April 29, 1969 R. J. GOOD 3,441,216

AIR DIFFUSER UNIT FOR AERATING SEWAGE

Filed Nov. 16, 1964 Sheet 1 of 3

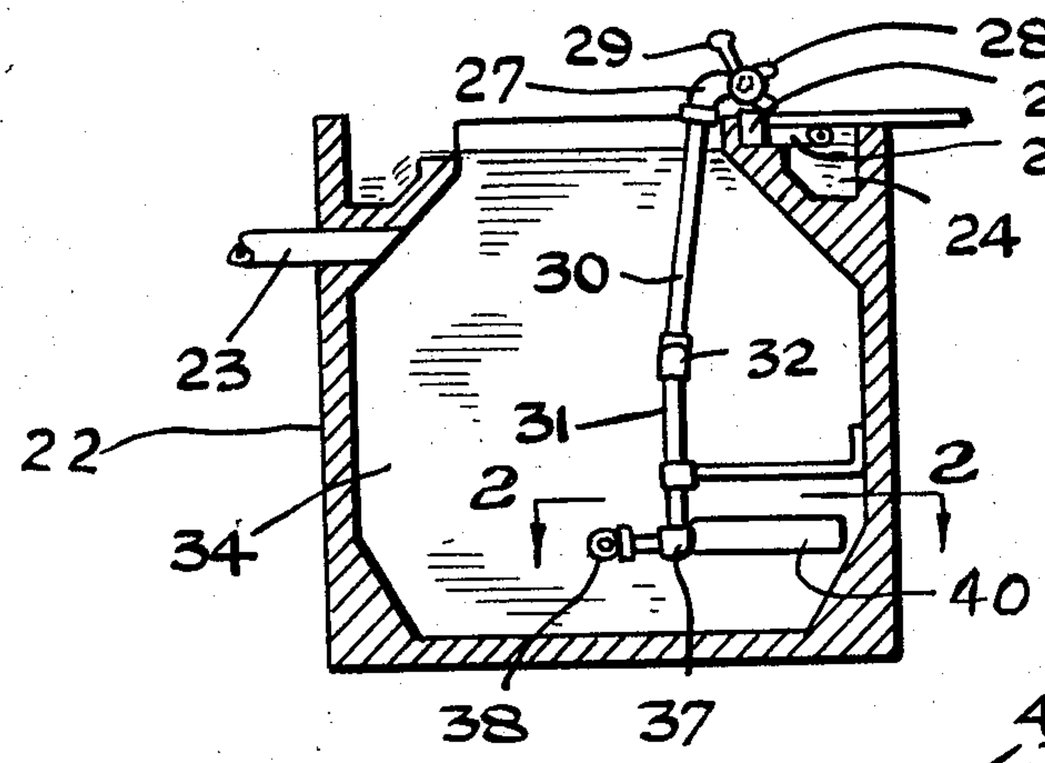


Fig. 1.

Fig. 2.

