April 9, 1929. C. S. LENZ ET AL 1,708,021

OIL SEPARATOR

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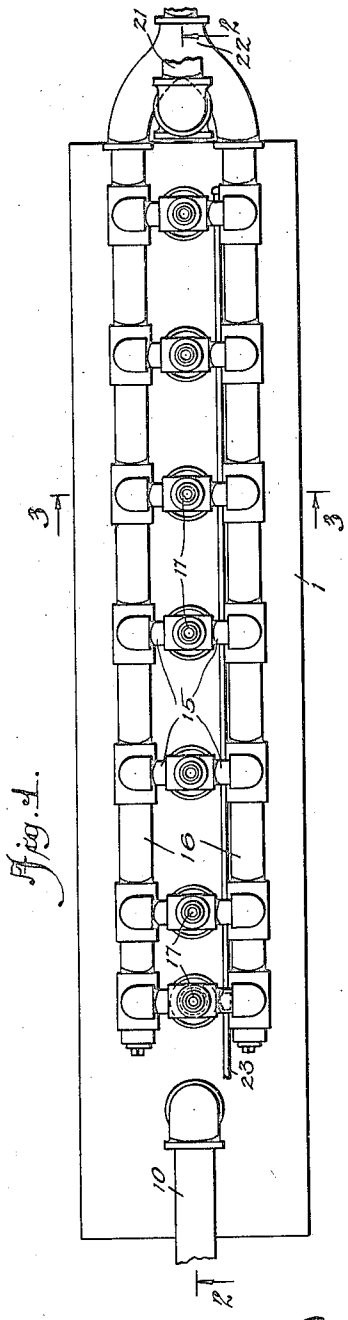


Fig. 1.

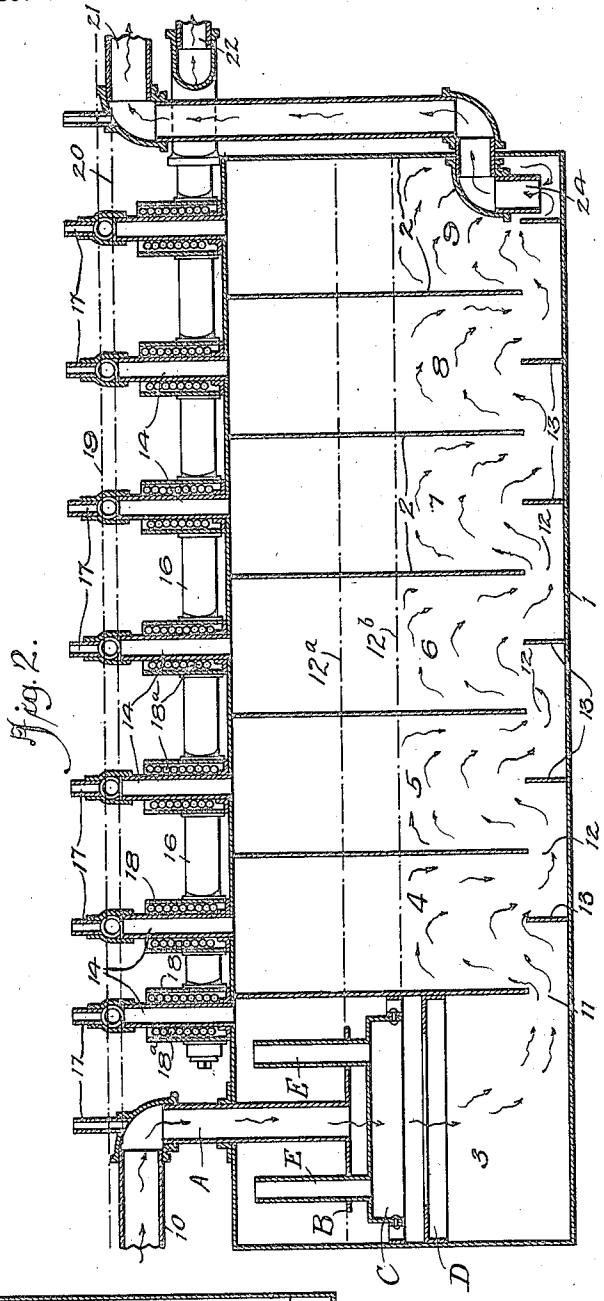


Fig. 2.

