O. H. NONNENBRUCH.

CONTINUOUS LIQUID SEPARATOR.

APPLICATION FILED MAR. 22, 1916.

**1,236,746.** Patented Aug. 14, 1917.

Fig: 1.

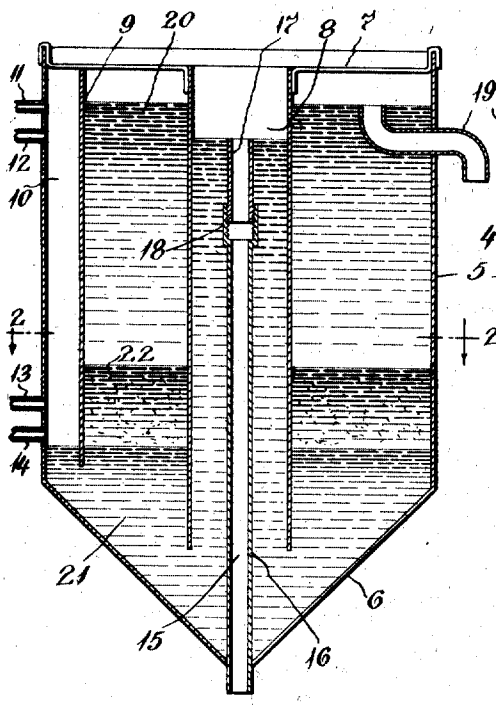



Fig: 3.

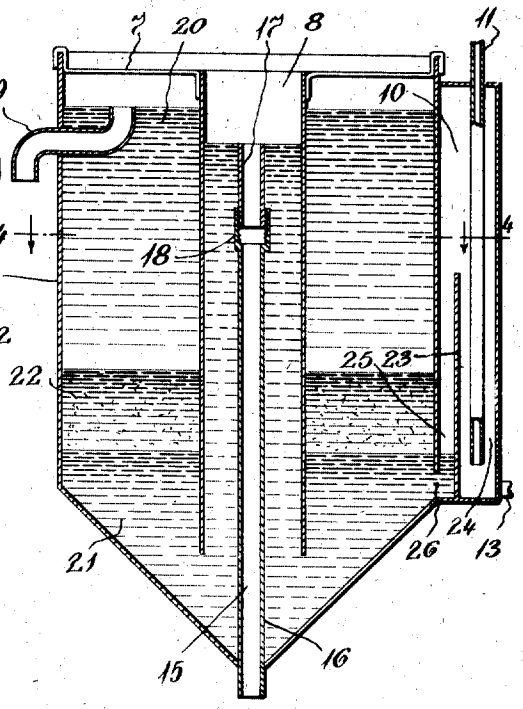



Fig: 2.

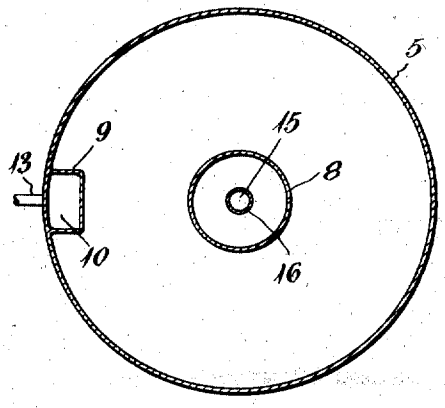
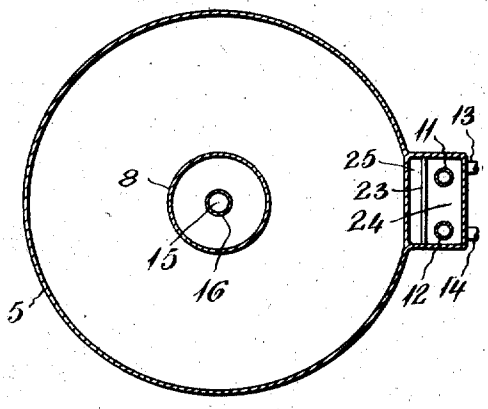



Fig: 4




Inventor

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By his Attorney

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# UNITED STATES PATENT OFFICE.

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## CONTINUOUS LIQUID-SEPARATOR.

1,236,746. Specification of Letters Patent. Patented Aug. 14, 1917.

Application filed March 22, 1916. Serial No. 85,759.

