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(54) **Household clothes washing machine with bactericidal treatment capability**

(57) Front-loading or top-loading horizontal-axis clothes washing machine comprising a perforated rotating drum, a stationary tub containing said drum, a filling conduit having the inflow end thereof connected to an external water-inlet control device and the outflow port thereof connected to the inner volume of the tub, and including a silver cell, said washing machine being adapted to perform a prearranged sequence of phases comprising at least a rinsing phase that comprises drain and spin-extraction sub-phases. The machine also comprises a re-circulation manifold connected on one side to

said drain manifold and, on the other side, to a spray nozzle that injects the liquor into said drum, appropriate pumping means being associated to said re-circulation manifold so as to be able to pump the liquor from said drain manifold to said nozzle. During at least a spin-extraction phase said silver cell is activated to produce a flow of water enriched with silver ions, which is let into said tub via said filling conduit. Even said pumping means associated to said re-circulation manifold are operated during at least a portion of the period in which said silver cell is activated.

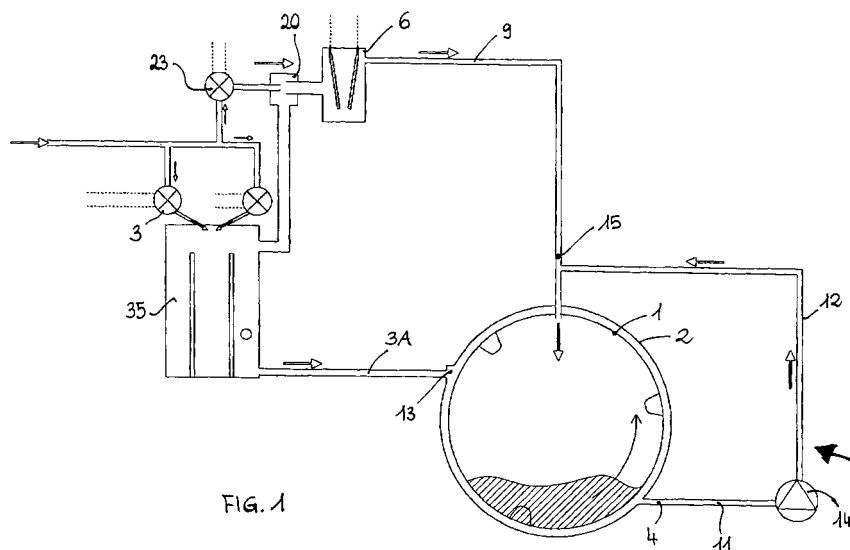


FIG. 1

Description

[0001] This invention refers to an improved type of washing machine, preferably of the household kind, able of offering remarkably effective performances from the point of view of bactericidal features.

[0002] It is well known the general demand to associate to a laundry washing treatment, also a treatment able of offering very improved features of hygienics and of disinfection against possible bacteria, which the usual laundry washing may have not eliminated.

[0003] Such demand is particularly strong when clothes of very young children are to be washed, or when the clothes are worn in specific environments, wherein the absolute hygienics is mandatory, as in surgery or infirmary rooms and so on.

[0004] To this purpose it is also well known the technique of using under various ways the elution, into the washing bath, of a flow of silver ions, which show bactericide properties.

[0005] Most antimicrobial substances in use today are effective against both bacteria and fungi. However, in just a very few cases they are equally effective against both of them, i.e. to a same extent. Most of these substances, furthermore, have not been designed or identified as additives to be mixed up in the plastic material intended to be so protected, but have been rather selected designed to be applied by deposition onto the outer surfaces of the material itself.

[0006] A number of antimicrobial additives are known in the art, which are available on the market to the purpose of opposing the growth of bacteria and fungi, as well as to general sanitation and hygiene purposes. These additives vary widely in their chemical composition, but can nevertheless be grouped into three main categories, i.e.:

- organic antimicrobial agents,
- organometallic antimicrobial agents, and
- inorganic antimicrobial agents, in particular metallic compounds.

[0007] However, all these substances are generally connected with a number of drawbacks, i.e.:

[0008] ORGANIC ANTIMICROBIAL AGENTS: As far as organic antimicrobial agents are concerned, the drawback that is generally encountered with each such antimicrobial substance lies in the tendency thereof to migrate, as well as a really non-negligible vapour pressure. This practically leads to a relatively remarkable loss of efficiency and/or a need for the amount of active substance in the polymer to be increased accordingly.

[0009] In addition, these substances usually have a decomposition temperature of approx. 200°C, which generally makes them unsuitable for use in plastic materials, such as for instance polycarbonate, that must be melted at high temperature. Owing to them dissolving molecularly in the polymer, they are not compatible with

all polymers and, furthermore, their efficiency largely depends on the nature of the material. In addition, they can also affect the recyclability of the material unfavourably.

[0010] INORGANIC ANTIMICROBIAL AGENTS: These substances have actually just a modest or even negligible migration capacity. On the other hand, however, this fact practically limits the capacity of action thereof to direct-contact activity; in other words there is no possibility for areas adjacent to or surrounding the directly treated area to be adequately protected as well. Since inorganic antimicrobial substances are not soluble in the polymers, it is rather difficult to be able to obtain a satisfactorily even and homogeneous mixing effect, which is clearly more important in organic antimicrobial compounds. In fact, there is no possibility at all for these inorganic compounds to migrate from the interior of the surface to such an extent as to be able to replace lost agents.

[0011] Since solubility or migration properties do not play any role in the case of inorganic antimicrobial agents, these are on principle compatible with almost all polymers. Not even melting/extrusion temperature plays any important role in this case; inorganic antimicrobial agents, in fact, withstand temperature to a much larger extent, i.e. are much more heat-resistant than the polymers themselves.

[0012] Inorganic antimicrobial agents are largely known to be based for the most part on silver; they may also include a modest proportion of copper or zinc. However, since silver is an expensive metal and, on the other hand, just modest amounts of it are actually required in the particular application, it is usually included in some kind of carrier material. And it is just the diversity of the materials used as a carrier that distinguishes the various trade marks and designations of the products. Usually, the carrier material consists of some natural or synthetic inorganic mixture, which shows some ion-exchange capacity for silver ions. It is fragmented and scattered in a very fine manner so as to both reach and cover a large surface area and mix up with the plastics without impairing the mechanical properties thereof to any appreciable extent. The size of the particles on the various carriers ranges from 0.1 to 4.0 µm; the amount of silver loaded onto a carrier is in the order of a few percent points of the total weight thereof, usually 2 percent.

[0013] In fact, in these machines, which share the - under this particular point of view - disadvantageous peculiarity of being top-loading vertical-axis machines, a treatment of the clothes with silver ions can only occur if the clothes to be handled, which lie on the bottom of the tub, are submerged in a bath of water that has previously been enriched with silver, wherein such submersion of the clothes can take place both during washing and/or during rinsing.

[0014] In order to obtain a submersion bath having an adequate silver concentration, and owing to silver having to finely and evenly disperse throughout the submersion bath, the need of course rises for a quite considerable

amount of silver to be used, i.e. a quite considerable silver usage to be sustained.

[0015] On the other hand, a good deal of such considerable amount of silver used in the application is practically wasted, since - upon conclusion of the bactericidal treatment - the water containing the silver is let off, thereby delivering also its silver content into the drain.

[0016] It would therefore be desirable, and it is actually a main object of the present invention, to provide a clothes washing machine of both the front-loading type, or anyway having the loading aperture lying orthogonal with the axis of rotation of the drum, and the top-loading type, but with a horizontal axis of rotation of the drum, which is provided with means for re-circulating washing and rinsing liquor, and which is adapted to enable the clothes to be washed to undergo a treatment with a silver elution, or through exposure to a flow of silver ions generated by an appropriate electrolytic cell, under quite a considerable reduction in silver usage and without the effectiveness and the final results of the bactericidal treatment being affected to any extent.

[0017] This clothes washing machine shall furthermore be capable of operating with both a silver-elution cell of a passive type and an electrolytic cell.

[0018] According to another purpose of the present invention, the clothes washing machine shall also be capable of being used in a fully safe manner with currently available water supply lines under full compliance of applying safety regulations concerning water backflow from the machine to the water supply line.

[0019] The clothes washing machine according to the present invention shall finally be capable of being easily manufactured with the use of existing techniques, and shall be competitive from a construction point of view and convenient to use.

[0020] These aims, along with other features of the present invention, are reached in a particular kind of clothes washing machine that is provided with a silver cell, as well as operating and control means, as described below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a simplified, symbolical schematic view of the water circuit of a front-loading clothes washing machine according to the present invention;
- Figure 2 is a schematic, representative view of the various water-carrying parts and related connections, as well as the mutual assembled arrangement thereof, in a front-loading clothes washing machine according to the present invention;
- Figure 3 is a simplified, schematic enlarged view of a representation of a detail of a clothes washing machine according to the present invention;
- Figure 4 is a simplified and symbolic view of a specific embodiment of a sub-assembly comprised in a ma-

chine according to the invention,

- Figure 5 is a see-through view of a side representation of the various water-carrying parts and related connections of the clothes washing machine shown in Figure 2;
- Figure 6 and Figure 7 are respective graphs showing the amount of silver retained in a plurality of fabric samples subjected to a treatment performed according to two operating modes of the clothes washing machine according to the present invention;
- Figure 8 is a schematic view of the various water-carrying parts and related connections, as well as the mutual assembled arrangement thereof, in a front-loading clothes washing machine according to the present invention, not provided with a water re-circulation manifold;
- Figure 9 is a same representative view as the one illustrated in Figure 8, but referring to a top-loading clothes washing machine according to the present invention, as provided with a water re-circulation manifold;
- Figure 10 is a schematic, median planar vertical-sectional view of a detail of washing tub, along with the related rotating drum, of a top-loading clothes washing machine according to Figure 9;
- Figure 11 is a perspective view of the drum illustrated in Figure 10;
- Figure 12 is a schematic view of the various water-carrying parts and related connections, as well as the mutual assembled arrangement thereof, in a top-loading clothes washing machine according to the present invention, not provided with a water re-circulation manifold;
- Figures 13 and 14 are enlarged planar top and vertical cross-sectional views, respectively, of a sub-assembly of a clothes washing machine according to the present invention.

