Aug. 28, 1945. C. YEOMANS 2,383,834

SEWAGE EJECTOR

Filed Nov. 5, 1943

Fig. 1

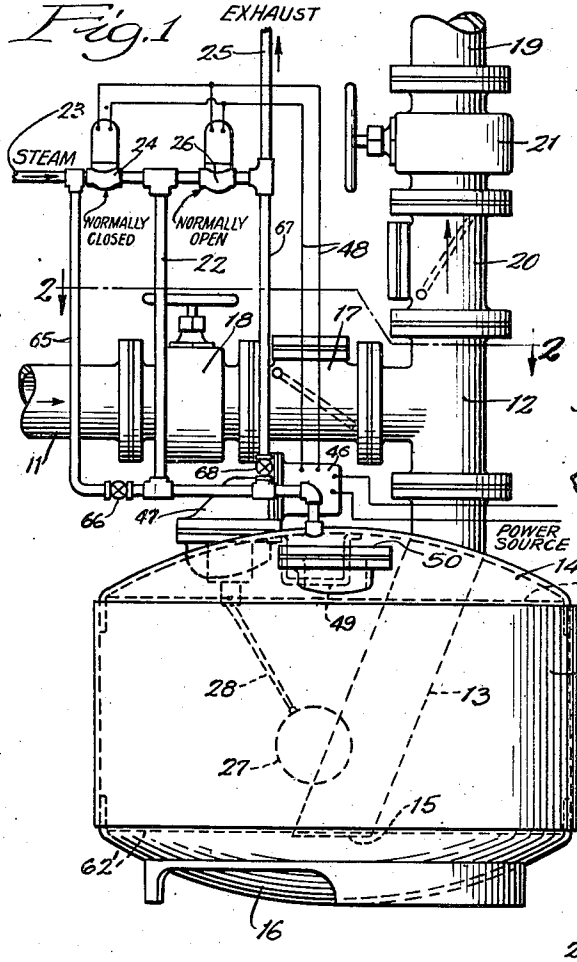


Fig. 3

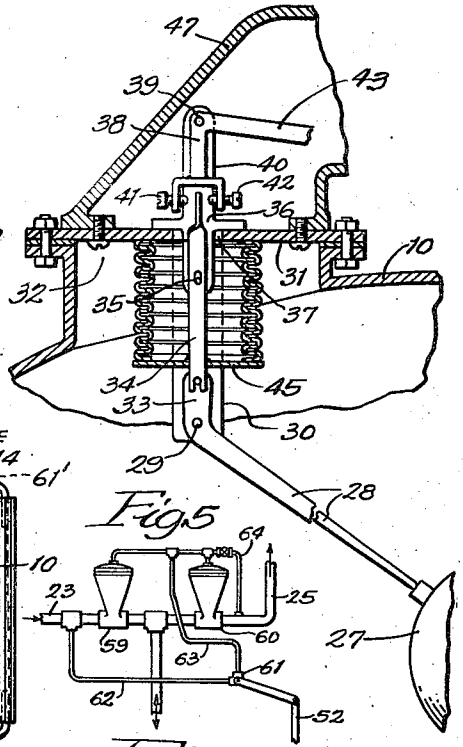


Fig. 5

Fig. 4

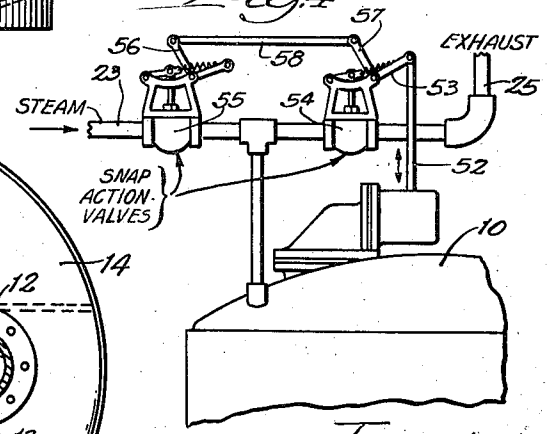
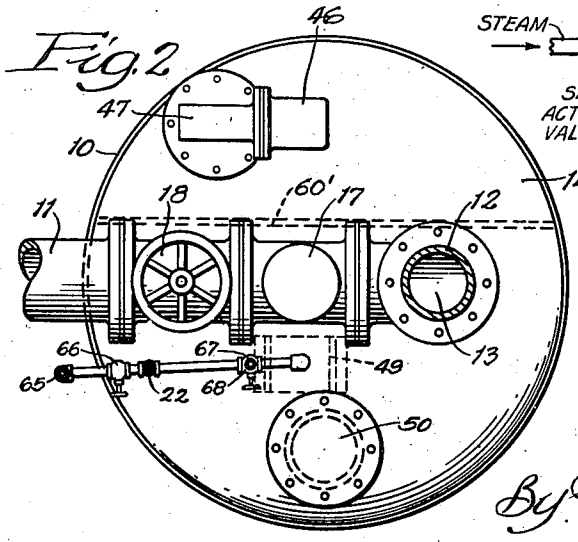


Fig. 2



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UNITED STATES PATENT OFFICE

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SEWAGE EJECTOR

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4 Claims. (Cl. 103—248)

This invention relates to improvements in apparatus such as used for handling sewage, and especially for lifting sewage from a receiver to an outlet located at a higher level than the receiver. One type of such device is well known as a Shone ejector, or Shone system of of sewage ejection.

In general, such a Shone system consists of a suitable cast iron, or sheet metal tank or pot having inlet and outlet sewage piping connected thereto, and a means for delivering compressed air to the upper portion of the receiver when the level of sewage therein reaches a predetermined height, whereupon the sewage will be pneumatically ejected. Suitable one-way or check valves are provided in the inlet and outlet lines to prevent reverse flow of sewage therein, and suitable controls are provided so that, when the level of sewage in the receiver is brought down to the desired low point, the source of compressed air will be shut off and the receiver vented so as to permit escape of the compressed air then in the receiver, whereupon sewage may again flow into the receiver.

In certain instances, where adequate supplies of steam are available, and where a supply of compressed air is not readily available, it is desirable to employ steam under pressure for effecting ejection of the sewage from the receiver, instead of compressed air. The use of steam instead of air is desirable, for example, on steam-propelled ships which are not necessarily or always equipped with a compressed air system.

