Jan. 15, 1957 G. P. SCHUMACKER ET AL 2,777,816

AUTOMATIC SEWAGE TREATMENT AND DISPOSAL UNIT

Filed Sept. 7, 1951

5 Sheets-Sheet 1

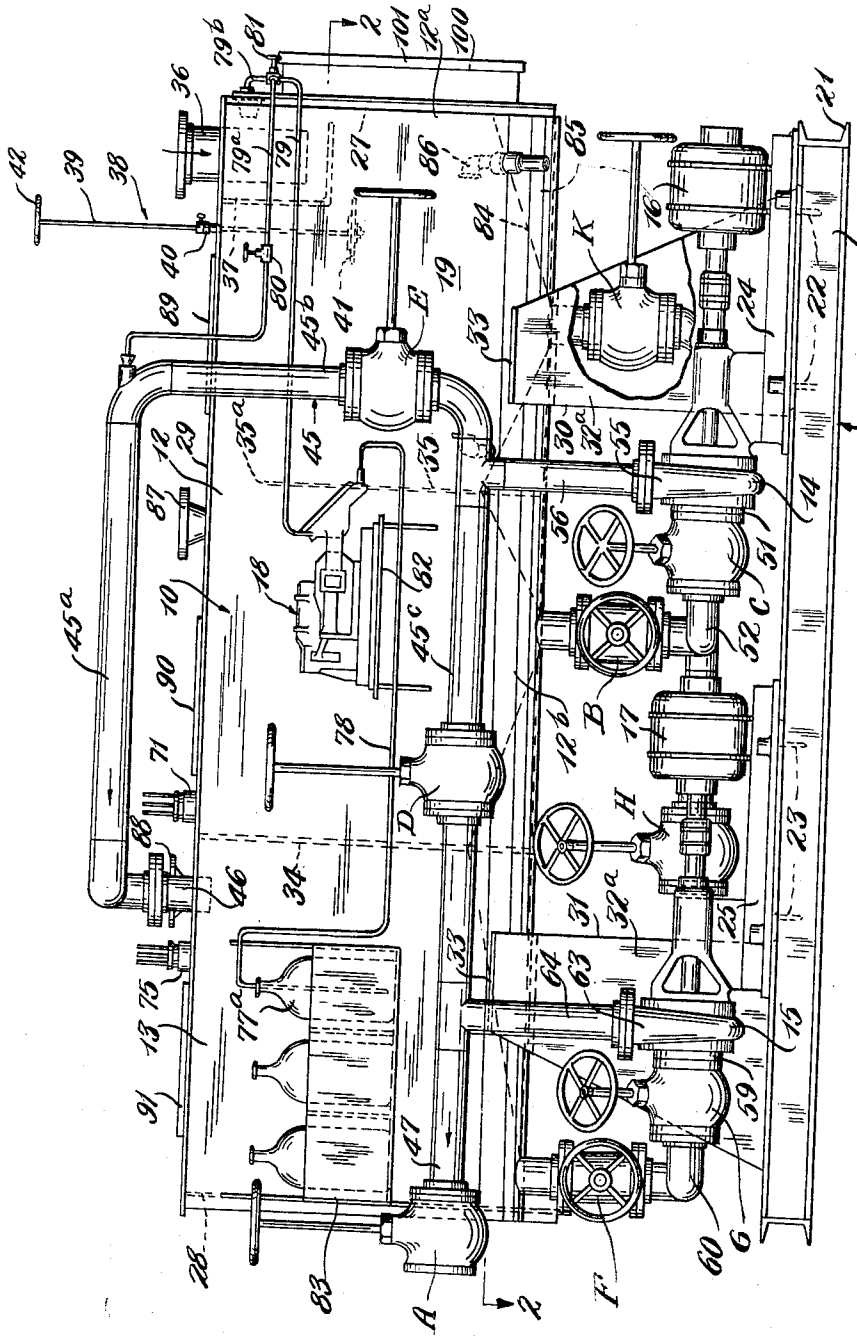

FIG. 1

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5 Sheets-Sheet 2

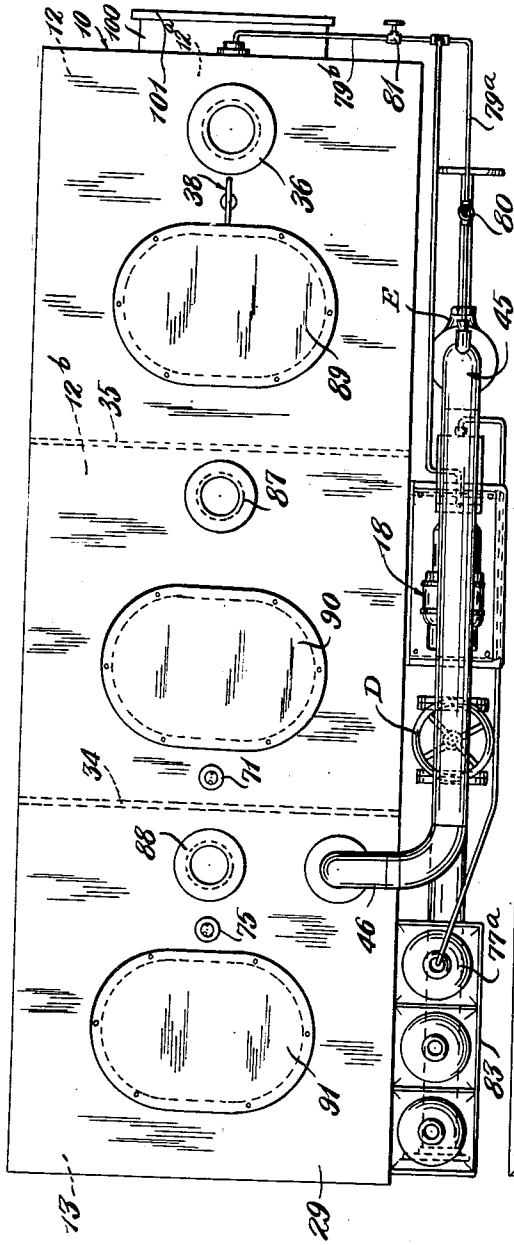

FIG. 3

