

Apparatus for cleaning tubs which contain liquid under operating conditions and use of the apparatus in a washer chamber

The invention relates to an apparatus for the cleaning of tubs which contain liquid under operating conditions. It can also preferably be used, in particular, for washer chambers of aeration plant but also for water containers in cooling towers or cooling water reservoirs in air conditioning plant where there is also a constant supply of liquid.

During the operation of washer chambers of, in particular, aeration plant, deposits settle on the bases of the tubs in which a certain level of liquid is continuously maintained and lead to silting of the respective liquid, generally water. Chemicals are added, for example to prevent lime deposits and growth of algae, but these are only effective for a short period and also result in dead algae. This plant therefore has to be shut down and cleaned from time to time with or without chemicals, generally by hand. This is carried out at least every fortnight in the case of washer chambers of humidifiers or in the case of water containers of cooling towers.

GB 1 459 853 discloses an automatic cleaner for swimming pools wherein a suction device which can be moved by a drive communicating with a delivery pipe is arranged on the base of the tub, wherein the drive is effected by a pressure fluid and drives a water wheel which is non-positively coupled to a displacement means contacting the base of the tub and with a filter unit which is connected to a suction pipe. The base of the swimming pool has to be at such an inclination that the suction device equipped with three wheels cannot be overturned as it moves. The suction device also comprises a collecting bag for aspirated components, which constantly has to be opened periodically.

DE-C2-31 51 529 discloses an apparatus for removing sediment from a precipitation tank in which sediment from a liquid to be clarified settles during operation, with a dirt collecting device which can be submerged in the liquid, with a switching device comprising a first part capable of moving with respect to a second part, with a device for alternately stopping the movement of each of the two parts with respect to the container, wherein the unstopped part can be moved with respect to the container and with respect to the stopped part, and with a driving device for moving the unstopped part with respect to the other part, wherein the dirt collecting device can be moved over the container base during operation, wherein the switching device can be submerged in the liquid in the vicinity of the sediment deposited therein and the dirt collecting device is arranged on the switching device and the stopping device comprises a clamping device actuatable by liquid pressure, a diaphragm possessing an inlet for the supply and discharge of liquid for expansion and compression of the diaphragm, and a clamping plate which can be moved during expansion of the diaphragm into a position in which its movement and that of the associated part is stationary with respect to the container.

An object of the invention is to improve a device according to GB 1 459 853 so that it can be operated continuously and allows a predetermined area to be cleaned without constantly having to be stopped.

This object is achieved with an apparatus having the characteristics of claim 1.

The sub-claims describe advantageous developments of the invention.

The invention also relates to a use of the apparatus according to the invention in washer chambers.

This object is achieved by an apparatus for the cleaning of tubs, into which liquid flows under operating conditions, having the characteristics of claim 1.

Sub-claims 2 to 12 relate to advantageous developments.

Claim 13 relates to the use of the apparatus in washer chambers.

The invention is described in more detail hereinafter by means of a washer chamber of an aeration plant with reference to schematic drawings in which

Fig. 1 is a longitudinal section through a washer chamber of a humidifier;

Fig. 2 is section II-II from Fig. 1 of the washer chamber;

Fig. 3 is a partial section through a suction device;

Fig. 4 is a section through a suction chamber of the suction device;

Fig. 5 is a section through a pressure chamber of the pressure device.

The washer chamber 1 shown in Fig. 1 comprises a tub 2 arranged on the base. A fan 3 for incoming air is arranged outside the washer chamber 1 on one lateral wall. Rectifier profiles 3a for the incoming air supplied by the fan 3 are arranged on the side of the washer chamber 1 facing the fan 3. Drainage profiles 4 are arranged on the outlet side with the lower end projecting into the tub 2. On the base 6 of the tub 2, a suction device 5 is arranged movably over the base 6 of the tub 2. The suction device 5 preferably covers a cross section of the tub 2 and is preferably arranged so that it can

move to and fro parallel to the rectifier profiles 3a and the drainage profiles 4 in the tub 2, as indicated by the double arrow in Fig. 2.