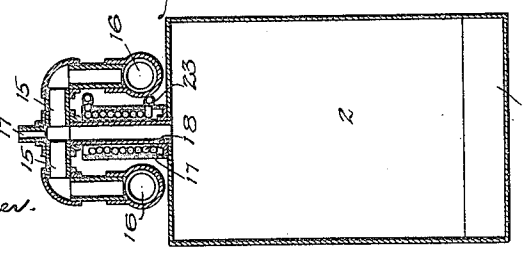


Fig. 3.

WITNESSES

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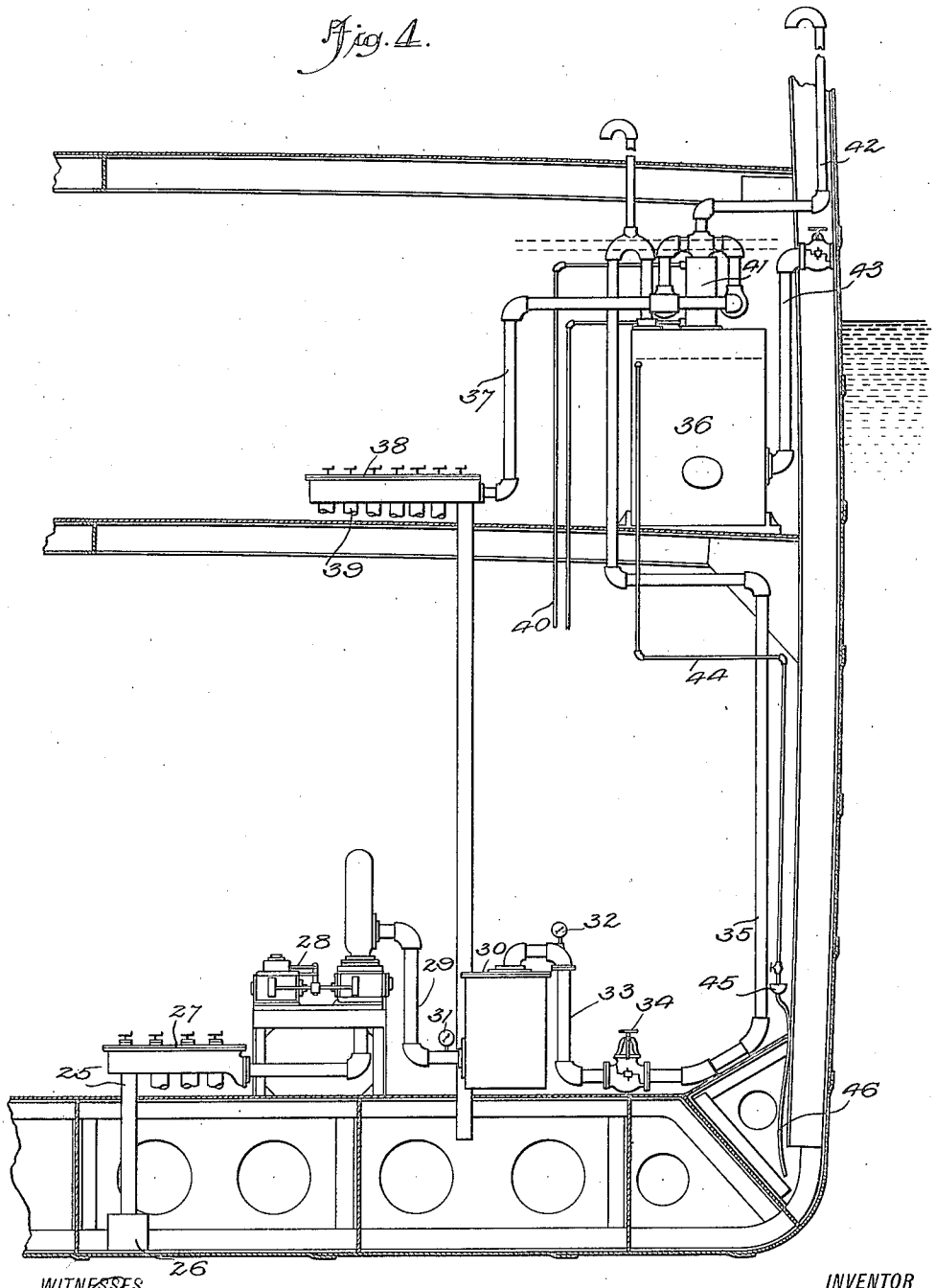
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Fig. 4.