*To all whom it may concern:*

Be it known that I, OTTO HEINRICH NONNENBRUCH, a citizen of Germany, and a resident of New Rochelle, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Continuous Liquid-Separators, of which the following is a specification.

My invention relates to a device for the separating of liquids of different specific gravities and refers particularly to a device whereby a mixture of impure oil may be separated into pure oil and the impurities, and whereby this separation will be automatic and continuous.

One object of my invention is a device into which a continuous flow of impure oil may be introduced, the device being so arranged that the oil and the impurities or sludge will be separated from each other, and removed automatically and continuously.

Another object of my invention is a device in which the time of the retention of the oil may be predetermined and retained during the operation.

Another object of my invention is a device for the continuous and automatic separation of liquids, that is capable of ready adaptability to mixtures of liquids of varying properties.

Another object of my invention is a device in which the amount of oil therein may be varied and retained automatically at any desired quantity.

Another object of my invention is a device from which the pure oil and the sludge are emitted automatically and continuously through separate exits.

Other objects of my invention will be evident upon a consideration of my specification and claims.

My invention is adaptable to those mixtures of liquids of different specific gravities which are not soluble in each other and hence, when allowed to rest, will separate into different layers and is particularly suitable for the separation of pure oil from its impurities when the specific gravities of the impurities is lighter than water and heavier than the pure oil.

The usually employed methods of separating these layers one from the other is to decant the upper layer, or to draw off the lower layer, the decantation or withdrawal being interrupted when all of the liquid of one specific gravity has been removed. This process requires the constant attention of the operator and demands the greatest care, in order that the one liquid may be completely recovered without admixture with the liquid of the next layer. In the use of opaque receptacles, such as iron, wood, etc., it is impossible to watch the condition of the procedure and there is no assurance that one layer has been completely withdrawn, until a portion of the next layer makes its appearance, and hence under these conditions a complete separation without admixture is impossible. It is evident that during this process the operator must be constantly employed in order that he may interrupt the separation.

Further, it is impossible to employ this method when it is desired to retain a certain proportion of one liquid within the receptacle, in order to admix it with the next layer of liquid, as there is no means of ascertaining the amount of liquid not withdrawn.

My invention overcomes all of the above and other difficulties incident to this method of separation and presents a device in which a complete and perfect separation of the liquids is effected, and automatically and continuously withdrawn from the device without any attention upon the part of the operator and in which the time of duration of the operation may be varied to suit the particular requirements of the operation and retained at that point.

In the accompanying drawings illustrating two modifications of my invention, like parts are represented by like numbers.

Figure 1 is a vertical cross-section of one form of my invention.

Fig. 2 is a cross-section through the line 2—2 of Fig. 1.

Fig. 3 is a vertical cross-section of a modification of my invention.

Fig. 4 is a cross-section through the line 4—4 of Fig. 3.

In the operation of engines, particularly of the oil consuming type, the introduced oil becomes impregnated with deleterious substances, such as carbon, grease, etc., rendering it unfit for re-use without purification. Numerous methods have been suggested for this purification, among which is the treatment of the impure oil with water and chem-

icals in order to separate the mixture into layers of oil, impurities and water, the most practical method being one in which the produced sludge is lighter than water and heavier than the pure oil, thus forming a layer between the oil and the water when allowed to separate; and the following description refers particularly to this method of procedure, although it is evident that the device may be readily used in a corresponding manner for the separation of any liquids which possess the property of being deposited in layers due to the difference in the specific gravities of the various ingredients of the mixture.

In the device shown in Figs. 1 and 2, 5 is a cylindrical tank or separating chamber, open at the top and having an inclined conical bottom 6. Resting upon the top of the tank 5, and suspended thereby, is a spider 7, the outer ends of the arms of which rest upon the top of the tank 5, the inner ends of the arms carrying a cylindrical receptacle or refuse chamber 8 open at the top and bottom, the bottom being above the bottom of the tank 5, in order to allow a free passage between the tank 5 and the receptacle 8. Integral with the tank 5 is a three-sided member 9, open at the top and bottom and which forms a receptacle or agitating chamber 10, with the side of the vat 5. The pipes 11, 12 communicate with the upper portion of receptacle 10, and the pipes 13, 14 with the lower portion of the receptacle 10. An overflow pipe 15, comprising the two members 16 and 17, connected by the threaded coupling 18, meshing with threads upon the two members 16 and 17, is so arranged that the member 17 may be raised or lowered. An overflow pipe 19 is within the receptacle 5. The bottom of receptacle 8 is lower than that of receptacle 10. By the arrangement shown, all of the compartment walls of receptacles 8 and 10 may be readily removed from receptacle 5 by raising the spider 7.