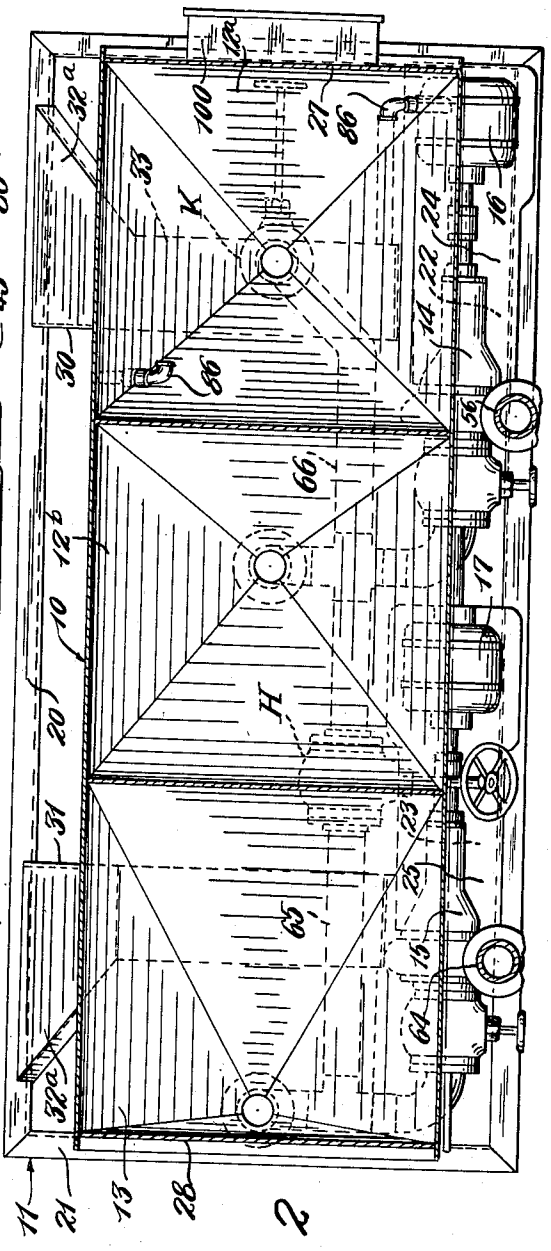

FIG. 2

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5 Sheets-Sheet 3

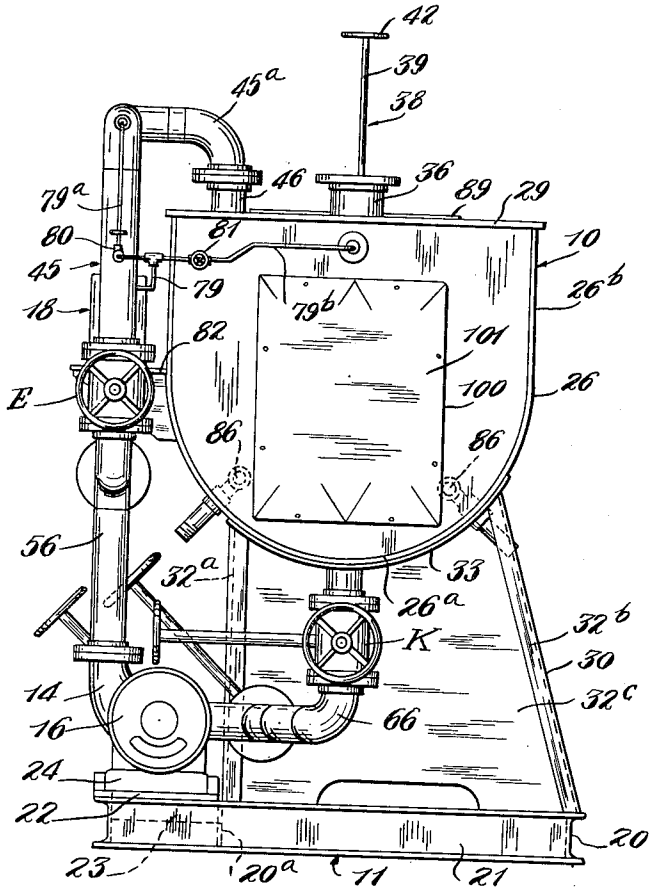

FIG. 4

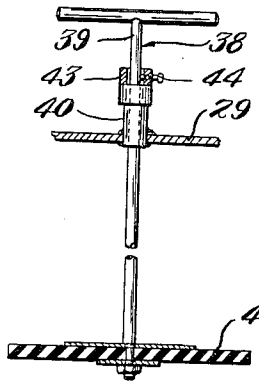

FIG. 5

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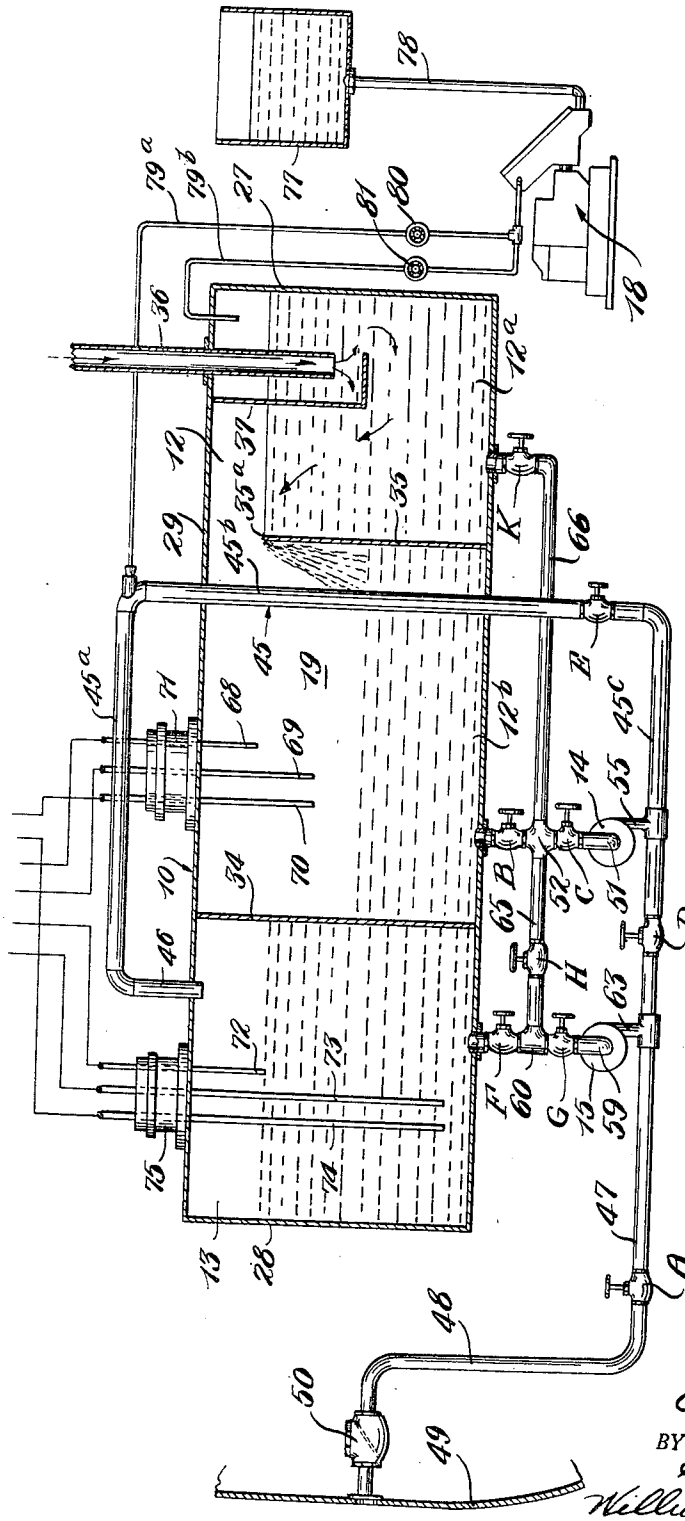
5 Sheets-Sheet 4



