AIR DIFFUSER UNIT FOR AERATING SEWAGE

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This invention relates to air diffusing units for aerating sewage of the type adapted to be completely immersed in the sewage and it is an object of this invention to provide an air diffusing unit which substantially reduces the maintenance of this type of diffuser.

Previously this type of diffuser has required periodic replacement, in whole or in part, or periodic cleaning. Such replacement or cleaning has been expensive. In my invention, I provide an air diffuser unit which includes a fabric sock or bag secured by a spring means. To remove the sock it is simply pulled from the unit. To substitute a new sock, the new sock is slipped over its cage. Of course, if desired, once a sock is removed it can be washed and reused.

A further object of my invention is to reduce the air friction to a minimum so as to provide an air diffuser of maximum efficiency. To this end I have provided a diffuser cage which is so constructed as to provide a minimum of impediment to the flow of air.

In one embodiment of my invention, I provide an air diffusing unit for aerating sewage and adapted to be completely immersed in the sewage comprising a cage formed by a head having a hole for the flow of air therethrough. Extending from and secured to the head, are rods and spacer tubes to complete the cage. About the rods and spacer tubes and a part of the head is placed a fabric sock or bag. The head has an undercut annular recess and the end of the sock or bag around the head carries a circular spring to spring seat, with a snap action, a portion of the sock in the annular undercut. Thus, to remove the sock or bag all one need do is to pull on it until the spring seated part rides out of the undercut recess and a continued pull on the sock will thereafter remove it altogether from the cage. Likewise, to add a sock, it is slipped over the cage until the forward end spring seats itself with a snap action in the annular undercut recess.

The foregoing and other objects of the invention, the principles of the invention, and the best modes of carrying out it contemplated applying such principles will more fully appear from the following description and accompanying drawings in illustration thereof.

In the drawings:

FIG. 1 is a cross sectional view through a sewage tank incorporating an air diffuser unit constructed in accordance with my invention;

FIG. 2 is a plan view taken along the line 2--2 in FIG. 1 and illustrating the air supply pipe to the air diffuser units and a plurality of air diffuser units;

FIG. 3 is an elevation of a diffuser unit illustrating the sock assembled to the cage, the unit being shown by itself and at an enlarged scale as compared to FIGS. 1 and 2 and rotated 90° from the position shown in FIG. 2;

FIG. 4 is an elevation of the diffuser cage, i.e., the diffuser unit shown in FIG. 3 but with the sock removed;

FIGS. 5, 6 and 7 are views of the cage taken along the lines 5--5, 6--6, and 7--7 respectively in FIG. 4;

FIG. 8 is a partial view of the lower end of the unit illustrated in FIG. 3 but the sock is broken away to illustrate the spring and clip for securing the bag to the head;

FIG. 9 is a partial sectional view taken along the line 9--9 in FIG. 3 when the diffuser unit is secured to its air supply pipe;

FIG. 10 is a view similar to FIG. 4 but illustrating a shorter cage;

FIG. 11 is a partial view, partly in section and partly in elevation, of a further modification in which a ball valve is included in the head;

FIG. 12 is a sectional view, partly in elevation, taken along the line 12--12 in FIG. 11;

FIG. 13 is a view similar to FIG. 11 but illustrating a modified valve arrangement; and

FIG. 14 is an end view taken along the line 14--14 in FIG. 13.

Referring to the drawings, a sewage tank 21 is illustrated in FIG. 1 having an inlet pipe 23 and an outlet conduit 24. A hollow stanchion 25 connects a pipe 26 to a pipe elbow 27, and air under pressure is forced through the pipe 26, by any suitable pump or blower (not illustrated), and into the pipe elbow 27. A valve 28 operated by a handle 29, is positioned in the elbow 27 and opens to the atmosphere, so that when it is in the air supply from main 28 flows directly to the atmosphere. When the valve 28 is closed, the air flows through the elbow 27 and into a connecting pipe 30.

A pipe 31, having its upper end offset laterally from the lower end of the pipe 30, is pivotally connected thereto, as indicated at 32. The elbow 27 is pivoted to the stanchion 25 to permit the pipes 30 and 31 to be swung out of the sewage tank 22, for cleaning, or for repairs, of the mechanism normally immersed in the sewage 34.

At the lower end of the pipe 31 there is a coupling 37 which is connected to an air supply pipe 38. The pipe 38 is closed at each end, as illustrated in FIG. 2, so that the air passing through the pipe 38 will enter the air diffuser units 40. The air diffuser units 40 are secured to the pipe 38 parallel to one another, as illustrated in FIG. 2.