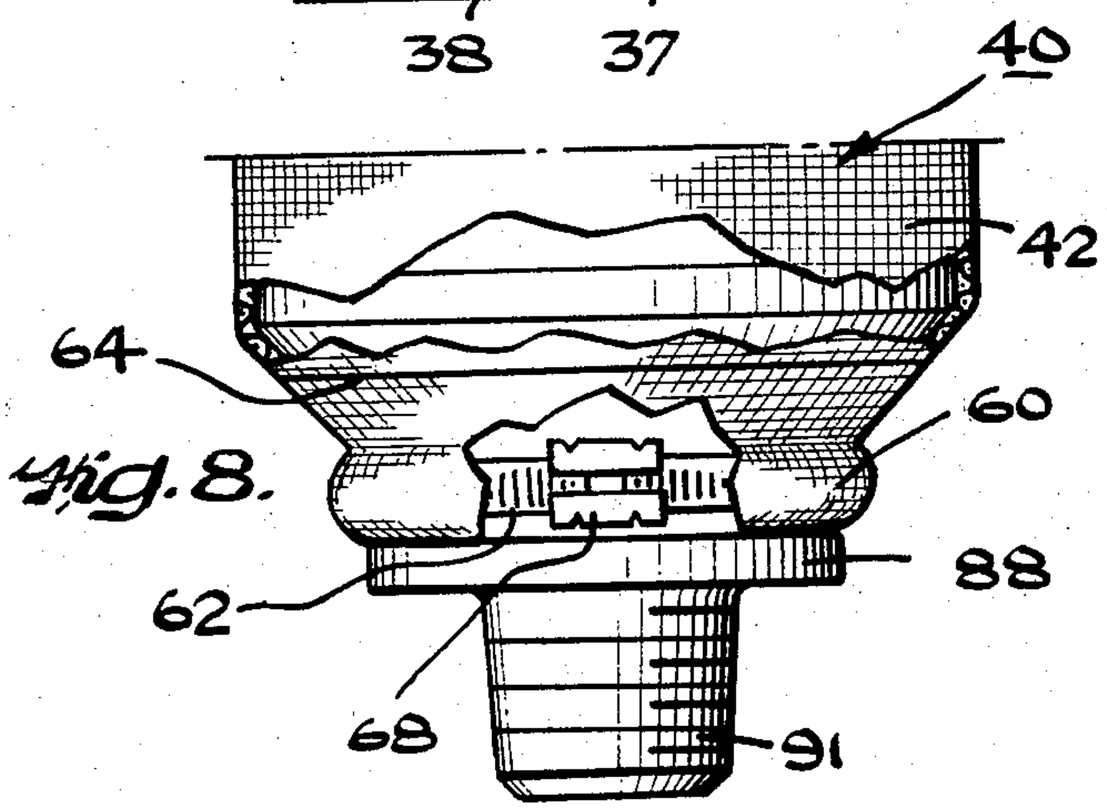
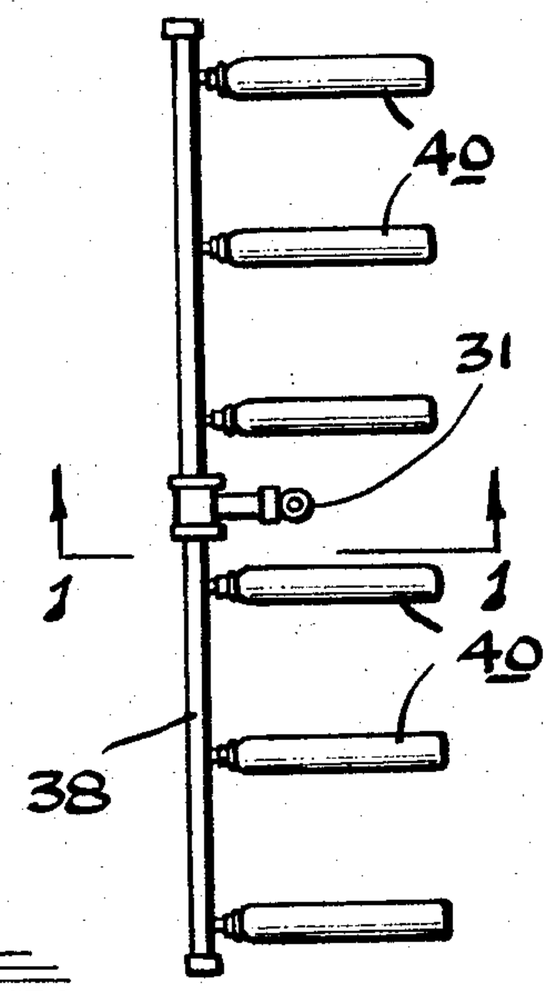


Fig. 8.