OPERATION OF UNIT	VALVE DESIGNATION AND SETTING									
	A	B	C	D	E	F	G	H	I	K
NORMAL AUTOMATIC OPERATION OF UNIT	O	O	O	C	O	O	O	C	C	
DELIVERY PUMP USED AS TRANSFER PUMP	C	O	C	O	O	C	O	O	C	
TRANSFER PUMP USED AS DELIVERY PUMP	O	C	O	O	C	O	C	O	C	
DELIVERY PUMP USED FOR SLUDGE DISCHARGE	O	C	C	C	X	C	O	O	O	
TRANSFER PUMP USED FOR SLUDGE DISCHARGE	O	C	O	O	C	C	X	C	O	

O = OPEN
C = CLOSED
X = EITHER OPEN OR CLOSED

FIG. 7

FIG. 6

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5 Sheets-Sheet 5

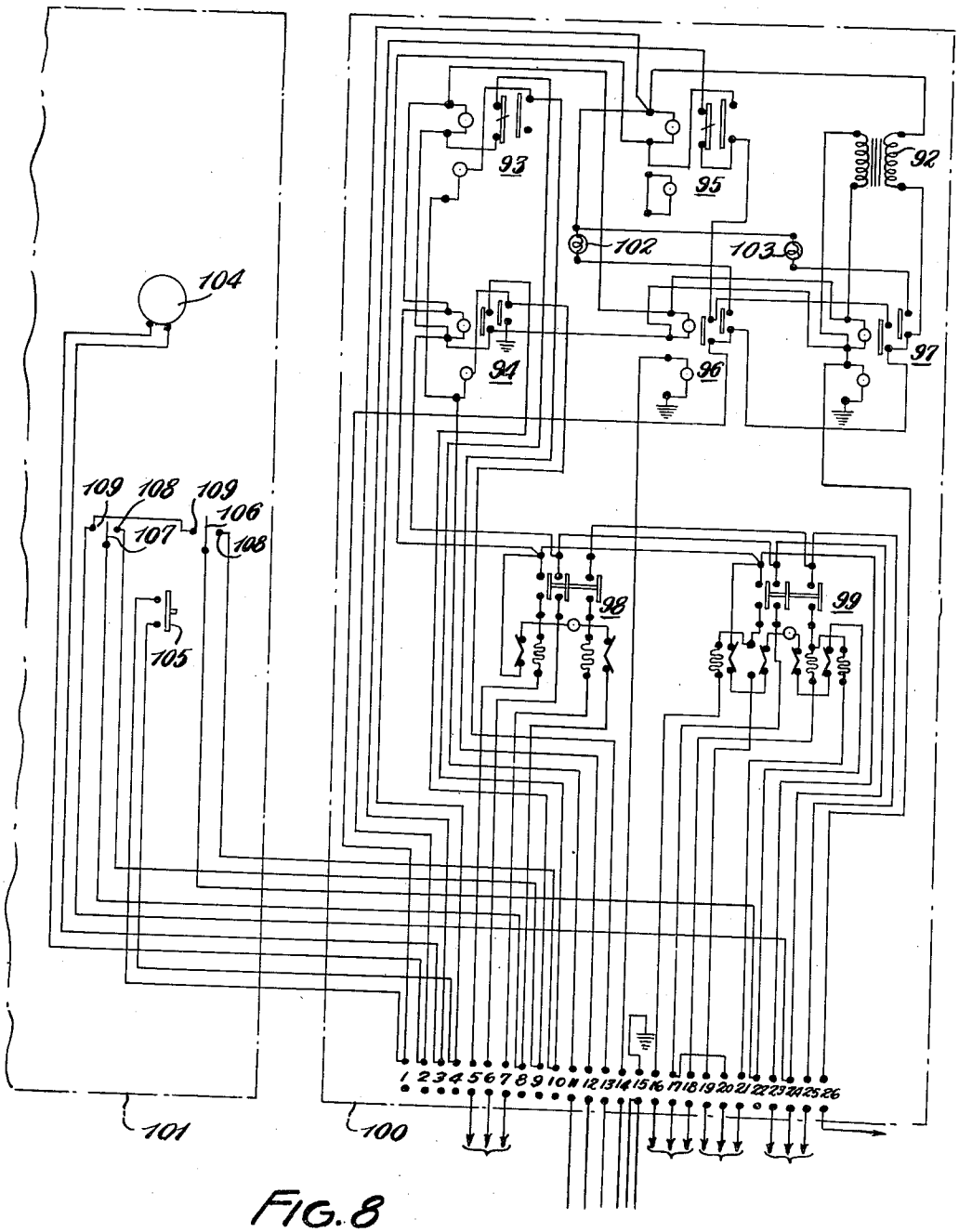

FIG. 8

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Patented Jan. 15, 1957

2,777,816

AUTOMATIC SEWAGE TREATMENT AND DISPOSAL UNIT

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Application September 7, 1951, Serial No. 245,572

12 Claims. (Cl. 210—2)

This invention relates to sewage treatment and disposal apparatus and, as one of its objects, aims to provide improved apparatus of this kind in which the component parts are all assembled in connected relation to constitute a factory-built unit adapted to be tested and transported as such prior to installation in its final location. The improved sewage treatment and disposal apparatus of this invention is especially suitable for ships and accordingly is hereinafter described as applied to that use but without any intention of limiting the apparatus in that respect since it can also be used to serve schools, factories, municipalities and the like.

Another object of this invention is to provide improved sewage treatment and disposal apparatus embodying tank structure having sewage receiving and treating chambers and including transfer and delivery pumps which operate, respectively, to transfer sewage from the receiving chamber to the treating chamber and to deliver the effluent from the treating chamber to a disposal point, and in which such pumps are automatically controlled in response to predetermined changes in the level of liquid in the chambers such that these pumps operate in sequence with the transfer pump preferably operating only while the delivery pump is stopped and the delivery pump preferably operating only while the transfer pump is stopped.

Still another object of the invention is to provide improved sewage treatment and disposal apparatus of the character just mentioned which embodies a treating chemical supply means including a pump having delivery means by which the chemical can be mixed with sewage supplied to the treating chamber and, if desired, can also be mixed with the sewage of the receiving chamber.

A further object is to provide improved sewage treating and disposal apparatus of this character in which the receiving chamber comprises a solids collecting compartment and a liquid collecting compartment, and in which the automatic control of the delivery pump is responsive to a predetermined change in the liquid level of the liquid collecting compartment.

Yet another object is to provide improved sewage treatment and disposal apparatus of the character mentioned in which valve and conduit means connecting the transfer and delivery pumps with the tank structure permits the delivery pump to be used as a transfer pump when desired or the transfer pump to be used as a delivery pump, and in which either of these two pumps can be used as a sludge discharge means for emptying the solids collecting compartment of the receiving chamber.

As another of its objects this invention provides improved sewage treatment and disposal apparatus of the character referred to in which the valve and conduit means includes a conduit loop having one end thereof connected with the treating chamber and its other end adapted for connection with the point of effluent disposal, and in which the transfer and delivery pumps have their discharges connected with an intermediate portion of such conduit loop.

It is also an object of this invention to provide improved sewage treating and disposal apparatus of the kind above referred to in which a tank containing the sewage receiving and treating chambers, together with the transfer and delivery pumps, are mounted on a common base and are connected in operative relation by the valve and conduit means to constitute a prefabricated factory-built unit adapted to be tested as such and then shipped as an assembled unit to an installation point.

The invention can be further briefly summarized as consisting in certain novel combinations and arrangements of parts hereinafter described and particularly set out in the claims hereof.

