially a circular arc.

[0035] The curved portion 17 traces an angle of 180°.

[0036] The external wall 21 of the curved portion 17 lies along a circumference the diameter of which is substantially three times the transverse width of the rectilinear portion 18 of the tank 12.

[0037] The internal wall 22 of the curved portion 17 lies on a circumference the diameter of which is substantially one third of the diameter related to the external wall 21 of the curved portion 17.

[0038] The tank 12 is made of stainless steel.

[0039] The tank 12 is closed by a cover 12a.

[0040] The cleaning and drying means 16 are supported by a supporting frame 24 and are formed by two blowers 25.

[0041] The sheathed electrical cable 14 that exits from the oven 11 and from the tank 12 passes within the blowers 25.

[0042] Each blower 25 is constituted by an outer jacket 26, into which air is injected which arrives from an injection tube 27 functionally connected thereto.

[0043] A tubular element 28, provided with a plurality of holes 29, is present inside the jacket 26.

[0044] The electrical cable 14 passes axially through the tubular element 28.

[0045] The cable 14 is cleaned and at least partially dried by the air pushed through the plurality of holes 29.

[0046] In the embodiment of the apparatus 10 described here, the jacket 26 and the tubular element 28 rigidly coupled thereto are cylindrical and coaxial.

[0047] The tubular element 28 is provided, on the side where the cable 14 enters, with an opening 30 toward the outside of the blower 25, so as to allow the exit of the grains of salt separated by the injected air.

[0048] The holes 29 are arranged substantially along helical paths on the tubular element 28.

[0049] The blowers 25 are arranged so that the electrical cable 14 passes through them, moving upward along an inclined path.

[0050] The two blowers 25 are then arranged in series along a rising ramp of the supporting frame 24, so that the grains of salt that detach fall back toward the tank 12.

[0051] The blowers 25 are fed with hot air (at approximately 180 °C) which arrives from a copper duct 31, which is immersed, over at least part of its length, in the molten salts.

[0052] The duct 31 heats the air intended for the cleaning means 16, since it is connected to the blowers 25 by means of the injection tubes 27 described above.

[0053] The tubes 27 are advantageously made of flexible material which can withstand temperatures up to 200 °C.

[0054] The tubes 27 are made of Teflon.

[0055] The cable 14, pulled between tensioning means arranged upstream of the oven and downstream of the cleaning means and not shown for the sake of simplicity, enters the tank 12 from the inlet 20a.

[0056] The cable 14 is immersed in the bath of molten salts 13, and by advancing at a very high speed (up to 400 meters per minute) entrains part of the salts 13 toward the curved portion 17.

[0057] Here, while the cable 14 rises, with the aid of redirection wheels 35, from the tank 12 and exits from the salts 13, the salts 13, by inertia, are redirected by the curved portion 17 toward the recirculation channel 19, which converges toward the centerline wall 34 of the tank 12.

[0058] The wall 34 therefore separates the rectilinear portion 18 in which the cable 14 advances from the recirculation channel 19.

[0059] The wall 34 ends at the part 20 of the tank 12 where the salts 13 encounter the new incoming cable 14.

[0060] In practice it has been found that the invention thus described solves the problems noted in known types of apparatus for manufacturing electrical cables with sheathing made of silicone rubber and the like.

[0061] In particular, the present invention provides an apparatus for manufacturing electrical cables with sheathing made of silicone rubber and the like which is capable of redistributing and recirculating the molten salts no less effectively than known types of apparatus.

[0062] Moreover, the present invention provides an apparatus which allows to increase production speed and capacity.

[0063] Most of all, the present invention provides an apparatus which is far simpler and cheaper than known apparatuses and entails at the same time a saving both in terms of components and in terms of assembly and maintenance, as well as an extremely important energy saving.

[0064] Further, the present invention provides an apparatus which ensures a cleaning and drying of the sheathed cable that exits from the oven whose quality is not lower than that of known types of apparatus.

[0065] Moreover, the present invention provides an apparatus which can be manufactured cheaply with known types of equipment and technology.

[0066] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims; all the details may further be replaced with other technically equivalent elements.

[0067] In practice, the materials employed, so long as they are compatible with the specific use, as well as the dimensions, may be any according to requirements and to the state of the art.

[0068] The disclosures in Italian Patent Application No. PD2005A000005 from which this application claims priority are incorporated herein by reference.