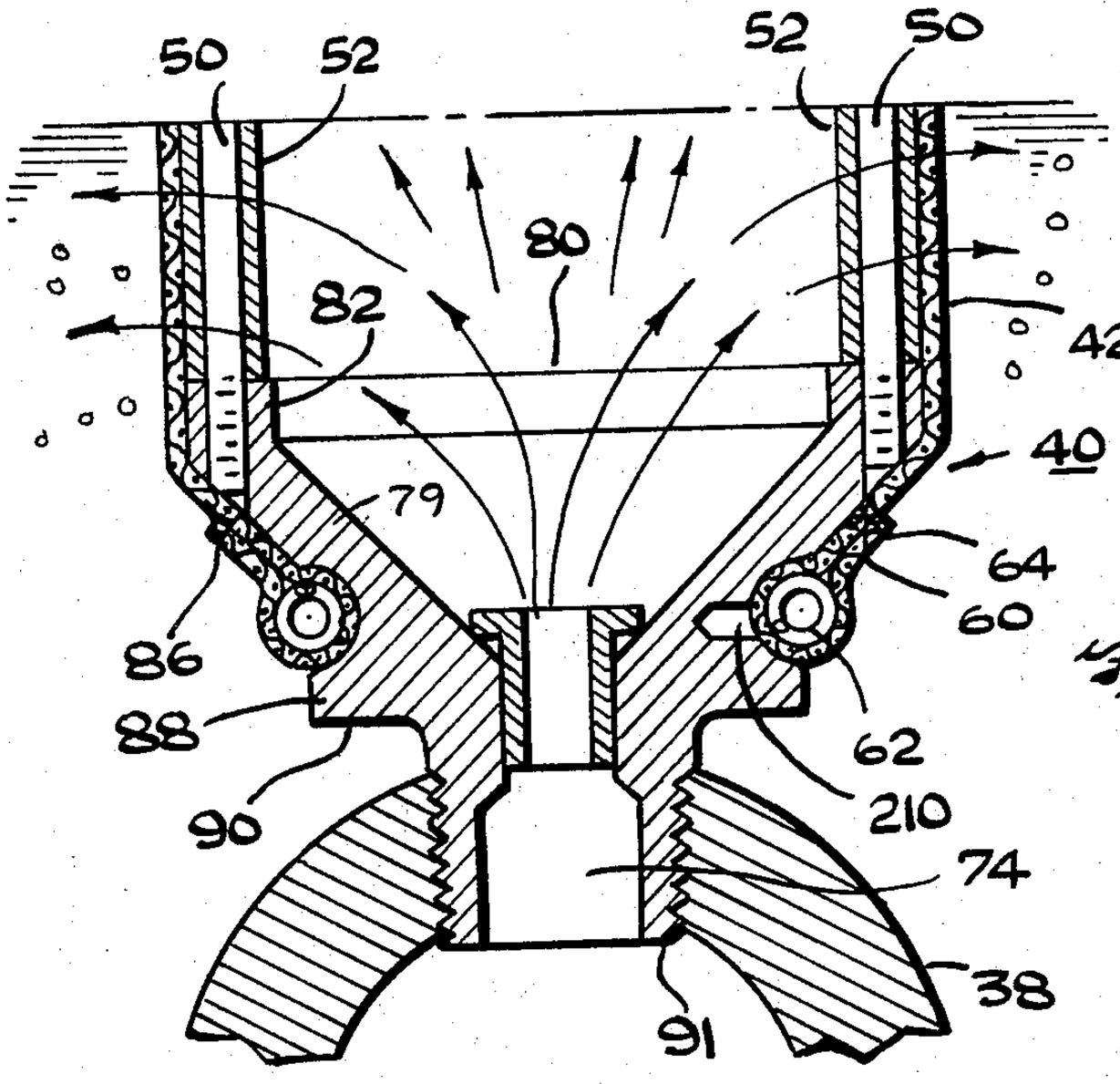


Fig. 9.

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Fig. 3.