In the accompanying sheets of drawings,

Fig. 1 is a side elevation showing a sewage treatment and disposal apparatus embodying the present invention and having the form of a substantially complete prefabricated factory-built unit;

Fig. 2 is a longitudinal transverse section taken through the apparatus substantially as indicated by the irregular section line 2—2 of Fig. 1;

Fig. 3 is a top plan view of the apparatus;

Fig. 4 is an end view of the apparatus;

Fig. 5 is a fragmentary vertical section showing a sounding device for determining the depth of accumulated solids in the solids collecting compartment;

Fig. 6 is a mechanical diagram, mainly in longitudinal section, showing the pumping system embodied in the apparatus;

Fig. 7 is a chart showing the open and closed condition of the main valves for accomplishing different pumping operations in the functioning of the apparatus; and

Fig. 8 is a wiring diagram illustrating electrical control means embodied in the apparatus.

As one practical embodiment of the sewage treating and disposal apparatus of this invention, the drawings show a tank **10** mounted on a base **11** and containing sewage receiving and treating chambers **12** and **13**. This improved apparatus also comprises, in general, a pair of transfer and delivery pumps **14** and **15** which are driven by motors **16** and **17** and whose functions will be described hereinafter, and a treating chemical supply pump **18**. Additionally, this apparatus includes conduit means and valves by which these components are connected in operative relation, as will be explained hereinafter. The driving motors **16** and **17** are here shown as being electric motors although steam turbines could be used if desired.

As one important feature of the present invention, the improved sewage treatment and disposal apparatus embodying the components just mentioned, is in the form of a compact, prefabricated unit **19**, which is completely assembled and tested in a shop or factory and can then be transported as such a complete and tested unit to a point of final installations or to a point where it will be embodied in a ship structure. The invention contemplates that the prefabricated and tested unit **19** can be disassembled or partially disassembled, to facilitate handling or shipment thereof or movement thorugh hatches, doorways or the like.

The base 11 can be any suitably constructed supporting base which, in this instance, is in the form of a substantially horizontal rigid frame composed of suitably connected longitudinal and transverse frame members **20**, **20***a* and **21**. The base **11** also includes foundations **22** and **23** on which pump assemblies embodying the transfer and delivery pumps **14** and **15** are mounted. The foundations **22** and **23** constitute reinforced portions of the base **11** and are located at longitudinally spaced points along the front of the later. The transfer pump **14** and its driving motor **16** are suitably mounted on a base **24** to constitute a transfer pump assembly which is, in turn,

suitably secured to the foundation 22. The delivery pump 15 and its driving motor 17 are suitably mounted on a base 25 to constitute a discharge pump assembly which is suitably secured to the foundation 23.

The tank 10 is here shown as being an elongated tank structure which is located in spaced relation above the base 11 and is substantially longitudinally coextensive therewith. This tank comprises a transversely curved longitudinal shell 26 forming a substantially semi-cylindrical bottom wall 26*a* and a pair of substantially parallel flat upright side walls 26*b*. Substantially flat upright walls connected with the shell 26 at the ends thereof form the end walls or beads 27 and 28 of the tank. The tank 10 is closed at the top thereof by a substantially flat longitudinal cover 29.

The tank 10 is supported by the base 11 and is connected therewith in the above-mentioned spaced relation by a pair of longitudnially spaced upright supports 30 and 31. The supports 30 and 31 may be in the form of brackets or saddles fabricated from plate members or other structural components. In this instance each of the supports 30 and 31 comprises a pair of longitudinal upright front and rear flanged plate members 32*a* and 32*b* connected by a transverse upright plate member 32*c*, and a transversely curved plate member 33 forming a concave saddle top. These plate members are welded or otherwise suitably connected together.

The lower edges of the rear plate members 32*b* are suitably secured to the rear longitudinal frame member 20 of the base 11 and the lower edge of the front plate members 32*a* are secured to an intermediate longitudinal frame member 20*a*. The portion of the base 11 which projects forwardly from the supports 30 and 31 forms a longitudinal shelf embodying the above-mentioned foundations 22 and 23 for the pump assemblies. The concave saddle tops formed by the plate members 33 receive and support the tank 10 which is secured to such saddle tops by suitable welding.

As shown in the drawings, the tank 10 is provided with a transverse internal wall or bulkhead 34 forming a partition between the receiving chamber 12 and the treating chamber 13. The tank is also provided with a transverse internal wall 35 forming a partition in the receiving chamber 12 and which divides the latter into a solids collecting compartment 12*a* and a liquid collecting compartment 12*b*. The partition 34 extends upwardly to the cover 29 such that the treating chamber 13 will be completely separated from the receiving chamber 12. The partition 35, on the other hand, has its upper edge 35*a* spaced a short distance below the cover 29 such that this partition forms a baffle or dam over which liquid can flow from the solids collecting compartment 12*a* into the liquid collecting compartment 12*b*.

The tank 10 is also provided with a sewage inlet connection in the form of a conduit 36 extending through the cover 29 into the solids collecting compartment 12*a* of the receiving chamber 12. A substantially L-shaped baffle 37 is located in the compartment 12*a* adjacent the lower end of the sewage inlet conduit 36 and serves the purpose of deflecting the incoming stream of sewage in a lateral direction to prevent such stream from flowing directly downwardly in the compartment 12*a* and agitating the solids which have already settled or collected in the bottom of this compartment. As sewage in the form of a mixture of liquid and solid materials is delivered into the compartment 12*a* through the conduit 36, such sewage will fill this compartment whereupon the clear liquid will flow over the edge 35*a* of the partition 35 into the liquid collecting compartment 12*b*. The solid material delivered into the compartment 12*a* will settle to the bottom of this compartment and will be retained therein as a sludge until such time as the collected sludge is to be discharged therefrom in the manner hereinafter explained.

The depth of sludge accumulation in the collecting compartment 12*a* can be measured from time to time by means of a novel sounding device 38 with which the unit 19 is equipped. As shown in Figs. 1 and 5, the sounding device 38 comprises an upright stem 39 extending through a sleeve 40 which is welded or otherwise suitably secured to the cover 29 and a transverse feeler plate 41 carried by the stem 39 and suitably secured to the lower end thereof. The sounding device 38 also includes a suitable handle 42 secured to the upper end of the stem 39 by which the device is adapted to be manually grasped and operated.

In taking a sounding of the sludge accumulation in the compartment 12*a*, the stem 39 is moved up and down through the sleeve 40 causing the feeler plate 41 to engage the surface of the sludge accumulation which will enable the operator to determine the location of such surface by noting the greater resistance to movement of the feeler plate into the body of sludge and the lessened resistance to movement of the feeler plate through the body of liquid standing in the compartment 12*a* above the body of sludge. The feeler plate 41 can be retained in a parked position or can be left in a fixed location designating the surface level of the accumulated sludge at any given time, by means of a collar 43 surrounding the stem 39 and adapted to be secured thereto by means of a clamping screw 44. When the collar 43 is thus secured to the stem 39 it forms a shoulder thereon which is engageable with the upper end of the sleeve 40 for supporting the rod on the latter.