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Patented Apr. 9, 1929. 1,708,021

UNITED STATES PATENT OFFICE.

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OIL SEPARATOR.

Application filed November 18, 1922. Serial No. 601,780.

This apparatus is designed and has been developed especially for installation on a ship and to form a permanent part of the outboard discharge system, so that all discharge water must pass through the apparatus no matter whence it comes to prevent any oils contained in such discharge water from going overboard at all and to make such recovered oils fit for use again.

The apparatus is further designed to require no attention at all during its operation.

A further object resides in the particular construction and arrangement of parts which are hereinafter described and claimed and shown in the accompanying drawings.

The invention is illustrated in the drawings, of which—

Figure 1 is a plan view of the apparatus.

Figure 2 is a section taken on the line 2—2 of Fig. 1.

Figure 3 is a section taken on the line 3—3 of Fig. 1.

Figure 4 is a section showing part of the midship section of a ship and the manner in which the combination of elements forming my invention are disposed in their proper location thereon.

The form of the invention shown in the drawings is a preferred form, although it is understood that modifications in the construction and arrangement of the parts and in the character of the materials used may be adopted without departing from the spirit of the invention.

In contemplating this invention, it will be observable that advantage has been taken of a natural law with respect to the interaction of fluids of different characteristics, especially oil and water, namely, the buoyancy of oil on water, whereby if oil and water are placed in a U-tube the oil will rest on the water in one leg of the tube and the level of the top of the oil column will be higher than the level of the column of water in the other leg of the tube. This particular phenomenon is taken advantage of in this apparatus, whereby in passing a mixture of oil and water or similar liquids through the apparatus the liquids will automatically separate because the difference in level assumed and the flow of the oil from the apparatus may be effected without the use of valves or other controlling media owing to the fact that the inlet and outlet pipes for the water are arranged at the same level, while the outlets for the oil are at a higher level. The greater the amount of oil maintained in the tanks used the greater will be the normal difference in level between the two liquids. As more oil is added to this normal body of oil the excess will flow out at the proper level to reestablish the normal relations. Furthermore, provision has been made whereby the discharge pipes for the oil are suitably heated so that any slight moisture or volatile material therein is readily removed. This heating also assists in the flow of oil because of the expansive effect it has on the oil to raise its level.

The apparatus is designed so that the liquid passing therethrough meets with a minimum amount of obstruction, provision being made merely to cause it to flow in a slightly zigzag course whereby it is subjected to a series of directional and velocity changes, during which time the more buoyant material separates from the other.

As shown in the drawings, the invention comprises a tank 1 throughout the length of which a plurality of dependent partitions 2 are exposed, the lower ends of which extend nearly to the bottom of the tank. These partitions extend across the tank and divide it into a series of chambers 3 to 9, inclusive. An inlet pipe 10 into the first chamber 3 is associated with apparatus within said chamber of the type and construction referred to more specifically in our Patent No. 1,614,074 filed May 22, 1922, issued January 11, 1927, entitled "Separator".