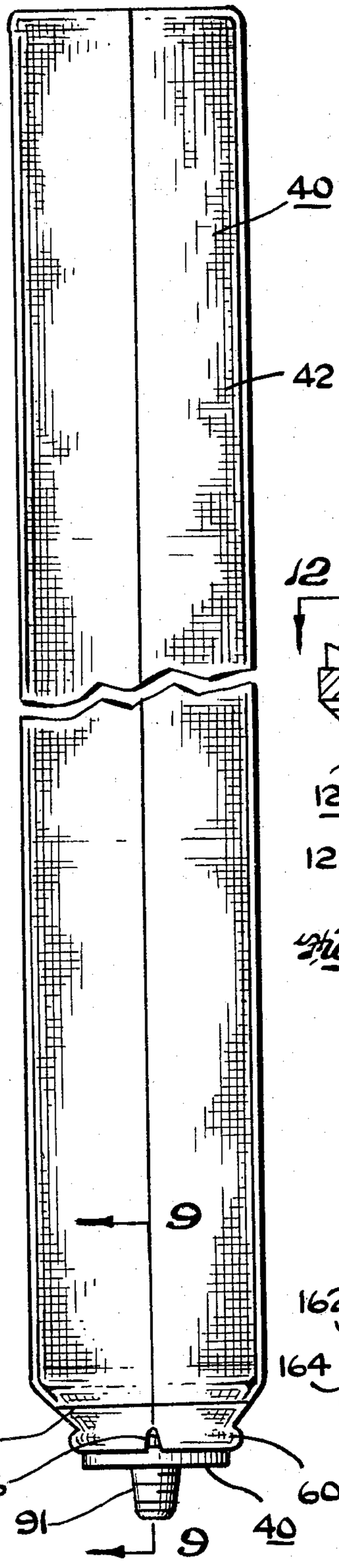
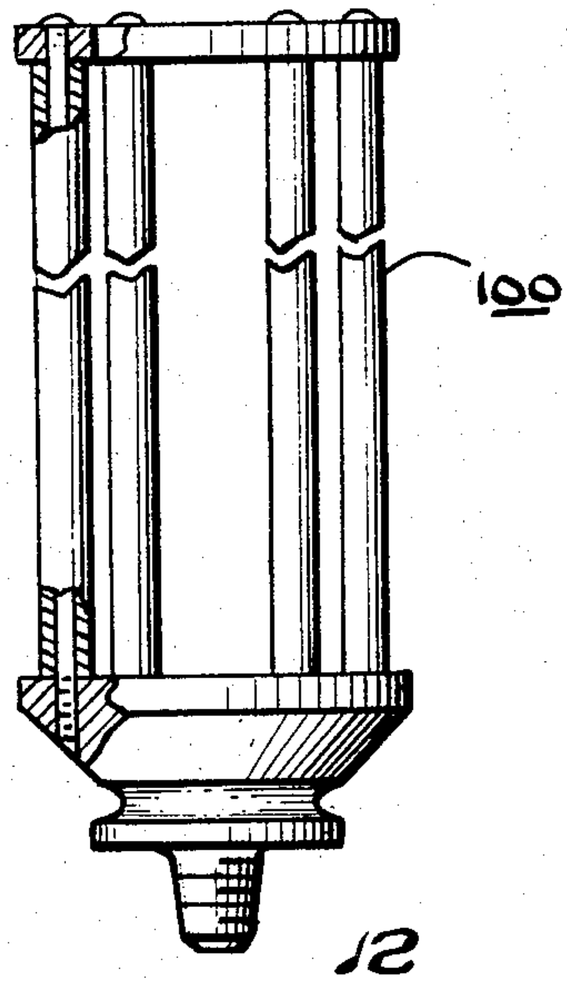


Fig. 10.