[0021] The following description will particularly deal with following kinds of clothes washing machines:

- a) front-loading clothes washing machines provided with water-recirculation manifold,
- b) front-loading clothes washing machines not provided with a water-recirculation manifold,
- c) top-loading horizontal-axis clothes washing machines provided with water-recirculation manifold,
- d) top-loading horizontal-axis clothes washing machines not provided with a water-recirculation manifold.

a) Front-loading clothes washing machines provided with water-recirculation manifold

[0022] A clothes washing machine according to the present invention comprises a perforated drum 1 that is rotatably supported within a closed washing tub 2; it further comprises an electromagnetic valve 3 for letting water from the water supply line into said tub, wherein said water can possibly be caused to first flow through a washing-product dispenser 35 and a conduit 3A connecting said dispenser and said tub with each other.

[0023] Below said tub there is arranged a so-called drain manifold 4 that is connected to the drain pipe on one side and, on the opposite or intake side, to a connecting hose 7, which is in turn connected with the other end portion thereof to an aperture 8 provided in the bottom of said tub.

[0024] This drain manifold is provided with an appropriate pump 5 of a traditional type and with traditional operating functions, which shall therefore not be dealt with any further here.

[0025] The coupling point, i.e. pressure tap for a pressure switch 9 is provided in an appropriate position along said connecting hose.

[0026] In particular, since this section of the description of the present invention deals with a front-loading clothes washing machine featuring liquor re-circulation in the tub thereof, i.e. in which process liquor is recirculated, there is provided an appropriate re-circulation manifold 10, which is connected via a proper first conduit 11 to said drain manifold and, via a second conduit 12, to means 13 that, as largely known as such in the art, are adapted to direct a jet of water towards the interior of said drum. Although said means 13 is shown to seemingly lie inside the drum, it should be made right away clear that such representation is a merely symbolical one, and that a preferred embodiment is the one in which said means 13, which are practically constituted by a nozzle, are arranged so as to pass through the bellows-like gasket that sealingly and elastically joins the tub with the loading aperture in the outer casing of the machine; furthermore, said nozzle 13 is located in the upper portion of said bellows-like gasket, so as to favour the penetration by gravity of the water jet into the central portion of the drum.

[0027] It will be appreciated that other solutions are of course possible in this connection, such as the one in which said means 13 are located between the tub and the rotating drum and the water jet issuing therefrom enters the drum, and hits the clothes contained therein, by passing through the perforations in the side wall of the same drum.

[0028] Even said re-circulation manifold 10 is provided with an appropriate pump 14, which is adapted to take in the liquor from the drain manifold and pump it towards said means 13 for letting the same liquor into said drum.

[0029] The operating mode of this clothes washing machine is partly traditional, in that the machine goes through a washing cycle followed by a drain cycle, in

which the liquor is let off the tub, and then preferably a spinning cycle, in which the drum is driven to rotate at a high speed while the drain pump 5 is kept constantly operating; after a certain pre-set period of time, the spinning and drain function is stopped, while a sequence of rinsing cycles, each followed by a respective water-drain phase, is started in a manner that is largely known in the art, so that no need arises here for the whole process to be explained any further.

[0030] The inventive machine also comprises a specific device, which shall be conventionally referred to as "silver cell" hereinafter. His device is practically a cell that is so made and adapted as to enable a flow of water, or any other liquor, as the case may be, to pass there-through, so that it can add a small percentage of silver ions to such through-flowing liquor. The resulting silver-enriched liquor is then let into the washing tub.

[0031] Such silver cells can be of various kinds and types, actually. They can however be substantially divided into two main categories, i.e. simpleelution cells and electrolytic cells. Both these cell categories are largely known as such in the art, and are also described in full detail in the afore-cited patent publications.

[0032] The actual feature that differentiates them from each other lies rather in the fact that - all other conditions and, above all, dimensions being equal - the electrolytic cell, although more complex and expensive, is anyway able to transfer a far greater amount of silver to the electrolysis liquor. Such feature is of primary importance to the purposes of the present invention, as this will be described in greater detail and will become fully apparent hereinbelow, since - according to the present invention - generating and transferring silver ions into the carrier medium, i.e. the liquor, and from such medium into the tub, is a process that takes place within the short period of time of spin-extraction phases, especially the final spin-extraction one, so that, for a sufficient generation of silver ions to be obtained, it is by all means necessary for such generation to take place within quite a limited period of time, as practically only an electrolytic silver cell is capable of doing.

[0033] The part of description of the invention that follows immediately below refers in particular to the combination of a clothes washing machine of the above-described type, i.e. provided with a liquor re-circulation conduit 10, with a silver cell of a kind as is generally known as such in the art, as well as the addition of a fully novel operating mode to the traditional operating modes known as such in the art.

[0034] In the machine according to the present invention there is therefore provided a filling conduit 9 that has an end portion thereof connected to a second inlet valve 23, whereas then opposite end portion thereof, which shall be referred to as filling port 15 hereinafter, lets into said tub 2.

[0035] Along the flowpath of said filling conduit 9 there is arranged a silver cell 6 - of a type as is generally known as such in the art - that is selectively operable, i.e. actu-

atable by control means (not shown)

[0036] This silver cell is made and associated to said filling conduit 9 in such a manner that, when it is activated by said control means, it generates an emission of silver ions that, if water is flowing through said filling conduit 9, mixes with said flow of water to be thereby carried further along said filling conduit 9, through said filling port 15, and finally let into said tub 2.

[0037] As far as the above-cited novel operating mode of the machine is concerned, this consists in enabling said silver cell 6 (with associated water flowing through the conduit 9, of course) to operate during one or more drain phases, in which water, or liquor, is let off the tub, wherein these may correspond to one or more of the various drain phases that takes place following each one of the various rinses.

[0038] The advantage deriving from this circumstance lies in the fact that during and, in particular, towards the end of the drain phase, just a very small amount of water remains in the tub, i.e. practically the sole water still present in the tub is the one contained in the washload itself.

[0039] It therefore ensue that, for a same amount of silver ions let into the tub, the concentration of these ions will ultimately depend on the amount of water that is present in the tub and, conclusively, if said ions are let into the tub during a water drain phase, then silver concentration is able to reach the highest possible value for the greatest possible treatment effectiveness.

[0040] Such effect is further boosted if the silver ions are let into the tub during a spin-extraction phase (which, as may be appropriate to specially stress once again, is part of the drain phase, since water keeps being let off the tub during spin-extraction, actually) and, in particular, in the final portion of such spin-extraction phase. In fact, since silver concentration in the washload increases in proportion (all other conditions being equal) to the decrease in the amount of water that is present in the tub, the best effectiveness is reached when the amount of water in the tub is at its lowest, i.e. a condition that most clearly occurs during a spin-extraction phase, more particularly when this spin-extraction phase comes near to its end, when the amount of water still to be found in the tub reaches a minimum.

[0041] Silver is therefore no longer added to a water bath in which the washload is submerged, such as during washing or rinsing, and this ensures a number of clear and quite considerable advantages, particularly in terms of a reduction in silver usage and an increase of silver concentration in the washload.

[0042] It will be further appreciated that the spin-extraction phase, in which the operation of the silver cell should best be activated, is the final spin-extraction phase, since any rinsing phase possibly following a spin-extraction involving silver addition would most clearly produce the effect of removing any and all silver previously deposited onto the clothes forming the washload.

[0043] The advantageous effect of this novel operating

mode of a clothes washing machine is certainly magnified through the use of a clothes washing machine of the "re-circulating" type, as already known as such in the art, duly provided with the afore-cited re-circulation manifold 10 and appropriate pump 14 associated therewith.

[0044] If the silver cell 6 is in fact set to operate during the final spin-extraction phase - as this has been explained above - and provision is taken to have also the pump 14 operating at the same time, so as to activate the re-circulating mode during this process, and if draining is interrupted, i.e. water from the tub is no longer let off during the period in which such re-circulating mode is activated, which - in the example being considered - practically means that the pump 5 is kept switched off during such period, then the optimum result is obtained that not only the silver being let into the tub is allowed to disperse in the washload with the best possible concentration, but also the silver-containing water being extracted from the washload due to spinning is first collected and then sent back again onto the washload in the tub through said re-circulation manifold 10, thereby increasing the final concentration of silver in the same washload.

[0045] Under the circumstances, the washload is in fact traversed by such modest amount of silver-containing water not only once, but repeatedly, so that the percentage of silver being able to settle onto the clothes in the washload increases each time that the same washload is traversed by said water-containing liquor.