The air diffuser units 40 may be arranged so as to accent the wall of the tank opposite the inlet pipe 23, as shown. The liquid flowing through the inlet pipe 23 into the tank causes a circulatory movement of the sewage in the tank, and, accordingly, the air bubbles which are formed as the air leaves the diffuser units 40, are carried by this circulatory motion of the sewage in a certain path as long as the diffuser units remain in fixed position relative to the tank.

Each diffuser unit 40, referring to FIGS. 3 to 9 inclusive, comprises a sock or bag 42 covering substantially the entire length of a cage 44. Referring to FIGS. 4 and 9 inclusive, the cage 44 includes a head 46 having an annular array of six threaded holes 48 into which are placed the threaded stems of six rods 50. The rods 50 extend through six, hollow spacer tubes of substantially equal length and the uppermost (FIG. 3) ends of the rods 50 extend through the ring 54, the rods also passing through the two rings 56 intermediate the head 46 and the ring 54. The ends of the rods 50 are riveted to the ring 54, or spun over, to secure the assembly of head 46, rods 50, tubes 52, and rings 54 and 56. In FIG. 4 the middle section of the cage is shortened for convenience of illustration, as is the entire diffuser unit in FIG. 3 for the same reason.

The head 46 has a generally conical shape and includes an undercut, annular recess 58 adapted to receive a part of the lower (FIGS. 3, 8 and 9) end portion of the sock 42. The lower end portion of the sock 42 is formed with a cuff 60 by a length of the fabric turned upon itself. The cuff 60 houses an annular, coil spring 62 which biases a part of the cuff 60 into the annular undercut 58, so as to spring seat it in the undercut, see FIG. 9.

The sock or bag 42 is preferably knitted from nylon yarns of 800-denier thickness in an arrangement of 16 wales per inch and 24 courses per inch to provide 384 interlaces per square inch through which the air may bubble. The lower end of the sock 42 is formed with a welted knitted portion during the knitting process to define the cuff 60, the welt being secured to the main body of the sock along substantially a straight line, as at 64.
After the completion of the knitting operation, the knitted fabric is folded lengthwise and is sewn together along its long side from just above the cuff upward (FIG. 3) and the end opposite to that of the cuff is also sewn together.

Thus, a fabric sock open only at one end results, having a slip 68 (FIG. 3) by which the spring 62 may be inserted into the cuff 60. After the spring 62 is inserted into the cuff 60 the spring is stretched and its ends slightly overlapped, the spring assuming a substantially circular shape at this time, and the overlapped spring ends are secured by a slit tube or clamping clip 68 (FIG. 8) which is placed over the end portions of the spring 62 and the tube 68 is crimped to secure it to the spring ends. The sock is preferably turned inside out before the spring is inserted into the cuff, although this could be done afterwards also.

The head 46 further comprises a central hole 74 having a diverging conical portion. The wall 79 of the head has a varying cross section, as illustrated, and terminates in a flat, upper surface 80. The threaded holes 48 for the threaded lower rod ends are drilled through the surface 80 and through the annular flange 82 forming part of the wall 79, emerging through the conical surface 86 which communicates with the undercut recess 88. Below the recess 88, the wall 79 forms a circular shoulder 89 having a flat surface 90. The wall 79 further defines an externally thread connector 91 of smaller diameter than the shoulder 89 and is adapted to be screwed into mating female threads in a suitable opening in the air supply pipe 38, FIGS. 2 and 9.

A portion of the cuff 60, FIGS. 8 and 9, is seated in the undercut recess 88 and the part of the sock above this part of the cuff is stretched over the conical outer surface 86 and the flange 82. When under pressure is supplied to the inside of the sock, the bore 64 is made to length, as needed. The single section shown in FIG. 10 is shown to indicate the increasing slope and diameter of the surface 86.

FIG. 10 illustrates a modified cage 100 which is essentially the same as the cage 44 illustrated in FIG. 4, except that the cage 100 is of shorter length. Since the spacer tubes 52 in the embodiment of FIG. 4 are all of equal length, cages can be conveniently made in lengths of one, two or three sections by using rods of corresponding size and a suitable number of rings. FIG. 10 illustrates a cage of one section in length whereas FIG. 4 illustrates a cage of three sections in length. The sections are the same in both cages 44 and 100. Of course, the socks are made to length, as needed. The single section shown in FIG. 10 is shown to indicate the increasing slope and diameter of the surface 86.

FIGS. 11 to 14 show further modifications of my invention in which valves are incorporated in the heads to prevent backflow and to provide a more even annular peripheral air flow, instead of permitting the air to act directly against the closed end of the sock.

Referring to FIGS. 11 and 12, a valve 118 comprises a ball 120 trapped in the diverging conical part of 122 of the central portion 124 of the head 126 by cross bars 128 and 130 having ends secured to the wall 132. Thus, movement of the ball 120 downwardly is limited by abutment of the ball 120 with the outwardly diverging surface 123 and movement of the valve upwardly is limited by abutment of the ball with the cross bars 128 and 130.