[0069] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. An apparatus for manufacturing electrical cables with sheathing made of silicone rubber and the like, of the type which comprises, within a substantially longitudinally elongated catalysis oven (11), a tank (12) for containing molten salts (13), an electrical cable (14) sheathed in silicone rubber or the like being immersed in said salts (13) so as to transit therein, said tank (12) being provided with means for recirculating said molten salts (13), means (16) for cleaning and drying the sheathed electrical cable (14) being provided in output from said oven (11), said apparatus (10) being **characterized in that** said recirculation means for the molten salts are constituted by a curved portion (17) of said tank (12), said curved portion (17) being adapted to redirect the molten salts (13) entrained by the advancement of the cable (14) immersed in said salts (13) within the rectilinear portion (18) of said tank (12) toward a recirculation channel (19), which is adapted to guide the molten salts (13) toward the initial part (20) of said tank (12), in which the inlet (20a) of the electrical cable (14) is located.

2. The apparatus according to claim 1, **characterized in that** said curved portion (17) of the tank (12) traces substantially a circular arc.

3. The apparatus according to one or more of the preceding claims, **characterized in that** said curved portion (17) of the tank (12) traces an angle of at least 180°.

4. The apparatus according to one or more of the preceding claims, **characterized in that** the external wall (21) of said curved portion (17) lies along a circumference whose diameter is substantially not less than three times the transverse width of said rectilinear portion (18) of the tank (12).

5. The apparatus according to one or more of the preceding claims, **characterized in that** the internal wall (22) of said curved portion (17) lies along a circle the diameter of which is substantially one third of the diameter related to the external wall (21) of said curved portion (17).

6. The apparatus according to one or more of the preceding claims, **characterized in that** said tank (12) is made of stainless steel.

7. The apparatus according to one or more of the preceding claims, **characterized in that** said cleaning and drying means (16) are formed, monolithically with a supporting frame (24), by at least one blower (25), inside which said sheathed electrical cable (14) which exits from said oven (11) and said tank (12) passes.

8. The apparatus according to claim 7, **characterized in that** said at least one blower (25) is constituted by an external jacket (26), into which air that arrives from an injection tube (27) functionally connected thereto is injected, a tubular element (28) provided with a plurality of holes (29) being provided inside said jacket (26), the electrical cable (14) being adapted to cross in an axial direction said tubular element (28), said cable (14) being cleaned and at least partially dried by the air pushed through said plurality of holes (29).

9. The apparatus according to claim 8, **characterized in that** said jacket (26) and said tubular element (28) monolithically coupled thereto are cylindrical and coaxial.

10. The apparatus according to one or more of claims 7 to 9, **characterized in that** said tubular element (28) is provided, on the side where the cable (14) enters, with an opening (30) toward the outside of the device (25), so as to allow the exit of the grains of salt detached by the injected air.

11. The apparatus according to one or more of claims 7 to 10, **characterized in that** said holes (29) are arranged substantially along helical paths on said tubular element (28).

12. The apparatus according to one or more of claims 7 to 11, **characterized in that** said at least one blower (25) is arranged so that said electrical cable (14) passes through it by moving upward along an inclined path.

13. The apparatus according to one or more of the preceding claims, **characterized in that** it comprises two of said at least one blowers (25), said two blowers (25) being arranged in series along an ascending ramp of said supporting frame (24).

14. The apparatus according to one or more of the preceding claims, **characterized in that** said blowers (25) are fed with hot air which arrives from a copper duct (31), which is immersed for at least part of its length in the molten salts, said duct (31) being adapted to heat the air intended for the cleaning means (16), said duct (31) being connected to said blowers (25) by means of said injection tube (27).

