July 29, 1952 J. H. WIGGINS ET AL 2,605,014

FLOATING COVER FOR SEWAGE DIGESTING APPARATUS

Filed Oct. 26, 1949 3 Sheets-Sheet 1

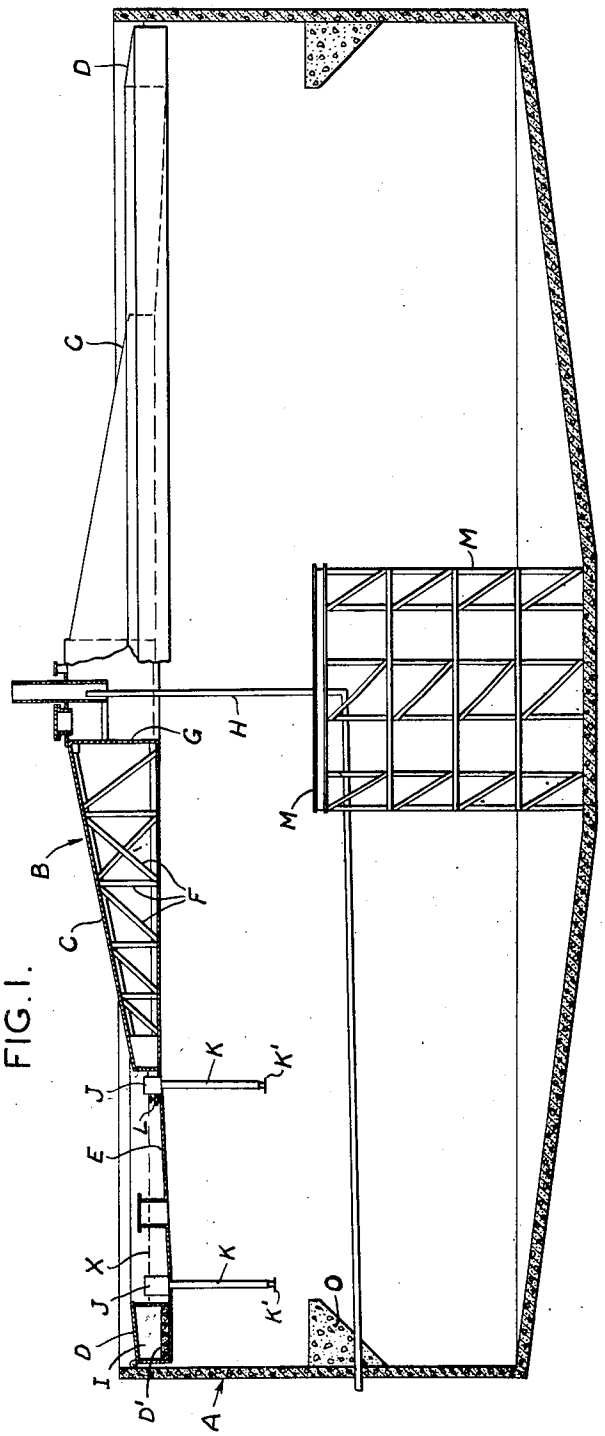


FIG. 1.

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Filed Oct. 26, 1949 3 Sheets-Sheet 2