A brush unit 7 is arranged inside the washer chamber 1 in such a way that its bristles can enter the entry region of the drainage profiles 4, the drainage profiles 4 being mechanically cleaned of deposits during the up and down movement of the brush unit 7. The brush unit 7 can consist of rigidly arranged brushes with rigid bristles and/or also of a brush roller with flexible and/or rigid bristles.

Spray nozzles 8 are arranged in the washer chamber 1 between the front and rear end face, distributed over the height in the lateral walls and directed towards one another in a plane (see Fig. 2). The spray nozzles 8 are connected via a piping system 9 to a pump 10 of which the suction nozzle 11 opens in a lateral or end wall of the tub 2 beneath the ever present level of liquid 12 in the tub. A preferably exchangeable filter 13 can be arranged in front of or behind the pump 10 in the suction nozzle 11 or in the piping system 9. In a particularly preferred embodiment, the filter 13 is arranged in the straight part of a diverting elbow (indicated in Fig. 2). This allows a rapid exchange of a circular filter adapted to the pipe diameter by opening of the lid, removal of the circular filter, optionally the flushing thereof and reinsertion or insertion of a new filter into the path of flow and re-closure of the lid.

The suction device 5 can be connected by a flexible suction pipe 14 to a known filter plant, not shown, which contains a delivery pipe 15 for recirculating the cleaned liquid (water) in addition to a filter, valves and pumps. The filter plant can be so designed that the filter is exchangeable and backwashable and comprises nozzles for drainage and silt removal, wherein valves, for example solenoid valves, controlled via time clocks can also perform an operating

programme, which is predetermined or is controlled on the basis of test parameters automatically, optionally also with interposition of sensors. As filter plant of this type and developments thereof are widely known, they will not be described here. The cleaned liquid can be recirculated to the tub 2 by means of the delivery pipe 15 of the filter plant.

As already mentioned, the suction device 5 should be movable to and fro within the tub 2. The water pressure supplied through the delivery pipe from the filter plant can preferably be used for this purpose. To this end, the suction device 5 contains a central pressure chamber 16 (see Fig. 3 and 5) in which a water wheel 18 is arranged rotatably on an axis of rotation 17 or round a stationary axis. The delivery pipe 15 passes into a nozzle 19 which ends in two separate passages 20, 21 into the pressure chamber 16 arranged symmetrically to the central axis ZA (Fig. 5) at a distance therefrom. The passages 20, 21 are preceded by a two-way valve 22 which selectively seals one of the two passages and opens the other or vice versa. Roughly in the 90° to 130° range and in the 230° to 270° range of the cross section the central pressure chamber 16 comprises longitudinal slots 23 with flaps 24, the flaps 24 being arranged movably in such a way that they close when flown against from above and open when flown against from below (see the arrows with black heads in Fig. 5).

In the embodiment according to Fig. 3 and Fig. 5, the axis 17 or the water wheel 18 is coupled to a displacement means in the form of belts, preferably two mutually spaced toothed belts 25 (only one of which is shown in the partial section in Fig. 3). The toothed belts 25 are guided by return rollers or return toothed wheels 27 mounted rotatably on the housing of the suction device 5 preferably at the end of extension arms 26 and can additionally be guided at least via a support roller or a support gearwheel 28 in the intermediate region. The toothed belt 25 can preferably also have teeth on both

sides to increase the friction on the base 6 of the tub 2. With a design of this type, inclinations of the base and small steps do not pose any problems.

Brushes 29 (see Fig. 3) which are stationary and/or rotate and/or perform up and down and/or to and fro movements and are in contact with the base 6 of the tub 2 are provided between the displacement means and to the side of it. To compensate wear, the brushes 29 can be adjustable and can optionally also be driven, preferably via a clutch with the drive of the displacement means, optionally with interposition of a gear for varying the speed of movement or the speed of rotation or the frequency of the proposed rotational and/or to and fro movements of the brushes 29. Rotating brushes can optionally also be used as displacement means.