The tank 10 is constructed of such a size that the collecting compartment 12*a* thereof will provide a storage space of sufficient capacity to store the solid sewage materials being supplied during a predetermined time interval. Thus when the sewage treating apparatus is installed aboard a steamship, the collecting compartment 12*a* would be of such capacity as to store the solid sewage material of the ship for a predetermined time interval corresponding with the time interval which the ship usually remains in port. By thus collecting the solid portion of the ship sewage in the compartment 12*a* and retaining the same therein as sludge while the ship remains in port, it will ordinarily not be necessary to discharge untreated sewage solids into the harbor waters during such period.

The liquid portion of the sewage which is supplied to the chamber 12 is also initially collected in the compartment 12*a* as indicated above, but when this compartment has become full, the liquid flows over the edge 35*a* of the partition 35 into the compartment 12*b* and is temporarily collected in the latter. When the liquid collected in the compartment 12*b* reaches a predetermined level it is transferred to the treating chamber 13 by operation of the transfer pump 14 and is treated with a disinfecting chemical which is supplied thereto in a manner to be presently explained.

The treated liquid sewage material or effluent is retained in the treating chamber 13 until it reaches a predetermined level whereupon the effluent is discharged from this chamber by operation of the delivery pump 15 as will be presently explained. When the ship has left port, the sludge which has accumulated in the compartment 12*a* is discharged therefrom by operation of one or the other of the pumps 14 or 15 in such a manner as to discharge the sludge overboard into unrestricted waters as will be further explained presently.

The sewage treating and disposal unit 19 includes a main conduit loop 45 located adjacent the tank 10 and here shown as comprising an upper conduit portion 45*a* having the discharge end 46 thereof communicating with the treating chamber 13 through the cover 29. The main conduit loop 45 also includes upright and intermediate conduit portions 45*b* and 45*c* and a discharge end 47 controlled by a valve A and adapted for connection with conduit means extending to a point of effluent disposal, such as the conduit portion 48 shown in Fig. 6 which

leads to the outer shell 49 of the ship for discharging the effluent overboard through an opening in such shell and through an outwardly opening check valve 50.

As shown in Figs. 1 and 6, the transfer pump 14 has an intake 51 which is connected with the bottom of the liquid collecting compartment 12*b* by conduit means 52 having the valves B and C located therein in series relation. The discharge 55 of the transfer pump 14 is connected with the intermediate portion 45*c* of the main conduit loop 45 by conduit means 56. The point of connection of the discharge 55 of the transfer pump 14 with the main conduit loop 45 is located between a pair of valves D and E which are installed in the main conduit loop and to which further reference will be made hereinafter.

The discharge or overboard pump 15 has its intake 59 connected with the bottom of the treating chamber 13 by a conduit means 60 having a pair of valves F and G therein in series relation. The discharge 63 of the delivery pump 15 is connected with the intermediate portion 45*c* of the main conduit loop 45 by conduit means 64. The connection of the discharge 63 of the delivery pump 15 with the conduit loop 45 is at a point located between the valves A and D of this conduit loop.

As shown in Fig. 6 a conduit 65 forms an intercommunicating connection between the intakes 55 and 63 of the transfer and delivery pumps 14 and 15. The conduit 65 has one end thereof connected with the intake conduit means 52 of the transfer pump at a point between series valves B and C. The other end of the conduit 65 is connected with the intake conduit means 60 of the delivery pump 15 at a point between the series valves F and G. The conduit 65 is controlled by a valve H.

For the removal of sludge from the solids collecting compartment 12*a*, a conduit 66 has one end thereof connected with the bottom of this compartment through a valve K and has its other end connected with the intake means 52 of the transfer pump 14 at a point between the series valves B and C. As shown in Fig. 6, the connection 65 permits the delivery pump 15 to be used for discharging sludge from the compartment 12*a* instead of the transfer pump 14 if that should be desirable.

For controlling the operation of the transfer and delivery pumps 14 and 15, the unit 19 is provided with suitable electric control apparatus which includes contact members or probes extending into the liquid collecting compartment 12*b* and the treating chamber 13. In this instance there are three such probes, 68, 69 and 70 extending into the compartment 12*b* in depending relation from an insulating fitting 71 carried by the cover 29. Three such probes 72, 73 ad 74 extend into the treating chamber 13 in depending relation from an insulating fitting 75 also carried by the cover 29.

The electric control apparatus of which the above-mentioned probes form a part can be any conventional electric control apparatus of the switch relay type which will operate to automatically start and stop the pumps 14 and 15 in sequence in response to predetermined changes of the liquid levels in the compartment 12*b* and the chamber 13. One suitable form of such electric control apparatus is illustrated in the wiring diagram of Fig. 8 to which further reference will be made hereinafter.

The probe 68 extends into the compartment 12*b* for only a relatively short distance and forms a portion of a high level alarm circuit. The probes 69 and 70 extend into the compartment 12*b* for a somewhat greater distance than the probe 68 and have their lower ends at the upper operating level for the liquid which collects in this compartment. The probe 69 constitutes a portion of the electric control circuit which causes automatic starting of the discharge pump 15 when the liquid in the compartment 12*b* reaches such upper operating level. The probe 70 constitutes a common electrode for the control circuits which are dependent on the liquid level in the compartment 12*b*.

The probe 72 of the treating chamber 13 extends into this chamber for a distance such that the lower end of this probe is located at the upper operating level of the liquid which collects in this chamber. The probe 72 constitutes a portion of an electric control circuit which causes automatic stopping of the transfer pump 14 when the liquid in the treating chamber reaches such upper operating level. The probes 73 and 74 extend into the treating chamber 13 for a distance such that the lower ends of these probes are located adjacent the bottom of this chamber. The probe 73 forms a portion of a control circuit which causes automatic stopping of the delivery pump 15 when the level of liquid in this chamber falls to a level just below the lower end of this probe. The probe 74 constitutes a common electrode for the control circuits serving the treating chamber 13.

In the operation of the improved unit 19 as thus far described, it will be seen that when this unit is placed in operation at the desired point of use, the sewage inlet pipe 36 will be connected with the sewage system or sewer such that the sewage delivered to the tank 10 will gradually cause an accumulation of solids in the compartment 12*a* and an accumulation of clear liquid in the compartment 12*b* as explained above. In initially placing the unit 19 in operation, the treating chamber 13 is filled with water to the point where the upper operating level contacts the probe 72 to thereby energize the electric control apparatus to a condition corresponding with the stopped condition of the transfer pump 14, When the level of liquid in the collecting compartment 12*b* reaches its upper operating level and contacts the probes 69 and 70, the electric control apparatus will then be energized to cause the delivery pump 15 to be automatically started.

The operation of the delivery pump 15 causes the liquid or effluent of the treating chamber 13 to be withdrawn therefrom and discharged overboard through the conduit portion 47 and the conduit means 48. When the delivery pump 15 has operated for a period of time sufficient to cause the level of the effluent in the chamber 13 to be lowered to a point just below the lower ends of the probes 73 and 74, the electric control apparatus will cause the delivery pump 15 to be automatically stopped and will cause the transfer pump 14 to be automatically started. The operation of the transfer pump 14 caues the liquid collected in the compartment 12*b* to be withdrawn therefrom and to be delivered into the treating chamber 13 through the main conduit loop 45.