[0046] Practically, this re-circulation of the silver-containing liquor through the washload during spin-extraction brings about a kind of filtering effect, as this is on the other hand well known in the art, which means that the substance contained in the liquor, i.e. silver, is actually filtered away by a filter that, in the particular case being considered, is formed by the washload itself. Now, all those skilled in the art are able to readily appreciate that the more a mixture is filtered through a given filter, the more the resulting filtering action becomes effective, since each passage through the filter will enable more of the previously slipped-through particles to be retained or, in this case, to settle onto the clothes.

[0047] Conclusively, it may be stated that an optimum condition for silver ions to be able to deposit onto the clothes when passing therethrough is given when following conditions occur simultaneously:

- the washing process is going through the final spin-extraction phase,
- said second valve 23 is switched into open state,
- the silver cell 6 is activated,
- the liquor being let off the tub is re-circulated by the pump 14 operating in the re-circulation manifold 10.

[0048] The provision and the operation of such re-circulation manifold generate an improvement effect that can not only be explained in theory, as this has been done hereinbefore, but can also be most easily verified in practice; in this connection, the graphs illustrated in

Figures 6 and 7 show in fact the amounts of silver - per kilogram of washload weight - that have been measured in clothes handled in a clothes washing machine according to the present invention in two distinct washing/spin-extraction cycles, wherein a first cycle (Figure 6) has been carried out with the use of the re-circulation manifold 10 during the final spin-extraction phase, whereas no use was made of such manifold in the other cycle (Figure 7). Since all other conditions and process parameters were the same in both washing/spin-extraction cycles tested, the resulting differences can be ascribed to the sole presence/absence of said recirculation manifold, i.e. to the sole effect of said manifold being in operation or not.

[0049] It will of course be appreciated that it is not necessary for all of the above-mentioned operating conditions to just and exactly occur at the same time, since some of them may start to occur even in advance of or continue to occur even after the actual phase or period in which they are required to be simultaneously in operation. However, the present invention is fundamentally based on the fact that at least a portion of respective ones of said operating states is concurrent to the corresponding other portions.

[0050] In addition, with reference to Figure 3, it is found advantageous for said filling port 15 to be integrated with said jet-issuing and spray means 13; in fact, especially in the case that such spray means 13 consist of a nozzle provided and arranged in the front bellows-like gasket of the washing machine, and oriented so that the jet issuing therefrom is directed towards the centre of the drum, as this typically occurs in the prior art, such integration enables a still more favourable result to be obtained in that the whole amount of water containing silver ions, and flowing in from the silver cell 6, is directed right onto the washload and, therefore, "filtered" by the latter, with a clear improvement in the capability of the silver ions in said water of settling onto the clothes in said washload.

[0051] Upstream of said filling conduit 9 there is provided a so-called air-break gap 20 of a conventional kind, the function of which is largely known in the art, and which is in turn so situated as to come before said second valve 23. This second valve 23 may be connected upstream to both the outlet of said valve 3 and - either directly or indirectly with the use of appropriate means (not shown) - to the water supply line.

[0052] However, reasons of optimized construction and functionality make it advantageous if said two valves 3 and 23 are not connected in series with each other, but are rather connected in parallel to the water supply line, so that, when the silver cell 6 is required to be allowed to operate, only the selectively controllable valve 23 is opened, without having to also open the valve 3, thereby preventing the latter to cause also fresh water to be let into the tub (see Figure 1).

[0053] In view of enabling the washing machine to operate in a manner that is consistent with the whole above-described process, the need of course arises for suitable control means - as generally known as such in the art or,

anyway, readily conceivable by those skilled in the art - to be so provided and connected as to be able to control in an appropriately synchronized manner:

- 5 - the operation of said pump means 14, jointly with the activation of said silver cell 6,
- the operation of said drum to rotate at a spin-extraction speed,
- 10 - the opening and closing of said valve 23 supplying water to said silver cell 6.

b) Front-loading clothes washing machines not provided with a water-recirculation manifold

15 **[0054]** The description given hereinabove can also be applied to a front-loading clothes washing machine that is not provided with a re-circulation manifold, provided that the part of the same description that more specifically refers to such re-circulation manifold is eliminated jointly with the explanations given in connection thereto (see Figure 8).

20 **[0055]** In particular, even in this case the nozzle 13 is provided and arranged in the upper portion of the bellows-like gasket that elastically and sealingly connects the loading opening in the outer casing of the machine with the washing tub thereof.

25 **[0056]** The operation of such clothes washing machine, as far as the inflow and addition of silver ions is concerned, is much the same as the one described hereinabove with reference to the previously considered case: in fact, the flow of water through and from the silver cell 6 is again activated during the final spin-extraction phase.

30 **[0057]** However, if a particularly intensive treatment with silver ions is desired, then the valve 23 letting the flow of water into and through the silver cell 6 is opened earlier, i.e. in advance of said final spin-extraction phase, so that the flow of water containing silver ions can be activated also during the final rinse and related water discharge phase.

35 **[0058]** It can be readily appreciated that in this case, in which there is no possibility for the water to be re-circulated, it becomes particularly advantageous for the filling port 15 to be situated in the upper portion of the bellows-like gasket, so that the water containing the silver ions, although not re-circulated, and the more so just on this ground, is capable of directly hitting the clothes and, as a result, ensuring that most of the clothes in the washload are effectively treated therewith, by just bringing about the afore-described "filtration" effect and achieving in this way the maximum possible level of efficiency allowed for by the fact that the silver-containing liquor is poured onto the clothes just once, and is not re-circulated.

55 c) Top-loading horizontal-axis clothes washing machines provided with water-recirculation manifold

[0059] With reference to Figure 5e, which schemati-

cally shows a symbolical representation of a top-loading clothes washing machine provided with recirculation manifold, the same reference numerals as the ones used in connection with the front-loading washing machine are used there to indicate corresponding or similar details and parts.

[0060] This washing machine is characterized in that its filling port 15, which even in this case coincides with the jet-issuing nozzle 13 (and which cannot clearly be applied through the bellows-like gasket as in the previously considered cases, for the simple reason that no such bellows-like gasket is used in this case), is arranged in the wall of the tub in close proximity of the axis of rotation X of the drum 1, as this is shown schematically in Figure 10. Said port 15 is furthermore oriented against the planar vertical wall 25 of the drum, as shown again in the Figure.

[0061] In order to enable the jet of water to be appropriately directed at and let into the drum 1, the latter is made as follows: with reference to Figure 11, the planar vertical wall 25 thereof, which is arranged to stand opposite to said filling port 15, is provided with a multiplicity of perforations 26, wherein the distance of said perforations 26 from the axis X of the drum is substantially the same as the distance of said filling port 15 - as integrated with the nozzle 13 - from the same axis X.

[0062] Thanks to such construction, the jet of water issuing from the filling port 15, and pumped by the recirculation pump 14, enters the interior of the drum in a substantially continuous manner. More than that, since the point at which such jet is let into the drum lies along the axis thereof, and therefore centrally relative thereto, with the described construction the desired result is also obtained of having said jet - either enriched with silver ions or not - directed so as to totally impinge against the washload and move therethrough from the inside towards the outside, exactly as this occurs in the case of the afore-described front-loading washing machine, thereby ensuring the desired "filtering" effect also in this case.

[0063] The operating mode is quite the same as the one described in connection with the front-loading washing machine provided with recirculation manifold, to which reference should therefore be made for reasons of brevity.

[0064] Suffice here to once again stress the fact that - even in this case - the best possible efficiency in the utilization of the silver ions is reached in the final spin-extraction phase, although it may under certain circumstance be also contemplated that a flow of water from the silver cell be let into the drum during the final drain phase of the washing process or, if desired, even during any of the rinses.

d) Top-loading horizontal-axis clothes washing machines not provided with a water-recirculation manifold

[0065] The description set forth under c) hereinabove

can also be applied to a top-loading clothes washing machine that is not provided with a recirculation manifold, provided that the part of the same description that more specifically refers to such re-circulation manifold is eliminated jointly with the explanations given in connection thereto (see Figure 12)

[0066] Anyway, with particular reference to Figure 12, in a clothes washing machine of this kind the conduit 3A departing from the detergent dispenser is arranged to once again terminate at, i.e. debouch into the nozzle 13 that lets water into the washing tub, rather than having it debouching directly into the tub in any position whatsoever therewithin.

[0067] Therefore, even in this case the filling port 15, connected to said silver cell 6, is advantageously integrated with said nozzle 13.

[0068] For the same reason as explained above, even in this case the nozzle 13 is arranged in the wall of the tub in close proximity of the axis of rotation X of the drum.

[0069] The operation of such clothes washing machine, as far as the inflow and addition of silver ions is concerned, is much the same as the one described hereinabove with reference to the previously considered case of a front-loading clothes washing machine not provided with a recirculation manifold: in fact, the flow of water through and from the silver cell 6 is again activated during the final spin-extraction phase.

[0070] Suffice here to once again stress the fact that - even in this case - the best possible efficiency in the utilization of the silver ions is reached in the final spin-extraction phase, although it may under certain circumstance be also contemplated that a flow of water from the silver cell be let into the drum during the final drain phase of the washing process or, if desired, even during any of the rinses.