When the Shone system is pneumatically operated, it is convenient to employ pneumatically-operated valves for controlling the admission and exhaust of compressed air into and from the receiver. The operation of such valves by means of steam is not very desirable because of complexities introduced in the design of the required valves and operating mechanisms, and because of the required extra steam lines, condensation losses, etc. In some instances, it is feasible to employ electrically actuated or solenoid valves for controlling the admission and exhaust of steam to the receiver, but in certain other instances, it is desirable to avoid the use of electric power.

It is the object of the present invention to provide a steam-actuated sewage ejecting apparatus, or system, of the character indicated; to provide simple but efficient means for controlling the admission of steam and the exhaust thereof, to and from the receiver, either electrically or mechanically as may be preferred; to provide an arrangement whereby, in the case of a ship installation, the normal rolling of the ship will not objectionably affect the operation of the apparatus; and in general, it is the object of the invention to provide a simple, efficient, durable and generally practicable steam-operated sewage ejecting apparatus or system of the character indicated.

Other objects and advantages of the invention will be understood by reference to the following specification and accompanying drawing wherein there is more or less diagrammatically illustrated a Shone sewage ejecting apparatus embodying a selected form of the invention.

In the drawing, Fig. 1 is a more or less diagrammatic side elevation; Fig. 2 is a section on the line 2—2 of Fig. 1; Fig. 3 is a more or less diagrammatic illustration of a portion of the apparatus shown in Fig. 1, but on an enlarged scale and in section to more clearly disclose the operation of the structure; Figs. 4 and 5 are fragmentary side elevations corresponding to a portion of Fig. 1, but respectively showing modified controlling arrangements.