The operation of this form of my invention is as follows:—The receptacle 5 is about half filled with water by means of the pipe 11, the water level being the same in receptacles 5, 8 and 10. The flow of water is continued through pipe 11 and the impure oil introduced into receptacle 10 through the pipe 12. If it is desirous to introduce a chemical to facilitate the purification of the oil, it may be readily introduced with the water through the pipe 11. Pipe 13 is connected with a steam source and pipe 14 with an air pressure supply. Air or steam, or both, are then introduced into receptacle 10, causing an agitation and heating of the contents. As the introduction of oil and water is continued, the mixture will find its way under the walls 9 of receptacle 10 into receptacle 5, where the oil 20 will separate and rise to the top above the water 21, the sludge 22, if it is lighter than water and heavier than oil, forming a layer between the oil and the water. During this operation, it is evident that the water 21 will gradually rise in receptacle 8, the head of liquid in receptacle 8 always being equal to the head of liquids in receptacle 5. As the mixture of liquids in receptacle 5 is of less specific gravity than of that in receptacle 8, the height of liquids in the latter will be less than in the former in equilibrium, and therefore any desired head may be obtained and retained in receptacle 5, by raising or lowering the outlet 17 of the overflow pipe 15, the contents of receptacle 5 passing out through the overflow pipe 19. If it is desirable to increase the amount of accumulated oil in receptacle 5, thus reducing the head, the outlet 17 of the overflow pipe 15 is lowered until the head in receptacle 8 is equal to the head in receptacle 5, and the reverse operation, that is the raising of the outlet 17, will cause a greater head in receptacle 5 and a corresponding decrease in the amount of accumulated oil. It is further evident that by increasing the amount of accumulated oil in receptacle 5, the sludge 22 will be forced downwardly and into the receptacle 8, and hence removed by means of the overflow pipe 15. For a continuous process, it is evident that the amount of pure oil contained in the impure oil introduced through the pipe 12, must be equal to the amount of pure oil carried off by the outlet pipe 19. As the object of the operation in receptacle 10 is to properly mix the ingredients to allow of separation of the oil, sludge and water, and as the operation in receptacle 5 is to allow of their complete separation into layers, the capacity of the receptacles, and the positions of the overflow pipes may be readily arranged to allow of the successful carrying out of the object of the device, consistent with the properties of the materials introduced, and treated. When experiment has shown the proper position of the outlet 17 of the overflow pipe 15, for the retention of the desired amount of oil head in receptacle 5, the device needs no further attention, as the pure oil will continually and regularly flow through the overflow 19, and the water and sludge will continually flow through the overflow 15. It is thus seen that the device presents a method whereby impure oil may be separated into pure oil and sludge and these two ingredients removed from each other continuously and automatically, and that the device is adaptable to mixtures of varying properties.

The modification shown in Figs. 3 and 4 is similar to that shown in Figs. 1 and 2 with the exception that receptacle 10 is entirely outside of receptacle 5, and carries a divisional wall 23 extending upwardly from the bottom, the impure oil and water being

introduced into compartment 24, and after agitation, passing over the wall 23 into the compartment 25 and from there into receptacle 5 through the opening 26, the control of the amount of time during which the oil is allowed to separate in receptacle 5, and the amount of oil allowed to accumulate in receptacle 5 being the same as in the modification shown in Figs. 1 and 2.

In the term "liquids," I include the true liquids with their suspended and precipitated impurities and ingredients.

I do not limit myself to the particular size, number, shape or arrangement of parts as shown in the drawings and described, all of which may be varied without going beyond the scope of my invention as described and claimed.

What is claimed, is:

1. In a device of the character specified, in combination, a liquid holding receptacle carrying means for the introduction of liquids, means for agitating the contents of said receptacle, a second liquid-holding receptacle, connecting means between the lower portion of the second receptacle and the first receptacle, an overflow pipe in the second receptacle, a third liquid-holding receptacle, connecting means between the lower portion of the second receptacle and the lower portion of the third receptacle, an overflow pipe in the third receptacle, means whereby the overflow pipe in the third receptacle may be raised or lowered, and means for the continuous and automatic removal of the contents of the receptacles.