When the liquid thus delivered into the treating chamber 13 fills this chamber to the point where the upper level of the liquid contacts the probe 72, the electric control apparatus will be energized to cause the transfer pump 14 to be automatically stopped. The liquid thus delivered into the treating chamber 13 will be retained therein until the liquid being collected in the compartment 12*b* again rises to the level where it will contact the probes 69 and 70 to again cause the delivery pump 15 to be automatically started. The period of time during which liquid is collecting in the compartment 12*b* provides a desired time interval or detention period during which the liquid of the chamber 13 is retained in the latter to be acted upon by the treating chemical.

If the unit 19 is not in proper operating condition such that the delivery pump 15 will be automatically started when the liquid level in the compartment 12*b* contacts the probes 69 and 70, the level will continue to rise and will ultimately contact the high level alarm probe 68. When this occurs a signal circuit of the electric control apparatus is energized to cause sounding of an alarm bell 104 to give warning of such flooded condition of the receiving chamber 12 of the tank 10.

During the normal operation of the unit 19, the sewage handled thereby is chemically treated with a desired or predetermined amount of a disinfecting chemical,

preferably a chemical of the chlorinating type such as sodium hypochlorite, such that the sewage delivered from the unit will not be raw or untreated sewage such as might pollute the surrounding waters. For this purpose the unit **19** embodies treating chemical supply means which includes the above-mentioned pump **18** and which can be conveniently referred to as the chemical pump. The chemical supply means also includes a reservoir **77** containing a suitable supply of the sodium hypochlorite or other treating chemical. Fig. 1 of the drawings shows the reservoir means for the chemical supply as comprising a plurality of bottles **77***a*.

The chemical pump **18** is provided with a suction conduit in the form of a tube **78** extending to the reservior means and is also provided with a delivery conduit **79** which preferably has branch portions **79***a* and **79***b*. The branch conduit **79***a* may be controlled by a valve **80** and is here shown as having its delivery end communicating with the delivery portion **45***a* of the main conduit loop **45**. The branch portion **79***b* may be controlled by a valve **81** and is here shown as having its delivery end communicating with the sewage receiving chamber **12** at a point adjacent the inlet conduit **36**, preferably at a location between the end wall **27** and the baffle **37** as shown in Fig. 6.

The chemical pump **18** can be a pump of any construction suitable for this purpose, such as an adjustable stroke positive displacement pump, and is driven by an electric motor embodied therein or connected therewith. This pump is embodied in the unit **19** by being mounted on a suitable bracket or shelf **82** which is here shown as being secured to the upright front wall **26***b* of the tank **10**. The bottles **77***a* containing the supply of chemical are here shown as being supported by a shelf structure **83** which is also embodied in the unit **19** by being suitably secured to the upright front wall **26***b* of the tank **10**.

When the treating chemical delivered by the pump **18** is supplied to the conduit portion **45***a* of the main conduit loop **45** as shown in the drawings, the sewage being transferred from the compartment **12***b* to the treating chamber **13** by the transfer pump **14** will be effectively treated by an efficient mixing of a proportional amount of the chemical with the stream of sewage which is entering the compartment **13** through the conduit connection **46**. The chemical pump **18** is normally operated under control of the electric control means such that this pump will automatically operate intermittently and substantially simultaneously with the operation of the transfer pump **14**. Thus when the transfer pump **14** is started automatically by the control means, the chemical pump **18** will be automatically started substantially simultaneously and will discharge chemical through the conduit branch **79***a* into the main conduit portion **45***a* for an efficient mixing of this chemical with the sewage being supplied to the treating chamber **13** by the transfer pump.

When the liquid has been transferred from the compartment **12***b* to the treating chamber **13** and the desired or predetermined amount of treating chemical has been mixed therewith as just explained above, the mixture of sewage and chemical remains in the treating chamber **13** for a period of time corresponding with that required to refill the compartment **12***b* with liquid up to the level of contact with the probes **69** and **70**. The capacity of the compartment **12***b* is such that this detention period will be of at least a predetermined minimum duration during which the mixture of sewage and chemical will be retained in the treating chamber **13** to permit the chemical to accomplish its disinfecting action on the sewage.

During the time that a ship equipped with the unit **19** normally remains in port, the unit is operated automatically in the manner already explained above in which the liquid portion of the sewage is intermittently transferred from the compartment **12***b* to the treating chamber **13** and treating chemical is added to the sewage during such transfer, after which the effluent is discharged overboard from the treating chamber. The solids collected in the compartment **12***a* are retained therein and discharged overboard after the ship leaves port, and at a location where the discharge of untreated sewage will not be objectionable. Such discharge of the solids or sludge from the compartment **12***a* is accomplished by manual control of one of the pumps **14** or **15**, depending upon which of these pumps has been selected to perform this work.

If, however, the period of time which the ship is expected to remain in port is too long for the solids storage capacity of the compartment **12***a*, the unit **19** can be operated by supplying the treating chemical to the storage compartment **12***a* through the branch conduit **79***b* by a manually controlled continuous operation of the chemical pump **18**. At this time the valve **80** of the branch conduit **79***a* is closed. When the unit **19** is being operated under these conditions, all of the sewage solids collected in the compartment **12***a* will be treated with chemical while they remain in the compartment. Under this condition of operation, liquid will be transferred from the collecting compartment **12***b* to the treating chamber **13** intermittently by the pump **14** and the effluent will be intermittently discharged overboard from the treating chamber by the pump **15** and these functions will be carried out automatically in the manner already explained above. When it becomes necessary to discharge the sludge from the compartment **12***a*, it can then be done even though the ship is still in port inasmuch as the sludge will then be a chemically treated sludge.

When the ship is operating out of port and in unrestricted waters, the chemical pump **18** can be stopped so that no treating chemical will then be supplied to the sewage and the sewage will be discharged overboard as untreated sewage by operation of the unit **19** in a manner which is otherwise identical with the automatic operation already explained above. The solid material which collects in the compartment **12***a* during this condition of operation will need to be discharged from time to time and this can be readily done by manual manipulation of the valves of the conduit means, and by manual control of the pump which is used as the sludge discharge pump and which can be either the pump **14** or the pump **15** depending upon the setting of the control valves.

During the operation of the ship in unrestricted waters, it may be desirable to treat the sewage which is being handled by the unit **19** in the same manner as the sewage which is handled by this unit when the ship is in port and, in that case, the sewage which is discharged from the treating chamber **13** will always be a treated sewage and the settled solids or sludge which is discharged from the compartment **12***a* will be a chemically treated sludge whenever the operation of the unit is such that treating chemical is supplied through the branch conduit **79***b*.

Reverting to the description of the tank structure **10**, it should be explained that the compartments **12***a* and **12***b* and the treating chamber **13** are provided with bottom surfaces **84** which slope toward the outlet connections of these compartments. This sloping bottom surface can be obtained by providing a partial filling of varying thickness of cement **85**. The portion of the tank defining the compartment **12***a* is also provided with a pair of internal discharge nozzles **86** to which a supply of flushing water under pressure can be connected for washing out this compartment after the sludge has been discharged therefrom. As shown in the drawings, the nozzles **86** are located in staggered relation in the compartment **12***a*, that is on opposite sides of this compartment and facing each other, so that substantially all of the interior of this compartment will be subjected to the streams of flushing water.

