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TANK WASHING EQUIPMENT

THIS INVENTION concerns tank washing equipment particularly, though not exclusively, for flushing away settled solids from the bottom of a storm or humus tank after drainage thereof.

Usually such tanks have an inclined floor so that the tank has a shallow end and a deep end.

Conventional devices for cleaning the bottom of such tanks before or after drainage consists essentially of mechanical devices which sweep the tank bottom from end-to-end to collect and transfer the solids progressively towards an outlet, usually at the deep end of the tank.

Such equipment is normally located in the base of the tank where it is subjected continuously to the hostile environment therein, leading to rapid wear and failure of the equipment and poor cleansing results.

According to the present invention, there is provided a tank washing system having means for sweeping residual solids along the tank bottom towards a collection

outlet therein; characterised in that said sweeping means comprises at least one row of jet nozzles spaced apart across a tank; means supplying a jet of washing medium directed via said nozzles at least at the tank bottom initially in one end region thereof; and means for swinging the nozzles forwardly and upwardly through an arc to direct said medium progressively along the tank bottom thus to generate a surge or wave of said medium which sweeps along the tank bottom from the said one end region towards the other end thereof and entrains settled solids therein.

Preferably, two or more such rows of jet nozzles supplied with washing medium, are provided with means for swinging said rows successively such that a first row sweeps an initial part of the length of the tank bottom, and the or each succeeding row of nozzles is swung forwardly and upwardly to sweep a region of the tank bottom forwards of that swept by the immediately preceding row, the velocity of flow of washing medium from the or each succeeding row of nozzles being greater than that from the preceding row, such that the velocity at which the washing medium is projected from the nozzles increases progressively as said wave sweeps along the tank.

Still further, it is preferable that washing medium commences to be directed from each succeeding row of nozzles before the flow from the immediately

preceding row is discontinued thereby to provide a slight overlap and thus avoid hydraulic shock loading.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Fig. 1 is schematic, part-sectional side view elevation of a tank washing system located within one end region of a tank;

Fig. 2 illustrates, in vertical cross-section, the internal structure of each of a series of jet nozzles forming part of the system as illustrated in Fig. 1;

and Fig. 3 is a diagrammatic illustration of the system with means to supply washing medium to the nozzles.

Referring now to the drawings, there is illustrated a tank 10 having an end wall 11 and a floor or bottom 12. Preferably, although not illustrated in Fig. 1, the tank floor 12 slopes progressively away from the end 11 towards an opposed deeper end.

The washing system includes a bracket assembly 13 attached to end wall 11, on which is

rotatably mounted three transverse supply pipes 14 each carrying and communicating internally via ports 15 with a series of transversely spaced jet nozzle pipes. In a first series 16, such nozzle pipes are relatively short and are spaced apart by a distance of say 700 mm across the length of the first and lowermost supply pipe 14. The pipe 14 is connected by an arm 17 to a linear actuator 18 so that it may be rotated in bearings or rotary unions 19. Thus it is possible to swing the first set of nozzle pipes 16 about an arc such that the nozzles sweep forwardly and upwardly along the tank.

Similarly, two further rows 20 and 21 of nozzle pipes are connected respectively by arms 22 and 23 to linear actuators 24 and 25. The apparatus is illustrated in Fig. 1 in preparation for a washing cycle although the first row 16 of nozzle pipes may point or be rotated backwards to be directed at the adjacent end 25 of the tank.

Referring now to Fig. 3 a washing medium supply system for producing, in this example, a supply of water, comprises an initial supply pump 30 connected via a motorised valve 31 to a storage vessel 32. Level sensors 32a and 32b control operation of pump 30 to ensure that the vessel 32 id maintained full. The

outlet of the storage vessel 32 is connected by a motorised valve 33 to a delivery pump 34 having a 50 kilowatt rating and being capable of delivering water at 2 cubic metres per minute.

Through a manifold pipe 35 the pump 34 supplies water via motorised valves 37, 38 and 39 to the supply pipes 14 extending transversely across the tank.

Preferential setting of the motorised valves 37 to 39, or alternatively the provision of flow restrictors within the transverse pipes 14, is designed to ensure that the first set of nozzles 16 may direct water at a pressure of 2 - 5 Bar whilst the second set issues at 4 - 8 Bar and the third at 7 - 10 Bar.

The outlet aperture at the tip of each nozzle determines the velocity of liquid issuing from the nozzle, commensurate with the supply pressure.

In operation, when it is desired to wash the base of the tank 10, a 3 - 5 minute operational cycle commences by initially opening the valves 33 and 37 to permit water to flow to the first set of nozzles 16. The pressure and velocity are sufficiently low to avoid damage to the tank floor beneath the nozzles whilst nevertheless establishing a wave of water in the region

beneath the nozzles.

Simultaneously, linear actuator 18 is extended to cause nozzles 16 to swing forwardly and upwardly thus advancing the wave of water until the first row of nozzles reach a point at which they are approaching the same angle of inclination as the second row of nozzles 20. Slightly before the first row reaches the end of its travel, the valve 38 to the pipe serving the second set of nozzles is opened so that water at a higher velocity but lesser volume is projected from the second set of nozzles 20. Once the second set has been actuated the first set 16 is switched off by valve 37 and then the second pipe 14 is swung forwardly and upwardly to continue progressing the wave of water and settled solids down the tank.

Again, immediately before the second set of nozzles 20 reaches the end of its arcuate travel, the third set 21 is activated at a very high velocity providing "reach" to continue progressing said wave right to the far end (usually the deep end) of the tank 10, whilst valve 38 shuts off nozzles 20.