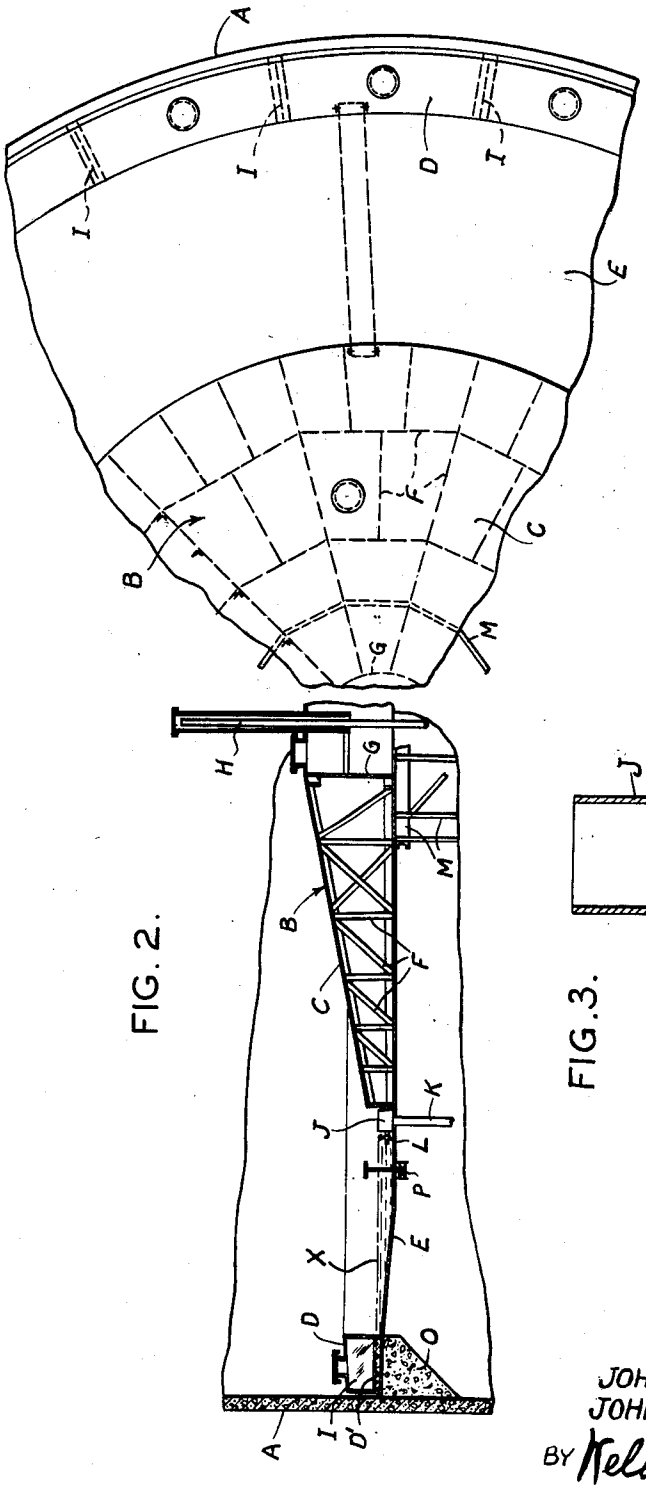


FIG. 2.

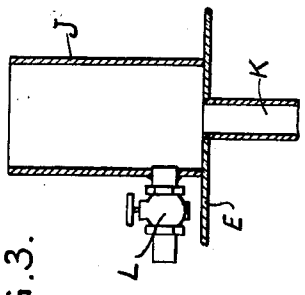


FIG. 3.

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Filed Oct. 26, 1949 3 Sheets-Sheet 3