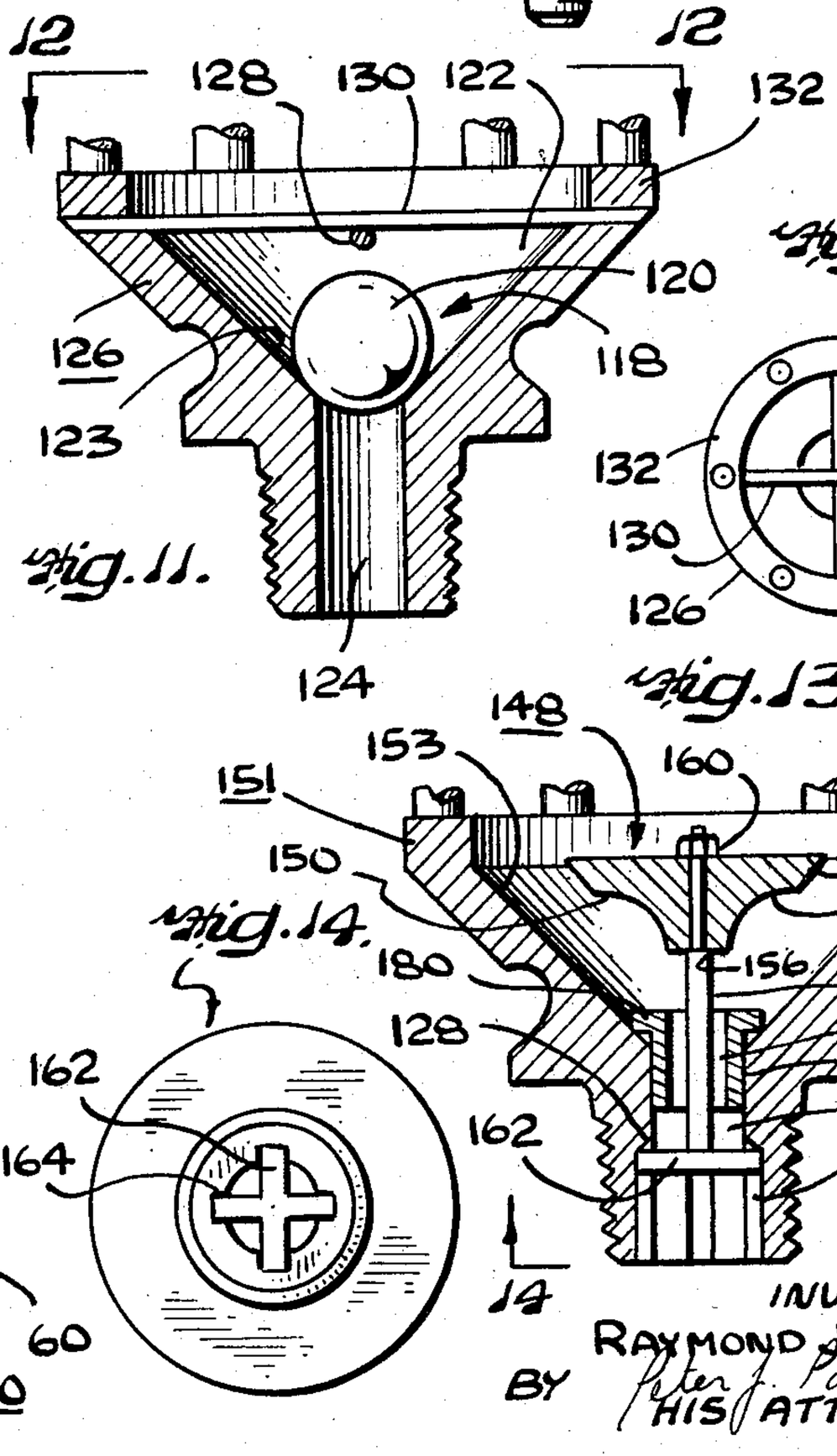


Fig. 11.

Fig. 12

Fig. 13.

Fig. 14.

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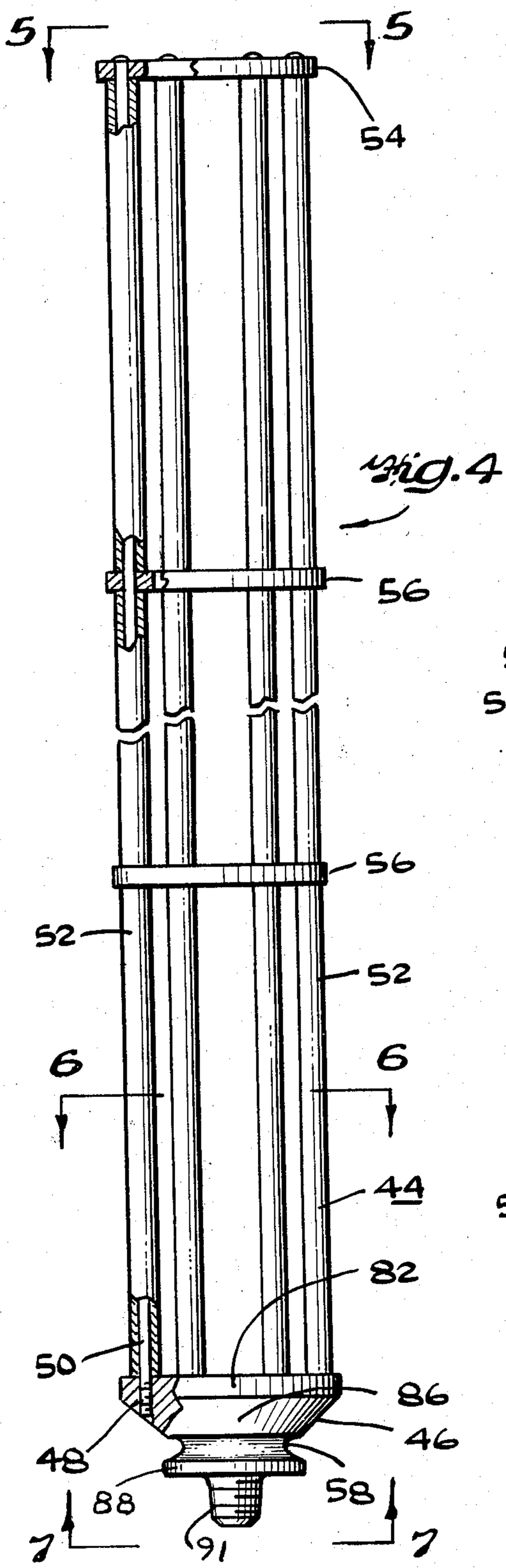