Suction chambers 30 (Fig. 1 showing a suction chamber on only one side) which communicate with the connecting nozzles 32 of the suction pipe 14 via a duct 31 arranged above the central chamber 16 are arranged, in particular, on either side of the central pressure chamber 16. In the direction of the base 6 of the tub 2, the suction chambers 30 have intake orifices 33 in the vicinity of the brushes 29 (see Fig. 4).

At least one duct 34 (Fig. 4) which is connected at each end to the suction chambers 30 can preferably additionally be provided beneath the central pressure chamber 16. These ducts 34 can have slot-shaped and/or annular intake apertures 33'.

As mentioned hereinbefore, the suction device 5 should preferably be designed so as to cover a cross section of the tub 2, preferably that with the smallest dimensions. This can optionally be achieved with lateral projections or extension arms (not shown) which should then also carry stationary or moving brushes. To guarantee directed movement and to prevent tilting of the suction device 5 during its longitudinal movements within the tub 2, the suction device 5 can be

designed with a guide system which also includes arrangements in the lateral walls of the washer chamber 1. Fig. 3 illustrates a possible guide system of this type which consists of two spaced guide rollers 37 (only one of which is illustrated) on each end face of the suction device 5 and one respective guide rail 38 formed in the lateral walls of the tub 2, preferably above the water level 12, and brush devices can optionally also be provided for cleaning the guide rails 38 (not shown). Any other desired known guide can also be used, for example also a remotely controlled system which allows the base aspirator any free or predetermined movement over the base, this being useful, in particular with relatively large tubs, where it would be difficult or impossible to handle a base aspirator covering a cross section.

If the cross section of a tub 2 is somewhat greater, several suction devices 5 can also be arranged side by side and can be coupled to one another in use. Each of the suction devices 5 can be virtually identical in construction and can be mutually coupled purely mechanically. However, it is also possible to arrange, in particular, smaller modules at each end of a suction device 5, wherein the drive of the water wheel 18 can be transmitted to the secondary modules via a clutch to the rotatable axis 17. A flexible connecting pipe can optionally connect the suction chamber 30 to corresponding chambers of the secondary modules. This can also be effected by a direct connection via a closable orifice 39 (see Fig. 3) in the suction chamber 30.

The device according to the invention for the cleaning of tubs operates as follows. With a suction device 5 arranged on the base of a tub and designed in accordance with the foregoing description, cleaned liquid (water) is supplied through the delivery pipe 15 into the suction device 5. Water under pressure is supplied to the blades of the water wheel 18 to the side of the central axis ZA, depending on the position of

the two-way valve 22. The water wheel 18 is therefore set into rotation and the flow of water indicated by closed arrows in Fig. 5 is achieved. This flow closes the flaps 24 of the slots 23 as it descends, so a closed wall is formed. During further movement to the opposite side, the same stream opens the flaps 24 of the slots 23 in the range of the 230° to 270° position so that the stream of water under pressure issues from the housing and the pressure is reduced. The displacement means, at least two toothed belts 25 arranged at a distance from one another in this case, is also moved by the rotational movement of the water wheel and, with the direction of flow illustrated by black arrows in Fig. 5, the suction device moves to the right in Fig. 5. This movement is assisted by the discharge of the stream of water under pressure through the opened flaps 24 of the slots 23. If the suction device 5 driven in this way reaches one end face of the tub 2, a limit switch, not shown, on the suction device 5 in contact with the end wall actuates the two-way valve 22 so that the passage 21 is closed and the passage 20 is opened so that the fresh supply of the stream of water under pressure in the direction of the open arrow in Fig. 5 causes a reversal of the direction of movement of the water wheel 18 so a reversal of movement is also achieved. The same applies on attainment of the other end face of the tub 2. The suction device 5 therefore moves automatically over the entire base of the tub, moving it continuously to and fro, and keeps it free from deposits owing to the aspiration and the mechanical cleaning by the brushes.