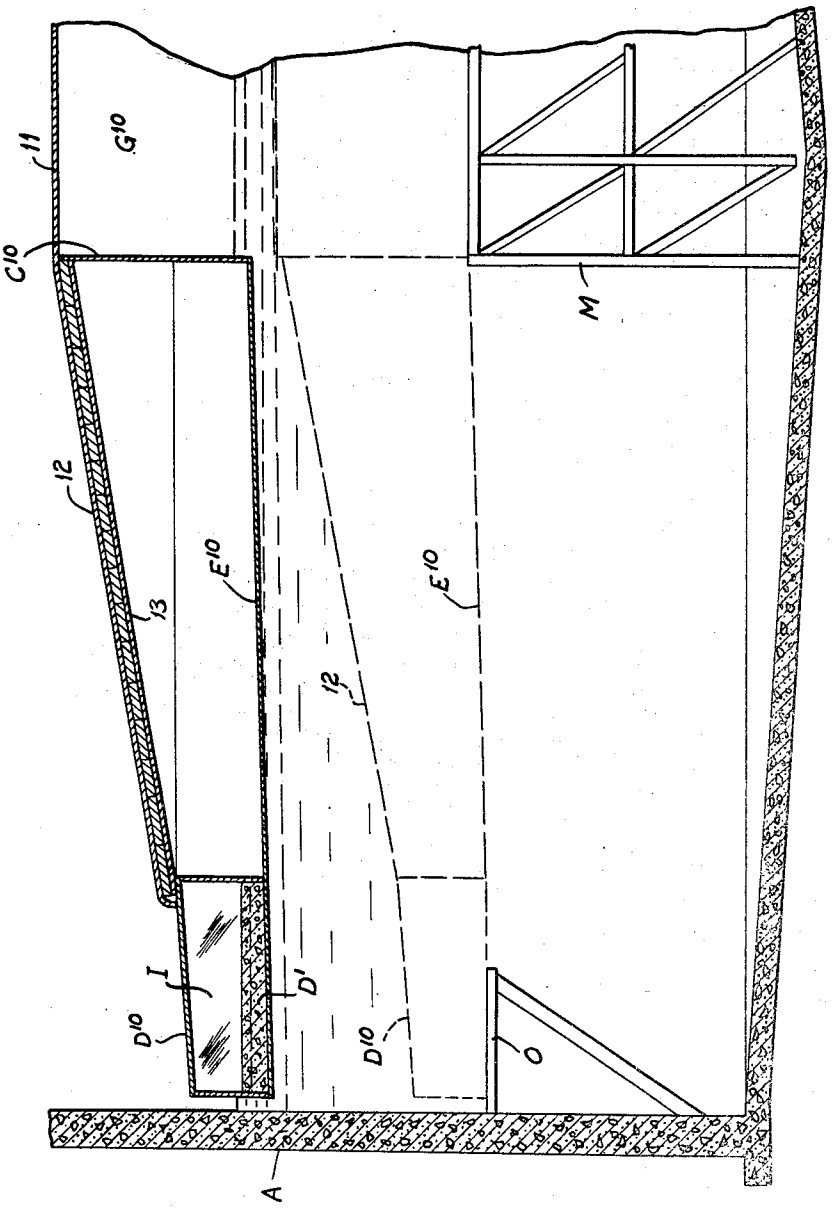


FIG. 4.

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FLOATING COVER FOR SEWAGE DIGESTING APPARATUS

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5 Claims. (Cl. 220—26)

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This invention relates to apparatus of the general type or kind that comprise a tank adapted to hold a liquid material or substance that is being stored or processed, and a cover or closure for said tank that normally floats upon and is supported by the liquid in the tank. We have herein illustrated our invention applied to or embodied in a sewage digesting apparatus, but we wish it to be understood that our invention is applicable to apparatus used for other purposes than digesting sewage.

The main object of our invention is to reduce the cost and improve the operation of apparatus of the general type or kind above mentioned.

One of the novel features or characteristics of our improved apparatus is that its floating cover comprises a flexible or limber deck portion combined with a rigid, annular, peripheral portion having a built-in load member constructed of a relatively heavy, pourable or moldable substance, such as concrete, and made of such weight that it sinks or depresses the peripheral portion of the cover into the liquid to a point or level lower than the degree of submergence of said peripheral portion in the absence of said built-in load member, whereby the flexible deck portion will be maintained in intimate contact with the liquid and in an inclined position sloping upwardly towards the center of the cover.

Another novel feature of our improved apparatus is that the peripheral portion of the floating cover of same is constructed in the form of a ring girder, composed of a fabricated, metal part and a molded load member of concrete, or the like, combined in such a way that when the substance of which said load member is constructed hardens or sets, said load member will co-act with the fabricated metal part to carry compression loads.

Another novel feature of our improved apparatus is that the built-in load member, in addition to increasing the weight and absorbing compression stresses set up in the peripheral portion of the floating cover, also acts as an insulator that tends to prevent heat that is applied to or generated in the liquid on which the cover floats, from flowing to the atmosphere through the peripheral portion of the cover.

Another novel feature of our invention consists of a floating cover for a sewage digesting apparatus, constructed in such a manner that

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the top side of the cover is adapted to receive and hold a body of water that constitutes a load which increases the weight of the cover sufficiently to maintain the cover in intimate contact with the sewage in the tank, thereby tending to prevent a thick cake of organic matter from collecting between the cover and the liquid portion of the sewage, and the bottom surface of the cover is of such shape or form that gases evolved from the sewage have a natural tendency to flow towards a gas collecting chamber at the center of the cover.

Another novel feature consists of a floating cover of the kind referred to in the preceding paragraph having provision for enabling the water load on the top side of the cover to be replenished by practically clear water in the tank that has separated from the solid particles of the sewage.

And still another desirable feature of our improved apparatus is that snow or rain which falls on the floating cover will not injuriously affect the operation of the apparatus, and when the tank is emptied and the cover moves downwardly onto a stationary supporting means or structure on the interior of the tank, the water load on the cover can either manually or automatically be drained off the cover. Other desirable features or characteristics of the apparatus constituting our invention will be hereinafter pointed out.