Fig. 4

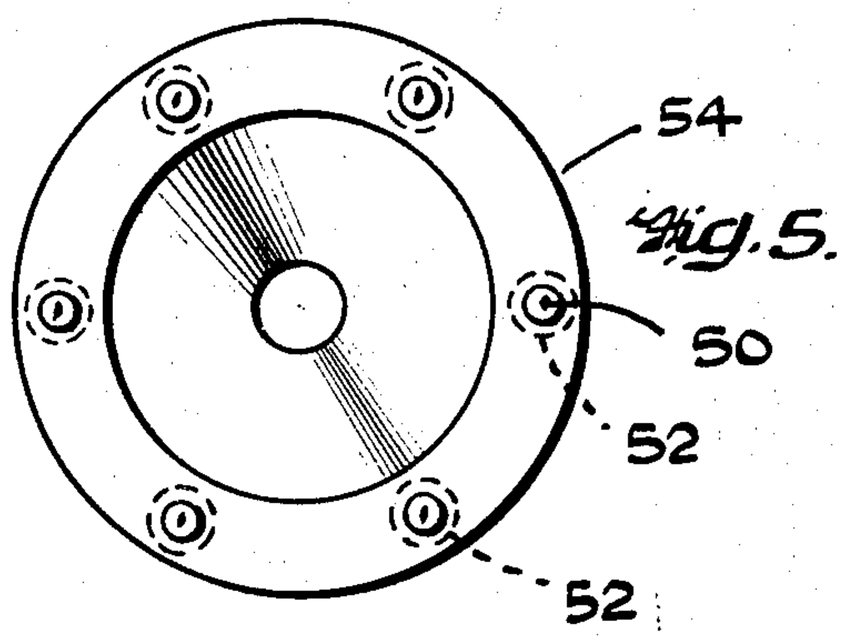


Fig. 5.