[0071] This operating mode can be considered as being particularly advantageous, especially if the desired effect is to minimize the drawback brought about by the fact that only a part of the jet of silver-containing water enters the drum, and penetrates the washload contained therewithin, while the remaining part impinges against said wall 25 and, by splashing back, falls obviously onto the bottom of the tub.

[0072] Moreover, in the cases described with reference to the machines considered under b), c) and d) hereinabove the same characteristics as the ones described with reference to the front-loading washing machine provided with the re-circulation feature are maintained as far as not only the provision of the air-break gap 23 safety feature is concerned, but also in connection with the preferred option of having the silver cell 6 provided in the form of an electrolytic cell. Finally, as already noted above, the filling port 15 is in all cases integrated with the jet-issuing nozzle 13.

[0073] With reference to Figures 13 and 14, a further improvement is finally illustrated, which can be applied to all four afore-described washing-machine configurations.

[0074] This improvement answers a twofold purpose, i.e.:

- 1) it is first of all aimed at preventing the unavoidable small water leakages from the air-break gap from falling back into the machine, with the risk of giving rise to short-circuit conditions or alarming the user, who may in fact fear that it is the internal water-carrying circuit of the machine that is leaking somewhere, actually;
- 2) it is further aimed at preventing possible water backflows from the silver cell 6 from ending up in the same way, i.e. producing the same effects as the water leaking from the air-break gap.

[0075] To such purpose there is provided an appropriate channel system 33 that hems in, i.e. encloses the two mutually opposing edges of the air-break device there-within, so that all water that may leak therefrom can be collected in that channel to be properly conveyed to some appropriate point included in the water-carrying circuit of the machine.

[0076] Therefore, an edge 34 of an end portion of said channel 33 is caused to abut against and joined to the filling conduit 9 leading to said silver cell 6, whereas the remaining portion of said channel 31 is connected to said point properly provided to that purpose along the water-carrying circuit of the machine.

[0077] For practical reasons of manufacturing convenience, as well as on the grounds that it lies on top, i.e. in the highest position of the entire water-carrying circuit and, finally, that it is permanently connected with the washing tub, it is certainly advantageous that said channel is so arranged as to be caused to debouch directly into the dispenser 35 containing the washing and rinsing products.

[0078] With reference to Figure 4, such improvement can be further enhanced in the following manner, wherein the detergent dispenser 35 should in particular be considered. In fact, this detergent dispenser is sometimes provided with four separate compartments, one of which, i.e. the compartment 36, is used to hold a special kind of spot-removing product due to be flushed into the tub during the washing process. Even on the afore-noted grounds, it can at this point be readily appreciated that, when such compartment is flushed by the corresponding inflow of water, there is no release of silver ions from the cell 6 - since there must be no such release, actually.

[0079] Now, such circumstance may be used to practical advantage if the filling conduit 9 is caused to let out into this fourth compartment 36, instead of letting out directly into the drum as in the afore-considered case.

[0080] By selecting a proper control and operating sequence, such configuration would by no means affect a correct operation of the machine; in fact, as the washing aid held in the compartment 36 is flushed off therefrom by the inflowing water during the washing process, the silver cell 6 is de-energized, so that there is no release

of silver ions therefrom. Conversely, when - during the last rinse and the final spin-extraction step of the process - water is caused to flow through said silver cell 6 and into said compartment 36, which by now does not contain any spot-removing aid any longer, even the silver cell 6 is appropriately energized, thereby bringing about the desired elution of silver ions to be carried into the washing tub by the flow of water being let thereinto.

[0081] The practical advantage of such solution is basically a construction-related one, since it allows the costs and the complications to be avoided, which are associated to the conduit 9 having to be provided so as to start from a position on the upper portion of the machine and reach down - under unavoidable assembly and safety problems - to the filling port 15 that - depending on the particular case - is located either in front of or behind the washing tub and, anyway, in a position that is considerably lower than the silver cell 6 itself.

Claims

1. Front-loading or top-loading horizontal-axis clothes washing machine, comprising:

- a perforated rotating drum (1) for holding and agitating the clothes to be washed,
- a stationary tub (2) containing said drum (1),
- a water-inlet control device provided thereout-side, preferably an electromagnetic valve (3) adapted to selectively let pre-defined amounts of water into said tub via appropriate water-injecting means,
- a drain manifold (4) arranged below said tub and housing appropriate water pumping means (5),
- a filling conduit (9), which has the inflow end thereof connected to a relative water-inlet control device (23) and the outflow port (15) thereof connected to the inner volume of said tub, and which includes a silver cell (6) adapted to provide the water flowing through said filling conduit (9) with a pre-defined amount of silver ions in a dispersed form,
- a hose (7) connecting an aperture (8) in the bottom of said tub with said drain manifold (4),
- said washing machine being adapted to carry out a prearranged sequence of phases comprising at least a washing phase, followed by one or more rinsing phases, each one of which is in turn followed by respective drain phases comprising simultaneously occurring drain and spin-extraction phases,

characterized in that during at least one of said spin-extraction phases said silver cell (6) is activated to produce a flow of water enriched with silver ions, which is let into said tub via said filling conduit (9).

2. Clothes washing machine according to claim 1, **characterized in that** it comprises:
- a re-circulation manifold (10) connected to an appropriate nozzle (13), and adapted to let the liquor it takes in from said drain manifold (4) into said drum (1),
 - appropriate pumping means (14) associated to said re-circulation manifold (10) and adapted to pump the water from said drain manifold to said nozzle means (13) injecting said water into said drum.
3. Clothes washing machine according to claim 2, **characterized in that** said silver cell (6) is activated during at least a portion of the final spin-extraction phase.
4. Clothes washing machine according to claim 3, **characterized in that** said silver cell (6) is activated during the final portion of said final spin-extraction phase.
5. Clothes washing machine according to any of the preceding claims 2 to 4, **characterized in that** also said pumping means (14) associated to said re-circulation manifold (10) are operated during at least a portion of the period in which said silver cell (6) is activated.
6. Clothes washing machine according to any of the preceding claims 2 to 5, **characterized in that**:
- said pumping means (14),
 - said high-speed rotation of said drum for spin-extraction and
 - said silver cell (6)
- are activated to operate concurrently during at least a part of the respective running times thereof.
7. Front-loading or top-loading horizontal-axis clothes washing machine according to claim 1, **characterized in that** said silver cell (6) is activated during at least a portion of the final spin-extraction phase.
8. Clothes washing machine according to claim 7, **characterized in that** said silver cell (6) is activated during the final portion of the final spin-extraction phase.
9. Clothes washing machine according to claim 7 or 8, **characterized in that**
- said high-speed rotation of said drum for spin-extraction and
 - said silver cell (6)
- are activated to operate concurrently during at least a part of the respective running times thereof.
10. Front-loading clothes washing machine according to any of the preceding claims, **characterized in that** said filling port (15) and said water-injecting nozzle (13) are so arranged and oriented as to inject the respective flow of liquor through the access opening of said drum (1) towards the centre thereof.
11. Clothes washing machine according to claim 10, **characterized in that** said filling port (15) and said water-injecting means (13) are arranged so as to pass through the bellows-like gasket that elastically and sealingly joins the loading opening of the tub with the corresponding loading opening in the outer casing of the washing machine.
12. Top-loading horizontal-axis clothes washing machine according to any of the claims 7 to 9, **characterized in that** said filling port (15) and said water-injecting nozzle (13) are arranged in the wall of the tub in close proximity of the axis of rotation (X) of the drum (1), and are oriented towards the planar wall (25) of the drum lying opposite thereto.
13. Clothes washing machine according to claim 12, **characterized in that** said planar wall (25) of the drum is provided with a multiplicity of perforations (26).
14. Clothes washing machine according to claim 12 or 13, **characterized in that** said silver cell (6) is adapted to be selectively activated also during a rinse phase.
15. Clothes washing machine according to any of the preceding claims, **characterized in that** upstream of said filling conduit (9) there is arranged an air-break device (20).
16. Clothes washing machine according to claim 15, **characterized in that** said air-break device (20) is supplied with water from a respective second, selectively controllable valve (23) adapted to be connected to the water supply line.
17. Clothes machine according to any of the preceding claims, **characterized in that** said filling conduit (9), downstream said silver cell (6), is directed to a specific compartment of the washing product dispenser (35).
18. Clothes washing machine according to any of the preceding claims, **characterized in that** said silver cell (6) is a selectively controllable electrolytic cell.
19. Clothes washing machine according to any of the

preceding claims, **characterized in that** upstream of said filling port (15) provided at the outflow end of said filling conduit (9) coincides with said water-injecting nozzle means (13) of said re-circulation manifold (10).

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20. Clothes washing machine according to claim 15 or 16, **characterized in that** the outflow port of said air-break device is hemmed in and separated from the outside by a channel (33) that fits with an end edge (34) thereof against the conduit leading to said silver cell (6).

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21. Clothes washing machine according to claim 20, **characterized in that** said channel (33) flows into the dispenser (35) containing the washing and rinsing products.

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22. Clothes washing machine according to any of the preceding claims, **characterized in that** there are provided programmable control means adapted to selectively control the operation of the phases of:

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- switching on said pumping means (14), if any,
- opening said second valve (23),
- activating said silver cell (6),
- driving said drum at a high rotation speed for spin extraction.