Figure 1 of the drawings illustrates a sewage digesting apparatus embodying one form of our invention, showing the cover floating on the liquid in the tank, the left hand half of said figure being in vertical, transverse section, and the right hand half being in elevation.

Figure 2 shows the cover resting on the supporting structure inside of the tank, the left hand half of said figure being in vertical, transverse section and the right hand half in top plan.

Figure 3 is an enlarged sectional view of one of the overflow wells on the deck portion of the floating cover shown in Figures 1 and 2; and

Figure 4 illustrates another form of our invention, said figure being a half, vertical, transverse sectional view.

In Figures 1 and 2, the reference character A designated the tank of the apparatus which is adapted to hold the sewage, and B designates, as

an entirety the floating cover, the tank A being herein illustrated as constructed of concrete and provided with a vertical side wall of circular form. The cover B, which floats on the sewage in the tank A, can be constructed in various ways, without departing from the spirit of our invention, so long as it comprises a flexible deck portion of circular form, whose underside is in direct contact with the sewage or other liquid in the tank, and a stiff, annular load member constructed of concrete or the like, attached to the peripheral edge of said deck portion so as to maintain said deck portion in an inclined position sloping upwardly and inwardly from the peripheral edge. In the particular form of our invention shown in Figures 1 and 2, the cover comprises the following elements, i. e., a center pontoon C of circular form, a peripheral pontoon D of annular form surrounding the center pontoon and arranged in close proximity to the side wall of the tank, and a flexible single deck portion E bridging the space between said pontoons and rigidly connected to same, preferably at the lower ends of said pontoons, said deck portion being constructed from metal plates. The center pontoon C consists of a fabricated metal structure that is reinforced and strengthened by a plurality of radially-disposed trusses F, the top of said pontoon preferably having a downward pitch or slope from its center towards its outer edge, and the bottom of said pontoon preferably having a slight upward slope from its outer edge towards its center. At the center of the pontoon C there is a gas dome or gas collecting chamber G, whose lower end is open, so that gases which are evolved from the sewage in the tank A, can collect in the chamber G, and subsequently, escape from same through a gas eductor pipe H that leads to the atmosphere, or to a point where the gases are utilized as a heating medium.

The peripheral pontoon D is of novel construction, in that it is provided with a built-in load member, which, in addition to adding considerable weight to said pontoon and causing it to float in the liquid at a level lower than the degree of submergence of said pontoon in the absence of said load member, also acts as a stiffening member that absorbs compression stresses set up in the pontoon D when the apparatus is in use. Due to the particular way said load member is located, said member also acts as a heat insulating medium for the submerged portion of the pontoon D in contact with the liquid on which the cover B of the apparatus floats. In the apparatus herein illustrated the peripheral pontoon D is constructed of metal plates fabricated in such a way as to produce an annular girder of substantial box-shape in cross section, and on the interior of said hollow girder, there is located a load member D′ formed from a relatively heavy substance or material that can be poured into the pontoon D while in a liquid or plastic state and which subsequently will solidify or harden into a dense, flat slab of great weight and substantial thickness. We prefer to form the load member D′ from concrete, due to the low cost of concrete and the ease with which it can be installed in and combined with the metal shell of the pontoon D, but said load member can be formed of various other substances or materials without departing from the spirit of our invention. As shown in the drawings, the pontoon D is provided with a plurality of vertically-disposed internal bulkheads I arranged in spaced relation around the circumference of said pontoon. Said bulkheads I are rigidly attached to the top wall and to the side walls of the pontoon, but the bottom edges or lower ends of said bulkheads terminate short of the bottom wall of the pontoon, so as to produce a space in the lower portion of the pontoon that extends continuously around the circumference of the pontoon and which is not broken up or divided into sections by the bulkheads I. It is this continuous or unbroken space in the pontoon D that receives the load member D′, and in constructing said load member, it is made of such thickness that the lower end portions of the bulkheads I will be imbedded in the top portion of the load member. To effectively tie the load member to said bulkheads, the lower end portions of said bulkheads are provided with lugs or projections that become imbedded in the material of which the load member D′ is constructed when said material sets or hardens, thereby causing the load member and bulkheads to become interlocked with each other. The load member D′ is also preferably interlocked with or tied to the bottom wall and the side walls of the pontoon D by lugs or projections on the inner surfaces of said walls that become imbedded in the load member during the operation of pouring, molding, or casting the self-hardening plastic substance of which the load member is constructed.