This apparatus includes an axial conduit A, a baffle B, a hood C spaced from the chamber walls, a baffle ring D and decanting conduits E to communicate separated oil collected under the hood to the top of the chamber. From this first chamber the liquid passes through beneath the first partition, through a narrow space or passageway 11, thence into the second chamber 4. The successive chambers are traversed by the liquid, and it passes from one to the other through successive passages such as 12. During its passage through these spaces, which are relatively narrow, the stream of liquid is subjected to an increase in velocity as it passes through such spaces; and, in passing through each chamber, the stream expands and has its velocity checked, thereby facilitating the

separation of oily matter from water. The line 12[a] indicates the body of oil maintained in each tank and the line 12[b] indicates the bottom of the neutral zone in which the liquid mixture is relatively quiet and the oil is separating from the water.

Disposed along the bottom of the tank 1 are a plurality of deflector or baffle plates 13 each of which extends across the bottom of the tank at a point midway the respective chambers 4 to 9, inclusive. These deflectors or baffle plates tend to force the liquid passing from one chamber to another to pursue a zigzag course, which assists in the more effective separation of the oil from the water.

From the above it will be obvious that the flow of liquid is subjected to changes in velocity at points of narrowed orifice such as 12, and to changes in direction by the baffle plates 13 both of which functions have the effect of promoting the separation of one liquid from another according to their respective specific gravities.

When this apparatus is filled with water, which is a necessary condition to its proper operation, and then a mixture of oil and water is pumped therein under a desired amount of pressure, the oil, or the more buoyant fluid of the mixture, whatever it may be, will commence to flow out through discharge pipes 14 disposed above and connected to the top of each chamber. This flow of oil begins as soon as the amount of oil in the tank has reached the point where the body of oil in the tank balances the body of water and additional oil has raised the oil level above that of water. The oil discharged from time to time is equivalent to that accumulated at the under surface of the body of oil. This state of equilibrium is maintained at all times, only the accumulated increment of oil being discharged. These discharge pipes are connected by cross pipes 15 which connect to discharge mains 16. The level of the pipes 15 is arranged slightly higher than the levels of the inlet 10 and the water outlet 21. The inlet 10 and the outlet 21 for the water are arranged at the same level. The tops of each of the pipes 14, inlet pipe 10 and the outlet pipe 21 are provided with air tubes 17 permitting air to be driven out of the apparatus, whereby air pockets are avoided and whereby the discharge of the oil by air pressure whenever said pockets are formed is eliminated. Furthermore, it avoids the passage of air out of the apparatus with the oil, which may become objectionable if the oil is to be stored in tanks by itself.

In order to facilitate the discharge of oil and to recover it at a substantial degree of purity, each of the discharge pipes 14 is surrounded by a casing 18 having a heating coil 18[a] disposed therein. Said heating device is adapted for the supply of steam or any other suitable heating fluid by means of pipe 23, alternately suitable electric means of heating may be applied thereto. The purpose of the heating device is to improve the viscosity of the oil and also to drive off any particles of moisture that might be entrained thereby.

In Fig. 2 the dot and dash lines at the top of Figures 19 and 20 illustrate respectively the approximate oil and water level, showing the difference in the levels whereby the oil will tend to flow automatically from the apparatus regardless of the speed at which the apparatus operates and also regardless of the kind of liquid passing therethrough. It will be noticed that the water or heavier fluid passing from the apparatus leaves by the pipe 21, whereas the oil or lighter fluid discharge pipes 16 are joined to a main 22. The discharge pipe 21 is connected to the bottom of the chamber 9, which is the last chamber of the series, by means of a pipe 24 disposed near the bottom of said chamber.