The sewage handling apparatus herein illustrated embodies a receptacle or pot 10, which is completely closed so as to be air-tight. A sewage inlet pipe 11 is connected through a T fitting 12 to the upper end of an angularly disposed pipe 13, which passes through the top wall 14 of the receiver adjacent the periphery thereof and its bottom end 15 open and spaced from the bottom 16 of the receptacle so that sewage flowing through the pipe 11 and fitting 12 may enter the receiver 10. The pipe 13 may have its upper end welded to the top 14 of the tank so as to be rigidly held in place, the welding being carefully done so as to avoid any possible leakage from the receiver 10 around the outside of the pipe 13. A one-way or check valve 17 is provided in the sewage intake pipe 11, such valve being arranged to permit the flow of sewage from the pipe 11 into the receiver, and to prevent rearward flow of sewage from the receiver into the pipe 11. As indicated, a manually operated gate valve 18 is also usually provided in the inlet pipe 11.

The sewage outlet for the receiver embodies the pipe 13, the vertically extending portion of the T fitting 12, and a pipe 19 which extends upwardly to the level at which the sewage is to be discharged in a more or less horizontal direction. A check valve 20 is provided in the pipe line 19 to permit sewage to travel upwardly in said pipe line, but not downwardly. A manually operated gate valve 21 may also be provided in the pipe line 19, as is customary.

Steam at suitable pressure is delivered to the

upper portion of the receiver above the level of sewage received therein by a pipe 22, which has its lower end threaded into a suitable boss formed on the top of the receiver. The upper end of the pipe 22 is connected to a steam supply pipe 23. A valve, in this instance, a solenoid valve 24 is provided in the steam line 23, said valve being normally closed so as to prevent the passage of steam from the supply pipe 23 into the pipe 22 and the receiver 10. The steam supply is usually at much higher pressure than is required or desirable for the sewage ejecting operation. A pressure-reducing valve (not shown) should, of course, be provided in the steam line ahead of the valve 24, to reduce the pressure of the steam conducted to the receiver 10 to the lower pressure desired. Other devices, such as a pressure gauge, a safety valve, a strainer, and a manually controllable main valve (not shown), may, of course, be provided in the steam lines, in accordance with good engineering practice. The upper end of the pipe 22 also has an exhaust pipe 25 connected thereto and a normally open valve 26 is provided in the exhaust pipe 25 to control its communication with the pipe 22 and receiver 10. In this instance, the valve 26 is also solenoid-operated.

It will be seen that when sewage enters the receiver, the level of sewage in the receiver will gradually rise, the air trapped in the upper portion of the receiver being relieved or exhausted through the pipe 22 and the exhaust pipe 25. When the level of sewage reaches a predetermined height in the receiver, the exhaust valve 26 is closed and the steam valve 24 is opened to permit steam under pressure to enter the upper portion of the receiver, whereby the sewage contained therein will be forced out through the pipe 13, the check valve 20 and the discharge, or outlet pipe 19. When the level of sewage in the tank is lowered to the desired extent, the valves 24 and 26 are restored to their normally closed and normally open positions respectively, whereby steam then trapped in the receiver will be relieved through the exhaust line 25, which may be connected to any suitable vent or other outlet.