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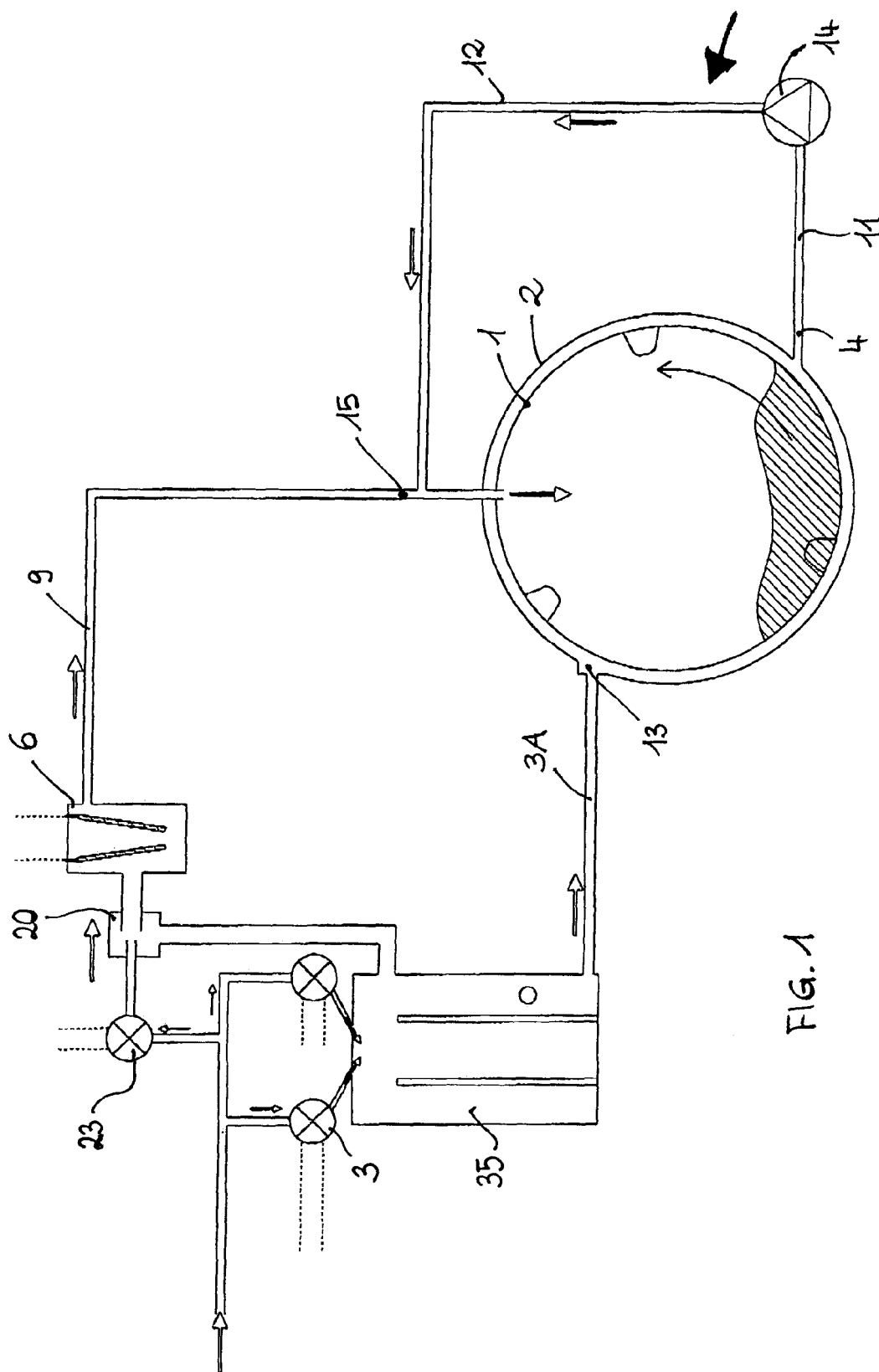