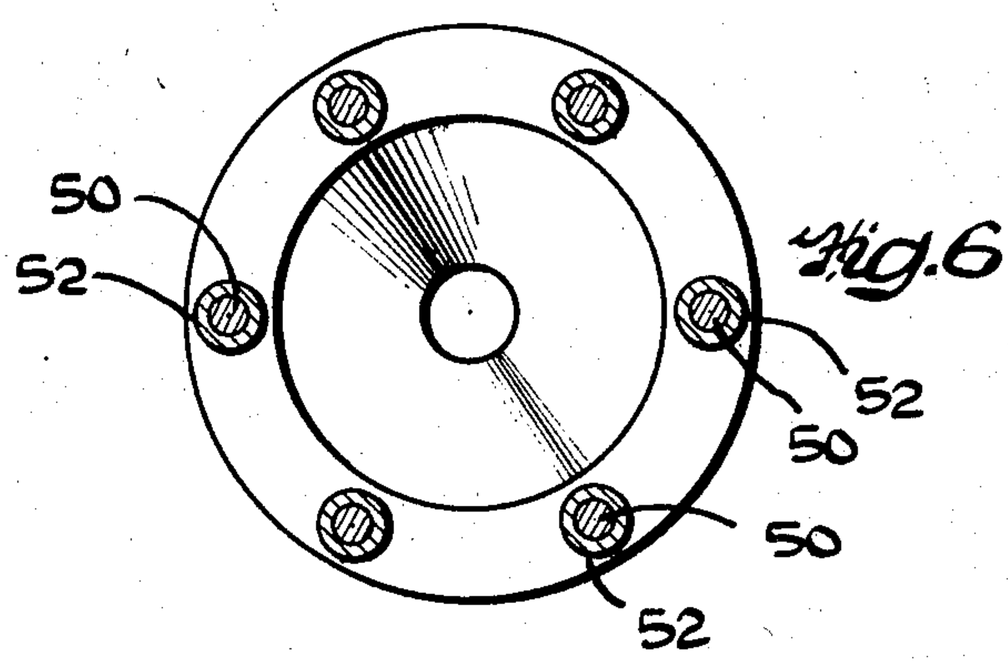


Fig. 6

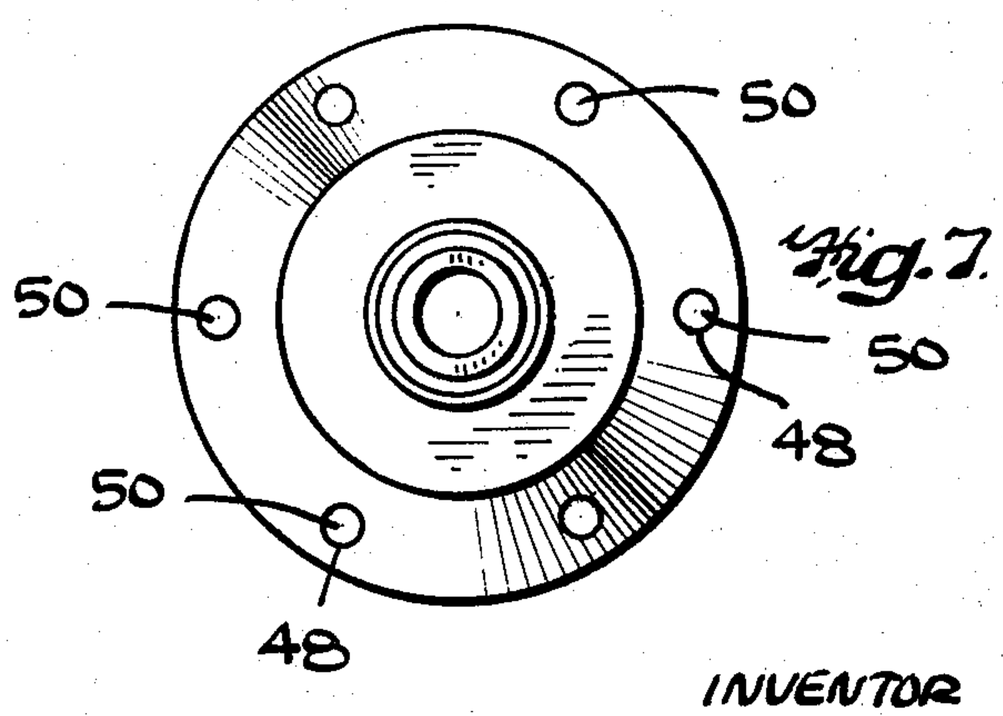


Fig. 7.

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United States Patent Office

3,441,216

Patented Apr. 29, 1969

3,441,216

AIR DIFFUSER UNIT FOR AERATING SEWAGE

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Filed Nov. 16, 1964, Ser. No. 411,429
Int. Cl. A01g 27/00
U.S. Cl. 239—145 3 Claims

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 in which it is 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 **22** 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 open position the air from main **26** 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 adjacent 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 interstices per square inch through which the air may bubble. The lower end of the sock **42** is formed with a knitted welt 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 slit **66** (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 **58**. Below the recess **58**, the wall **79** forms a circular shoulder **88** having a flat surface **90**. The wall **79** further defines an externally threaded connector **91** of smaller diameter than the shoulder **88** 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 **58** 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 air under pressure is supplied to the inside of the sock, the bag tends to move away from the head, but such movement is resisted due to 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 heads 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 shortened for convenience of illustration.

Also, I have found that for short diffusers, i.e., those less than 10 inches long, the only cage structure that need be provided is the head. That is, the annular array of rods illustrated in FIG. 10 and the end ring are not need be provided is the head. That is, the annular array tend the sock when in operation.

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 hole **124** of the head **126** by crossed 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 crossed 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**, upward movement of the arms being limited by the slot end walls **128**, thus limiting upward movement of the valve conical portion **150** and downward movement of the latter being, 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 sewage 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 rubber or a non-ferrous material. The crossed bars **128** and **130** in FIGS. 11 and 12 and the stem **158**, nut **160** and guide **162** in FIGS. 13 and 14 are perferably 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 **124** 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, a denier between 600 and 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 for aerating sewage and adapted to be completely immersed in said sewage, said unit comprising a cage, said cage comprising a head having a hole for the flow of air therethrough 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 rings 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

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 and seamed lengthwise from 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 silt.

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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RONALD R. WEAVER, *Primary Examiner.*

U.S. Cl. X.R.

55—377; 137—533.27; 239—542; 261—64, 122