Referring to FIGS. 13 and 14, a valve 148 is illustrated for closing the central opening 149 in the head 151 comprising a conical portion 150 having a conical surface 152 mating with the inner surface 153 of the head and a relieved, annularly recessed part 154. The conical valve portion 150 is secured against a shoulder 156 on a stem 158 by a nut 160 which is threaded to the upper end of the stem 158. The lower end of the stem 158 is secured to a four armed guide 162 which has end portions received in slots 164, the four armed guide could, of course, have only two or three arms, as desired. The radially outer ends of the guide arms are received in long slots 126, the radially inward movement of the arms being limited by the slot end walls 128, thus limiting upward movement of the central conical portion 150 and downward movement of the latter, of course, limited by its abutment with conical surface 153.

It is seen that for both embodiments of FIGS. 11 to 14, when the air flows through the openings 124 (FIG. 11) and 149 (FIG. 13) in the heads 126 and 151, respectively, the air pressure forces the valves to their upper positions and the valves help to distribute the air annularly and peripherally for better aeration. When the air pressure is terminated or reduced, the sewing might tend to enter the central holes 124 (FIG. 11) and 149 (FIG. 13) but is prevented from doing so by the valve 118 in FIG. 11 and the valve 148 in FIG. 13.

Preferably the ball 120 and the conical part 150 are formed from plastic material, although they may be formed of other material. The cross bars 128 and 130 in FIGS. 11 and 12 and the stem 158, nut 160 and guide 162 in FIGS. 13 and 14 are preferably formed of non-ferrous material.

As also illustrated in FIG. 13, the head 151 which I have provided is easily adapted to regulating the air flow through the central hole 149. For this purpose I provide a bushing 180 insertable in the smallest part 125 of the hole 149. The bushing 180 has a central hole 181 of the diameter desired for the regulation of the air and an outside diameter sufficient to form with the smallest part 125 of the central hole 149 a press fit. Of course, if desired, the smallest part 125 of the central hole 149 could be threaded, and the outside mating surface of the bushing as well, to provide a threaded connection between the bushing 180 and the head 151.

In all embodiments, I prefer to form the heads, rods, spacer tubes and bushing of aluminum or stainless steel. The spring may be made of cadmium plated steel for rust resistance or it may be of stainless steel construction also. Likewise, the clip 68 is of aluminum or stainless steel, also.

While the sock has been described heretofore as preferably of 800-denier nylon, it is understood that 800 is preferred for satisfactory wear. Use of a lower denier yarn would result in a lighter weight fabric and would not be as long-lasting as the socks of heavier denier yarns. Although nylon is preferred, other materials could also be used for the yarn without departing from the essence of my invention.

To facilitate installation and removal, referring to FIG. 9, the head 46 may be provided with a wrench hole 210, preferably at the undercut 58.

The diverging conical surfaces, for instance surface 76 in FIG. 9, defining the diverging part of the central hole 74, has been shown to be in all embodiments at 45° with a vertical line, but it is seen that my invention is not limited to this particular angle, although I prefer an angle of divergence between 35° and 55°.

Having thus described the invention, I claim:

1. An air diffusing unit comprising a cage comprising a said cage comprising a head having a bore for the flow of air therethrough and an annular array of rods having ends secured to said head, a plurality of spacer tubes around said rods, support rings through which said rods extend, said being spaced along said rods by said tubes, said head having an annular undercut, a fabric sock over said rods, tubes and rings and a part of said head, and a spring for securing said sock to said head at said undercut, said sock being made from a knitted

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5 fabric and comprises a length of material folded upon itself and having a cuff at one end, said sock being seamed at the end opposite the cuff to the other end, but for a portion which defines a slit, and said spring being inserted into said cuff through said slit.

2. The structure recited in claim 1 and further including valve means within said cage to prevent the backflow of sewage and better distribute the air to said sock, said head having a conical inner surface defining a valve seat, said valve means including a ball seated on a part of said valve seat, and crossed-bars secured to said head and spaced from said valve seat to trap said ball between said crossed-bars and said valve seat.

3. The structure recited in claim 1 and further including valve means within said head to prevent the backflow of sewage and to better distribute the air to said sock, said head having a conical inner surface, said valve means including a bushing secured to said head in said hole to restrict the size of said hole, a stem extending through said hole, a conical valve portion secured to one end of said stem, and a guide secured to the other end of said stem, said head having slots receiving portions of said guide, said conical valve portion mating with said conical inner surface of said head to limit movement of said conical valve portion in one direction, said guide abutting a portion of said head to limit movement of said conical valve portion in the other direction, and said conical valve surface deflecting the flow of air through said bushing.

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