Such a pontoon is easy to build and inexpensive to construct; it will float at a lower level in the sewage or sink into the sewage to a depth in excess of the degree of submergence of the pontoon in the absence of the load member D′, thereby exerting a downward force on the peripheral edge of the deck portion E that deflects said deck portion and maintains it in a sloping position that enhances the flow of gases on the underside of said deck portion and on the underside of the peripheral pontoon, towards or into the gas dome G at the center of the floating cover of the apparatus; it is stronger and of greater rigidity than an annular pontoon of conventional construction, inasmuch as the load member D′ consists of a dense slab of rigid material of substantial thickness, interlocked with the metal top, bottom, and side walls of the pontoon in such a way that it absorbs stresses set up in the pontoon when the apparatus is in use; and it has the further desirable characteristic of retarding the escape of heat employed to speed digestion of the sewage, due to the fact that the load member D′ constitutes a heat insulating medium for the entire area of the bottom wall of the pontoon upon which said load member is superimposed and interlocked with.

In order to effectively prevent a thick cake of organic matter from forming between the underside of the cover B and the liquid on which the cover floats, a water load x is carried on the cover 8 so as to increase the weight of said cover. In the apparatus herein illustrated said water load is confined in an annular water trough on the top side of the cover B, formed by the deck portion E and the side wall portions of the center pontoon C and peripheral pontoon D that project upwardly a substantial distance above the top surface of said deck portion. Said water load x is prevented from rising above a certain level, and hence, is maintained at a predetermined approximate weight by means of a plurality of overflow wells J on the top side of the deck portion E, equipped with water outlets K that project downwardly a considerable distance into the sewage and discharge rain water or snow water into the tank, said water outlets prefer-

ably being of such length that the lower ends of same terminate in practically clear water. The water outlets K can either be formed by rigid metal pipes provided at their lower ends with baffles K' disposed so as to prevent solid particles in the sewage from rising in said pipes, or said water outlets may be formed by metal pipes projecting downwardly from the overflow wells J and having their lower ends attached to flexible extensions that extend downwardly to a point in relatively close proximity to the bottom of the tank A. Due to the fact that the water outlets K from the overflow wells on the deck portion E terminate in tank water that is substantially clear and free from solid particles of sewage, one or more of the overflow wells can be provided at its lower end with a water orifice or passageway, disposed so that in the event the water load x on the deck portion E falls below a certain approximate level, clear water in the tank A will rise through one or more of the water outlets K and discharge onto the deck portion E, through the above mentioned water discharge orifices or passageways in the overflow wells, thus replenishing the water load on said deck portion, this feature of our apparatus being of considerable value in localities where water is scarce. Instead of using an uncontrolled water orifice or passageway for adding water to the water load x on the deck portion, we prefer to equip one or more of the overflow wells J with a valve L mounted in the lower end portion of the side wall of the well at such a point that water which rises in the overflow pipe leading from the well can pass, practically directly, from the overflow pipe onto the deck portion E. In the event such a valve L is normally set in its open position, the water load x on the top side of the deck portion E will automatically be maintained at the ideal height, depth or level. Also such an orifice or valve facilitates drainage or discharge of water from the top side of the deck portion E when the floating cover B of the apparatus comes to rest on its supporting structure inside of the tank, during the operation of emptying said tank. Preferably, one or more manually-operated drain valves P are mounted in the deck portion E, as shown in Figure 2, so as to facilitate the discharge of the water load x when the cover is resting on the supporting structure in the tank. In the apparatus herein illustrated the supporting structure just referred to comprises a tower M of skeleton-like construction at the center of the tank A which is adapted to support the center pontoon when the cover is not floating, and a plurality of inwardly-projecting brackets O on the side wall of said tank that are adapted to support the annular, peripheral pontoon D.