For controlling the valves 24 and 26, it is preferred to employ a float-actuated structure of strong but simple and durable character, and one which will operate freely and with but little or no power loss due to stuffing boxes or similar friction-producing means. In this instance, there is employed a suitable hollow float member 27 carried by the free end of an arm 28, which is pivoted near its upper end as indicated at 29 on a bracket 30. The bracket 30 depends from a plate 31 which closes a suitably formed opening 32 in the top wall of the receiver, said plate being suitably fastened as represented in Fig. 3. The arm 28 is in the form of a bell crank having a short arm extension 33 extending upwardly beyond the pivot 29. Said arm 33 is connected by a pin and slot, or other suitable connection, to one end of a lever 34, which is pivoted intermediate its ends, as indicated at 35 on a bracket 36, which is suitably mounted on the plate 31. As illustrated, the lever 34 extends upwardly through an opening 37 in the plate 31, and has its upper end arranged to co-operate with the spaced arms of a fork or clevis 38, which may be suitably pivotably mounted as indicated at 39 on a bracket portion 40, which may be formed integrally with the bracket part 36. The forked arm 38 may be equipped with adjustable screws 41 and 42 for regulating the operative effect of the rocking movement of the lever 34 on the arm 38. The said arm 38 may also be extended horizontally by means of an arm 43 which may be connected to suitable electric switch mechanism for controlling an electric circuit to the solenoid valves 24 and 26. The switch mechanism is not herein illustrated since it is a commercially available standard construction, the details of which form no part of the present invention.

For preventing the escape of steam through the opening 37 in the plate 31, there is provided a suitable bellows 44. The bellows 44 may be made of brass, or other metal of suitable flexibility, the upper end of the bellows being soldered to the plate 31 around the opening 37 therein, and the lower end being soldered to a closure plate 45 through which the arm 34 passes, and to which said arm is rigidly united by welding, brazing, or the like. Any movement imparted to the lever 34 by the float actuated bell crank 28—33 will, of course, be accompanied by corresponding movement of the bellows 44. Said bellows, because of its high degree of flexibility, offers only a negligible resistance to the operating movement of the lever 34 and the float carrying arm 28, and hence is well suited to the purpose indicated.

As shown in Fig. 1, the float arm 28 actuates electric switch mechanism housed in a box 46, which may be mounted on one side of a housing 47 of the float actuated mechanism. A suitable source of electric power may be connected through the switch structure in the housing 46 to electrical conductors 48, which are also connected to the solenoid valves 24 and 26.

In order to prevent the steam under pressure delivered to the receiver 10 from the pipe 22 from boring into and mixing with the sewage in the receiver, with consequent condensation and pressure loss, there is provided a baffle 49 which extends horizontally between the discharge end of the pipe 22 and the highest level to which sewage is permitted to rise in the receiver 10. The baffle 49 may be fixedly secured by welding or otherwise, to the top of the receiver. If desired, the baffle 49 may be secured to a cover plate 50, which closes an access opening 51 provided in the top of the receiver 10, so as to be removable with the cover plate. As shown in Fig. 1, the baffle is in the form of a U-shaped member having the upper ends of its legs welded to the top of the receiver 10.

In the event that some particular installation requires that there be no electrical circuits, the arm 43 of the switch operating mechanism may, instead of being connected to electrical switch mechanism, be connected by means of a link 52, to an arm 53 of a snap action valve 54, provided in the exhaust line pipe 25, instead of the solenoid-operated valve 26 (see Fig. 4). A similar snap action valve 55 is provided in the steam supply line 23 instead of the solenoid valve 24 and said valve 55 is mechanically connected to operate simultaneously with the valve 54 by suitable means, such as arms 56 and 57, and a connecting link 58. The snap acting valves 54 and 55 may be of any suitable type, of which one or more are available on the market. Such valves generally comprise a valve stem, which is connected to a pivoted arm for movement therewith, the arm being connected to an over-the-center spring mechanism which will produce the desired snap action after predetermined limited movement of

an arm is produced by some external means, such as the link 52.

In the arrangement shown in Fig. 4, when the level of sewage rises to the predetermined height in the receiver, the link 52 will have imparted thereto upward movement which will, in turn, be transmitted to the arm 53. As soon as the arm 53 has been moved through a short arc of travel, the snap valve spring mechanism will effect the required additional movement for closing the valve 54. The valve 55 will be simultaneously opened through the connections described. Thus, it will be seen that steam will be admitted to the receiver to cause ejection of the sewage content therein. When the level of the sewage reaches a predetermined lower level, the float mechanism will, of course, impart downward movement to the link 52 to thereby reversely operate the valves 54 and 55, so as to restore them to their normal positions, to permit sewage to be again delivered to the receiver.