The tank **10** is preferably also provided at the top thereof with suitable vent connections **87** and **88** which com-

municate respectively with the upper portion of the receiving chamber 12 and the treating chamber 13 and with which suitable vent pipes can be connected. The cover 29 is preferably also provided with access openings or manholes for cleaning and inspection purposes and which openings are normally closed by suitable manhole covers 89, 90 and 91.

As has already been indicated above, the conduit means and the control valves of the unit 19 are such that the pump 14 will be used as a transfer pump under normal automatic control but under manual control can also be used as a delivery pump, and likewise, the pump 15 will be used as a delivery or overboard pump under normal automatic control but under manual control can also be used as a transfer pump. The conduit means and the control valves of the unit 19 are also such that the discharge of sludge from the compartment 12*a* can be accomplished by use of either the pump 14 or the pump 15 under manual control for this purpose. The use of the pumps 14 and 15 for these different functions depends upon the setting of the control valves and, as a simple explanation of the different settings for these valves, reference is made to the valve setting diagram of Fig. 7. This diagram shows graphically the functions of the pumps 14 and 15 during the different operating conditions of the unit 19 and the corresponding settings of the various control valves which will result in the attainment of the desired functions by these pumps.

As has been indicated above, the electric control apparatus for automatically controlling the operation of the transfer and delivery pumps 14 and 15 and the operation of the chemical pump 18 can be electric control apparatus of a conventional type and for that reason a detailed description of the electrical apparatus is considered unnecessary. In connection with this electrical control apparatus it is deemed sufficient to explain that, as shown in the wiring diagram of Fig. 8, it comprises a transformer 92 and a group of liquid level responsive pump control relay switches 93, 94 and 95 and a group of liquid level responsive signal control relay switches 96 and 97. This control apparatus also comprises pump starting switch units 98 and 99. All of the devices just mentioned are suitably located in a control box 100 which is mounted on the end wall 27 of the tank 10 and is normally closed by a cover 101.

By locating the electrical control apparatus in the box 100 it can be connected in operative relation with the electric motors of the pumps and with the control probes of the tank 10 such that the unit 19 can be fully tested in the shop or factory in which it is built and prior to the delivery or shipment of the unit for final installation. The location of the electric control apparatus in the box 100 also protects this apparatus from harmful blows or from damaging contact by moisture or other harmful agents.

This electric control apparatus also includes signal lamps 102 and 103, a signal bell 104, and manually operable switches 105, 106 and 107. The signal bell 104 and the manual switches 105, 106 and 107 are preferably mounted on the inside of the cover 101 of the control box 100. The bell 104 and the lamps 102 and 103 are signal devices for automatically indicating an abnormal condition in the functioning of the unit 19, or of a plurality of such units as when similar units are located at different points on the same ship. The signal lamps 102 and 103 can be located on the outside of the box 100 or at any other desired place or places on the ship.

In connection with this electric control apparatus it can be further briefly explained that the relay switch 93 is a pump circuit holding switch which is responsive to a rising liquid level and the relay switch 94 is a pump circuit holding switch which is responsive to a falling liquid level. The relay switches 96 and 97 are high liquid level responsive switches which control the lamps 102 and 103 and the signal bell 104. The switch 105 is a push button switch which stops the ringing of the bell 104. The switch device 98 is an automatic starting switch for the delivery pump 15 and the switch device 99 is an automatic starting switch for the transfer pump 14 and the chemical pump 18.

The switches 106 and 107 are selector switches for the transfer and delivery pump, respectively, for shifting from automatic operation to manual operation or vice versa. Each of the latter switches has an intermediate open position and contact settings 108 and 109 for automatic and manual control of the operation of the transfer and delivery pumps. When these switches are in their open position the pumps will be stopped and inoperative but when the movable switch members of these switches have been manually engaged with the contacts 108, the transfer and delivery pumps will be under the automotive control of the relay switches and starting switches mentioned above. When one or the other of the movable switch members of these switches is manually engaged with the contacts 109, the corresponding transfer or delivery pump will be running and will then be operating under manual control.

From the foregoing detailed description and the accompanying drawings, it will now be readily understood that this invention provides a novel form of automatic sewage treatment and disposal unit which can be prefabricated and assembled in a shop or factory and can be tested out as such a complete unit prior to delivery thereof to the point of final installation. It will also be understood that the sewage treatment and disposal unit provided by this invention will permit the liquid portion of the sewage of a ship to be chemically treated while the ship is in port and the solid portion of the sewage to be stored for discharge overboard into unrestricted waters after the ship leaves port. It will also be seen that the unit 19 is of such construction that it is very flexible and adaptable in its operation such that it can be operated in various different ways for handling the ship's sewage to best advantage and in accordance with regulations covering the discharge of sewage from ships into harbor waters.

Although the automatic sewage treatment and disposal unit of this invention has been illustrated and described herein to a detailed extent, it will be understood of course that the invention is not to be regarded as being limited correspondingly in scope but includes all changes and modifications coming within the terms of the claims hereof.

Having thus described our invention, we claim:

1. A prefabricated sewage disposal unit for shipboard use comprising; a unitary structure constituting a preformed base; a substantially closed tank mounted on said base and having therein a sewage receiving and storage chamber and a sewage treating chamber; a transfer pump; a delivery pump; driving motors connected with said pumps to drive the same; means on said base forming foundations for said transfer and delivery pumps and their driving motors and having said pumps and motors mounted thereon; conduit means connecting the intake of said transfer pump with said receiving chamber; conduit means connecting the discharge of said transfer pump with said treating chamber; conduit means connecting the intake of said delivery pump with said treating chamber; and conduit means extending from said delivery pump and adapted for connection with an overboard discharge means; said base, tank, pumps, driving motors and conduit means being all assembled in their connected and operative relation to constitute a prefabricated unit adapted to be tested and transported as such prior to installation for its intended regular service operation on a ship.

2. A prefabricated sewage disposal unit particularly for ships comprising; a unitary structure constituting a preformed base; a substantially closed tank mounted on said base and having therein a receiving and storage chamber and a treating chamber; a transfer pump; an overboard pump; driving motors connected with said pumps to drive the same; means on said base forming

foundations for said transfer and overboard pumps and their driving motors and having said pumps and motors mounted thereon; conduit means forming a loop having one end thereof connected with said treating chamber and having its other end adapted for connection with an overboard discharge means; conduit means connecting the intakes of said transfer and overboard pumps with said receiving and treating chambers; conduit means connecting the discharges of said pumps with the intermediate portion of said loop; and valves controlling all of said conduit means; said base, tank, pumps, driving motors, conduit means and valves being all assembled in their connected and operative relation to constitute a prefabricated unit adapted to be tested and transported as such prior to installation for its intended regular service operation on a ship.