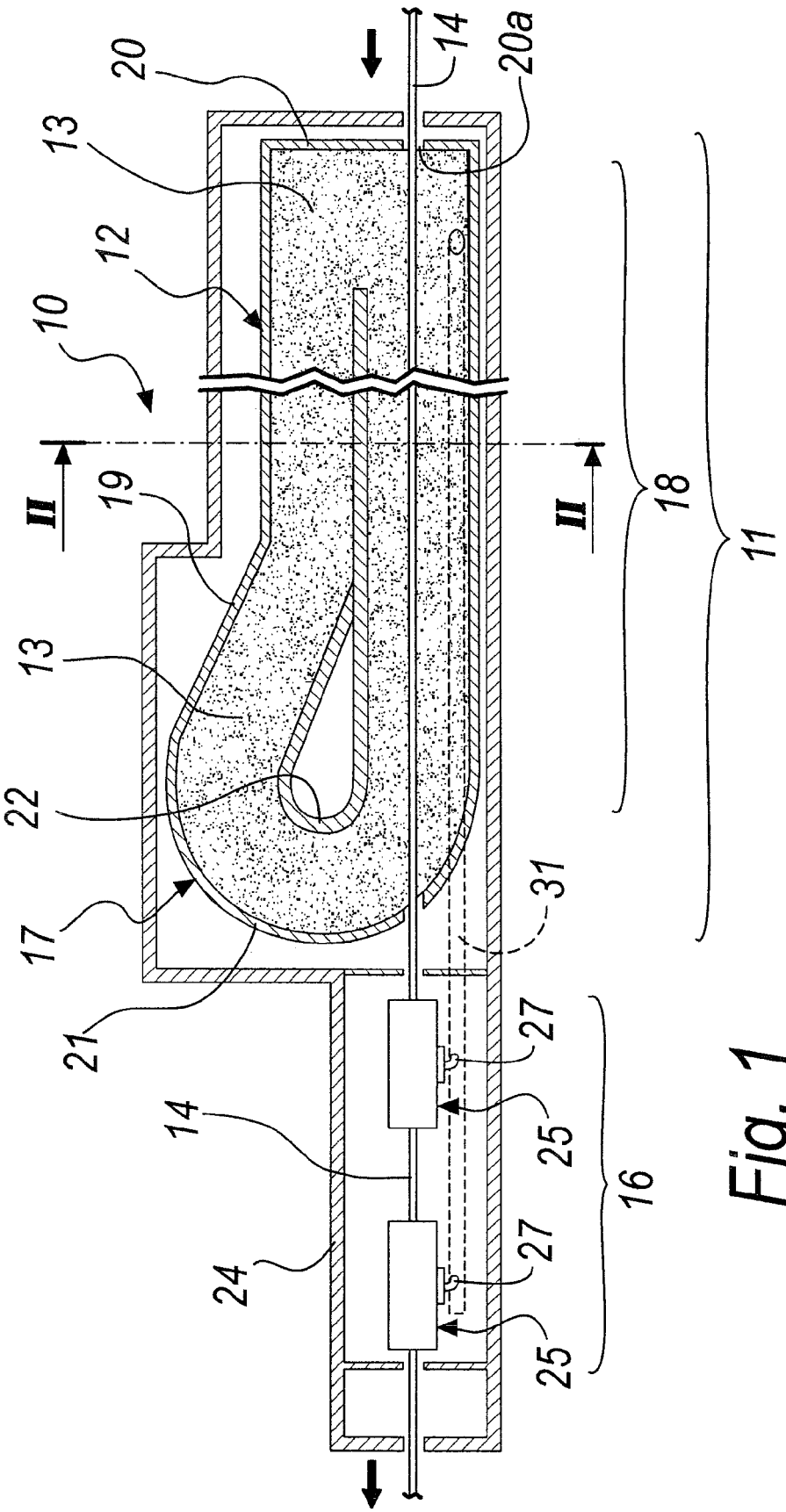

Fig. 1

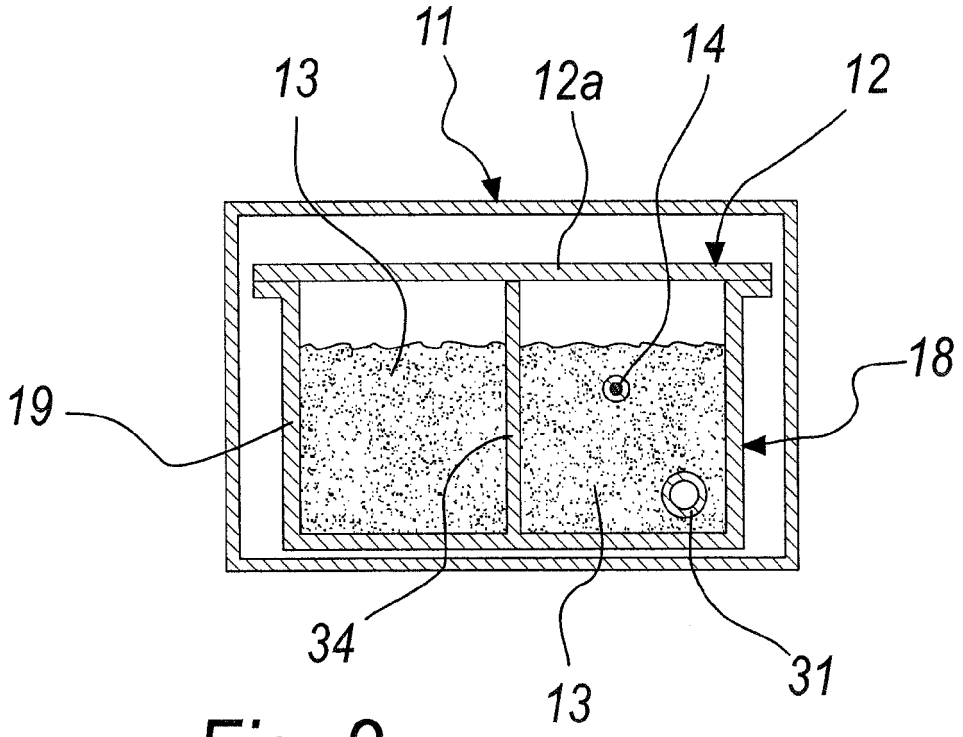