It will be apparent that the lost motion between the upper end of the lever 34 and the forked end of the arm 38 will permit the float arm 28 to swing upwardly and downwardly through certain arcs without actually imparting movement to the operating elements 38, 43, etc. The extent of such lost motion is, of course, adjustable by adjusting the abutment screws 41 and 42, and such adjustment should, of course, be properly related to the lost motion encountered in the snap acting valves of the kind above referred to, when such valves are employed instead of electric switches and solenoid-operated valves.

Another form of non-electrical controlling means is shown in Fig. 5, wherein diaphragm valves 59 and 60 are provided in the steam and exhaust lines 23 and 25 respectively. These diaphragm valves replace the solenoid valves 24 and 26 respectively of the Fig. 1 arrangement.

The link 52 is connected to a small valve 61 provided in a small sized steam line 62, 63, which extends from the steam supply pipe 23 ahead of the valve 59 to the diaphragm chambers of the valves 59 and 60.

When the level of sewage reaches the predetermined height in the receiver, the link 52 operates the valve 61 to permit steam to enter the diaphragm chambers of the valves 59 and 60. The valve 59 is thereby opened and the valve 60 closed so that steam pressure will be built up in the receiver 10 to eject the sewage in the manner already explained.

When the sewage level in the receiver falls to the required point, the valve 61 will again be closed. A bleeder 64 connects the diaphragm chambers of the valves 59 and 60 with the exhaust pipe 25 and effects relief of the steam pressure in said diaphragm chambers whereby, when the valve 61 is closed, the valves 59 and 60 will be permitted to return to their normal closed and open positions respectively. The diaphragm valve 59 is, of course, a normally closed valve, and the valve 60, a normally open valve.

The bleeder 64 will occasion a slight and negligible loss of steam when the valve 61 is opened. This loss may be avoided, if desired, by employing a three-way valve in place of the valve 61. Such a three-way valve may be arranged to control the pasage of steam through the line 62, 63, as does the valve 61. The other outlet of the three-way valve would be connected to the exhaust line 25 and the arrangement would be such that when the steam line 62, 63 is closed, steam pressure initially trapped in the diaphragm valve chambers would be relieved through the three-way valve to the exhaust line. In that arrangement, the bleeder 64 would not be employed.

The bleeder arrangement shown in Fig. 5 appears more desirable than the alternate three-way valve arrangement explained, in that it is somewhat easier to obtain from the float-actuated link 52, the smaller amount of power and travel required for opening and closing the simple open and shut valve 61.

When the sewage ejector is installed on board a ship, the rocking motion to which the ship is often subjected is, of course, imparted to the sewage ejector apparatus, and may produce such turbulence or wave motion on the surface of the sewage in the ejector, as to cause objectionable side thrusts on the valve controlling float arm. To reduce such turbulence within the sewage receiver, and to thereby prevent the indicated, possibly damaging, side thrusts on the float arm mechanism, a vertically disposed partition 60', extending transversely of the receiver may be provided. The partition or baffle 60' should be of such vertical dimension that space remains between its upper edge 61', and the top of the receiver, and between its lower edge 62', and the bottom of the receiver, so that there will be free communication between the receiver portions on opposite sides of the baffle. As indicated in Fig. 2, the baffle is preferably located somewhat off-center, so as to provide a relatively narrow compartment in which the float arm operates. This arrangement is quite effective to prevent excessive turbulence, or sudden changing of the sewage level in the float arm compartment of the receiver, and it prevents the application of excessive sidewise directed forces on the float arm mechanism so that the normal operativeness thereof will more certainly be maintained without extra attention.