3. A prefabricated sewage treatment and disposal unit for shipboard use comprising; a unitary structure constituting a preformed base; a substantially closed tank mounted on said base and having therein a sewage receiving and storage chamber and a sewage treating chamber; a transfer pump; a delivery pump; driving motors connected with said pumps to drive the same; means on said base forming foundations for said transfer and delivery pumps and their driving motors and having said pumps and motors mounted thereon; conduit means operably connecting said transfer and deilvery pumps with said receiving and treating chambers and providing for the transfer of sewage from said receiving chamber to said treating chamber and the delivery of treated sewage from said treating chamber; treating chemical supply means operable to supply treating chemical for mixing with the sewage delivered to said treating chamber; and electric control means responsive to predetermined liquid levels in said receiving and treating chambers and effective on said driving motors for automatically causing intermittent operation of said pumps in sequence; said base, tank, pumps, driving motors, chemical supply means, and electric control means being all assembled in their connected and operative relation to constitute a substantially complete prefabricated unit adapted to be preliminarily tested and transported as such prior to installation for its intended regular service operation on a ship.

4. A prefabricated sewage treatment and disposal unit as defined in claim 3 in which said treating chemical supply means includes a motor driven chemical pump; and in which said electric control means includes means for causing operation of the chemical pump substantially simultaneously with the operation of said transfer pump.

5. A prefabricated sewage treatment and disposal unit as defined in claim 3 in which said electric control means includes contact probes extending into said receiving and treating chambers and switch means electrically connected with said probes and effective to control said motors; and in which a control box mounted on said unit has said switch means housed therein.

6. A sewage treatment and disposal unit comprising, substantially closed tank structure having therein a sewage receiving and storage chamber and a sewage treating chamber, a transfer pump having its intake connected with said receiving chamber and its discharge connected with said treating chamber, a delivery pump having its intake connected with said treating chamber and its discharge connected with an effluent disposal point, driving motors connected with said pumps for driving the same, means operable to supply treating chemical for mixing with the sewage delivered to said treating chamber by said transfer pump, and electric control means responsive to predetermined liquid levels in said receiving and treating chambers and effective on said driving motors for automatically causing intermittent operation of said pumps including means responsive to the rise of liquid to a predetermined upper level in said storage chamber for starting said delivery pump and means responsive to the change in the liquid level in said treating chamber from a predetermined upper level to a predetermined lower level and vice versa for starting and stopping said transfer pump.

7. A sewage treatment and disposal unit comprising, substantially closed tank structure having therein a sewage receiving and storage chamber and a sewage treating chamber, a transfer pump having its intake connected with said receiving chamber and its discharge connected with said treating chamber, a delivery pump having its intake connected with said treating chamber and its discharge connected with an effluent disposal point, driving motors connected with said pumps for driving the same, means operable to supply treating chemical for mixing with the sewage delivered to said treating chamber by said transfer pump, and electric control means responsive to predetermined liquid levels in said receiving and treating chambers and effective on said driving motors for automatically causing intermittent operation of said pumps including means responsive to the rise of liquid to a predetermined upper level in said storage chamber to cause the starting of said delivery pump and means responsive to the change in the liquid level in said treating chamber from a predetermined upper level to a predetermined lower level and vice versa to cause the starting and stopping of said transfer pump, the capacity of said sewage receiving chamber being such that the filling of said receiving chamber to a level for causing the starting of said delivery by said electric control means provides a predetermined time interval during which the sewage of said treating chamber is retained therein in contact with said treating chemical.

8. A sewage treatment and disposal unit as defined in claim 6 in which the treating chemical supply means has its discharge connected with the discharge of said transfer pump for mixing contact of said chemical with the stream of sewage being delivered by said transfer pump at a point in advance of the admission of said stream to said treating chamber.

9. A sewage treatment and disposal unit as defined in claim 6 in which the treating chemical supply means is a motor driven chemical pump having its discharge connected with the discharge of said transfer pump for mixing contact of said chemical with the stream of sewage being delivered by said transfer pump at a point in advance of the admission of said stream to said treating chamber, and in which said electric control means also includes means effective on the driving motor of said chemical pump for automatically causing starting and stopping of the chemical pump substantially simultaneously with the starting and stopping of said transfer pump.

10. A sewage treatment and disposal unit comprising, substantially closed tank structure having therein a sewage receiving chamber and a sewage treating chamber, means dividing said receiving chamber into a solids storage compartment and a liquid storage compartment, a transfer pump having its intake connected with said liquid storage compartment and its discharge connected with said treating chamber, a delivery pump having its intake connected with said treating chamber and its discharge connected with an effluent disposal point, electric motors connected with said pumps for driving the same, means operable to supply treating chemical for mixing with the sewage delivered to said treating chamber by said transfer pump, and electric control means responsive to predetermined liquid levels in said liquid storage compartment and in said treating chamber and effective on said electric motors for automatically causing intermittent operation of said pumps in sequence such that the operation of said delivery pump takes place while said transfer pump is stopped and the operation of said transfer pump takes place while said delivery pump is stopped.

11. A sewage treatment and disposal unit comprising, substantially closed tank structure having therein a sewage receiving chamber and a sewage treating chamber, means dividing said receiving chamber into a solids storage com-

partment and a liquid storage compartment, a transfer pump having its intake connected with said liquid storage compartment and its discharge connected with said treating chamber, a delivery pump having its intake connected with said treating chamber and its discharge connected with an effluent disposal point, electric motors connected with said pumps for driving the same, means operable to supply treating chemical for mixing with the sewage delivered to said treating chamber by said transfer pump, and electric control means responsive to predetermined liquid levels in said liquid storage compartment and in said treating chamber and effective on said electric motors for automatically causing intermittent operation of said pumps in sequence, the capacity of said liquid storage compartment being such that the filling of said liquid storage compartment to a level for causing energization of said electric control means provides a predetermined time interval during which the sewage of said treating chamber is retained therein in contact with said treating chemical.

12. A prefabricated sewage treatment and disposal unit particularly for ships comprising; an elongated unitary structure constituting a preformed substantially rigid horizontal base; an elongated substantially closed tank spaced above said base and having therein a receiving chamber and a treating chamber; means in said tank dividing said receiving chamber into a solids collecting compartment and a liquid collecting compartment; upright supports extending between said base and tank and mounting the latter on said base in such spaced relation thereto; a transfer pump; an overboard pump; electric motors connected with said pumps to drive the same; means on said base forming foundations for said transfer and overboard pumps and their driving motors and having said pumps and motors mounted thereon; conduit means forming a conduit loop having one end thereof connected with said treating chamber and having its other end adapted for connection with an overboard discharge means; conduit means connecting the intake of said overboard pump with said treating chamber; conduit means connecting the discharge of said overboard pump with an intermediate portion of said conduit loop; conduit means connecting the intake of said transfer pump with said solids and liquid storage compartments; conduit means connecting the discharge of said transfer pump with said intermediate portion of said conduit loop; an interconnecting conduit means connecting the intakes of said transfer and overboard pumps; valves controlling all of said conduit means; treating chemical supply means including a motor driven chemical pump having discharge means connected with said conduit loop and with said solids storage compartment; a control box; and electric control means including contact probes extending into said liquid storage compartment and into said treating chamber and switch means located in said control box; said electric control means being responsive to predetermined liquid level changes in said liquids storage chamber and in said treating chamber and being effective on said motor driven chemical pump and on said transfer and overboard pumps to automatically cause a timed intermittent operation of said chemical pump and an intermittent operation of said overboard and transfer pumps in sequence; said base, tank, supports, transfer pump, overboard pump, chemical pump, driving motors, conduit means, valves, control box and electrical control means being all assembled in connected relation to constitute a factory-built unit adapted to be tested and transported as such for installation in a ship.

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