We prefer to construct the floating cover B of the apparatus so that the area of the two pontoons C and D constitutes 50% of the total area of the cover, and the area of the deck portion E constitutes 50% of the total area of said cover. The drain wells on said desk portion are so proportioned and arranged that under normal conditions when the cover is floating on the liquid in the tank A, the water load x on the deck portion E will be of such weight that the center pontoon C will carry itself and also the deck portion E, and the peripheral pontoon D will carry itself. If the weight of the water load on the deck portion were too little, said deck portion would exert an upward lift on the peripheral pontoon D, thereby causing part of the weight of said peripheral pontoon to be carried by the deck portion E. Similarly, if the weight of the water load on said deck portion were too great, the deck portion would sag slightly, thereby causing part of the weight of the water load x on the deck portion E to be carried by the peripheral pontoon D. The ideal water load x is that which causes the center pontoon to carry itself and the deck portion E, whereupon the peripheral pontoon D carries itself, and the liquid in the tank on which the cover floats, exactly carries the water load x on the deck portion E. To attain an operating gas pressure of 7'' H 20, the deck portion must be loaded with water until none of the weight of the peripheral pontoon D is carried by other parts of the floating cover. In this case the deck portion E is a substantially straight line and the entire structure is in stable equilibrium. As to the weight of the built-in load member D' in the peripheral pontoon, said member is so proportioned that when the cover is floating, said load member exerts a sufficient downward force on the peripheral edge of the deck portion E to impart an upward and inward slope to said deck portion, whereby gases on the underside of the cover evolved from the sewage, have a natural tendency to flow towards the gas dome G in the center pontoon C. We also prefer to form the bottom of said center pontoon so that it has a slight upward slope from its periphery towards its center.

The overflow wells J on the deck portion E are preferably designed or proportioned so that the weight of the water load x is not so great as to deflect the peripheral edge of the deck portion E, and thus destroy the ideal slope or angle at which said deck portion is maintained by the built-in load member in the peripheral pontoon. In the apparatus herein shown the side walls of said overflow wells are made about 2'' higher than the level of the ideal water load x on the deck portion. The tank water admitted to said overflow wells by the outlet pipes K, rises on the inside of the wells J only 1'' for a 2'' rise of the body of water x on the deck portion, because said deck portion constitutes only one-half of the total area of the floating cover B. Therefore, rain will automatically drain off the cover into the tank. In case of snow, any amount that falls onto the deck portion E will displace the water thereon, and hence, not increase that load beyond the overflow point. If snow collects on the tops of the pontoons C and D, it would require 20'' of dry snow (10'' per 1'' H 20) before the tank water would flow onto the deck portion E. If the water load x on the deck portion had a solid covering of ice, the tank water inside the overflow wells J would probably be frozen. If it is not frozen, then the water load x on the deck, on the outside of the overflow wells, would be melted and the normal overflow would take place. The worst situation (very remote) is where the deck portion has thick ice and the tank water is not frozen. This would not affect the operation of the floating roof of the apparatus.

When the tank A is emptied, the brackets O on the side wall of the tank stop or arrest the downward movement of the peripheral pontoon D first. Then the center pontoon C continues descending about eighteen inches more, so that the water on the top side of the deck portion E will flow into the tank through the overflow devices located adjacent the periphery of the center pontoon, until most of the water load x on the deck portion has drained into the tank. As pre-

viously stated, one or more hand drains P are provided so that all of the deck water can be discharged into the tank. Thus, the maximum live load is the snow load. The apparatus, as preferably designed, however, carries the snow load, plus the water that does not drain off the cover B automatically.

In covers of relatively small size the center pontoon previously referred to can be omitted. Accordingly, Figure 4 of the drawings we have illustrated another form of our invention consisting of a floating cover composed of a flexible or limber deck portion E^{10} of annular form, a single pontoon D^{10} of annular form attached to the peripheral edge of said deck portion and provided with a built-in load member D' of the same construction and functional characteristics as the load member of the peripheral pontoon of the apparatus, shown in Figures 1 and 2, and a vertically-disposed, tubular member C^{10} at the center of the cover, open at its lower end and attached to the inner edge of the deck portion E^{10} so as to serve as a gas dome or gas collection chamber G^{10}, the upper end of said tubular member being closed by a gas-tight cap 11. Instead of permitting rain water or the like to collect on the cover, we use a rain shield or weather roof 12 to bridge the space between the peripheral pontoon D^{10} and the center tubular member C^{10} and we make said weather roof of such shape that rain which falls on same will drain from the peripheral edge of said roof onto the top of the peripheral pontoon D^{10} which is inclined downwardly so as to discharge rain and snow into the annular space between the peripheral edge of the cover and the side wall of the tank A.