The establishment and maintenance of a travelling wave of liquid and suspended solids ensures that the latter are efficiently and completely washed

down to the other end of the tank where they may be disposed of via an outlet (not shown).

It will be seen from Fig. 2 that each nozzle pipe contains a rear end plug 40 which may be removed for rodding thus to clear any blockages which may occur in the nozzles.

Commencement of flow from each succeeding set of nozzles before the preceding set has been turned off, minimises hydraulic shock loading.

Once the washing cycle is complete each of the three linear actuators are returned rapidly to their starting positions in readiness for the next wash cycle.

Each of the rotary unions 18 is of the carbon faced type, and the rotational movement generated by each linear actuator is controlled by a variable speed motor connected to an a computerised control panel which memorises the variables so that once a tank has been commissioned to create an efficient washing programme the operation will be repeated automatically. Thus the operational cycle may be controlled very precisely in accordance with the prevailing conditions. The jet orifice size and the shape of "footprint" created thereby may be interchangeable to suit a

particular tank configuration.

In very long tanks it may be necessary to duplicate the apparatus at a number of positions along the tank, each subsequent assembly being actuated in timed sequence from the previous one to ensure that each assembly takes up the travelling wave and continues to move it towards the outlet end of the tank.

It is not intended to limit the invention to the above example only. For example, in very short tanks two or perhaps only one row of swing nozzles may be sufficient to create and maintain a wave of liquid travelling along the tank bottom.

Furthermore, in the embodiment described, instead of three separate linear actuators, a single actuator may be used and connected progressively to the three arms 17, 22 and 23 by a lost motion mechanism. Yet again, each of the pipes may be connected to an individual direct drive electric motor.

Whilst the first set of nozzles illustrated in Fig. 1 is shown as directed vertically downwards towards the tank bottom it may be mounted on its respective pipe at more of a backwards angle thus to

direct its initial feed of water to a position close to the adjacent end of the tank.

By modifying the configuration of each nozzle pipe so that it shall be curved in a generally vertical plane, and by providing means for rotating each nozzle pipe about its longitudinal axial connection to the supply pipe, in an oscillatory manner, it will be possible to direct the washing medium from each nozzle from side-to-side as the nozzle is swung forwardly. However, in most cases the necessity for this will be avoided by ensuring a wide footprint from each nozzle which overlaps with that issuing from adjacent nozzles in the row.

In Fig. 3, the tank 10 is shown as divided into three separate sections, and the supply pipes 14 may be sectionalised similarly by shut off valves, so that each tank section may be washed separately and in sequence if required.

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CLAIMS

1. A tank washing system having means for sweeping residual solids along the tank bottom towards a collection outlet therein; characterised in that said sweeping means comprises at least one row of jet nozzles spaced apart across a tank; means supplying a jet of washing medium directed via said nozzles at least at the tank bottom, initially in one end region thereof; and means for swinging the nozzles forwardly and upwardly through an arc to direct said medium progressively along the tank bottom thus to generate a surge or wave of said medium which sweeps along the tank bottom from said one end region towards the other end thereof and entrains settled solids therein.

2. A tank washing system according to Claim 1, including two or more such rows of jet nozzles supplied with washing medium, means for swinging said rows successively such that a first row sweeps an initial part of the length of the tank bottom, and the or each succeeding row of nozzles is swung forwardly and upwardly to sweep a region of the tank bottom forwards of that swept by the immediately preceding row, and means such that the velocity of flow of washing medium from the or each succeeding row of nozzles is greater than that from the preceding row such that the velocity at which the washing medium is projected from the nozzles increases progressively as said wave sweeps along the tank.

* C L M S *

3. A tank washing system according to Claim 2, wherein said rows of nozzles are supplied with washing medium successively and means are provided to commence directing washing medium from each succeeding row of nozzles before the flow from the immediately preceding row is discontinued thereby to provide a slight overlap and thus avoid hydraulic shock loading.

4. A tank washing system according to Claim 2, wherein said first row of nozzles is located at a position spaced inwardly from the adjacent end of the tank and is adapted to direct washing medium at the tank bottom initially at said adjacent end, at the commencement of its swinging motion.

5. A tank washing system according to any preceding claim, including a washing medium supply system which consists of a storage vessel for the washing medium, one or more level sensors to maintain a predetermined level of washing medium therein, one or more delivery pumps for supplying washing medium to the storage vessel, one or more rotatable supply pipes to which said nozzles are connected, and a plurality of valves to control the supply of washing medium selectively to said rows of nozzles.

* C L M S *

6. A tank washing system according to any preceding claim, including means to ensure that, in a set of three rows of nozzles, the nozzles of the first row may direct washing medium at a pressure of 2 - 5 bar whilst the second row issues at 4 - 8 bar and the third at 7 - 10 bar.

7. A tank washing system according to Claim 2, wherein the nozzles of the or each succeeding row are of greater length than those of the preceding row.

8. A tank washing system according to Claim 5, wherein means for rotating said supply pipes includes one or more linear actuators connected by a radial arm to its associated pipe.

9. A tank washing system according to any preceding claim, wherein the sweeping movement of the or each row of nozzles is controlled by a variable speed motor connected to a computerised control device.

10. A tank washing system according to any preceding claim, wherein the orifice of each nozzle is configured to create a wide footprint which overlaps that issuing from adjacent nozzles in the row.

11. A tank washing system according to any preceding claim, including means for rotating each

nozzle about its longitudinal axis in an oscillating manner such that washing medium is directed therefrom in a side-to-side motion as the nozzle is swung forwardly.

12. A tank washing system according to any preceding claim, adapted for washing a tank divided into three separate longitudinal sections, by shut-off valves to sectionalise groups of nozzles in the or each row so that each tank section may be washed individually.