The speed of movement can be influenced by changing the water pressure supplied, optionally also by controllable flow control valves. The base 6 of the tub 2 is continuously treated mechanically by the brushes 29 so deposits are unable to settle on the base of the tub. Falling particles are swirled from the base so they can be grasped particularly easily by the suction stream. The particularly endangered

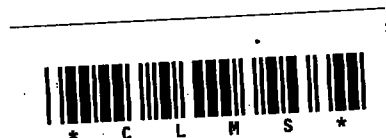
edge regions are aspirated more intensively by the arrangement of the suction chambers at the ends of the apparatus, so deposits are more strictly prevented at these critical edge regions.

Since there is virtually only cleaned liquid (water) in the tub, the shelf lives of the spray nozzles 8 in the washer chamber 1, which are also arranged laterally with protection, are invariably charged with cleaned water so deposits cannot form either internally or externally. For this reason, it is not absolutely essential to provide a filter in the supply pipe at all, let alone at the outlet of the suction nozzle where it is arranged in known devices. The use of a filter which can be exchanged, in particular, in the manner described hereinbefore, additionally increases the shelf lives of the spray nozzles 8. The brush unit 7 which can be displaced up and down cleans the drainage profiles 4 in their inlet region which is particularly endangered by deposits, so the shelf life thereof is also extended considerably prior to general cleaning.

To sum up, the characteristics according to the invention allow continuous cleaning of inorganic and/or organic deposits from the tub and allow the shelf life of devices containing the subject of the invention to be substantially extended.

Claims

1. Apparatus for cleaning tubs filled with a liquid, wherein a suction device (5) which can be moved by a drive communicating with a delivery pipe (15) is arranged on the base (6) of the tub (2), wherein the drive is effected by a pressure fluid and drives a water wheel (18) which is non-positively coupled to a displacement means contacting the base of the tub (2) and with a filter unit which is connected to a suction pipe (14), characterised in that the suction device (5) is provided with a guide system (36) for its to and fro movements and with a two-way valve (22) which can be actuated by limit switches for the alternative opening of a passage (21) or (20) for reversing the movement of the water wheel (18).
2. Apparatus according to claim 1, characterised in that the suction device (5) is connected to the suction pipe (14) of a filter unit provided with a pump and comprises at least one suction chamber (30) communicating with the suction pipe (14) and one pressure chamber (16) communicating with the delivery pipe (15) of the pump.
3. Apparatus according to claim 2, characterised in that the suction chamber (30) and/or the pressure chamber (16) consist respectively of a plurality of spatially separated partial chambers appropriately connected to the suction and delivery pipe (14, 15).
4. Apparatus according to one of claims 1 to 3, characterised in that the suction device (5) comprises cleaning brushes (29).
5. Apparatus according to claim 4, characterised in that at least one cleaning brush (29) is driven.



6. Apparatus according to claim 5, characterised in that at least one driven cleaning brush (29) serves as displacement means.
7. Apparatus according to one of claims 1 to 5, characterised in that the displacement means comprises at least two mutually spaced toothed belts (25).
8. Apparatus according to one of claims 1 to 7, characterised in that the pressure chamber (16) comprises slots (23) on mutually opposed wall faces.
9. Apparatus according to claim 8, characterised in that the slots (23) are provided with movable closure flaps (24).
10. Apparatus according to one of claims 1 to 9, characterised in that the suction device (5) covers the cross-sectional width of the tub (2).
11. Apparatus according to claim 10, characterised in that the suction device (5) has a base profile adapted to the cross-sectional base profile of the tub (2).
12. Apparatus according to claim 10 or 11, characterised in that the suction device (5) covering the cross-sectional width of the tub (2) consists of a plurality of modules arranged side by side.
13. Use of the apparatus according to one of claims 1 to 12 in a washer chamber.