The weather roof 12, which preferably is substantially cone-shaped, is of rigid construction and is herein illustrated as being supported by radially-disposed, downwardly-inclined rods 13 attached at their inner ends to the upper end of the center tubular member C^{10} and attached at their outer ends to the inner edge portion of the peripheral pontoon D^{10}. When the cover is not floating on the liquid in the tank, as shown in broken lines in Figure 4, it is supported by brackets O on the side wall of the tank and a tower M located at the center of the tank, proportioned and arranged so as not to subject the rigid weather roof 12 to strains.

When the cover is floating, as shown in full lines in Figure 4, the weight of the concrete load member D' in the peripheral pontoon D^{10} causes the peripheral portion of the cover to sink into the liquid to a point or level lower than the degree of submergence of said peripheral portion in the absence of said load member, thereby maintaining the flexible deck portion in an upwardly-sloping position, and causing gases that collect on the underside of the cover to flow into the gas dome G^{10} at the center of the cover. Thus, the cover is supported by the buoyance of the peripheral pontoon D^{10} and by the extra submergence of (over its own weight) the deck portion E^{10}. When the cover is not floating, the center tower M holds the bottom edge of the center tubular member C^{10} at a height above the tank side wall brackets O, which is substantially the same as the distance the outer rim of the pontoon D^{10} will be below the bottom edge of said center member C^{10} when the cover is floating on the liquid in the tank. Thus, when the cover "lands" or comes to rest during the operation of emptying the tank A, the opposite ends of the rods 13 that support the weather roof 12 remain in the same relative elevations as when the cover is floating, with the result that the weather roof is not subjected to strains that tend to flex or injure it. Such a cover has the same desirable characteristics as the cover shown in Figures 1 and 2, so far as the cost and accomplished results of the peripheral pontoon are concerned, and in practice, would be used in apparatus of such size that it is not necessary to provide the cover with a center pontoon.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. An apparatus comprising a tank that is adapted to hold a liquid or liquid-like substance that is being stored or processed, and a cover for said tank formed by a floating roof that rests upon the liquid in the ank and moves vertically, due to changes in the level of the liquid, said roof comprising a flexible deck having a peripheral portion that comprises a load member formed from a relatively heavy moldable material that exerts a sufficient downward force on said peripheral portion to maintain the flexible deck in an inclined position sloping upwardly and inwardly towards the center of the roof, said peripheral portion being constructed in the form of a fabricated metal girder of substantially box shape in cross section provided with bulkheads, and said load member being constructed in the form of a continuous ring-shaped slab disposed in superimposed relation with the bottom wall of the girder and interlocked with the side walls, bottom wall and lower end portions of the bulkheads of the girder.

2. An apparatus, comprising a tank adapted to hold a liquid or liquid-like substance, a floating cover for said tank provided adjacent its center with a gas collecting chamber open at its lower end, a flexible deck portion extending radially from said gas collecting chamber, and an annular-shaped load member made of a heavy moldable material, attached to the peripheral edge of said flexible deck portion so as to maintain same in such a position as to induce the flow of gases on the underside of said cover, into said gas collecting chamber.

3. An apparatus of the kind described in claim 2, provided with means for discharging the water load on the deck portion into the interior of the tank.

4. An apparatus of the kind described in claim 2, in which said deck portion is provided with a drain device, consisting of an overflow well projecting upwardly from the deck portion and provided at its lower end with an orifice, and a conduit leading from the lower end of said well and terminating inside of the tank at a point a substantial distance below the level of the liquid on which the cover floats.

5. A floating cover for a tank that holds a liquid or liquid-like substance, composed of a center pontoon, an annular, peripheral pontoon provided with a built-in load member disposed on the interior of said pontoon and extending continuously around the circumference of same in contact with the bottom wall of said pontoon, and a flexible deck portion bridging the space between said pontoons and rigidly attached to the lower ends of same, said pontoons and deck portion being so proportioned and arranged that when the cover is floating with a water load of the proper weight on said deck portion, the center pontoon will carry its weight and also the weight of the deck portion, the annular pontoon will carry its weight and also the weight of said

built-in load member, and the liquid in the tank on which the cover floats will carry the weight of the water load on the deck portion, the said load member in the peripheral pontoon being made of concrete interlocked with the bottom wall and side walls of said pontoon and also with the lower end portions of vertically disposed internal bulkheads in said pontoon.

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