It will be apparent, therefore, from the construction of the above described apparatus that during its operation there is a steady flow of the mixture into the apparatus and that this mixture pursues a tortuous or zigzag course therethrough, during which time it undergoes a series of velocity changes causing the lighter liquid to separate from the heavier, the natural difference in the specific gravity of the two liquids causing the one to tend to assume a higher level than the other whereby the separation of the one and its outflow from the apparatus can be very easily effected without the use of valves or similar controlling devices. The inlet and outlet passages for the heavier fluid, however, are maintained at the same level, slightly below the level for the outflow of the lighter fluid, which in the case illustrated is oil.

The liquids will at all times balance each other and retain their respective levels. As more oil is added it will add to the oil body. increase its height and buoyancy and cause that amount of oil to flow out through oil lines until such time as a balance is restored.

The assembly of the device on shipboard in combination with other auxiliary apparatus for handling the bilge water and waste liquid is shown in Fig. 4, and in this case the waste fluid contained in the ship's bilge or tanks are drawn off in the usual manner through the suction line 25 and strainer 26. They pass thence through manifolds 27 which are interconnected by means of pipe lines with the various tanks and bilges of the ship and are forced through a short pipe 29 into a trap 30. This trap is provided with any suitable means for eliminating solid matter. The separation of the fluid in the oil separator 36 takes place in a continuous manner, and after the separation of the oil from the water, the oil and water assume different levels in respect to each other, causing the oil to be discharged through pipe 37 into a manifold

38, whence it passes through various pipes 39 into any desired storage tanks in the ship. The steam pipes 40 are connected with steam coils 41 around the neck of the discharge pipe to heat the oil. An air pipe 42 rises from the top of the oil separator to permit waste gases to escape. The water pipe 43 extends from near the bottom of the separator to a point outboard. A testing pipe 44 extends from a point in the separator 36 near the junction between the oil and water levels to a drip pan 45 located near the pump 28. This drip pan drains through a pipe 46 to any suitable point in the bilges of the ship. The drip pan is so located as to permit the engineer or operator running the pump 28 to know the condition of the fluids at the level at which the pipe 44 is connected to the separator 36 so that he may adjust the operation of the pump in accordance therewith.

From the above it will be evident that we have devised a simple and effective apparatus for the continuous and automatic separation of the components of a mixed fluid. We have shown a particular application of our device to shipboard use, in combination with an outboard discharge system, so as to effect the separation of the oil and water in bilge water and of oil drainings mixed with ballast tank water.

Having thus described our invention what we claim as new and desire to secure by Letters Patent is—

1. In a tank for the separation of oil from a flowing stream of oil and water, said tank including an inlet conduit for the oil and water, an outlet conduit for the water, means to alternately accelerate and retard the flow of fluid through the tank, and means interposed between said accelerating means to tortuously deflect the flow, the combination of a series of air vented decanting means each disposed above a retarding means, said decanting means being rendered individually effective by accumulating oil contiguously thereto above the hydrostatic level of the stream, and heating means associated with the decanting means to facilitate the flow of separated viscous oil therethrough.

2. In a tank for the separation of oil from a flowing stream of oil and water, said tank including an inlet conduit for the oil and water, an outlet conduit for the water, said conduits being disposed so as to determine the level of the stream at a point above the confines of the tank, means to alternately accelerate and retard the flow of fluid through the tank, and means interposed between said accelerating means to tortuously deflect the flow, the combination of a series of air vented decanting means each disposed above a retarding means, said decanting means being rendered individually effective by accumulating oil contiguously thereto above the hydrostatic level of the stream, and heating means associated with the decanting means to facilitate the flow of separated viscous oil therethrough.

3. In apparatus for continually separating oil from a flowing stream of oil and water, the combination of, a tank vertically sub-divided into a series of chambers, the first of said chambers including a downwardly directed inlet pipe axially disposed in the chamber, a baffle connected to the conduit, a hood beneath the baffle and spaced from the chamber walls, a baffle ring below the hood and carried by the chamber walls, and means in the hood to conduct oil separated thereunder to the top of said first chamber, lower conduit means between the several chambers, a decanting conduit for water in the last chamber, a baffle interposed between each pair of lower conduit means, a baffle in the last chamber and air vented means disposed in each chamber above the normal hydrostatic level of the stream to overflow supernatant oil accumulated therefrom.