FIG. 1

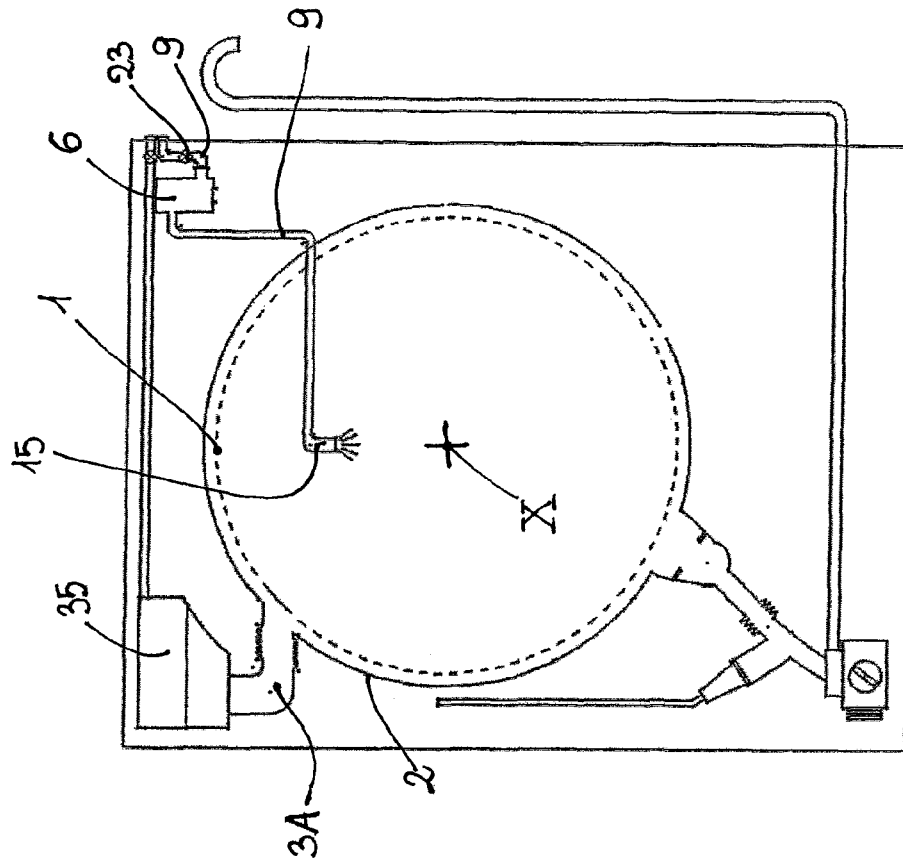


Fig. 8

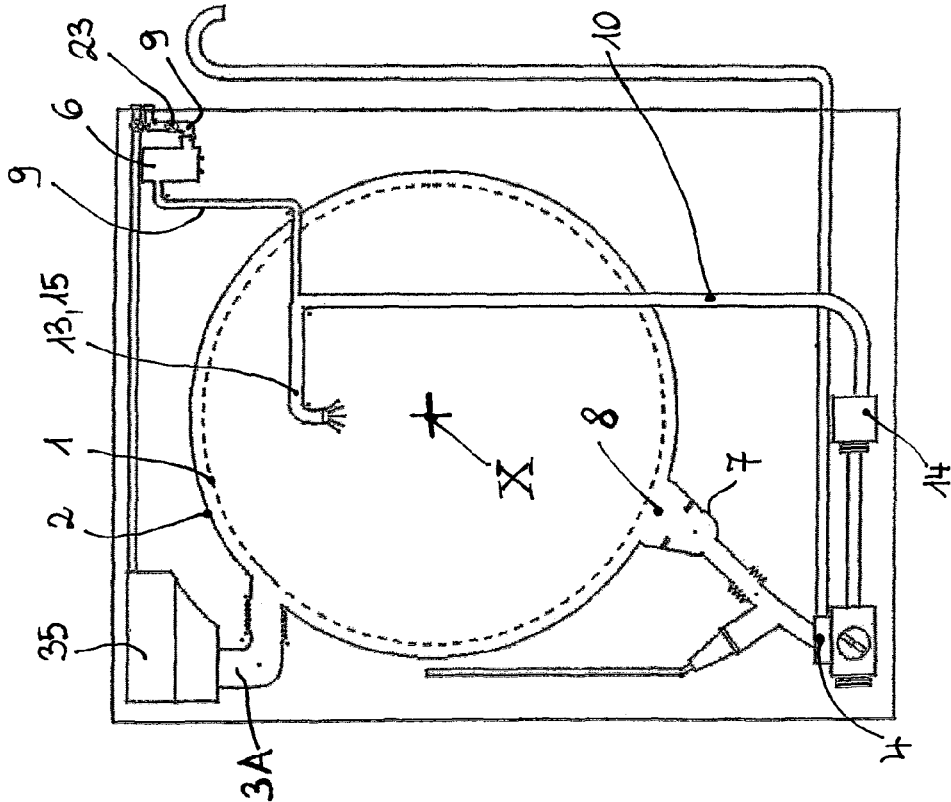


Fig. 2

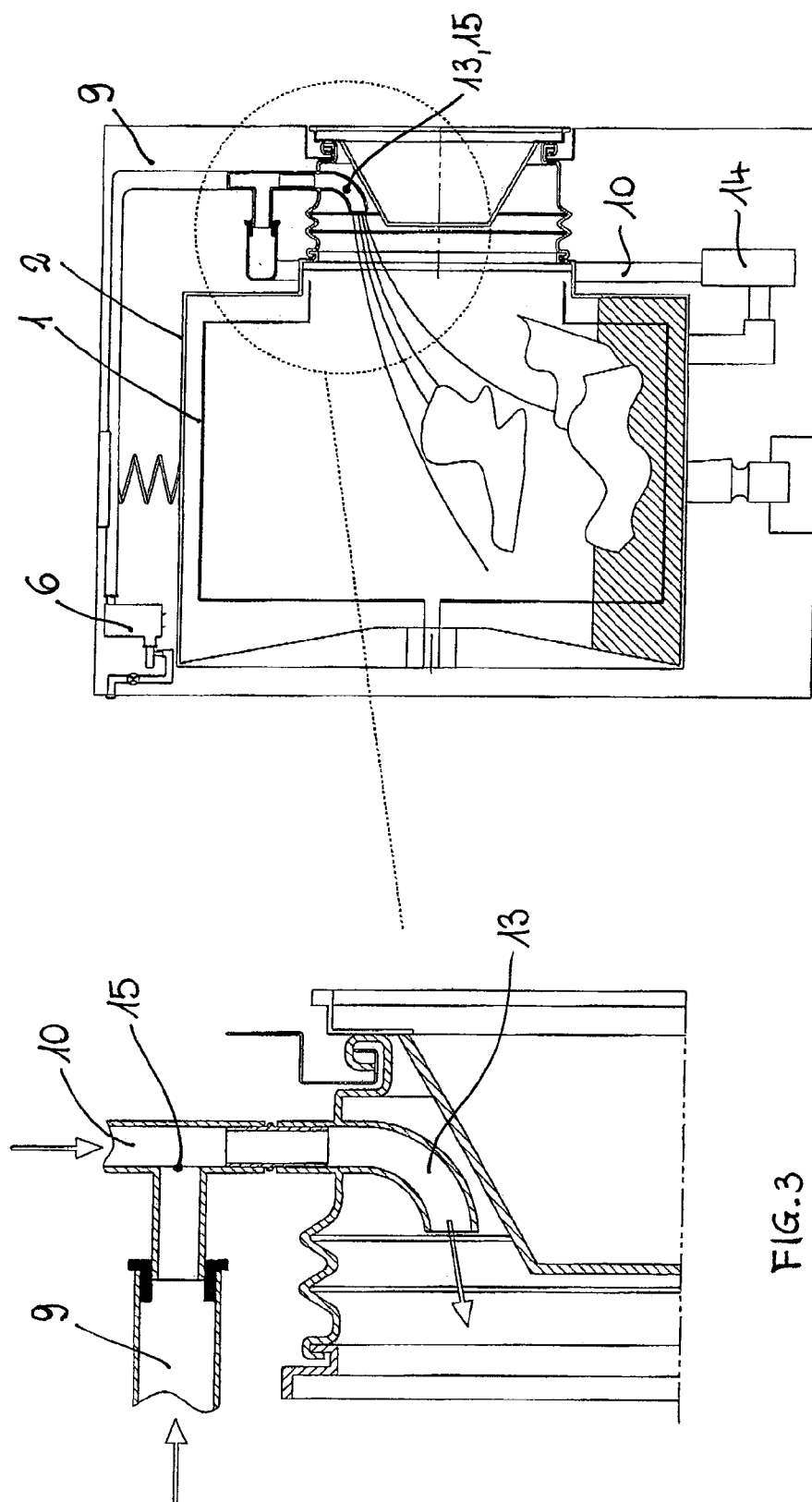


FIG. 5

FIG. 3

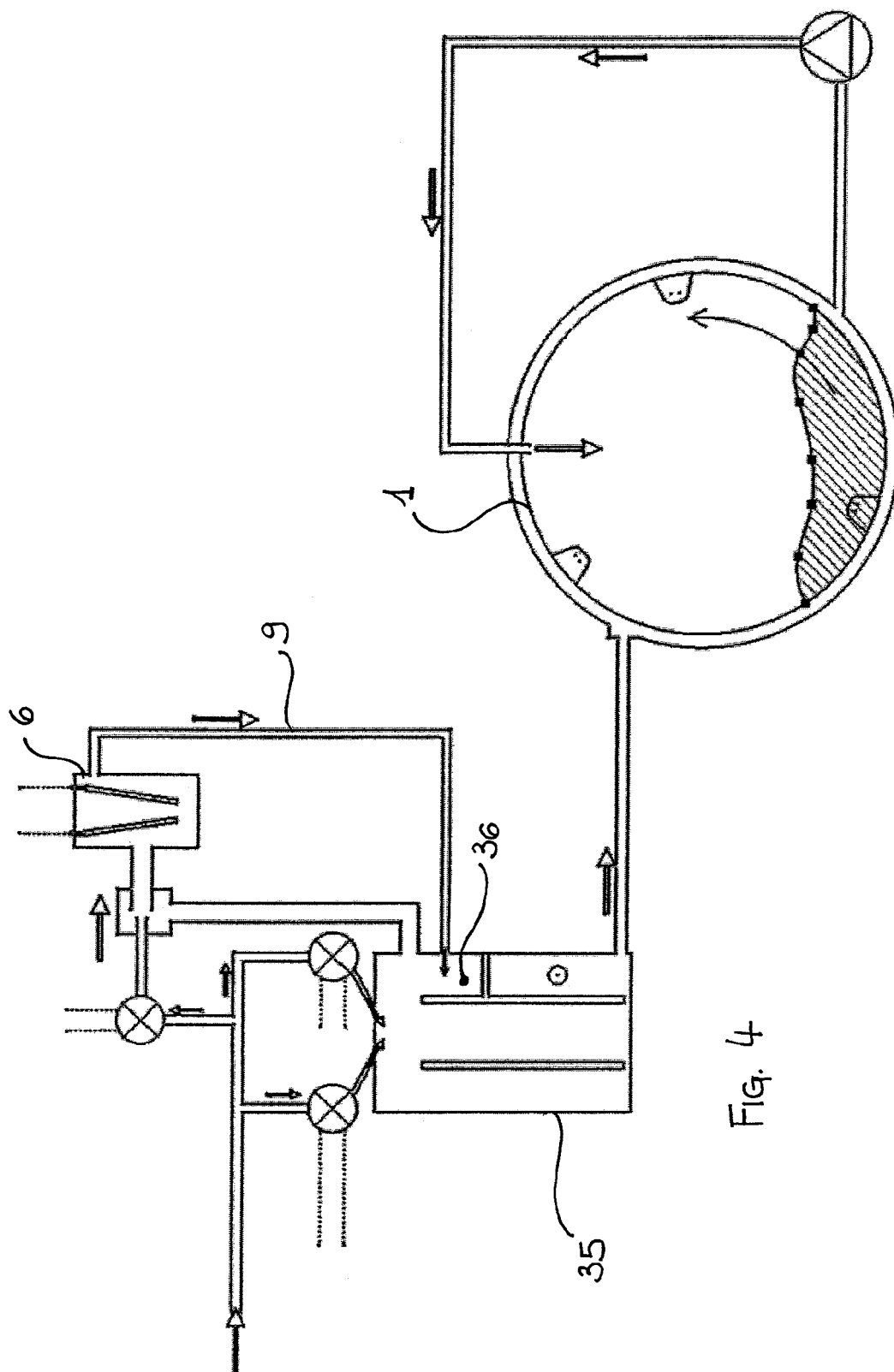


Fig. 4

Concentration of silver ions on cotton samples - Without Jet-System
 Load: 4 kg cotton Sample dimension: 10x10 cm Number of samples per load: 10