2. In a device of the character specified, in combination, a liquid-holding receptacle, walls within said receptacle extending downwardly and forming three chambers, said walls not extending to the bottom of the receptacle, inlet means within one chamber, an overflow outlet in each of the other two chambers, means for raising and lowering the overflow outlet in one chamber, and means for the continuous and automatic removal of the contents of the chambers.

3. In a device of the character specified, in combination, a liquid holding receptacle having a conical shaped bottom, walls within the receptacle forming three chambers connected with each other at the bottom portions, means for admitting impure oil and water into the first chamber, means for agitating the mixture of oil and water, means whereby the continued introduction of oil or water will force the agitated mixture into the second chamber, an overflow pipe in the second chamber, means whereby the impure oil and water will separate into layers of pure oil, sludge and water in the second chamber, means whereby the continued flow of oil or water in the first chamber will force the pure oil through the overflow pipe, means whereby the continued introduction of oil or water in the first chamber will force the separate sludge and water in the second chamber into the third chamber, and an overflow pipe in the third chamber, carrying means whereby its opening may be raised and lowered to maintain a predetermined head of pure oil in the second chamber.

4. In a device of the character specified, in combination, a liquid-holding receptacle, divided into three chambers open to each other at their bottoms, the mixing chamber being provided with means for the admission of impure oil and water and for agitation, the separating chamber being provided with an outlet, the refuse chamber being provided with an overflow, the opening of which is capable of being raised and lowered; the three chambers being so situated that the continual introduction of a mixture of impure oil and water into the mixing chamber, will force the mixture into the separating chamber where it will separate into its component layers, the upper layer being forced through the outlet, and the remaining layers being forced into the refuse chamber and from there through the outlet of said refuse chamber.

5. In a device of the character specified, in combination, a series of liquid-containing chambers, means in one chamber for the introduction of oil and water, means for agitating the oil and water, means for conveying the mixture of agitated oil and water into a second chamber, an oil overflow outlet within the second chamber and means therein for allowing the separation into layers of the oil, sludge and water, means for conveying the sludge and water into a third chamber, a sludge and water overflow in said chamber, and means whereby the overflow in the third chamber may be raised and lowered to maintain any desired head of liquids in equilibrium within the chambers.

6. In a device of the character specified, in combination, a series of liquid-holding receptacles, connecting means for the passage of liquids between the receptacles, means for introducing liquids into the first receptacle, an overflow pipe in the second receptacle, means for causing the passage of the liquids from the first receptacle into the second receptacle, means for causing the liquids to separate into layers in the second receptacle, means for causing the upper layer of liquid to pass through the overflow pipe, means for causing the other layers of liquids to pass into the third receptacle and through an overflow pipe, the position of which in relation to the overflow pipe in the second receptacle may be varied, the overflow of the separated liquids through the two outlet pipes being continuous with the introduction of liquids into the first receptacle.

7. In a device of the character specified, in

combination, a liquid-holding receptacle carrying a conical shaped bottom, a series of walls suspended within the liquid holding receptacle forming three chambers, an agitating chamber, a separating chamber and a refuse chamber, all open at the top and bottom, the walls of the refuse chamber extending below the walls of the agitating chamber, means for suspending the walls, inlet pipes near the top and bottom of the agitating chamber, means for introducing liquids into the agitating chamber, an outlet pipe in the separating chamber, an outlet pipe in the refuse chamber, means for regulating the position of the outlet pipe in the refuse chamber relative to the outlet pipe in the separating chamber, means whereby impure oil and water may be introduced into the agitating chamber, means for agitating the liquids within the agitating chamber, means for allowing a desired separation of the oil, impurities and water in the separating chamber, and means for forcing the impurities and water from the separating chamber into the refuse chamber, the elements of the device being so arranged that a continuous introduction of impure oil and water into the agitating chamber will cause a continuous and automatic flow of pure oil through the outlet in the separating chamber and a continuous and automatic flow of all of the impurities and water through the outlet in the refuse chamber.

Signed at New York city, in the county of New York and State of New York, this 20th day of March, 1916.

OTTO HEINRICH NONNENBRUCH.

Witnesses:
TERESA V. LYNCH,
RITA LYNCH.