Fig. 2

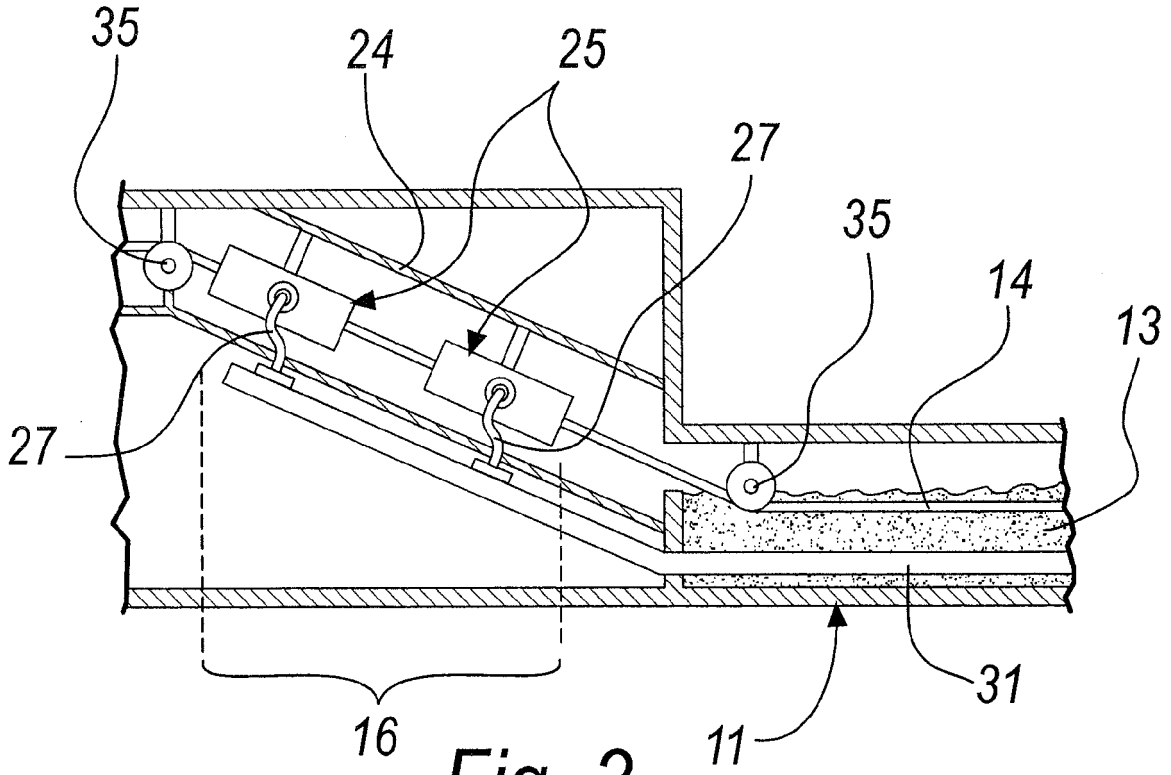

Fig. 3