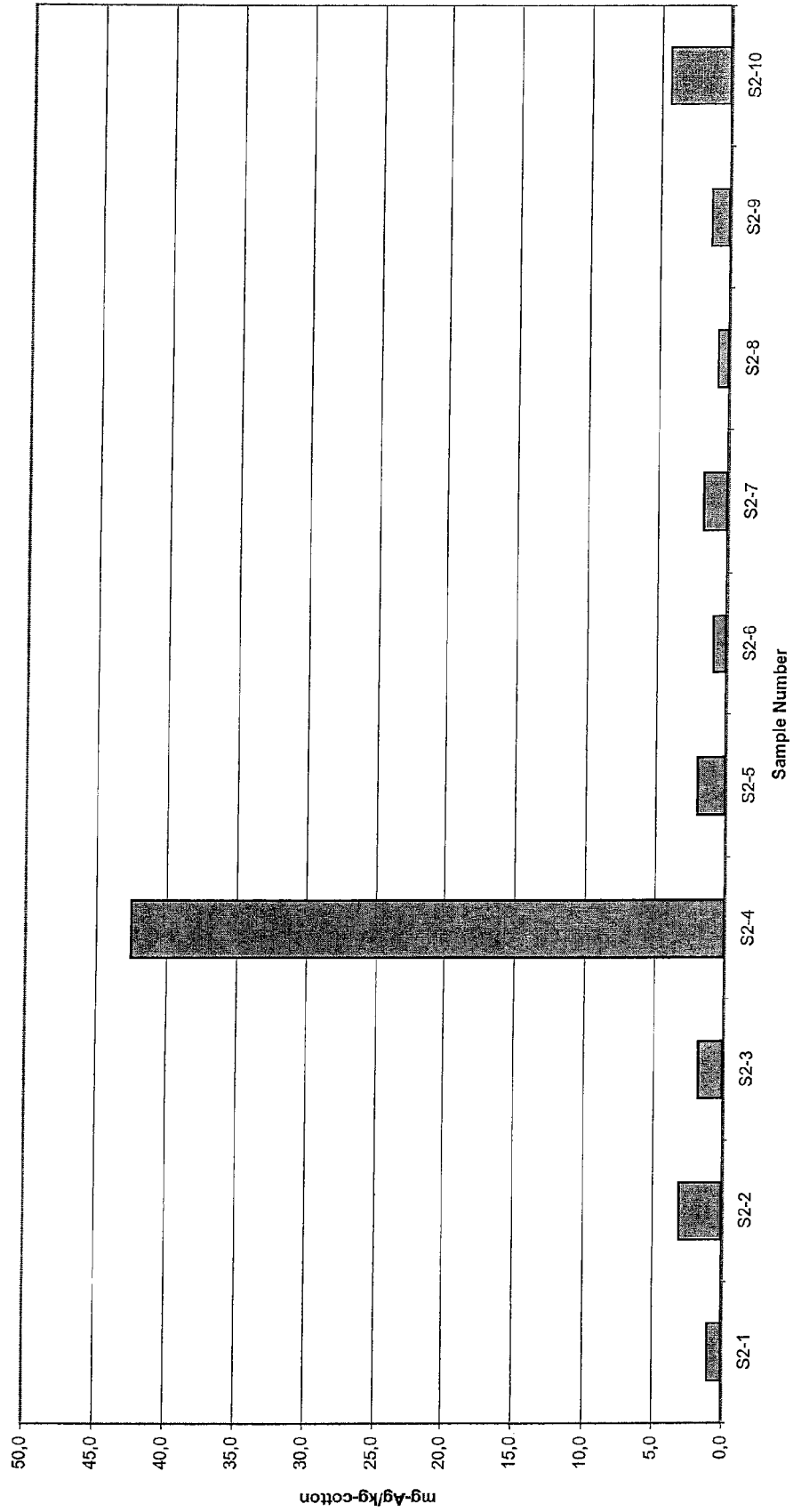


FIG. 6

Concentration of silver ions on cotton samples - With Jet-System
 Load: 4 kg cotton Sample dimension: 10x10 cm Number of samples per load: 10

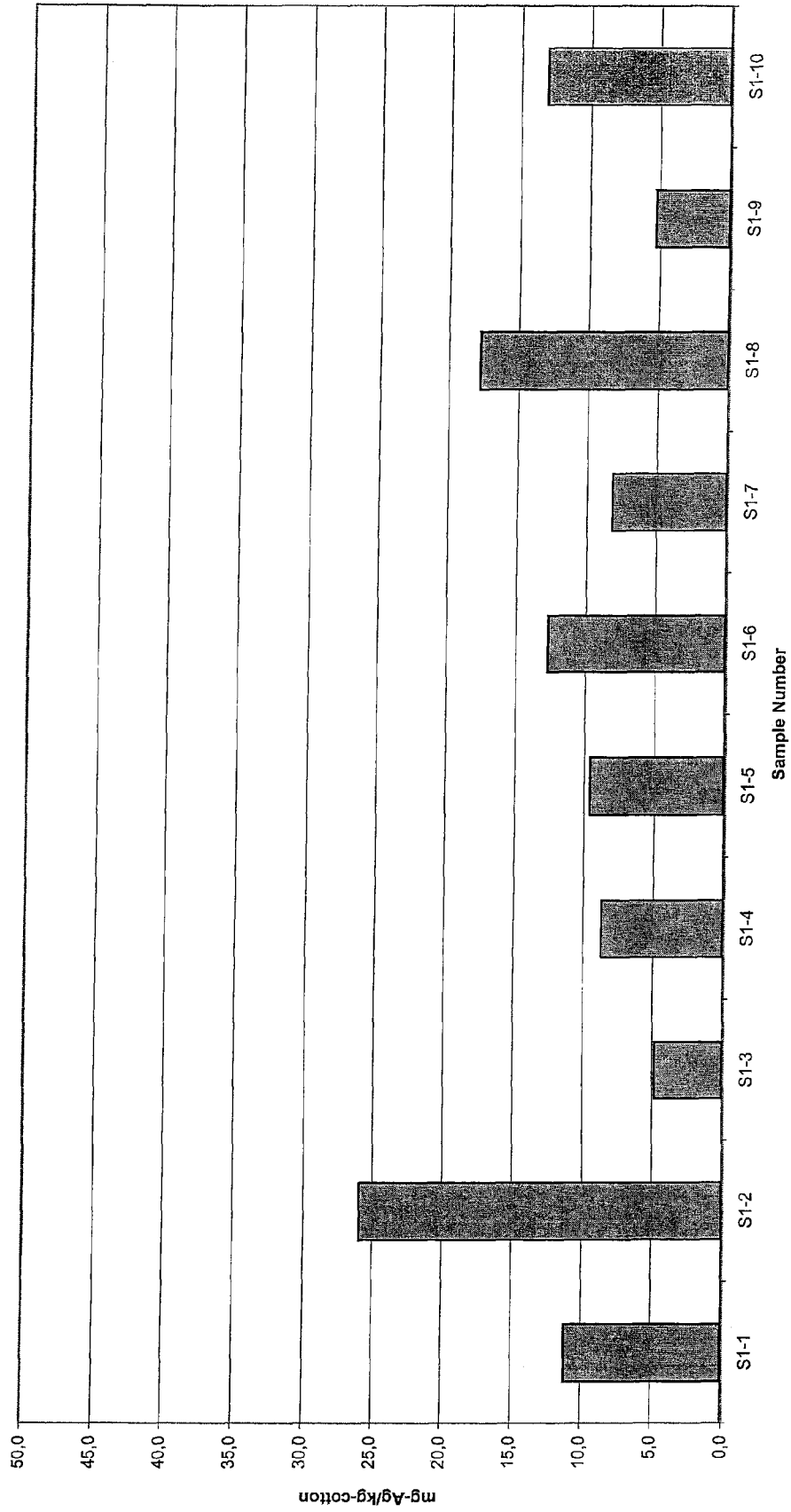


FIG. 7

FIG. 9

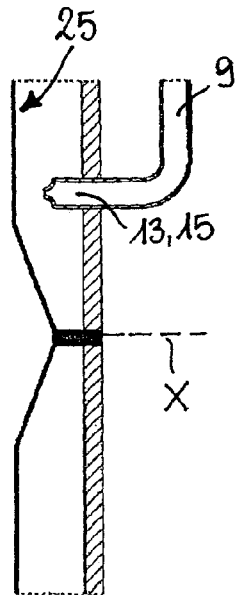
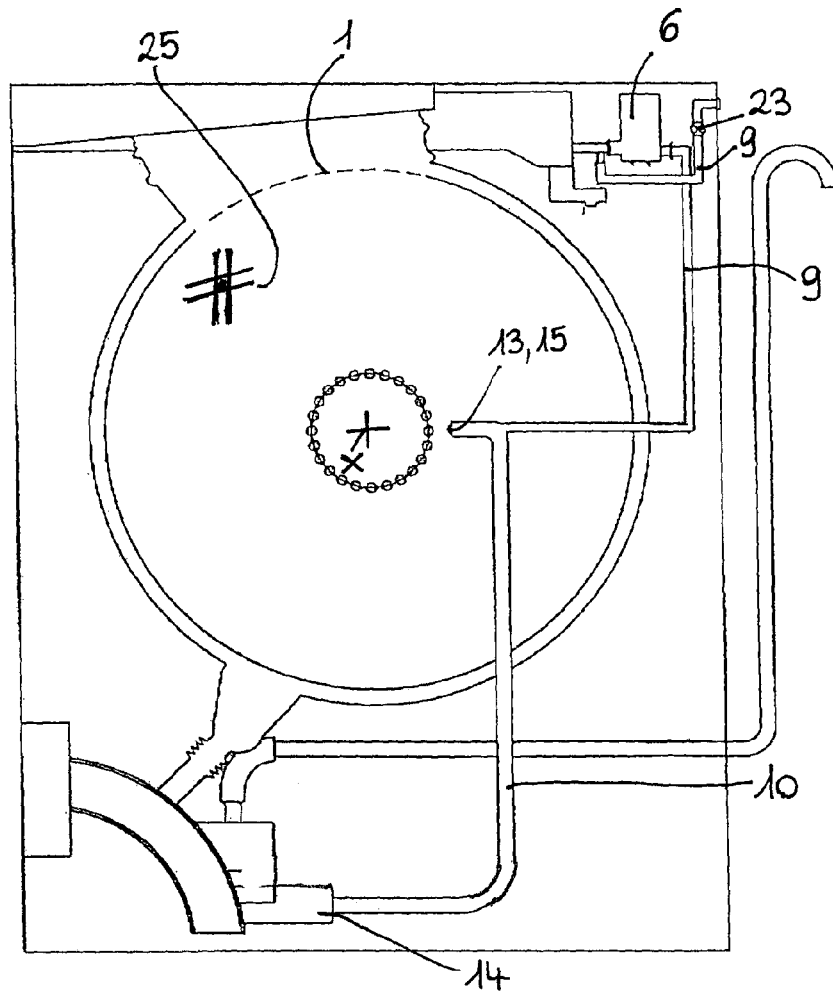