In some installations, for safety or emergency purposes, it may be desirable to provide manually controllable valved pipe lines by-passing the automatically controlled valves 24 and 26, or their equivalents, as shown in Figs. 4 and 5. In such an installation, a pipe line 65 (Fig. 1) by-passing the valve 24 would extend from the steam line 23 ahead of the valve 24, to the pipe 22, and such by-pass pipe would be provided with a manually adjustable valve 66. Similarly, a pipe line 67 by-passing the valve 26 would be connected to the exhaust pipe 25 between the valve 26 and the outlet end of the exhaust line, and to the pipe 22. A manually adjustable valve 68 would be provided in the pipe 67. By-passes of this character would permit manual control of the sewage ejecting operation in the event that the automatic controls became disabled.

In Diesel engine-driven ships, and possibly in other installations where a supply of compressed air is usually, if not necessarily, available, compressed air may be used for the sewage ejecting operation in connection with any of the described control means, it being noted that compressed air instead of steam may be used to operate the diaphragm valves of the Fig. 5 arrangement if employed in preference to the electrical or mechanical controls described. However, in such installations, or in others where it is preferable to reserve a stored air capacity for engine starting and like purposes, it is often the case that there is an abundance of electrical power available. In such instances, it may be preferable to provide a separate, electrically driven, air compressor for supplying air under pressure to op-

erate the apparatus. The air may, if desired, be delivered directly from the compressor to the ejector, and starting and stopping of the compressor may be automatically effected by suitable means responsive to the high and low sewage levels in the receiver. For example, the float-controlled electrical switch means shown in Fig. 1 for controlling the solenoid valves may be connected in control circuits for the compressor.

Changes in the described structure may be made without departing from the principles of construction typified by the described apparatus, and such modified constructions are considered to be within the scope of the following claims:

I claim:

1. Sewage handling apparatus comprising a sewage receiver having inlet and outlet sewage piping connected thereto, a conduit connected to the top of said receiver for delivering steam under pressure into the receiver portion above the highest level of sewage received therein, and a baffle mounted in said receiver intermediate the delivery end of said conduit and said highest sewage level, said baffle serving to prevent the steam from penetrating and mixing with said sewage content.

2. Sewage handling apparatus comprising a sewage receiver having inlet and outlet sewage piping connected thereto, a conduit connected to the top of said receiver for delivering steam under pressure into the receiver portion above the highest level of sewage received therein, and a baffle mounted in said receiver intermediate the delivery end of said conduit and said highest sewage level, for preventing the steam from penetrating and mixing with the sewage content of the receiver, the receiver being provided in its top portion with an access opening and with a removable closure for said access opening, and said baffle being mounted on and carried by said cover.

3. Sewage handling apparatus comprising a sewage receiver having inlet and outlet sewage piping connected thereto, means for delivering pressure gas to the upper portion of said receiver, for effecting discharge of the sewage therein and for relieving the gas pressure in said receiver to permit delivery of sewage to the receiver, valves for controlling the delivery of gas to and the exhaust thereof from said receiver, means in said receiver and acted upon by the sewage therein incident to changes in its level, for actuating said valves, and baffle means in said receiver for reducing the extent of sewage level changes in the receiver incident to rocking of the receiver about a horizontal axis, as occurs, for example, when the receiver is installed on a boat.

4. Sewage handling apparatus comprising a sewage receiver having inlet and outlet sewage piping connected thereto, means for delivering pressure gas to the upper portion of said receiver, for effecting discharge of the sewage therein and for relieving the gas pressure in said receiver to permit delivery of sewage to the receiver, valves for controlling the delivery of gas to and the exhaust thereof from said receiver, means in said receiver and acted upon by the sewage therein incident to changes in its level, for actuating said valves, and baffle means in said receiver for reducing the extent of sewage level changes in the receiver incident to rocking of the receiver about a horizontal axis, as occurs, for example, when the receiver is installed on a boat, said baffle means having upper and lower edges spaced from the top and bottom of the receiver so as to maintain communication between the receiver portions on opposite sides of the baffle.

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