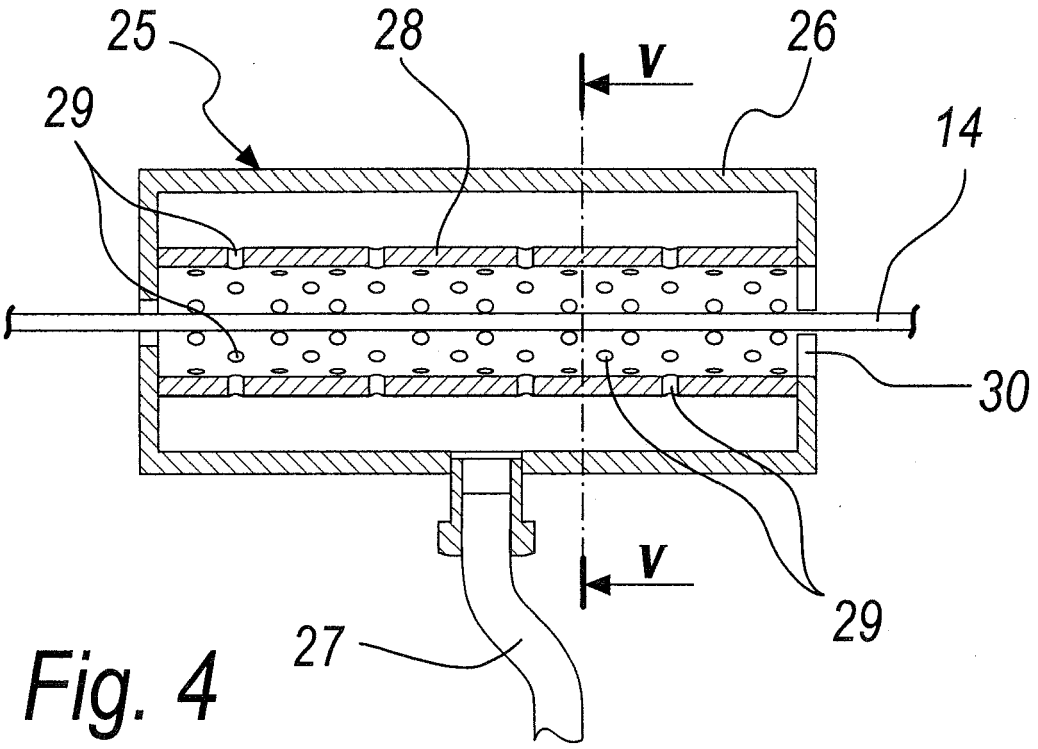

Fig. 4

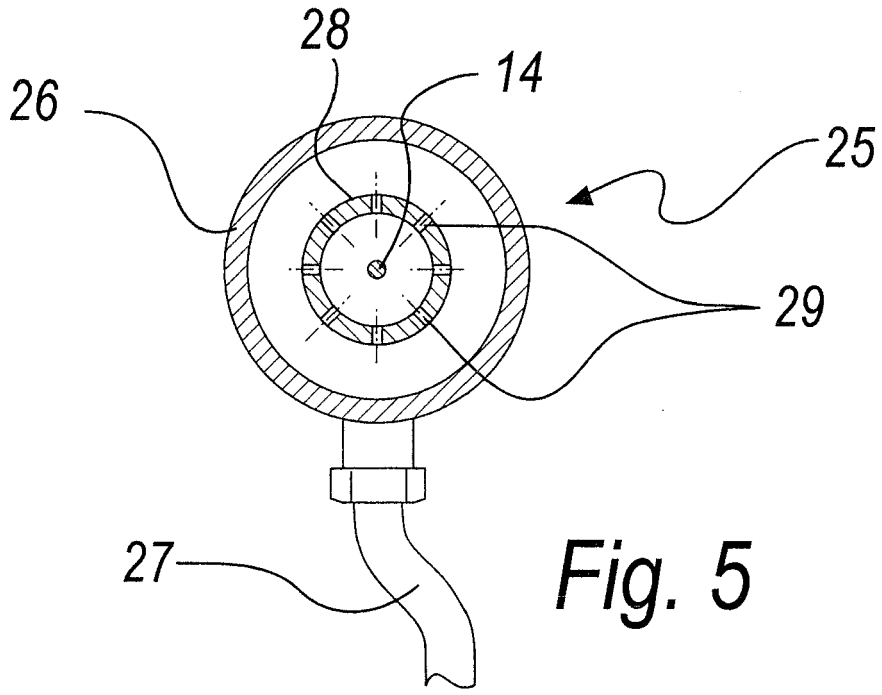

Fig. 5