4. In apparatus for continually separating oil from a flowing stream of oil and water, the combination of, a tank vertically sub-divided into a series of chambers, the first of said chambers including a downwardly directed inlet pipe axially disposed in the chamber, a baffle connected to the conduit, a hood beneath the baffle and spaced from the chamber walls, a baffle ring below the hood and carried by the chamber walls, and means in the hood to conduct oil separated thereunder to the top of said first chamber, lower conduit means between the several chambers, a decanting conduit for water in the last chamber, a baffle interposed between each pair of lower conduit means, a baffle in the last chamber, means disposed in each chamber above the normal hydrostatic level of the stream to overflow supernatant oil accumulated therefrom, and heating means associated with each overflow conduit to improve the fluidity of the separated oil.

5. In apparatus for separating a fluid of lower gravity from a fluid of higher specific gravity in a continuously flowing stream of the mixed fluids, the combination of, a tank, a horizontal feed conduit for the mixed fluids disposed above the tank, partitions in the tank for subdividing it into a plurality of chambers which communicate in series at the bottoms thereof, means in the first chamber to introduce mixed fluid from the feed conduit to the vertical axis of the chamber, a baffle associated with said means to spread the fluid radially to the walls of the chamber, a hood spaced from said walls a desired distance to form restricted passages therebetween for the flow of fluid, a peripherally disposed baffle below said passages, conduit means connecting the hood with the upper portion of the first chamber, the remaining chambers being each transversely intersected by a ver-

tical baffle to oppose the direct flow of fluid therethrough, means to decant fluid from the lower portion of the last chamber, said means communicating with a discharge conduit disposed at a level with the feed conduit aforementioned, and means in each chamber to overflow separated fluid of lower gravity at points above the common level of said feed and discharge conduits.

6. In apparatus for separating a fluid of lower specific gravity from a fluid of higher specific gravity in a continuously flowing stream of the mixed fluids, the combination of, a tank, a feed conduit for the mixed fluids, a discharge conduit for the fluid of higher gravity, both of said conduits being disposed at the same level above the tank, partitions in the tank for sub-dividing it into a plurality of chambers which communicate in series at the bottoms thereof, means in the first chamber connecting with the inlet conduit to promote a downwardly directed and radially tortuous flow of the fluid therethrough, means in the remaining chambers of the tank to promote a longitudinally directed and vertically tortuous flow of fluid through the latter, conduit means in the first chamber to convey separated fluid of lower gravity from intermediate points of the flow to the upper part of the chamber, conduit means in the final chamber to convey the residual fluid of higher gravity from the lower part of said chamber to the discharge conduit aforementioned, and means in each chamber to overflow separated fluid of lower gravity at points above the common level of said feed and discharge conduits.

7. In apparatus for separating fluid of lower specific gravity from a fluid of higher specific gravity in a continuously flowing stream of the mixed fluids, the combination of, a tank, a feed conduit for the mixed fluids, a discharge conduit for the fluid of higher gravity, both of said conduits being disposed at the same level above the tank, partitions in the tank for sub-dividing it into a plurality of chambers which communicate in series at the bottoms thereof, means in the first chamber connecting with the inlet conduit to induce directional and velocity changes in the flow of fluids downwardly through the chamber, means in the remaining chambers of the tank to induce directional and velocity changes in the flow of fluids laterally therethrough, conduit means in the first chamber to convey separated fluid of lower gravity from intermediate points of the flow to the upper part of the chamber, conduit means in the final chamber to convey the residual fluid of higher gravity from the lower part of said chamber to the discharge conduit aforementioned, and means in each chamber to overflow separated fluid of lower gravity at points above the common level of said feed and discharge conduits.

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