FIG. 10

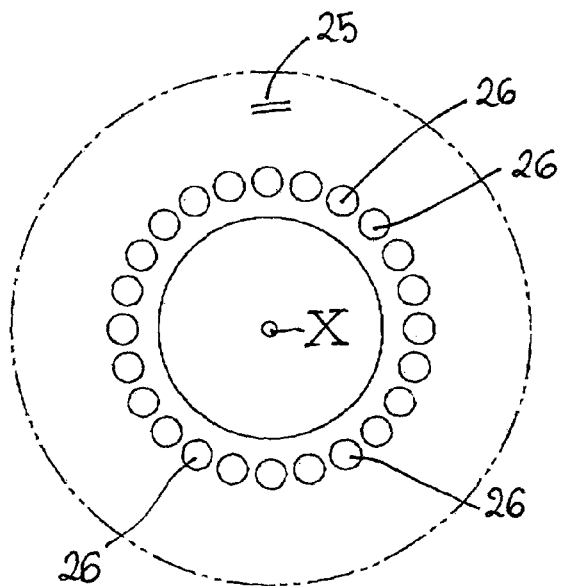


FIG. 11

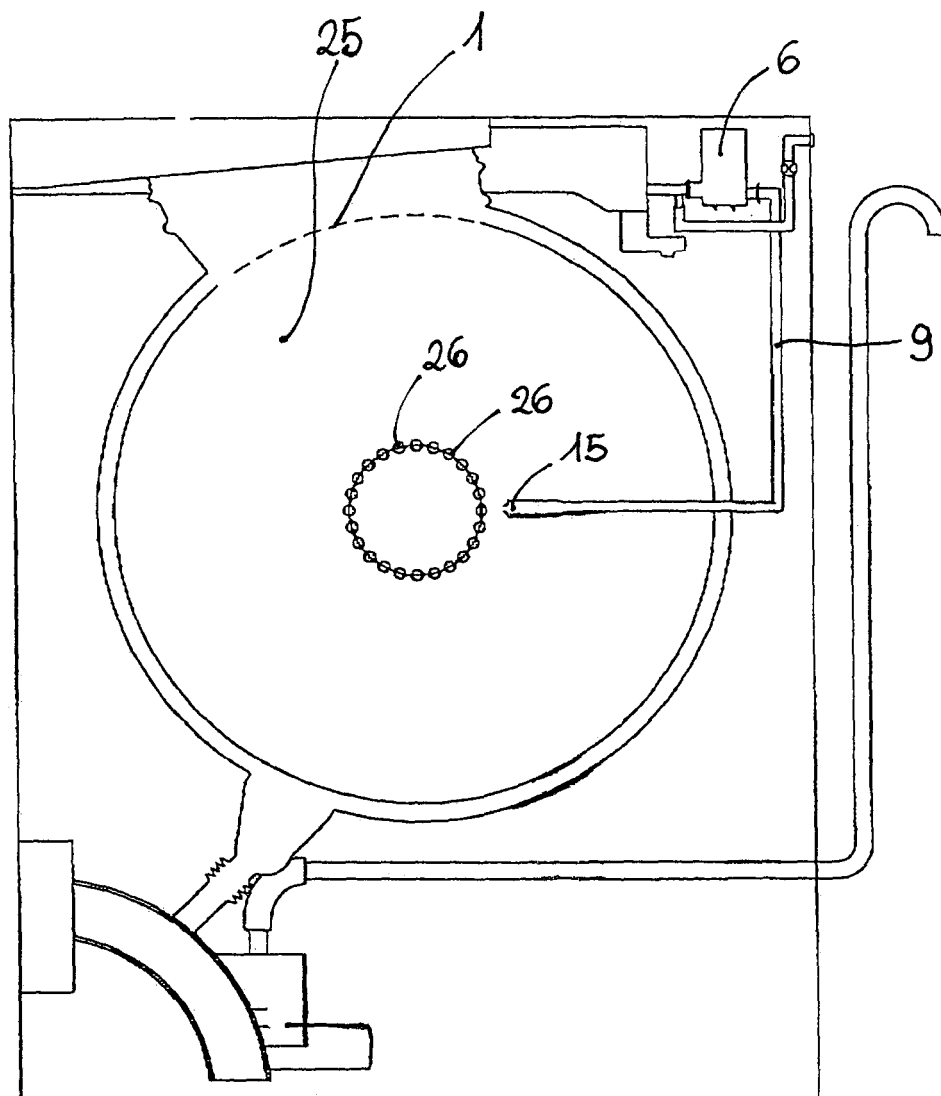
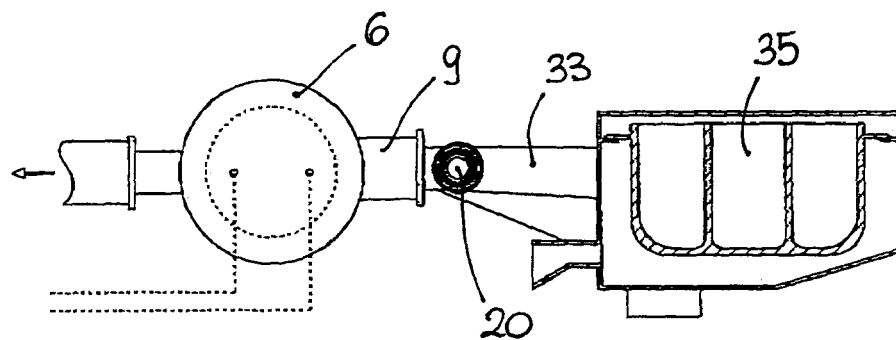
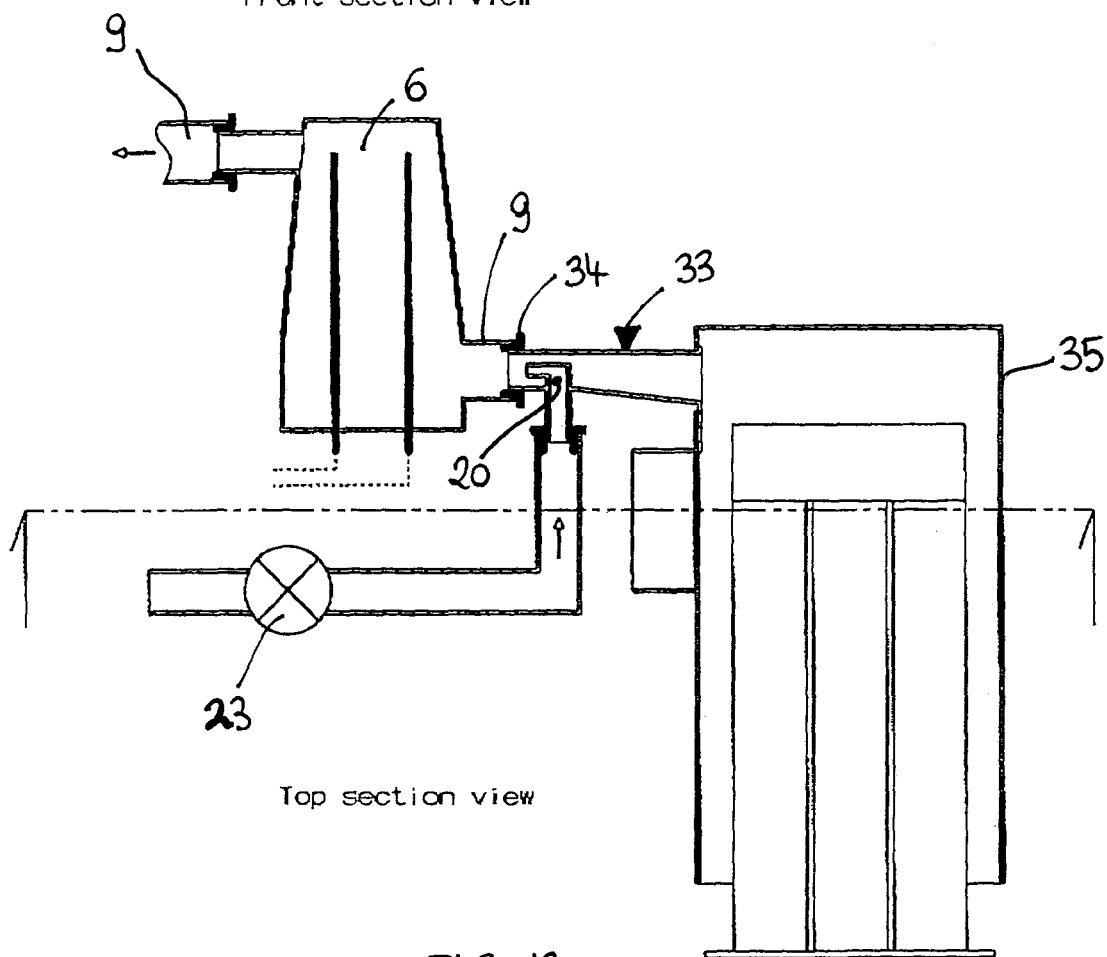


FIG. 12

FIG. 14



Front section view



Top section view

FIG. 13



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EUROPEAN SEARCH REPORT

Application Number
EP 05 11 0775

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Place of search Munich		Date of completion of the search 2 December 2005	Examiner Weinberg, E
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Place of search Munich		Date of completion of the search 2 December 2005	Examiner Weinberg, E
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